# EATING DISORDERS AND WEIGHT DISORDERS: ASSESSMENT, EARLY DIAGNOSIS, PROGNOSIS, TREATMENT OUTCOME AND THE ROLE OF POTENTIAL PSYCHOLOGICAL AND SOCIAL FACTORS

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PUBLISHED IN: Frontiers in Psychology

frontiers Research Topics

ISSN 1664-8714
ISBN 978-2-88976-432-7
DOI 10.3389/978-2-88976-432-7

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**Citation:** Peláez-Fernández, M. A., Sepúlveda, A. R., Compte, E. J., eds. (2022). Eating Disorders and Weight Disorders: Assessment, Early Diagnosis, Prognosis, Treatment Outcome and the Role of Potential Psychological and Social Factors. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88976-432-7

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frontiers | Frontiers in Psychology

EDITORIAL
published: 01 June 2022
doi: 10.3389/fpsyg.2022.924815

# Editorial: Eating Disorders and Weight Disorders: Assessment, Early Diagnosis, Prognosis, Treatment Outcome and the Role of Potential Psychological and Social Factors

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**Keywords: eating disorders, weight disorders, assessment, early diagnosis, prognosis, treatment, psychological and social factors**

## Editorial on the Research Topic

## Eating Disorders and Weight Disorders: Assessment, Early Diagnosis, Prognosis, Treatment Outcome and the Role of Potential Psychological and Social Factors

OPEN ACCESS

***Edited and reviewed by:***
*Anna Victoria Oldershaw, Canterbury Christ Church University, United Kingdom*

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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *20 April 2022*
***Accepted:*** *19 May 2022*
***Published:*** *01 June 2022*

***Citation:***
*Peláez-Fernández MA, Sepúlveda AR and Compte EJ (2022) Editorial: Eating Disorders and Weight Disorders: Assessment, Early Diagnosis, Prognosis, Treatment Outcome and the Role of Potential Psychological and Social Factors. Front. Psychol. 13:924815. doi: 10.3389/fpsyg.2022.924815*

We are delighted to introduce a very special Research Topic of Frontiers in Psychology. Eating disorders (ED) and weight disorders (WD) are severe illnesses in which especially, but not exclusively, young people go through critical disturbances in their eating behaviors and related thoughts and emotions. Given the severity and scope of obesity and unhealthy diets on health, these disorders could have serious outcomes on health, quality of life, and global economy if prevention mechanisms are not arranged. Despite the research conducted up to date, ED and WD are a subject of permanent relevance due their life-threatening condition. In this regard, the field is matter of continuous update aiming to increase the knowledge, improve treatment options, incorporate new research methods and technology, reaching understudied populations, and understanding the impact of external factors. This Research Topics therefore aims to be a contribution to the field of ED and WD; moreover, given the situation of the recent pandemic of COVID-19, which its outbreak on depression, anxiety, distress, insomnia, and post-traumatic stress have been explored (de Medeiros Carvalho et al., 2020; Torales et al., 2020), but little is yet known concerning the effects on ED and WD.

This Research Topic includes 16 articles, 13 of them are based on original research coming from different countries (Canada, Chile, China, France, Spain, and Germany). Most of the original research are quantitative studies, and only one study is qualitative (Ziser et al.). There is also a review article (Hampshire et al.) and a study protocol (Quiles et al.). The Research Topic also includes a correction (Marco et al.) of the corresponding study.

Four papers have explored the potential role of psychological resources (emotional intelligence and meaning in life) and psychosocial stressors (parenting styles, social weight stigma) on the development and maintenance of these disorders. Peláez-Fernández et al. carried out an empirical study with 516 Spanish undergraduate students and community adults of both sexes, age ranged 18–77. They found that deficits in emotional intelligence (EI) leads to ED symptomatology both directly and indirectly through a sequential mediating path. Specifically, high levels of EI

were associated to greater self-esteem, which subsequently reduces anxiety, thus predicting lower levels of ED symptomatology. Marco et al. estimated the mediating role of meaning in life in the relationship between emotional dysregulation and ED pathology in three Spanish samples with diverse risk (292 participants with ED, 122 with obesity and 156 control). They found that meaning in life acted as a mediator between emotional dysregulation and the main symptoms of ED. These results highlight the relevance of considering meaning in life as a variable in the onset and maintenance of ED. Fan et al. proposed a model to explain the relationship between diverse types of weight stigma and quality of life among children in Hong Kong. They found associations between the weight stigmas and both child-rated and parent-rated quality of life. Also, weight stigma and weight-related self-stigma mediated the association between body weight and children's quality of life. Finally, Hampshire et al. describe in their systematic review, that parenting styles characterized by high levels of control and low levels of responsiveness were associated to disordered eating among young adults such as unhealthy weight control behaviors. The association was frequently indirect and mediated by several underlying mechanisms including emotional reactivity, lowered self-competence and offspring psychological distress. These results suggest that parenting styles, parents' difficulties in managing their emotions, their perceived competence, and their psychological distress influence the development of disorders eating of their young-adult children.

Following the paradigm of *open science* (UNESCO, 2019), Quiles et al. have published their intervention protocol prior to conduct their study. Publications of study protocols ensures transparency in research, and provides a documented record of the research plan of action, detailing in advance the rationale, methodology and analyses. They adapted an intervention program (ECHOMANTRA) to Spanish caregivers and adolescent patients with ED. The intervention is based on emotional regulation and eating behaviors, with an emphasis on behavior change strategies. The objective is to generate cognitive and behavioral changes and strengthen relationships with family and friends to help the transit from inpatient care to daily life and to prevent relapses.

The study by Sierra et al. explores the emotional processing of food images comparing three clinical groups and a normal-weight comparison group. ED patients are characterized by more negative appraisal, less emotional dominance, and a higher level of arousal when processing food-relevant information. Negative affect mediated the relationship between eating symptomatology and emotional processing. This supports the transdiagnostic model of ED, and the use of similar treatments for different conditions.

To generate an exploratory bio-psychological-familial model, the case-control study conducted by Sepúlveda et al. identified some specific correlates associated with the development of an eating disorder. The model showed that patients' drive of thinness and self-oriented perfectionism, together with the decrease of triiodothyronine (T3) hormone and higher levels of anxiety increase adolescents' risk of developing an ED. Both the increase in fathers' emotional overinvolvement, and the decrease in fathers' depression and mothers' anxiety were specifically associated to the onset of an ED.

Using structural equation modeling, Obeid et al. explored a complex model of shared pathways integrating various theoretical facets for eating and weight disorders in a large community-based sample of male and female adolescents. Higher levels of stressors (weight-based teasing, negative life events), dysregulated eating and poor body image all directly influenced higher weight status. It confirmed the concept that socio-environmental factors would be associated with body image and dysregulated eating, mediated by the complex interplay of psychological and behavioral factors.

Among bariatric surgery patients, El Archi et al. explored the psychological factors associated with binge eating and food addiction, and the role of emotion dysregulation, alexithymia and personality dimensions in the association between attention-deficit/hyperactivity disorder and addictive-like eating. Emotion dysregulation, conscientiousness, agreeableness, and neuroticism are total mediators of this association, with alexithymia being a partial mediator. Negative emotion leads to food intake, increasing positive emotion seeking especially if associated with emotion dysregulation, leading to the development of an addiction. Despite the controversies of the concept of food addiction, authors suggested that certain foods may lead to addictive-like eating that could contribute to overeating and obesity.

The influence of the familial context was investigated in the qualitative study of Ziser et al., which explored the barriers to behavior change in a group of 16 parents of preschool children with overweight and/or obesity. They were identified through a primarily inductive content analysis conducted through an interview. The underestimation of health consequences of overweight and obesity, and a deficient awareness on the problem were the main barriers. The use of the motivational interview in the pediatric environment are suggested to address these topics.

Relevant to assessment, three articles aimed to validate measures of ED symptomatology as well as related constructs such as appearance perfectionism and food craving across Hispanic samples. Lizana-Calderón et al. analyzed the psychometric properties of the Eating Disorder Inventory-3 (EDI-3; Garner, 2004) in a large sample of adolescents and young-adult Chilean women and men. Following Brookings et al. (2020), the study sought to assess alternative models including a second-order two-factor model through exploratory structural equation modeling. The retained model presented a two-bifactor structure, with 12 specific factors. In addition, overall internal consistency was adequate suggesting that the EDI-3 is a valid measure to assess ED in Chilean population. On the other hand, Rica et al. presented results from a cross-validation exploratory and confirmatory approach for the validation of the Physical Appearance Perfectionism Scale (PAPS; Yang and Stoeber, 2012) in a representative sample of male college students in Spain. Findings from the Spanish validation replicates the 12-item two-factor structure of the PAPS that assess two dimensions of appearance perfectionism, Hope for Perfectionism (related to positive reinforcement of achieving attractiveness) and Worry about Imperfection (related to attempts to avoid imperfection,

disapproval, and criticism). With excellent levels of internal consistency, the validation of the PAPS not only represents a contribution for the study of ED and WD among Hispanics but also for a yet understudied population in the ED field such as men. Finally, in the framework of third-wave therapies such as Acceptance and Commitment Therapy, Manchón et al. conducted two studies to validate a measure of food craving acceptance, The Food Craving Acceptance and Action Questionnaire (FAAQ; Juarascio et al., 2011). A confirmatory factor analysis on the original model showed an inadequate fit in a sample of Spanish undergraduate students. Consequently, items reviewed, and the scale was modified. An exploratory factor analysis in a second community-based sample described a two-factor structure for the Spanish version of the FAAQ (FAAQ-S). Both subscales, Acceptance and Willingness, showed excellent levels of internal consistency suggesting that the FAAQ-S represents a contribution to the assessment of third-wave therapies constructs and for the dissemination of third-wave psychological therapies in Spain.

Finally, two papers aimed to assess the impact of the COVID-19 pandemic on ED and WD symptoms. Gobin et al. studied the impact of the COVID-19 lockdown on eating habits, body image, and social media use among adult women with and without symptoms of Orthorexia Nervosa (ON). Based on the diet-related lifestyle change during the pandemic, among women with symptoms of ON, findings showed an aggravation of disordered eating thoughts and behaviors and suggested that social media could be contributing factor to this exacerbation. Consistently, the study of Corno et al. described a tendency to report a higher frequency of disordered eating behaviors during the COVID-19 pandemic. Weight concerns predicted an overall increase in the frequency of restrictive behaviors, and body dissatisfaction was found to be associated with a self-perceived increase of emotional eating frequency among adult women who were never diagnosed with an ED. Altogether, both studies suggest that lifestyle change due to the COVID-19 pandemic influenced ED and WE symptoms.

A variety of populations from Asia, Europe, North America, and South America including clinical and community-based samples are represented across the studies. Diverse research designs were considered to assess mediational mechanisms underlying ED and WD symptoms, as well as emotional processing of ED-related stimuli, and specific correlates associated with the onset of ED among clinical samples. Additionally, factors associated with binge eating and food addition have been explored in bariatric surgery patients, and qualitative data describes barriers to behavior change among parents of overweight/obese children. This Research Topic also includes the validation of three measures across Hispanic samples, and a study protocol of an intervention aimed to improve the transit of inpatient care to daily life. Finally, two studies described the impact of the COVID-19 pandemic on disordered eating behaviors. We expect that this Research Topic represents a contribution to the ongoing scientific knowledge about ED and WD.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## ACKNOWLEDGMENTS

The editors of this Research Topic would like to thank all the authors for their valuable contribution to the ongoing scientific knowledge about eating and weight disorders.

## REFERENCES

Brookings, J. B., Jackson, D. L., and Garner, D. M. (2020). A bifactor and item response theory analysis of the eating disorder inventory-3. *J. Psychopathol. Behav. Assess.* 43:1. doi: 10.1007/s10862-020-09 827-2

de Medeiros Carvalho, P. M., Moreira, M. M., de Oliveira, M. N. A., Landim, J. M. M., and Neto, M. L. R. (2020). The psychiatric impact of the novel coronavirus outbreak. *Psychiatr. Res*, 286:112902. doi: 10.1016/j.psychres.2020.112902

Garner, D. M. (2004). *EDI-3 Eating Disorders Inventory-3: Professional Manual*. Odessa, FL: Psychological Assessment Resources, Inc.

Juarascio, A., Forman, E., Timko, C. A., Butryn, M., and Goodwin, C. (2011). The development and validation of the food craving acceptance and action questionnaire (FAAQ). *Eat. Behav.* 12, 182–187. doi: 10.1016/j.eatbeh.2011.04.008

Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., and Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int. J. Soc. Psychiatr.* 66, 317–320. doi: 10.1177/00207640209 15212

UNESCO (2019). *Consolidated Roadmap for a Possible UNESCO Recommendation on Open Science—UNESCO Digital Library (Nr. 207th Meeting of the Executive Board)*. UNESCO Executive Board website. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000369699 (accessed November 1, 2019).

Yang, H., and Stoeber, J. (2012). The physical appearance perfectionism scale: development and preliminary validation. *J. Psychopathol. Behav. Assess.* 34, 69–83. doi: 10.1007/s10862-011-9260-7

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frontiers in Psychology

ORIGINAL RESEARCH
published: 23 March 2021
doi: 10.3389/fpsyg.2021.635742

# Meaning in Life Mediates Between Emotional Deregulation and Eating Disorders Psychopathology: A Research From the Meaning-Making Model of Eating Disorders

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OPEN ACCESS

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**Specialty section:**
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

**Received:** *30 November 2020*
**Accepted:** *10 February 2021*
**Published:** *23 March 2021*

**Citation:**
*Marco JH, Cañabate M, Martinez C, Baños RM, Guillen V and Perez S (2021) Meaning in Life Mediates Between Emotional Deregulation and Eating Disorders Psychopathology: A Research From the Meaning-Making Model of Eating Disorders. Front. Psychol. 12:635742. doi: 10.3389/fpsyg.2021.635742*

Emotional dysregulation, age, gender, and obesity are transdiagnostic risk factors for the development and maintenance of eating disorders (EDs). Previous studies found that patients with ED had less meaning in life than the non-clinical population, and that meaning in life acted as a buffer in the course of ED; however, to the data, there are no studies about the mediator role of meaning in life in association between the emotional dysregulation and the ED psychopathology.

**Objective:** To analyze the mediating role of meaning in life in the relationship between emotional dysregulation and the ED psychopathology in three samples with diverse risk factors for ED.

**Method:** Sample 1, $n = 153$ undergraduate young women; sample 2, $n = 122$ participants with obesity; and sample 3, $n = 292$ participants with ED. Multiple mediation analysis was performed.

**Results:** Sample 1: meaning in life showed a mediation effect between emotional dysregulation and the ED psychopathology (direct effect $\beta = 0.390$, $p < 0.05$) (indirect effect $\beta = 0.227$, $p < 0.05$), body satisfaction (direct effect $\beta = -0.017$, $p < 0.05$) (indirect effect $\beta = -0.013$, $p < 0.01$), and depression symptoms (direct effect $\beta = 1.112$, $p < 0.001$) (indirect effect $\beta = 0.414$, $p < 0.001$); sample 2: meaning in life showed a mediation effect between emotional dysregulation and binge eating and purging behaviors (direct effect $\beta = 0.194$, $p < 0.01$) (indirect effect $\beta = 0.054$, $p < 0.05$) and depression symptoms (direct effect $\beta = 0.357$, $p < 0.001$) (indirect effect $\beta = 0.063$, $p < 0.05$); sample 3: meaning in life showed a mediation effect between emotional dysregulation and the ED psychopathology (direct effect $\beta = 0.884$, $p < 0.001$) (indirect effect $\beta = 0.252$, $p < 0.007$), body satisfaction (direct effect $\beta = -0.033$, $p < 0.05$) (indirect effect $\beta = -0.021$, $p < 0.001$), borderline symptoms (direct effect $\beta = 0.040$,

$p < 0.001$) (indirect effect $\beta = 0.025$, $p < 0.001$), and hopelessness (direct effect $\beta = 0.211$, $p < 0.001$) (indirect effect $\beta = 0.087$, $p < 0.001$).

**Conclusions:** These studies suggest the importance of considering meaning in life as a variable in the onset and maintenance of ED.

**Keywords: meaning in life, emotional deregulation, obesity, young women, eating disorders, meaning-making model**

## INTRODUCTION

Although the etiology of eating disorders (EDs) is multi-factorial (Long et al., 2017), there is a broad consensus in the literature that emotional dysregulation (Monell et al., 2015; Mallorquí-Bagué et al., 2018), age (adolescents and young adults), gender (female) (Rosenvinge and Pettersen, 2015a), and a personal history of obesity are transdiagnostic risk factors in the development and maintenance of ED (Micanti et al., 2017).

Emotional regulation can be defined as the ability to identify and modulate emotions (Gross, 1998), and the level of emotional dysregulation has been found to be associated with the severity of cognitive symptoms in ED (Aldao et al., 2010; Pisetsky et al., 2017) and predict the maintenance of AN after the treatment ends (Racine and Wildes, 2015). Moreover, engaging in the emotional strategy of avoiding negative and positive emotions becomes a maintainer of depressive and anxiety symptoms in participants with ED (Wildes et al., 2010).

Regarding age and gender, EDs affect between 11 and 15% of women, and there is a broad consensus in the literature that being a young woman is a specific risk factor for EDs (Allen et al., 2013). Theories suggest that, in young women, the internalization of the dominant beauty ideals, based on the idealization of thinness, would lead to body dissatisfaction in people with other vulnerability factors, such as overweight, negative affect or depression, perfectionism, and low self-esteem, which would contribute to extreme weight control behaviors and lead them to develop EDs (Rosenvinge and Pettersen, 2015b).

Obesity is another specific risk factor for developing an ED (Guisado et al., 2002), and ∼30–80% of individuals with bulimia nervosa (BN), binge eating disorder (BED), or other specified feeding or eating disorders (OSFED) are people with obesity (Villarejo et al., 2012). Some studies have shown that people with obesity share several clinical characteristics with people with ED (Brone and Fisher, 1988), as well as etiological, psychological, and social factors (Jarman et al., 1991), such as rumination, negative attitudes toward food and the tendency to diet (Guisado et al., 2002), and body dissatisfaction (Weinberger et al., 2016). Moreover, participants with obesity have a high comorbidity with depression (Dixon et al., 2003), anxiety disorders, BN, and BED (Black et al., 1992).

Despite the large number of studies on risk factors and prevention in ED, the incidence of EDs has kept stable in mental health services from 1970 to the first decades of the 21st century (Hoek, 2016). This could suggest that there may have been an increase in the incidence of ED not treated in mental health settings. Therefore, it is necessary to examine the preventive factors targeting shared risk of eating-/weight-related issues and explore new paths that can improve the existing prevention programs and the efficacy of the treatments. In this sense, a variable that has been found to be negatively associated with the psychopathology of ED is the meaning in life (e.g., Gongora, 2014; Brassai et al., 2015; Marco et al., 2017).

Meaning in life is made up of three dimensions that are interconnected and interact: (a) Coherence, the degree to which people feel that the world in which they live is an organized, structured, predictable, and explainable whole; (b) Purpose, which refers to the way people experience that their life is oriented and guided by important life goals and values; (c) Significance, which refers to the feeling that life itself has inherent value and involves having a life worth living (Martela and Steger, 2016). There are already studies that found that patients with ED had less meaning in life than the non-clinical population (Marco et al., 2017). Furthermore, meaning in life was highly and positively related to body satisfaction and negatively associated with concern about being overweight and negative attitudes toward food (Marco et al., 2019). Subsequently, a longitudinal study found that meaning in life was a buffer of the course of the ED, specifically of dysfunctional attitudes and behaviors toward food, hopelessness, suicidal ideation, and impulsiveness and emotional instability (Marco et al., 2020b).

Moreover, several studies suggested that meaning in life could be an important variable in the recovery from ED. de Vos et al. (2017) carried out a study to identify relevant criteria for ED recovery from the perspective of recovered patients, and they found that meaning in life and purpose were a main criterion for recovery. Garrett (1997) found that recovery involves escaping the obsession with food and weight, believing that life is meaningful and one is worthwhile, and having the conviction to not return to starvation. Bowlby et al. (2015) found that all ED participants described experiences of creating meaning and purpose in their lives outside of ED as a result of the recovery process.

For a more integrated and operational view of the role of meaning in life in ED patients, Marco et al. (2020b) proposed the Meaning-Making Model in Eating Disorders (MMMED). This model shares Frankl's (2006) premises: (a) the need to find meaning in life is a fundamental motivating factor in human beings; (b) low meaning in life is a vulnerability factor for developing emotional disorders, and meaning in life is a protector factor against psychopathology; (c) meaning in life can only be discovered in genuine and authentic sources of meaning (creating something, loving someone or something, facing a painful and unavoidable situation) that will lead to the discovery of an individual meaning in life at each moment and for each person differently; (d) the search for meaning in dysfunctional

sources would impede the development of authentic and genuine meaning, leading to the absence of meaning in life.

The MMMED states that people with high vulnerability to ED (young women with low self-esteem, high perfectionism, high body mass index, emotional dysregulation, and depression) when they face a situation that has led them to have low or no meaning in life, generally produced by an event that violates their global scheme of values, ideals, and goals (for example, an increase in weight would violate the global scheme "I have to control my weight"; "I need to have a good appearance"; "I am perfect"; "I want to be anorexic"). This violation of global meaning would lead to an absence of meaning and to launching a set of processes oriented toward meaning-making. These processes in people with high vulnerability to ED could include controlling food to lose weight, checking behaviors of the body, ruminant thoughts about food and the body, increased negative affect, and emotional dysregulation, which would lead to the patient losing weight in the case of anorexia nervosa (AN) or to developing binge eating and vomiting (in the case of BED or BN). Thus, according to the MMMED, this meaning-making process could have two consequences. In the short term, the ED symptoms could be dysfunctional strategies that give people a sense of structure, consistency in their lives, and identity (Serpell et al., 1999; Fox and Leung, 2009), creating a new coherent meaning in life ("After losing weight I am attractive, I control my body, and so I am perfect"; "I am Anorexic"). However, in the long term, if individuals with ED are oriented toward dysfunctional goals and values, including control of their bodies, weight, and food, and they avoid negative emotions and anxiety situations, which keeps them from developing an authentic and genuine sense of meaning in life, this leads to an absence of meaning in life, depression, hopelessness, suicidal ideation, and developing characteristic symptoms of borderline personality disorder (Marco et al., 2020b).

Regarding emotional deregulation, the MMMED model suggests that when there is an absence of or low meaning in life, the intensity of negative emotions and emotional instability will increase (e.g., negative affect or depression), and emotional regulation strategies (e.g., suppression, elaboration, avoidance, etc.) would either facilitate or prevent meaning-making. In the same way, developing meaning in life could buffer the emotional deregulation (Marco et al., 2017). Thus, the MMMED suggests that emotional regulation strategies will be adaptive or maladaptive depending on whether they lead to meaning-making in this specific situation or event.

The MMMED suggests that meaning in life would also act as a mediator in the relationship between emotional dysregulation and ED psychopathology. If meaning in life is a mediating variable of the risk factors for ED, this mediating role should be found in participants with different levels of risk of having an ED, that is, in participants with low risk (young women without an ED), participants with moderate risk (people with obesity), and, finally, patients diagnosed with ED. To date, the mediator role of meaning in life in several samples with different risk factors for ED has not been analyzed.

Thus, the aim of the present study is to analyze the mediating role of meaning in life in the relationship between emotional dysregulation and the ED psychopathology in three samples with diverse risk factors for ED: participants young women (sample 1), participants with obesity (sample 2), and participants with ED (sample 3). We hypothesize: (a) meaning in life could be a mediator in the association between emotional dysregulation and body dissatisfaction, depression, and ED psychopathology in women under 25 years old; (b) meaning in life could be a mediator in the association between emotional dysregulation and depression, BN, and BED psychopathology in participants with obesity; and (c) meaning in life could be a mediator in the association between emotional dysregulation and body dissatisfaction, ED psychopathology, borderline personality symptoms, and hopelessness in participants with ED.

# METHOD

## Participants

For the present study, the three samples recruited were selected by the same research team and belong to the same line of research entitled: Is meaning in life an important variable in the psychopathology of ED? To answer this general question, three samples were selected: sample 1 consisted of participants without a diagnosis of ED or obesity, and it was obtained in January 2017 (research code UCV2017–2018/116). Sample 2 consisted of participants with obesity who were recruited from 2016 to 2018 (research code FPNT-CEB-04-2015/0402), and sample 3 consisted of participants with a diagnosis of ED who were recruited in 2015–2018 (research code UCV2013–2014/0023). The general aim of the study was to analyze whether meaning in life is a mediator in the relationship between emotional dysregulation and the psychopathology of ED in groups with a different risk of developing an ED, the non-clinical population (low risk), the population with obesity (moderate risk), and the clinical population (high risk). **Table 1** shows the demographic and clinical characteristics of the three samples.

As you can see in **Table 1**, sample 1 was composed of 153 university female students with ages ranging from 18 to 25 years, with a mean of 21.06 years ($SD = 2.12$) who accepted and signed the informed consent. Regarding marital status, 60.7% ($n = 95$) were single, separated, or divorced, and 39.3% ($n = 58$) were living as a couple or married. Sample 2 was composed of 122 participants with obesity. The participants were recruited from the Bariatric Surgery Service of four hospitals in the city of Valencia (Spain). Convenience sampling was used to choose the participants from the waitlist for a bariatric surgery operation. The inclusion criteria were participants who were candidates for obesity surgery and had a BMI above 31 who accepted and signed the informed consent. The exclusion criteria were moderate or severe intellectual disability, diagnosis of an eating disorder, schizophrenia, and bipolar disorders. Most of the sample (64.8%, $n = 79$) is composed of women. The mean age of the sample was 47 years ($SD = 9.89$; range 17–68). The mean body mass index (BMI) was 44.41 ($SD = 6.03$; range 31.59–61.67). Regarding marital status, 60.3% ($n = 74$) were living as a couple or married, and 39.7 ($n = 48$) were single, separated, or divorced. Regarding the level of studies, 43.44% ($n = 53$) had primary studies, 41% ($n = 50$) had secondary studies, 13.11%

**TABLE 1 |** Demographic and clinical characteristics of the three samples.

| | Sample 1 Non-clinical | Sample 2 Participants with obesity | Sample 3 Participants with eating disorders |
|---|---|---|---|
| *N* | 156 | 122 | 292 |
| Age | 21.06 (2.12) | 47 (9.89) | 24.21 (11.01) |
| Gender | Women 100% $n = 156$ | Women 64.8% $n = 79$ | Women 93.5% $n = 273$ |
| Ethnic composition | 100% Caucasian | 100% Caucasian | 100% Caucasian |
| Marital status | | | |
| Single, separated, divorced | 60.7%, $n = 95$ | 39.7%, $n = 48$ | 58.6%, $n = 171$ |
| Living a couple or married | 39.3%, $n = 58$ | 60.3%, $n = 74$ | 41.4%, $n = 121$ |
| Mean body mass index | 21.72 (3.38) | 44.41 (6.03) | 22.60 (7.26) |
| Level of studies | | | |
| Had no studies | – | 2.45% ($n = 3$) | – |
| Primary studies | – | 43.44% ($n = 53$) | 26.4%, $n = 77$ |
| Secondary studies | – | 41% ($n = 50$) | 50.7%, $n = 148$ |
| Higher studies | 100% | 13. 11% ($n = 16$) | 22.9%, $n = 67$ |
| Comorbidity | | | |
| Medical diseases | – | 77.5% ($n = 93$) | – |
| Mental disorders | – | 9.8% ($n = 12$) | 22.6%, $n = 66$ |
| Sample provenance | University | Bariatric Surgery Service of hospital | Two Eating Disorders Specialized Service |
| Diagnoses of eating disorders | 0 | 0 | 292 |
| Anorexia nervosa restrictive | 0 | 0 | 28.8%, $n = 84$ |
| Anorexia Nervosa purgative | 0 | 0 | 11%, $n = 32$ |
| Bulimia nervosa | 0 | 0 | 22.9%, $n = 67$ |
| Binge eating disorder | 0 | 0 | 13%, $n = 38$ |
| OSFED | 0 | 0 | 24.3%, $n = 71$ |

*OSFED, other specified feeding or eating disorders.*

($n = 16$) had university studies, and 2.45% ($n = 3$) had no studies. As for medical comorbidity, 77.5% ($n = 93$) of the participants in the study had medical diseases related to morbid obesity, and 9.8% ($n = 12$) of the total sample had a diagnosis of a mental disorder related to anxiety or mood. Sample 3 consisted of 292 participants diagnosed with ED from two Public Mental Health services specialized in ED in Spain. The inclusion criterion was patients who met the DSM-5 criteria for ED. The exclusion criteria were moderate or severe intellectual disability, schizophrenia, and bipolar disorders. Of the 292 participants, 93.5%, $n = 273$, were women, and 6.5% were men, $n = 19$. Regarding diagnoses, 28.8%, $n = 84$, fulfilled the criteria for the AN restrictive diagnosis; 22.9%, $n = 67$, for BN; 11%, $n = 32$, for AN purgative; 13%, $n = 38$, for BED; and 24.3%, $n = 71$, for OSFED. In addition, 22.6%, $n = 66$, had a comorbid diagnosis of personality disorder. The ages of the participants ranged from 12 to 60 years, with a mean age of 24.21 (11.01) years. Regarding their level of studies, 26.4%, $n = 77$, had primary studies; 50.7%, $n = 148$, had secondary studies; and 22.9%, $n = 67$, had higher studies. Regarding marital status, 55.5%, $n = 162$, were single; 41.4%, $n = 121$, were married; and 3.1%, $n = 9$, were separated. All the participants were Caucasian who participated voluntarily and received no compensation.

## Assessments and Measures

### Sample 1

***Purpose in Life-10 (PIL-10; García-Alandete et al., 2013)***

The PIL is a 10-item Likert-type scale with seven response categories (1–7). It offers a measure of different aspects of meaning in life (for example, "In life I have many definite goals and longings," "My life is empty and full of despair," "If I died today, it would seem to me that my life has been very valuable," "I consider that my ability to find meaning in life is very great," "I have discovered clear goals and a satisfactory purpose for my life"). We used the Spanish version (García-Alandete et al., 2013), which offers good psychometric properties and high reliability ($\alpha = 0.88$) and showed excellent reliability in our sample ($\alpha = 0.93$).

***Eating Attitudes Test (EAT-40; Garner and Garfinkel, 1979)***

The EAT-40 assesses attitudes and behaviors associated with ED. The Spanish version has 40 items organized in three factors and answered on a 6-point Likert scale: (a) Diet and concern about food; (b) Perceived social pressure and discomfort with food; (c) Psychobiological disorders. The instrument offers good psychometric properties and high reliability in patients with AN ($\alpha = 0.93$) and BN ($\alpha = 0.92$) in its Spanish version (Castro et al., 1991). In our sample, it showed excellent reliability ($\alpha = 0.90$).

***Beck Depression Inventory-II (BDI-II; Beck et al., 1996)***

This inventory consists of 21 items with four response alternatives (0–4) that evaluate depressive symptoms. It offers good psychometric properties in its Spanish version (Sanz et al., 2005). In our sample, it presented adequate reliability ($\alpha = 0.93$).

***Multidimensional Body-Self Relations Questionnaire-Appearance Scales (MBSRQ-AS 34; Cash, 2000)***

The MBSRQ-AS is a self-report composed of five scales with good psychometric properties that assess beliefs and feelings of satisfaction or dissatisfaction with one's appearance. For the present study, we used the Body Areas Satisfaction scale, which consists of nine items and assesses satisfaction or dissatisfaction with specific body areas and attributes (face, hair, lower torso, mid torso, upper torso, muscle tone, weight, height, overall appearance) (Cash, 2000). Each item is scored on a 5-point scale (from 1: "Very dissatisfied" to 5: "Very satisfied"). The Spanish version (Roncero et al., 2015) showed good reliability ($\alpha = 0.84$). It presents adequate psychometric properties in our sample ($\alpha = 0.86$).

***Difficulties in Emotional Regulation Scale (DERS) (Gratz and Roemer, 2004)***

This scale assesses emotional regulation difficulties in adults. The Spanish validation of the DERS is made up of 28 elements with a Likert scale (five response levels) (Hervás and Jódar, 2008). For the present study, we chose the emotional dysregulation subscale. The Spanish version of the DERS offered good psychometric properties ($\alpha = 0.91$) and showed excellent internal consistency in our sample ($\alpha = 0.95$).

In sample 2, we used several of the assessment instruments described previously: PIL-10, DERS, and MBSRQ-AS. In addition:

***Structured Clinical Interview for DSM5-Clinical Version (SCID-CV, First et al., 2015)***

This is an interview for the main DSM-5 diagnoses (American Psychiatric Association, 2013).

***Structured Clinical Interview for Personality Disorders DSM-5 (SCID-PD, First et al., 2016)***

This is an interview for the diagnosis of personality disorder, based on the DSM-5.

***Bulimic Test of Edinburgh (BITE, Henderson and Freeman, 1987)***

The BITE is a 33-item self-report measure designed to identify subjects with symptoms of BN or BED. The BITE consists of two subscales: the symptom scale, which measures the frequency of symptoms; and the severity scale, which provides an index of the severity of binging and purging behavior. The items on the symptom subscale have a dichotomous format (yes/no), whereas the items on the severity subscale have a Likert-type response format (with 5 or 7 options). The questionnaire offers cutoff points according to levels of severity: (a) a score of 20 or more indicates a highly disordered eating pattern and the presence of binge-eating; (b) a score of 10 to 19 suggests an unusual eating pattern, and a score between 15 and 19 may reflect a subclinical group of binge-eaters, either in the initial stages of the disorder or recovered bulimics; and (c) a score below 10 indicates a non-altered food pattern. In the present study, we obtained adequate reliability ($\alpha = 0.79$) for the BITE.

***The Brief Symptoms Inventory (BSI-18; Derogatis, 2001)***

The BSI-18 is a self-applied test that consists of 18 items referring to physical, anxious, and depressive symptoms, with responses given on a 4-point Likert scale ranging from 0 (not at all) to 4 (very much). It is made up of three subscales: Depression (six items), Somatization (seven items), and Anxiety (six items). For our study, we only used the depression subscale of the Spanish version of the BIS (Andreu et al., 2008). The depression scale showed adequate reliability ($\alpha = 0.79$) in the original version, and adequate reliability indices ($\alpha = 0.86$) were obtained in our data.

In sample 3, we used several of the assessment instruments described previously: SCID-CV and SCID-PD (First et al., 2015, 2016), PIL-10 (García-Alandete et al., 2013), DERS (Gratz and Roemer, 2004), MBSRQ-AS (Cash, 2000), and EAT (Garner and Garfinkel, 1979). In addition:

***Borderline Symptom List-23 (Bohus et al., 2008)***

This is a self-report that assesses the main symptoms of BPD. It is made up of 23 Likert-type items (five response levels). Higher scores on the BSL-23 indicate more severe BPD symptoms. For the present study, we used the Spanish version of the BSL-23 (Soler et al., 2013), which offered good psychometric properties ($\alpha = 0.93$) and showed excellent internal consistency in our sample ($\alpha = 0.95$).

***Beck Hopelessness Scale (Beck et al., 1974)***

This is a self-report that assesses negative expectations and attitudes about the future and hopelessness. It is a dichotomous scale containing 20 items (true–false). The scale shows adequate psychometric properties in the Spanish version (Viñas et al., 2004). For our scores, the reliability was adequate ($\alpha = 0.89$).

## Procedure

In sample 1, participants filled out the questionnaires during their regular school day. Regarding samples 2 and 3, first, an individual evaluation session was carried out to establish the diagnosis using the SCID-CV and SCID-PD. Subsequently, the participants completed the questionnaires. The diagnostic interviews were carried out by a clinical psychologist, with more than 10 years of experience in the evaluation and treatment of ED.

## General Statistical Procedure

The statistical procedure was similar for all three samples. First, descriptive statistics and zero-order correlations (Pearson's coefficient) were calculated for the variables. Second, a multiple mediation analysis was performed. To test the mediational models, we calculated three effects (Frazier et al., 2004): (a) the direct effect, where the outcome variable (EAT, BAS, BDI in sample 1; BITE, BAS, BIS in sample 2; and EAT, BAS, HS, BSL in sample 3) is regressed on the predictor (DERS); (b) the indirect effect, which consists of two paths: first, the mediator (PIL) is regressed on the predictor variable (DERS), and second, the outcome variable (EAT, BAS, BDI in sample 1; BITE, BAS, BIS in sample 2; and EAT, BAS, HS, BSL in sample 3) is regressed on both the predictor (DERS) and the mediator (PIL); (c) third, the total effect, which is the sum of the direct and indirect effect. If the indirect effect is significantly smaller than the direct effect, the data suggest partial mediation. In addition, we tested the significance of the mediated effect with the CIs using bias-corrected bootstrap because the sampling distribution of the indirect effect is asymmetric. We used the Delta method SEs and bias-corrected percentile bootstrap (10,000 replications), and we calculated the variance explained (adjusted $R^2$) by the mediation. The calculations and the mediation model were performed with the statistical program JASP Team (2020).

# RESULTS

As you can see in **Table 2**, in the sample composed by participants without ED, meaning in life had a high and negative correlation with depression symptoms, a moderate and negative correlation

**TABLE 2 |** Mean and zero-order correlations for the variables in young women.

| | M (SD) | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Meaning in life (PIL) | 56.63 (8.27) | −0.46** | −0.29** | 0.37** | −0.53** |
| 2. Emotional dysregulation | 16 (7.01) | | 0.27** | −0.34** | 0.57** |
| 3. Eating attitude test | 11.59 (15.08) | | | −0.50** | 0.33** |
| 4. Body areas satisfaction | 3.32 (0.67) | | | | −0.28** |
| 5. Depression Inventory | 12.88 (.97) | | | | |

*PIL, Purpose in life.*
***p < 0.01.*

with emotional dysregulation, and a moderate and positive correlation with body satisfaction. Furthermore, meaning in life had a low and negative correlation with negative attitudes and behaviors toward the body. As **Table 3** reveals, meaning in life showed a multiple mediation effect between emotional dysregulation and the psychopathology of eating disorders (direct effect $\beta = 0.390$, $p < 0.05$) (indirect effect $\beta = 0.227$, $p < 0.05$) ($R^2 = 0.13$), body satisfaction (direct effect $\beta = -0.017$, $p < 0.05$) (indirect effect $\beta = -0.013$, $p < 0.01$) ($R^2 = 0.16$), and depression symptoms (direct effect $\beta = 1.112$, $p < 0.001$) (indirect effect $\beta = 0.414$, $p < 0.001$) ($R^2 = 0.42$). As **Figure 1** shows, the relationship between meaning in life and emotional dysregulation was negative, and the relationships between meaning in life and eating disorder symptoms and depression were negative. Finally, the relationship between meaning in life and body satisfaction was positive.

Regarding the sample composed by participants with obesity, **Table 4** shows that meaning in life had a moderate and negative correlation with BN and BED symptoms and with depression symptoms. Furthermore, meaning in life had a low and negative correlation with emotional dysregulation. On the other hand, meaning in life had a moderate and positive correlation with body satisfaction. Emotional dysregulation was not associated with body satisfaction, and so it was excluded from the mediation model. As **Table 5** reveals, meaning in life showed a multiple mediation effect between emotional dysregulation and the psychopathology of BN and BED symptoms (direct effect $\beta = 0.194$, $p < 0.01$) (indirect effect $\beta = 0.054$, $p < 0.05$) ($R^2 = 0.15$) and depression symptoms (direct effect $\beta = 0.357$, $p < 0.001$) (indirect effect $\beta = 0.063$, $p < 0.05$) ($R^2 = 0.35$). As **Figure 2** shows, the relationship between meaning in life and emotional dysregulation was negative, and the relationships between meaning in life and BN and BED symptoms and depression were negative.

In the sample composed by participants with ED diagnoses (see **Table 6**), meaning in life had a high and negative correlation with emotional dysregulation, hopelessness, and BPD symptoms and a high and positive association with body satisfaction. Moreover, meaning in life had a moderate and negative correlation with negative attitudes and behaviors toward the body and food. As **Table 7** reveals, meaning in life showed a multiple mediation effect between emotional dysregulation and negative attitudes toward food (direct effect $\beta = 0.884$, $p < 0.001$) (indirect effect $\beta = 0.252$, $p < 0.007$) ($R^2 = 0.24$), body satisfaction (direct effect $\beta = -0.033$, $p < 0.05$) (indirect effect $\beta = -0.021$, $p < 0.001$) ($R^2 = 0.37$), borderline symptoms (direct effect $\beta = 0.040$, $p < 0.001$) (indirect effect $\beta = 0.025$, $p < 0.001$) ($R^2 = 0.58$), and hopelessness (direct effect $\beta = 0.211$, $p < 0.001$) (indirect effect $\beta = 0.087$, $p < 0.001$) ($R^2 = 0.65$). As **Figure 3** shows, the relationship between meaning in life and emotional dysregulation was negative, and the relationships between meaning in life and negative attitudes toward food, hopelessness, and borderline symptoms were negative. However, the relationship between meaning in life and body satisfaction was positive.

## DISCUSSION

The aim of our study was to test the mediating role of meaning in life in the relationship between emotional dysregulation and the psychopathology of ED in three different samples of participants: young women participants, participants with morbid obesity, and participants with a diagnosis of ED.

In the first sample, meaning in life showed a partial mediation effect between emotional dysregulation and the ED psychopathology, body satisfaction, and depression. We would like to highlight that meaning in life showed a negative association with the ED psychopathology, a positive association with body satisfaction, and a negative association with depression, and these associations were similar in size to the associations with emotional dysregulation, an important variable in the etiology of ED. These results are similar to previous studies with samples without ED, where they found that meaning in life was negatively associated with ED symptoms in adolescents (Gongora, 2014) and positively associated with healthy eating (Brassai et al., 2015). However, in our study we have taken a step further by showing that meaning in life is a mediator variable in the relationship between the risk factor of emotional dysregulation and other risk factors for ED, such as negative attitudes toward food, body satisfaction, and depression in young women. This result is important because negative affect has been found to be a predictor of the onset of all types of EDs, including AN, BN, BED, and purging disorder, because it can decrease appetite, leading to unhealthy weight loss and increasing the likelihood of unhealthy weight control behaviors (Stice et al., 2017).

Regarding the second sample, participants with obesity, the results suggest that meaning in life was a mediating variable between emotional dysregulation and BN and BED symptoms and depression. As in the young women participants, meaning in life was moderately and positively associated with body satisfaction. We selected participants with obesity because it is a risk factor for developing ED and it has high comorbidity with BN and BED (Dixon et al., 2003). When we designed the study, we thought that if meaning in life is a mediating variable in the ED psychopathology, its mediating role should be confirmed with a sample with high vulnerability to ED, such as people with obesity. This hypothesis has been confirmed in the present study. Moreover, we want to emphasize that meaning in life was

highly and negatively associated with depression. This result is important because participants with morbid obesity have high comorbidity with depression (Dixon et al., 2003).

**TABLE 3 |** Multiple mediation model of meaning in life between emotional dysregulation and the psychopathology of eating disorders in young adult women without eating disorders.

| | Estimate | SE | *z*-Value | *p* | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **DER-PIL-EAT** | | | | | | |
| Total effect | 0.617 | 0.178 | 3.472 | <0.001 | 0.269 | 0.965 |
| Direct effect | 0.390 | 0.191 | 2.042 | 0.041 | 0.016 | 0.764 |
| Indirect effect | 0.227 | 0.097 | 2.347 | 0.019 | 0.037 | 0.417 |
| **DER-PIL-BAS** | | | | | | |
| Total effect | −0.031 | 0.008 | −3.963 | <0.001 | −0.046 | −0.016 |
| Direct effect | −0.017 | 0.008 | −2.066 | 0.039 | −0.034 | −8.949e−4 |
| Indirect effect | −0.013 | 0.004 | −2.970 | 0.003 | −0.022 | −0.005 |
| **DER-PIL-BDI** | | | | | | |
| Total effect | 1.527 | 0.189 | 8.090 | <0.001 | 1.157 | 1.896 |
| Direct effect | 1.112 | 0.205 | 5.439 | <0.001 | 0.712 | 1.513 |
| Indirect effect | 0.414 | 0.111 | 3.728 | <0.001 | 0.196 | 0.632 |

*DER, emotional deregulation; PIL, purpose in life; EAT, eating attitude test; BAS, body areas satisfaction; BDI, Beck Depression Inventory.*

Regarding the third sample, participants diagnosed with ED, meaning in life was a significant mediator between emotional dysregulation and the main symptoms of ED, such as a negative attitude toward food and the body, body satisfaction, hopelessness, and borderline symptoms. We want to highlight that meaning in life has a greater association with body satisfaction than with emotional dysregulation and negative attitudes and behaviors toward food and the body. Furthermore, these results agree with previous studies indicating that meaning in life is an important variable in participants with ED (Marco et al., 2020b), as well as other qualitative studies on the

**TABLE 4 |** Mean and zero-order correlations for the variables in participants with obesity.

| | M (SD) | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Meaning in life (PIL) | 53.88 (10.74) | −0.23* | −0.30** | 0.41** | −0.42** |
| 2. Emotional dysregulation | 14.48 (6.54) | | 0.27** | −0.15 | 0.55** |
| 3. BITE | 10.27 (5.88) | | | −0.40** | 0.22* |
| 4. Body Satisfaction Scale | 2.56 (0.57) | | | | −0.28** |
| 5. Depression (BSI) | 4.42 (5.44) | | | | – |

*PIL, purpose in life; BITE, Bulimic Inventory Test Edinburgh; BSI, Brief Symptoms Inventory.*
*$p < 0.05$, **$p < 0.01$.

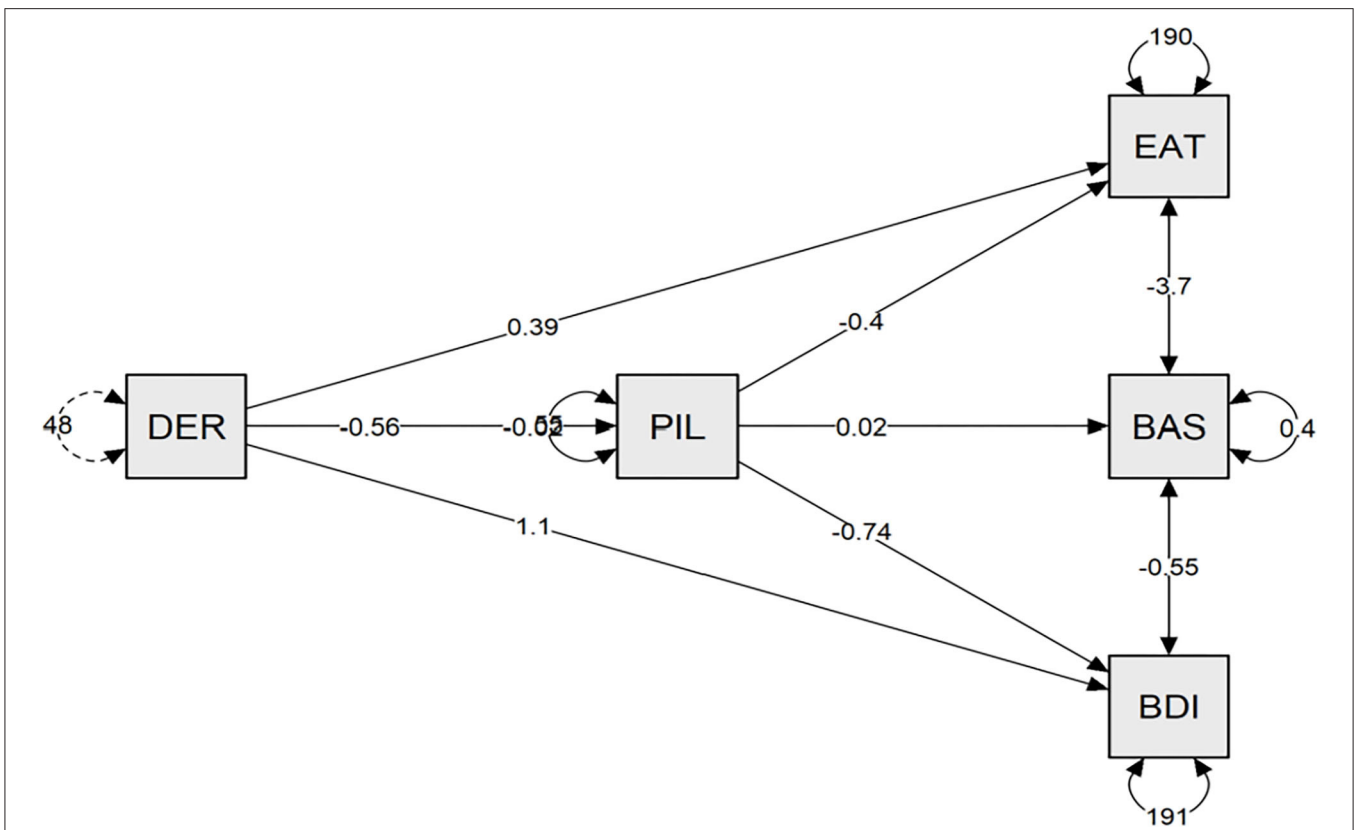


**FIGURE 1 |** The meaning in life is a mediating variable between the emotional deregulation and binge eating disorder psychopathology, and depression in young adult women without eating disorders. DER, emotional deregulation; PIL, purpose in life; BDI, Beck Depression Inventory; BAS, body area satisfaction.

analysis of recovery criteria in ED that found meaning in life and purpose to be important components of ED recovery (de Vos et al., 2017).

In all three samples, meaning in life was highly and negatively associated with depression and positively associated with body satisfaction, and several studies have found that body dissatisfaction and depressive symptoms are the main predictors of ED (e.g., Stice et al., 2011). In this regard, Troop (2016) suggests that negative affect about a loss is a precipitating factor of the ED, and Gulliksen et al. (2017) suggest that the initiation of the ED is an attempt to control the negative emotions, family environment, and challenges patients have experienced at any given moment in their lives. Thus, from the MMMED perspective, we can suggest that, in some patients, the ED symptoms could be a dysfunctional strategy to achieve a new meaning in life once the previous meaning in life has been threatened or lost at a certain time in their lives. If the new meaning in life is focused on the ED values, aims, and beliefs, this keeps patients from discovering an authentic, genuine, and individual meaning in life. If the person with ED does not discover an authentic meaning in life, it could lead to a state of hopelessness, a lack of identity, and low quality of life. In this regard, studies have found that people with ED have lower levels of meaning in life than recovered patients (de la Rie et al., 2007), problems with their identity (Stein and Corte, 2007), feelings of hopelessness (Robinson et al., 2015), and poor quality of life (Tomba et al., 2017). In a recent study, Wetzler et al. (2020) confirmed that connectedness, hope, and optimism about the future, identity, meaning in life, and empowerment are important components of recovery in ED participants. Thus, patients indicated that they found meaning in their lives from ED, and finding actual meaning in life and important goals and values beyond ED is a very important part of recovery.

Although the absence of meaning in life can be a symptom included in several mental disorders (e.g., major depressive

**TABLE 5 |** Multiple mediation model of meaning in life between emotional dysregulation and the bulimic and binge eating disorders symptoms and depression in participants with obesity.

| | Estimate | SE | *z*-Value | *p* | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **DER-PIL-BITE** | | | | | | |
| Total effect | 0.247 | 0.078 | 3.157 | <0.001 | 0.039 | 0.413 |
| Direct effect | 0.194 | 0.08 | 2.485 | <0.01 | 0.025 | 0.362 |
| Indirect effect | 0.054 | 0.027 | 1.960 | <0.05 | 0.006 | 0.154 |
| **DER-PIL-Depression (BSI)** | | | | | | |
| Total effect | 0.420 | 0.065 | 6.453 | <0.001 | 0.238 | 0.572 |
| Direct effect | 0.357 | 0.062 | 5.719 | <0.001 | 0.159 | 0.542 |
| Indirect effect | 0.063 | 0.028 | 2.247 | <0.05 | 0.010 | 0.165 |

*PIL, purpose in life; BITE, Bulimic Inventory Test Edinburgh; BSI, Brief Symptoms Inventory.*

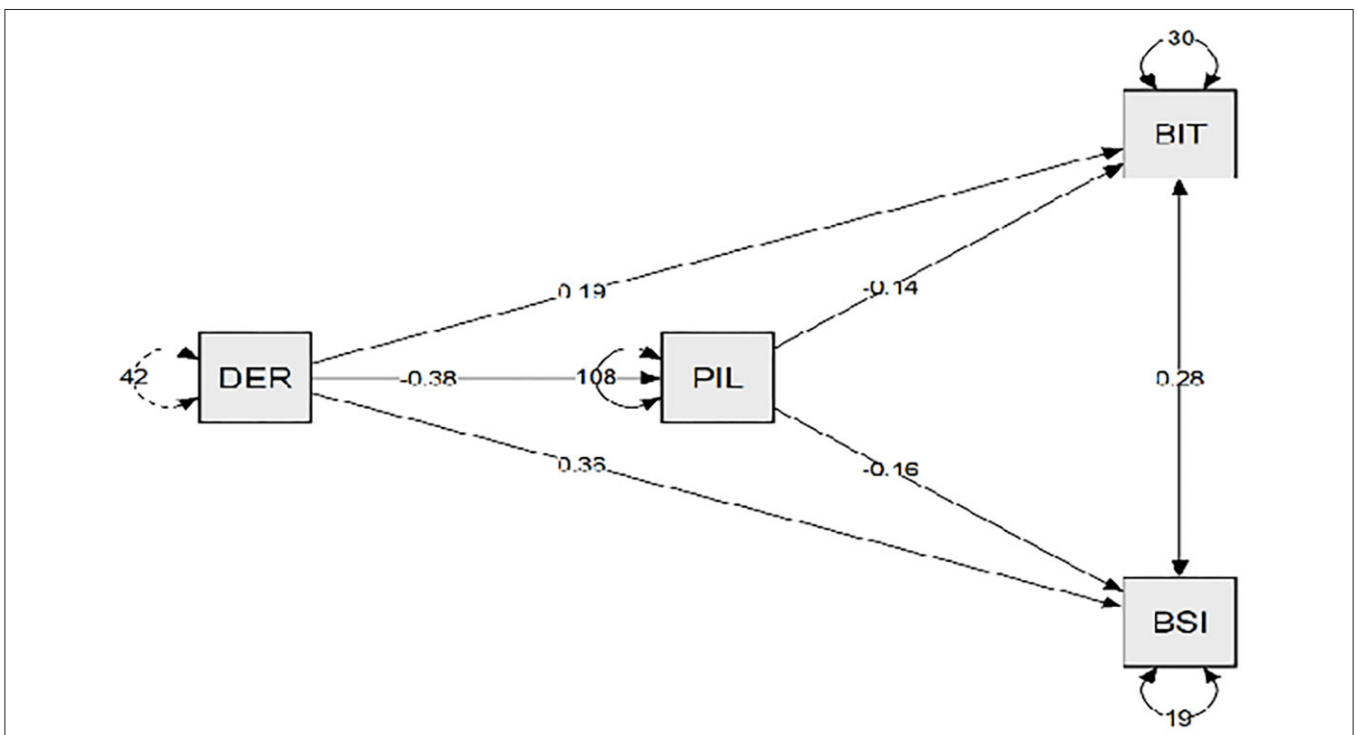


**FIGURE 2 |** The meaning in life is a mediating variable between the emotional deregulation and binge eating disorder psychopathology, and depression in participants with overweight. DER, emotional deregulation; PIL, purpose in life; BIT, Bulimic Inventory Test Edinburgh; BSI, depression subscale of the Brief Symptoms Inventory.

**TABLE 6 |** Mean and zero-order correlations for the variables in participants with ED.

| | M (SD) | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Meaning in life (PIL) | 43.88 (12.51) | −0.50** | −0.36** | 0.51** | −0.60** | −0.70** |
| 2. Emotional dysregulation | 24.29 (9.84) | | 0.44** | −0.45** | 0.68** | 0.55** |
| 3. Eating attitude test | 38.96 (23.11) | | | −0.40** | 0.52** | 0.40** |
| 4. Body areas satisfaction | 2.62 (0.74) | | | | −0.52 | −0.55** |
| 5. Borderline symptoms | 1.17 (0.97) | | | | | 0.66** |
| 6. Hopelessness Scale | 6.26 (5.30) | | | | | – |

*PIL, purpose in life; BSL, borderline symptoms list; HS, Hopelessness Scale.*
***p < 0.01.*

**TABLE 7 |** Multiple mediation model of meaning in life between emotional dysregulation and the psychopathology of eating disorders in participants with eating disorders.

| | Estimate | SE | *z*-Value | *p* | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **DER-PIL-EAT** | | | | | | |
| Total effect | 1.136 | 0.138 | 8.220 | <0.001 | 0.846 | 1.404 |
| Direct effect | 0.884 | 0.163 | 5.437 | <0.001 | 0.555 | 1.225 |
| Indirect effect | 0.252 | 0.093 | 2.718 | 0.007 | 0.087 | 0.437 |
| **DER-PIL-BAS** | | | | | | |
| Total effect | −0.054 | 0.004 | −7.563 | <0.001 | −0.043 | −0.024 |
| Direct effect | −0.033 | 0.005 | −2.688 | 0.007 | −0.022 | −0.003 |
| Indirect effect | −0.021 | 0.003 | −6.336 | <0.001 | −0.027 | −0.016 |
| **DER-PIL-BSL** | | | | | | |
| Total effect | 0.065 | 0.005 | 13.607 | <0.001 | 0.055 | 0.075 |
| Direct effect | 0.040 | 0.005 | 8.162 | <0.001 | 0.031 | 0.050 |
| Indirect effect | 0.025 | 0.004 | 6.874 | <0.001 | 0.019 | 0.033 |
| **DER-PIL-HS** | | | | | | |
| Total effect | 0.298 | 0.029 | 10.158 | <0.001 | 0.232 | 0.355 |
| Direct effect | 0.211 | 0.025 | 8.494 | <0.001 | 0.165 | 0.256 |
| Indirect effect | 0.087 | 0.025 | 3.515 | <0.001 | 0.039 | 0.142 |

*DER, emotional deregulation; PIL, purpose in life; EAT, eating attitude test; BAS, body areas satisfaction; BSL, borderline symptom list; HS, Hopelessness Scale.*

disorder, adjustment disorders, BPD, etc.), meaning in life is a different construct from depression for several reasons. Meaning in life is a transdiagnostic construct composed of the sense of coherence, purpose, and importance of our life that is not necessarily psychotogenic. Moreover, regarding patients with depressive symptoms, Frankl (2006) differentiated between noogenic depression (noos = meaning) and endogenous depression, to highlight the patients whose depression was caused by the absence of meaning in life. Frankl states that noogenic depression is characterized by an existential vacuum, absence of meaning in life, boredom, frustration, distress, anxiety, and aggressiveness, and that its etiology would be different from that of endogenous depressions (e.g., neurobiological disturbances, early depressive schemes), indicating that around 20% of depressions are noogenous. Regarding participants with adjustment disorder, several studies have found that meaning-making was an independent and buffering factor in adjustment in participants with depression and anxiety disorders (e.g., Marco et al., 2020a).

Our results could have several clinical implications. One of the main difficulties in treating ED is the rejection and resistance to change these patients usually show, often because they may not recognize ED symptoms as a problem, thus making collaboration in treatment difficult (Macdonald et al., 2012). In a qualitative study, Nordbø et al. (2012) asked AN patients specifically about what makes them not want to recover, and they found that having AN can evoke positive feelings, such as feelings of security or the feeling that there is meaning and purpose in life. These feelings compensated for the negative consequences of AN, and so the desire to recover decreased. Thus, taking into account the studies that suggest that meaning and purpose in life are important factors in the recovery process, it is possible that if we orient psychotherapy toward values and goals related to authentic and genuine sources of meaning, we can increase the motivation toward recovery. Second, our results could suggest the need to add meaning-centered therapy for ED participants with low meaning in life. Qualitative research carried out from the patients' perspective indicated that they need to be treated as a "whole person" (Rance et al., 2017), preferring treatments that take their psychological and social needs into account, and they stated that rigid treatments focused on weight and food did not work for them (Westwood and Kendal, 2012).

We want to emphasize that the MMMED does not suggest that all patients with ED have low meaning in life or that it is necessary to intervene in the meaning in life in all patients. On the contrary, in most cases the ED will develop and be maintained by other factors, such as self-esteem, depression, body dissatisfaction, and perfectionism (Fairburn, 2008). The MMMED suggests that only a percentage of participants will have problems with meaning in life. However, in cases where the absence of meaning in life is a problem, we suggest adapting the current psychotherapies, mainly cognitive behavioral therapy or dialectical behavioral therapy (Linehan, 2015), by adding a treatment component focused on meaning-centered therapy. Thus, meaning-centered therapy for ED with low meaning in life could focus on the following aims: (1) awareness of their absence of meaning in life because their life is oriented toward dysfunctional goals and values (e.g., weight control,

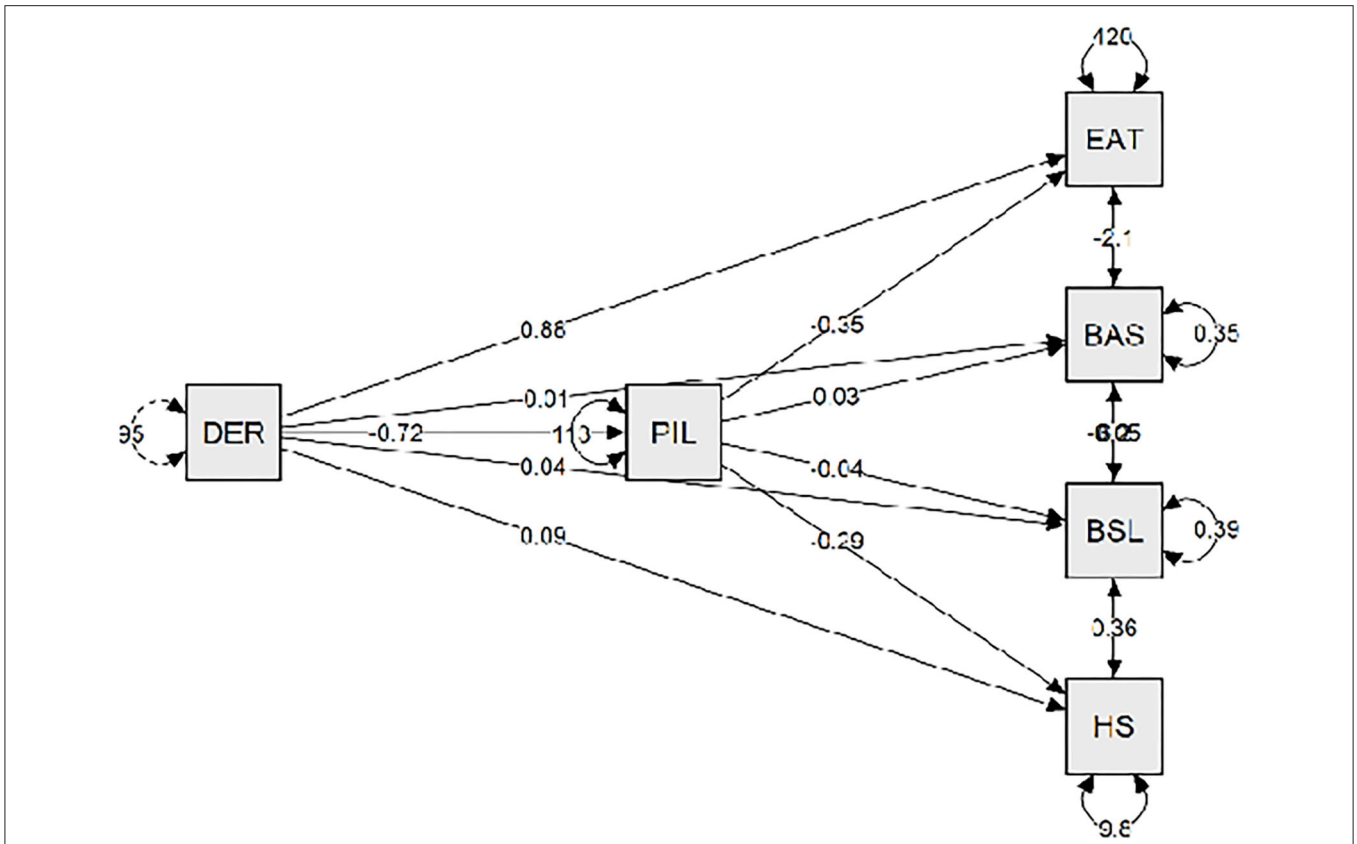


**FIGURE 3 |** The meaning in life is a mediating variable between the emotional deregulation and the main symptoms of eating disorders. DER, emotional deregulation; PIL, purpose in life; EAT, eating attitude test; BAS, body area satisfaction; BSL, borderline symptom list; HS, hopelessness scale.

food control, perfectionism, etc.); (2) psychoeducation about meaning in life as a protective factor against ED symptoms; (3) learning to recognize the potential sources of meaning, as well as discovering situations from the past that involved moments of fulfillment; (4) learning to discover authentic vital purpose and goals; (5) modifying their current aims and goals to follow their authentic values. Meaning-centered therapy could be added to the therapies that are efficacious in improving emotional regulation problems in ED. Meta-analytic studies found that meaning-centered therapy was primarily effective in improving general quality of life and meaning in life; reducing psychological stress and negative affect; and improving social relationships, self-efficacy, hope, hopelessness, and optimism (Vos and Vitali, 2018). To date, no studies have analyzed whether a treatment component focused on meaning in life added to CBT would be effective in improving emotional dysregulation, depression, and body dissatisfaction in people with ED. Thus, future research should analyze this.

Regarding the strategies for ED prevention, meta-analysis studies found that media literacy was effective for reducing ED risk factors up to 30 months after the intervention in both females and males, and that multicomponent and self-esteem enhancement interventions were effective only in females. Moreover, the cognitive dissonance intervention was superior to controls in reducing ED behaviors up to 3 years post-intervention. In the same way, healthy weight interventions and CBT interventions improved ED risk factors (Long et al., 2017). However, it is important to emphasize that the incidence of ED has not decreased in the past 50 years (Hoek, 2016), and so, in addition to the previously mentioned prevention strategies, an intervention could be carried out on other variables that have been shown to buffer the risk factors for ED. Our results suggest that interventions aimed at discovering authentic and genuine meaning in life could be a strategy for the prevention of risk factors: depression, body dissatisfaction, emotional dysregulation, and negative attitudes toward food and the body. In this regard, there are programs aimed at adolescents and young adults that have been shown to improve meaning in life. For example, Luz et al. (2017) found that, after the intervention to increase meaning in life in adolescents, the perception of meaning in life increased and negative affect decreased, providing evidence supporting the effectiveness of the intervention. Cheng et al. (2015) carried out a program with university students in China where therapy focused on meaning in life was found to increase psychological well-being. Thus, future research needs to analyze whether a meaning-focused intervention can be effective in reducing risk factors for ED in the general population.

The present study has some limitations: first, all the studies are cross-sectional, which means that we cannot speak of causality between variables. For this reason, the results obtained should be

considered in terms of correlates rather than causal risk factors. More research is needed to replicate the present study using a longitudinal design. Another limitation is that, although meaning in life was a mediator variable of ED psychopathology, the size of the mediation was high for hopelessness and borderline symptoms, moderate for depression symptoms (range between 0.35 and 0.45), low to moderate for body satisfaction (range between 0.16 and 0.37), and low for eating disorder symptoms (range between 0.13 and 0.24). These results indicate that other variables that we have not included in the present study may influence the relationships between emotional dysregulation, meaning in life, and ED psychopathology, such as perfectionism. All the studies were carried out with Spanish participants, and so these results are only generalizable to countries similar to the Spanish culture. Another limitation of our study is that we did not assess the exogenous or endogenous origins of obesity in the participants who suffered from obesity. We understood that obesity could be a consequence of ED, and that meaning in life is a mediator of ED psychopathology. Thus, future research should analyze this distinction to determine whether meaning in life buffers the association between ED psychopathology and obesity symptoms. Finally, another limitation of this research is that we cannot compare the three samples because the dependent variables were measured with different scales. For example, to assess depression, we used the BDI in the non-clinical sample, the BIS questionnaire in the participants with obesity, and the HS in the sample with ED. In the same way, to assess ED symptoms, we used the EAT in the non-clinical sample and the sample with ED, but in the sample with obesity, we used the BITE. Thus, future research will have to carry out a new study with three samples with different ED psychopathology severity, but assessed with the same measures, to compare the results of the three samples by performing a multi-group model (e.g., SEM) that includes all the participants and assessing the role of the diagnostic subtype with invariance tests.

In conclusion, our study suggests that meaning in life is a mediating variable between emotional dysregulation and the main risk factors for ED in participants with ED, participants with obesity, and young female participants. These results suggest the importance of considering meaning in life as a relevant variable in the onset and maintenance of people with ED.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Catholic University of Valencia's ethics committee prior to its implementation (research code UCV2013–2014/0023). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

JM did the experimental design, performed the analyses, and wrote the manuscript. MC and CM recruited the sample and wrote the manuscript. RB, VG, and SP designed the research and reviewed the final manuscript. All authors contributed to the article and approved the submitted version.

## FUNDING

Funding for the study was provided by (R + D + I) Projects of the State Programs Oriented to the Challenges of Society, within the framework of the State Research Plan Scientific and Technical and Innovation, with Code: PID2019-111036RB-I00, from Ministry of Science and Innovation of Spain.

## REFERENCES

Aldao, A., Nolen-Hoeksema, S., and Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: a meta-analytic review. *Clin. Psychol. Rev.* 30, 217–237. doi: 10.1016/j.cpr.2009.11.004

Allen, K., Byrne, S., Oddy, W., and Crosby, R. (2013). DSM-IV-TR and DSM-5 eating disorders in adolescents; Prevalence, stability, and psychosocial correlates in a population-based sample of male and female adolescents. *J. Abnorm. Psychol.* 122, 720–732. doi: 10.1037/a0034004

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders, 5th Edn*. Washington, DC: APA.

Andreu, Y., Galdón, M. J., Dura, E., Ferrando, M., Murgui, S., García, A., et al. (2008). Psychometric properties of the Brief Symptoms Inventory-18 (BSI-18) in a Spanish sample of outpatients with psychiatric disorders. *Psicothema* 20, 844–850.

Beck, A. T., Steer, R. A., and Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II, 2nd Edn.* San Antonio, TX: Psychological Corporation.

Beck, A. T., Weissman, A., Lester, D., and Trexler, L. (1974). The measurement of pessimism: the hopelessness scale. *J. Consult. Clin. Psychol.* 42, 861–865. doi: 10.1037/h0037562

Black, D. W., Goldstein, R. B., and Mason, E. E. (1992). Prevalence of mental disorders in 88 morbidly obese bariatric clinic patients. *Am. J. Psychiatry* 149, 227–234. doi: 10.1176/ajp.149.2.227

Bohus, M., Kleindienst, N., Limberger, M. F., Stieglitz, R. D., Domsalla, M., Chapman, A. L., et al. (2008). The short version of the Borderline Symptom List (BSL-23): development and initial data on psychometric properties. *Psychopathol* 42, 32–39. doi: 10.1159/000173701

Bowlby, C. G., Anderson, T. L., Hall, M. E. L., and Willingham, M. M. (2015). Recovered professionals exploring eating disorder recovery: a qualitative investigation of meaning. *Clin. Soc. Work J.* 43, 1–10. doi: 10.1007/s10615-012-0423-0

Brassai, L., Piko, B. F., and Steger, M. F. (2015). A reason to stay healthy: the role of meaning in life in relation to physical activity and healthy eating among adolescents. *J. Health Psychol.* 20, 473–482. doi: 10.1177/1359105315576604

Brone, R. J., and Fisher, C. B. (1988). Determinants of adolescent obesity: a comparison with anorexia nervosa. *Adolescence* 23, 155–169.

Cash, T. F. (2000). *The MBSRQ Users' Manual*, 3*rd Edn.* Available online at: www.body-images.com.Cash

Castro, J., Toro, J., Salamero, M., and Guimerá, E. (1991). The eating attitudes test: validation of the Spanish version. *Psychol. Assess.* 7, 175–190.

Cheng, M., Hasche, L., Huang, H., and Su, X. S. (2015). The effectiveness of a meaning-centered psychoeducational group intervention for Chinese college students. *J. Soc. Behav. Pers.* 43, 741–756. doi: 10.2224/sbp.2015.43.5.741

de la Rie, S., Noordenbos, G., Donker, M., and van Furth, E. (2007). The patient's view on quality of life and eating disorders. *Int. J. Eat. Disord.* 40, 13–20. doi: 10.1002/eat.20338

de Vos, J. A., LaMarre, A., Radstaak, M., Bijkerk, C. A., Bohlmeijer, E. T., and Westerhof, G. J. (2017). Identifying fundamental criteria for eating disorder recovery: a systematic review and qualitative meta-analysis. *J. Eat. Disord.* 5:34. doi: 10.1186/s40337-017-0164-0

Derogatis, L. R. (2001). *Brief Symptom Inventory (BSI)-18. Administration, Scoring and Procedures Manual.* Minneapolis, MN: NCS Pearson, Inc.

Dixon, J. B., Dixon, M. E., and O'Brien, P. E. (2003). Depression in association with severe obesity: changes with weight loss. *Arch. Intern. Med.* 163, 2058–2065. doi: 10.1001/archinte.163.17.2058

Fairburn, C. G. (2008). *Cognitive Behavior Therapy and Eating Disorders*. New York, NY: Guilford Press.

First, M. B., Williams, J. B., Benjamin, L. S., and Spitzer, R. L. (2016). *Structured Clinical Interview for DSM-5® Personality Disorders.* Washington, DC: American Psychiatric Association Publishing.

First, M. B., Williams, J. B. W., Karg, R. S., and Spitzer, R. L. (2015). *Structured Clinical Interview for DSM-5 Disorders—Clinician Version (SCID-5-CV).* Arlington, VA: American Psychiatric Association.

Fox, A. P., and Leung, N. (2009). Existential well-being in younger and older people with anorexia nervosa—a preliminary investigation. *Eur. Eat. Disord. Rev.* 17, 24–30. doi: 10.1002/erv.895

Frankl, V. E. (2006). *The Unheard Cry for Meaning. Psychotherapy and Humanism*. Boston, MA: Beacon Press.

Frazier, P., Tix, A. P., and Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *J. Couns. Psychol.* 51, 115–134. doi: 10.1037/0022-0167.51.1.115

García-Alandete, J., Rosa, E., and Sellés, P. (2013). Estructura factorial y consistencia interna de una version española del Purpose-In-Life Test [Factorial structure and internal consistency of a Spanish version of the Purpose-In-Life Test]. *Univ. Psychol.* 12, 517–530. doi: 10.11144/Javeriana.UPSY12-2.efci

Garner, D. M., and Garfinkel, P. E. (1979). The eating attitudes test: an index of the symptoms of anorexia nervosa. *Psychol. Med.* 9, 273–279. doi: 10.1017/S0033291700030762

Garrett, C. J. (1997). Recovery from anorexia nervosa: a sociological perspective. *Int. J. Eat. Disord.* 21, 261–272. doi: 10.1002/(SICI)1098-108X(199704)21:3<261::AID-EAT6>3.0.CO;2-I

Gongora, V. (2014). Satisfaction with life, well-being, and meaning in life as protective factors of eating disorder symptoms and body dissatisfaction in adolescents. *Eat. Disord.* 22, 435–449. doi: 10.1080/10640266.2014.931765

Gratz, K. L., and Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. *J. Psychopathol. Behav. Assess.* 26, 41–54. doi: 10.1023/B:JOBA.0000007455.08539.94

Gross, J. J. (1998). The emerging field of emotion regulation: an integrative review. *Rev. Gen. Psychol.* 2, 271–299. doi: 10.1037/1089-2680.2.3.271

Guisado, J. A., Vaz, F. J., López-Ibor, J. J., Inés López-Ibor, M., del Río, J., and Rubio, M. A. (2002). Gastric surgery and restraint from food as triggering factors of eating disorders in morbid obesity. *Int. J. Eat. Disord.* 31, 97–100. doi: 10.1002/eat.1114

Gulliksen, K. S., Nordbø, R. H., Espeset, E. M., Skårderud, F., and Holte, A. (2017). Four pathways to anorexia nervosa: patients' perspective on the emergence of AN. *Clin. Psychol. Psychother.* 24, 846–858. doi: 10.1002/cpp.2050

Henderson, M., and Freeman, C. P. L. (1987). A self-rating scale for Bulimia. The BITE. *Br. J. Psychiatry* 150, 18–24. doi: 10.1192/bjp.150.1.18

Hervás, G., and Jódar, R. (2008). The Spanish version of the difficulties in emotion regulation scale. *Clín. Salud* 19, 139–156.

Hoek, H. W. (2016). Review of the worldwide epidemiology of eating disorders. *Curr. Opin. Psychiatry* 29, 336–339. doi: 10.1097/YCO.0000000000000282

Jarman, F. C., Rickards, W. S., and Hudson, I. L. (1991). Late adolescent outcome of early unset anorexia nervosa. *Pediatr. Child Health* 27, 221–227. doi: 10.1111/j.1440-1754.1991.tb00396.x

JASP Team (2020). *JASP (Version 0.14.1) [Computer Software]*. Available online at: https://jasp-stats.org/

Linehan, M. M. (2015). *DBT Skills Training Manual, 3nd Edn.* New York, NY: Guilford Press.

Long, K. D. L., Barendregt, J. J., Hay, P., and Mihalopoulos, C. (2017). Prevention of eating disorders: a systematic review and meta-analysis. *Clin. Psychol. Rev.* 53, 46–58. doi: 10.1016/j.cpr.2017.02.001

Luz, J. M. O. D., Murta, S. G., and Aquino, T. A. A. D. (2017). Intervention for promoting meaning in life in adolescents: evaluation of the process and results. *Trends Psychol.* 25, 1795–1811. doi: 10.9788/TP2017.4-14En

Macdonald, P., Hibbs, R., Corfield, F., and Treasure, J. (2012). The use of motivational interviewing in eating disorders: a systematic review. *Psychiatry Res.* 200, 1–11. doi: 10.1016/j.psychres.2012.05.013

Mallorquí-Bagué, N., Vintró-Alcaraz, C., Sánchez, I., Riesco, N., Agüera, Z., Granero, R., et al. (2018). Emotion regulation as a transdiagnostic feature among eating disorders: cross-sectional and longitudinal approach. *Eur. Eat. Disord. Rev.* 26, 53–61. doi: 10.1002/erv.2570

Marco, J. H., Alonso, S., and Baños, R. (2020a). Meaning-making as a mediator of anxiety and depression reduction during cognitive behavioral therapy intervention in participants with adjustment disorders. *Clin. Psychol. Psychother.* doi: 10.1002/cpp.2506. [Epub ahead of print].

Marco, J. H., Cañabate, M., Llorca, G., and Pérez, S. (2020b). Meaning in life moderates hopelessness, suicide ideation, and borderline psychopathology in participants with eating disorders: a longitudinal study. *Clin. Psychol. Psychother.* 27, 146–158. doi: 10.1002/cpp.2414

Marco, J. H., Cañabate, M., and Pérez, S. (2019). Meaning in life is associated with the psychopathology of eating disorders: differences depending on the diagnosis. *Eat. Disord.* 27, 550–564. doi: 10.1080/10640266.2018.1560852

Marco, J. H., Cañabate, M., Pérez, S., and Llorca, G. (2017). Associations among meaning in life, body image, psychopathology, and suicide ideation in Spanish participants with eating disorders. *J. Clin. Psychol.* 73, 1768–1781. doi: 10.1002/jclp.22481

Martela, F., and Steger, M. F. (2016). The three meanings of meaning in life: distinguishing coherence, purpose, and significance. *J. Posit. Psychol.* 11, 531–545. doi: 10.1080/17439760.2015.1137623

Micanti, F., Iasevoli, F., Cucciniello, C., Costabile, R., Loiarro, G., Pecoraro, G., et al. (2017). The relationship between emotional regulation and eating behaviour: a multidimensional analysis of obesity psychopathology. *Eat. Weight Disord.* 22, 105–115. doi: 10.1007/s40519-016-0275-7

Monell, E., Högdahl, L., Mantilla, E. F., and Birgegård, A. (2015). Emotion dysregulation, self-image and eating disorder symptoms in University Women. *J. Eat. Disord.* 3, 1–11. doi: 10.1186/s40337-015-0083-x

Nordbø, R. H., Espeset, E. M., Gulliksen, K. S., Skårderud, F., Geller, J., and Holte, A. (2012). Reluctance to recover in anorexia nervosa. *Eur. Eat. Disord. Rev.* 20, 60–67. doi: 10.1002/erv.1097

Pisetsky, E. M., Haynos, A. F., Lavender, J. M., Crow, S. J., and Peterson, C. B. (2017). Associations between emotion regulation difficulties, eating disorder symptoms, non-suicidal self-injury, and suicide attempts in a heterogeneous eating disorder sample. *Compr. Psychiatry* 73, 143–150. doi: 10.1016/j.comppsych.2016.11.012

Racine, S. E., and Wildes, J. E. (2015). Dynamic longitudinal relations between emotion regulation difficulties and anorexia nervosa symptoms over the year following intensive treatment. *J. Consult. Clin. Psychol.* 83, 785–795. doi: 10.1037/ccp0000011

Rance, N., Moller, N. P., and Clarke, V. (2017). 'Eating disorders are not about food, they're about life': client perspectives on anorexia nervosa treatment. *J. Health Serv. Psychol.* 22, 582–594. doi: 10.1177/1359105315609088

Robinson, P. H., Kukucska, R., Guidetti, G., and Leavey, G. (2015). Severe and enduring anorexia nervosa (SEED-AN): a qualitative study of patients with 20+ years of anorexia nervosa. *Eur. Eat. Disord. Rev.* 23, 318–326. doi: 10.1002/erv.2367

Roncero, M., Perpiña, C., Marco, J. H., and Sanchez-Reales, S. (2015). Confirmatory factoranalysis and psychometric properties of the Spanish version of the multidimensional body-self relations questionnaire-appearance scales. *Body Image* 14, 47–53. doi: 10.1016/j.bodyim.2015.03.005

Rosenvinge, J. H., and Pettersen, G. (2015a). Epidemiology of eating disorders part II: an update with a special reference to the DSM-5. *Adv. Eat. Disord.* 3, 198–220. doi: 10.1080/21662630.2014.940549

Rosenvinge, J. H., and Pettersen, G. (2015b). Epidemiology of eating disorders, part I: introduction to the series and a historical panorama. *Adv. Eat. Disord.* 3, 76–90. doi: 10.1080/21662630.2014.898206

Sanz, J., García-Vera, M. P., Espinosa, R., Fortun, M., and Vázquez, C. (2005). Adaptación española del Inventario para la depresión de Beck-II (BDI-II): propiedades psicométricas en pacientes con trastornos psicológicos. *Clín. Salud* 16, 121–142.

Serpell, L., Treasure, J., Teasdale, J., and Sullivan, V. (1999). Anorexia nervosa: friend or foe? *Int. J. Eat. Disord.* 25, 177–186. doi: 10.1002/(SICI)1098-108X(199903)25:2<177::AID-EAT7>3.0.CO;2-D

Soler, J., Vega, D., Feliu-Soler, A., Trujols, J., Soto, Á., Elices, M., et al. (2013). Validation of the Spanish version of the borderline symptom list, short form (BSL-23). *BMC Psychiatry* 13, 139–146. doi: 10.1186/1471-244X-13-139

Stein, K. F., and Corte, C. (2007). Identity impairment and the eating disorders: content and organization of the self-concept in women with anorexia nervosa and bulimia nervosa. *Eur. Eat. Disord. Rev.* 15, 58–69. doi: 10.1002/erv.726

Stice, E., Gau, J. M., Rohde, P., and Shaw, H. (2017). Risk factors that predict future onset of each DSM−5 eating disorder: predictive specificity in high-risk adolescent females. *J. Abnorm. Psychol.* 126, 38–51. doi: 10.1037/abn0000219

Stice, E., Marti, C. N., and Durant, S. (2011). Risk factors for onset of eating disorders: evidence of multiple risk pathways from an 8-year prospective study. *Behav. Res. Ther.* 49, 622–627. doi: 10.1016/j.brat.2011.06.009

Tomba, E., Tecuta, L., Schumann, R., and Ballardini, D. (2017). Does psychological well-being change following treatment? An exploratory study on outpatients with eating disorders. *Compr. Psychiatry* 74, 61–69. doi: 10.1016/j.comppsych.2017.01.001

Troop, N. A. (2016). Social rank, rank-related life events and eating pathology. *Eur. Eat Disord. Rev.* 24, 75–77. doi: 10.1002/erv.2386

Villarejo, C., Fernández-Aranda, F., Jiménez-Murcia, S., Peñas-Lledó, E., Granero, R., Penelo, E., et al. (2012). Lifetime obesity in patients with eating disorders: increasing prevalence, clinical and personality correlates. *Eur. Eat. Disord. Rev.* 20, 250–254. doi: 10.1002/erv.2166

Viñas, F., Villar, E., Caparrós, B., Juan, J., Cornellá, M., and Pérez, I. (2004). Feelings of hopelessness in a Spanish university population: descriptive analysis and its relationship to adapting university, depressive symptomatology and suicidal ideation. *Soc. Psychiatry Psychiatr. Epidemiol.* 39, 326–334. doi: 10.1007/s00127-004-0756-2

Vos, J., and Vitali, D. (2018). The effects of psychological meaning-centered therapies on quality of life and psychological stress: a metaanalysis. *Palliat. Support Care* 16, 608–632. doi: 10.1017/S1478951517000931

Weinberger, N. A., Kersting, A., Riedel-Heller, S. G., and Luck-Sikorski, C. (2016). Body dissatisfaction in individuals with obesity compared to normal-weight individuals: a systematic review and meta-analysis. *Obes. Facts* 9, 424–441. doi: 10.1159/000454837

Westwood, L. M., and Kendal, S. E. (2012). Adolescent client views towards the treatment of anorexia nervosa: a review of the literature. *J. Psychiatr. Ment. Health Nurs.* 19, 500–508. doi: 10.1111/j.1365-2850.2011.01819.x

Wetzler, S., Hackmann, C., Peryer, G., Clayman, K., Friedman, D., Saffran, K., et al. (2020). A framework to conceptualize personal recovery from eating disorders: a systematic review and qualitative meta-synthesis of perspectives from individuals with lived experience. *Int. J. Eat. Disord.* 53, 1188–1203. doi: 10.1002/eat.23260

Wildes, J. E., Ringham, R. M., and Marcus, M. D. (2010). Emotion avoidance in patients with anorexia nervosa: initial test of a functional model. *Int. J. Eat. Disord.* 43, 398–404. doi: 10.1002/eat.20730

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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CORRECTION
published: 15 February 2022
doi: 10.3389/fpsyg.2022.849974

# Corrigendum: Meaning in Life Mediates Between Emotional Deregulation and Eating Disorders Psychopathology: A Research From the Meaning-Making Model of Eating Disorders

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**Keywords: meaning in life, emotional deregulation, obesity, young women, eating disorders, meaning-making model**

OPEN ACCESS

***Approved by:***
*Frontiers Editorial Office, Frontiers Media SA, Switzerland*

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*Jose H. Marco*
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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *12 January 2022*
***Accepted:*** *12 January 2022*
***Published:*** *15 February 2022*

***Citation:***
*Marco JH, Cañabate M, Martinez C, Baños RM, Guillen V and Perez S (2022) Corrigendum: Meaning in Life Mediates Between Emotional Deregulation and Eating Disorders Psychopathology: A Research From the Meaning-Making Model of Eating Disorders. Front. Psychol. 13:849974. doi: 10.3389/fpsyg.2022.849974*

**A Corrigendum on**

**Meaning in Life Mediates Between Emotional Deregulation and Eating Disorders Psychopathology: A Research From the Meaning-Making Model of Eating Disorders**
*by Marco, J. H., Cañabate, M., Martinez, C., Baños, R. M., Guillen, V., and Perez, S. (2021). Front. Psychol. 12:635742. doi: 10.3389/fpsyg.2021.635742*

In the original article, we neglected to include a Funding statement. The correct Funding statement can be found below:

## FUNDING

Funding for the study was provided by (R + D + I) Projects of the State Programs Oriented to the Challenges of Society, within the framework of the State Research Plan Scientific and Technical and Innovation, with Code: PID2019-111036RB-I00, from Ministry of Science and Innovation of Spain.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

frontiers in Psychology

ORIGINAL RESEARCH
published: 26 March 2021
doi: 10.3389/fpsyg.2021.631678

# Barriers to Behavior Change in Parents With Overweight or Obese Children: A Qualitative Interview Study

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Overweight and obesity among children and adolescents are global problems of our time. Due to their authority and role modeling, parents play an essential part in the efficacy of prevention and intervention programs. This study assessed the barriers that parents of overweight/obese children face in preventive and interventional health care utilization. Sixteen parents were qualitatively interviewed. A content analysis was performed, and barriers to change were allocated to their stage of change according to the transtheoretical model. Among the main barriers is the underestimation of health risks caused by overweight/obesity in association with diminished problem awareness. Parents seem not necessarily in need of theoretical knowledge for prevention and interventions. They do however need support in evaluating the weight status of their child and the knowledge of whom to turn to for help as well as specific and hands-on possibilities for change. The results extend past studies by adding specific barriers to change that parents commonly experience. Possibilities to address these barriers, e.g., through trainings at the pediatric practice or adoption of conversation techniques, are discussed. Future studies might identify subgroups experiencing specific barriers and thus be able to address these in an individualized way.

**Keywords: readiness to change, parental role, obesity, overweight, children**

OPEN ACCESS

***Edited by:***
*Ana Rosa Sepúlveda, Autonomous University of Madrid, Spain*

***Reviewed by:***
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*Miriam Patricia Félix Alcántara, Hospital Universitario Infanta Leonor, Spain*

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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *20 November 2020*
***Accepted:*** *24 February 2021*
***Published:*** *26 March 2021*

***Citation:***
*Ziser K, Decker S, Stuber F, Herschbach A, Giel KE, Zipfel S, Ehehalt S and Junne F (2021) Barriers to Behavior Change in Parents With Overweight or Obese Children: A Qualitative Interview Study. Front. Psychol. 12:631678. doi: 10.3389/fpsyg.2021.631678*

## INTRODUCTION

Overweight and obesity among children and adolescents are global problems of our time (World Health Organization (WHO), 2014). In Germany, about 15% of children and adolescents are affected by overweight and about 6% by obesity (Kurth and Schaffrath Rosario, 2007; Schienkiewitz et al., 2018). Many children and adolescents stay overweight/obese during their life span, leading to an increased risk for somatic and mental health comorbidities, high health expenditure, and even a shorter life expectancy (Wardle and Cooke, 2005; Giel et al., 2012; Linder et al., 2014; Effertz et al., 2016). Advancing intervention as well as prevention programs seems therefore inevitable.

Evidence suggests the importance of starting intervention and prevention programs at an early age. Childhood overweight and obesity in preschool children have dramatically increased in the last decades (De Onis et al., 2010). A longitudinal study by Shankaran et al. (2011) showed a two-fold

risk for being overweight/obese at the age of 11 when the body mass index (BMI) values of preschool children were above the 85th percentile. In light of the strong association between childhood obesity and adulthood obesity (Simmonds et al., 2016), interventions should already start at the preschool level. Expanding intervention and prevention programs to other contexts such as childcare settings or the family/parents is also important (Birch and Ventura, 2009).

Due to their authority and role modeling, parents play an essential part in the efficacy of prevention and intervention programs targeting their children. For example, Sigmund et al. (2018) reported on parents' key role in forming children's health behaviors. The American Heart Association also refers to parents as "agents of change" for their children (Faith et al., 2012). Both emphasize the defining role of parents for the success or failure of or even participation in weight management and/or lifestyle interventions for overweight and obesity. Perceived barriers of parents to prevention and intervention seem therefore of great importance.

Studies to date have shown only parts of the complex barriers parents can experience. Schmied et al. (2018) for example identified lack of family support and scheduling difficulties as barriers for parents to participate in the specific intervention program that was offered. An interview study by Nepper and Chai (2016) identified parental barriers to healthy eating, but their sample was not overweight/obesity specific and focused solely on nutrition. Concerning portion sizes, parents seem to be mostly concerned about their children not getting enough food at mealtimes and not sure about the appropriate amount of food, thus being hesitant to restrict portion sizes (Eck et al., 2018). A systematic review of parental perceptions regarding healthy behaviors for preventing overweight/obesity in children did extract some barriers of parents (Pocock et al., 2010). It remains unclear, however, if these barriers also apply to parents of children who are already overweight/obese. In summary, most of the studies until now have not looked at overweight-/obesity-specific groups and/or only looked at specific aspects of potential barriers (e.g., nutrition or physical activity), thus omitting the bigger picture.

The present study therefore aims to qualitatively assess the barriers of parents with overweight and obese children to preventive and interventional health care utilization in a phenomenological qualitative research approach (Groenewald, 2004). Due to the early occurrence of overweight and obesity, the strong association with high weight later in life, and the defining role of parents at this age, parents of preschool children were selected to participate in the current study. An emphasis was put on including parents who belonged to at least one of three risk groups for childhood overweight/obesity as determined in a representative study in Germany: overweight/obesity of at least one parent, a migration background, and low family income (Kurth and Schaffrath Rosario, 2007). Evidence from international studies also highlights the importance of these risk factors (Eagle et al., 2012; Furthner et al., 2017; Heslehurst et al., 2019).

For a guiding theory, the results are allocated according to the stages of change of the transtheoretical model (TTM; Prochaska and Diclemente, 1982; Norcross et al., 2011) of behavior change. The TTM was chosen in its common representation with four stages of change on the way to changing health behaviors (e.g., in the case of overweight/obesity): (1) precontemplation, where problem awareness is absent and there is no intention for change; (2) contemplation, where problem awareness is present, intention to change is being evaluated or present, and no action has been taken yet; (3) action, where active effort is made to change the problematic behavior; and (4) maintenance, where problematic behaviors have been changed and there is an active effort to maintain change.

Evidence supports the efficacy of interventions tailored to the stage of change of individuals for a variety of behavioral problems including eating behavior and physical activity (Marcus et al., 1998; Klöckner and Ofstad, 2017; Krebs et al., 2018; Teng et al., 2020). In the childhood overweight/obesity literature, the TTM has been applied as a helpful conceptual framework in a variety of quantitative studies (Rhee et al., 2005, 2014; Sealy and Farmer, 2011; Giannisi et al., 2014). It therefore provides an important framework for the identification of specific barriers within the different stages of change. Assembling the barriers according to these stages enables the derivation of a model of barriers to change of parents with overweight and obese children and promotes the development and advancement of individualized prevention and intervention programs.

# MATERIALS AND METHODS

## Sample and Sampling Strategy

Parents presenting their children at the school enrollment medical examination within a 12 months' time span in a large German city were asked to participate in a large quantitative study. Out of 5,017 parents, 1,320 participated in the quantitative study, of which 113 parents had overweight or obese children (Junne et al., 2016). Ninety-four parents consented to be approached for this qualitative study. Inclusion criteria were that parents had at least one child with overweight (BMI > 90th percentile) or obesity (BMI > 97th percentile) (Kromeyer-Hauschild et al., 2001) and had sufficient German language skills to be interviewed.

The school enrollment medical examination was chosen for recruiting parents since it is mandatory in Germany for their children and therefore provides the opportunity to recruit in an unbiased setting in comparison to, e.g., a pediatrician practice in which parents might only present themselves if overweight/obesity of their children is already a concerning topic for them. No criterion for sampling saturation was set, and all parents of overweight/obese children could participate. To ensure heterogeneity of the final sample, when contacting potential participants for the second time, emphasis was put on trying to contact and invite families in which parents belonged to at least one of three risk groups for childhood overweight/obesity: (1) at least one parent is overweight/obese themselves, (2) at least one

**Abbreviations:** BMI, Body mass index; GP, General practitioner; IM[no.]/IF[no.], Interview mother [no.]/interview father [no.]; TTM, Transtheoretical model.

parent has a migration background, and (3) the net household income per month is below the 25th percentile (<2,000€) (Kurth and Schaffrath Rosario, 2007).

## Measures

Parents were interviewed according to a semi-structured interview guideline addressing six core topics concerning the overweight/obesity of their children: (1) problem awareness, (2) possibilities of the parental role, (3) utilization of preventive and interventional actions, (4) barriers to change, (5) stigma and social network, and (6) prevention. The interview guideline consisted of 25 open main questions with up to seven side questions each for deepening the respective topic (see **Supplementary Table 1**). It was developed by the study team, pilot-tested, and adapted with regard to practicality, comprehensibility, and specification of questions. Since the interview was semi-structured and conducted on the phone, researchers' characteristics potentially influencing the study were kept to a minimum.

## Procedure

Ethical approval was obtained from the ethics committee of the medical faculty of the University of Tübingen (no. 509/2013BO1). Parents were informed about the study and invited to participate. Participating parents were given a short demographic questionnaire and consented to participate in the study and to be contacted by phone for an interview in the near future. Only one parent per family could participate. The interview length ranged between 13 and 69 min, with a mean duration of 40 min, and was predominately dependent on the elaborateness of parents' answers. All interviews were recorded and subsequently sent to a transcription company. The anonymized transcripts were analyzed by the study team.

## Qualitative Analysis

A primarily inductive qualitative content analysis according to Mayring (2014) was performed. This method was chosen due to the perceived shortcomings of previous studies that applied predefined categories/criteria that parents could rate as important/unimportant. This inductive approach accounts for the diversity and individuality of barriers parents were expected to experience.

To ensure trustworthiness and credibility of the data analysis, it was triangulated between different members of the study team: All interviews were independently analyzed by two members of the study team (team 1). In a first step, categories were deduced from three sufficiently long (>30 min) randomly chosen interviews by paraphrasing, with generalization to the required level of abstraction and reduction. The categories identified by team 1 were discussed in the study team and combined to a category system which was applied to two other interviews of the sample by two other instructed members of the study team (team 2) as well as team 1. The resulting category system was discussed in the study team, adapted, and applied to three additional interviews for refining. Disagreements were discursively solved. At this point, reproducibility was achieved, and no new categories could be deduced. The seven interviews that were used to develop the final category system were about 44% of the total material for analysis, therefore ranging within the 10–50% Mayring (2014) plans for revision of categories and rules. The final category system was subsequently applied to the remaining transcripts. All of the codification was performed using the qualitative data analysis software "MAXQDA 11" (Verbi Software, 2019).

After the category system was applied to all interviews, the content of each main category was analyzed by extracting the quintessence, discussing and interpreting it in the study team, and evaluating it as either a resource or a barrier to change. The derived barriers were grouped into the stages of change according to the TTM; hence, the final model of perceived barriers to behavior change was derived. After the model was established, a cross analysis of the material from all categories was performed to ensure fit.

# RESULTS

## Participants

Out of the approached families, 62 fulfilled the criteria to be contacted by phone and asked to participate, and 22 parents were interviewed, of which five had to be excluded because their child's BMI was less than the 90th percentile, and one interview was excluded because of technical problems. Finally, 16 interviews could be included in the final analyses. The flow diagram of the study enrollment and analysis process can be found in **Figure 1**.

The demographics of participating parents and their overweight/obese children are presented in **Table 1**. Notably, all parents belonged to at least one of the risk groups for childhood overweight/obesity: overweight/obesity of at least one parent, migration background of at least one parent, or total household income at less than the 25th percentile (<2,000€/month after deductions).

## Category System

The final category system of the qualitative analysis consisted of 25 main categories that are listed in **Table 2**.

## Model of Barriers to Behavior Change of Parents With Overweight and Obese Children

The final model is presented in **Figure 2**. The background section contains variables representing background information or factors influencing parents' views on the subject of overweight/obesity in the stage of precontemplation (and beyond that). Each of these factors can enhance or hinder problem awareness, although, in the presented model, the focus is on barriers. Problem awareness is the key stage leading to action and can thereby in itself be a barrier to changing children's overweight/obesity. Barriers to action are the factors mentioned by parents who are aware of the problem but are not (adequately) taking action against it. These also represent the action stage of the TTM.

Unsurprisingly, since all of the interviewed parents had children who were overweight/obese, no barriers to maintaining achieved change (i.e., weight normalization or weight loss) were explicitly mentioned; thus, the maintenance stage of the TTM

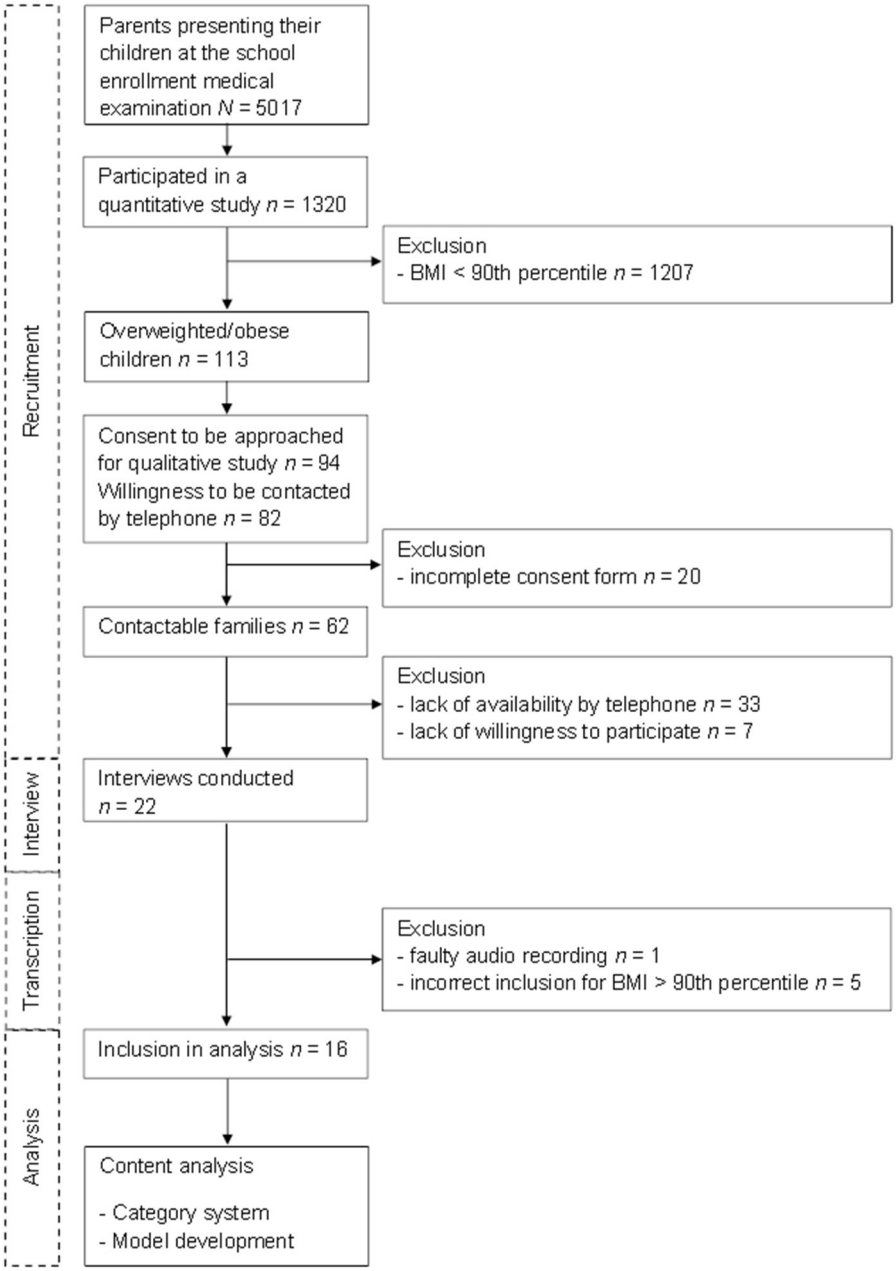


**FIGURE 1 |** Flow diagram of the study enrollment and analysis process.

was not represented in our final model. However, a lot of the barriers experienced in the action stage, such as lack of time, desire to be supported by others, or a hindering infrastructure, might apply to the maintenance stage as well. In the following, the different sections of the final model as well as some exemplary barriers are presented. A list of exemplary quotes of all identified barriers can be found in **Supplementary Table 2**.

## Background

This section contains areas affecting the knowledge and/or living environment of the interviewed parents. The "knowledge/level of information" category, for example, refers to heterogeneous statements of parents either negating the need of information on childhood overweight/obesity or showing satisfaction with their knowledge even if it was false. Example statements of parents were as follows:

> "[…] no, I am informed. Well informed." (Interview Mother no. 12, IM12)
>
> "Having 2, 3 or even 5 kg more at the moment is okay, I think." (Interview Father no. 3, IF3)

**TABLE 1 |** Demographics of participating families.

| | *N* | *M (SD)* |
|---|---|---|
| **Overweight/obese children** | | |
| Gender | | |
| Female | 12 | |
| Male | 4 | |
| Age | | 5.1 (0.3) |
| BMI percentile | | 95 (3) |
| Overweight | 12 | |
| Obesity | 4 | |
| **Participating parents** | | |
| Gender | | |
| Female | 14 | |
| Male | 2 | |
| Age | | |
| Mother | | 38.7 (4.0) |
| Father | | 41.5 (0.5) |
| Migration background | | |
| None | 5 | |
| One-sided | 4 | |
| Both | 5 | |
| Not specified | 2 | |
| Net household income per month | | |
| <2,000€ | 3 | |
| >2,000€ | 12 | |
| Not specified | 1 | |
| Weight category | | |
| No overweight/obesity | 6 | |
| Overweight | 8 | |
| Obesity | 2 | |
| Family weight | | |
| One-sided overweight/obese | 9 | |
| Both overweight/obese | 6 | |
| Not specified | 1 | |

*BMI, body mass index; M (SD), mean (standard deviation).*

**TABLE 2 |** Main categories of the final category system.

- Handling strategies/perceptions of weight
- Perception of children's weight
- Level of information
- Migration/culture
- Environmental conditions: society/politics/infrastructure
- Upbringing
- Role modeling of parents
- Habits/comfort zones
- Causes/explanations of overweight/obesity by parents
- Shame and fault
- Time
- Financial resources
- Mental health
- Physical health
- Other barriers
- Other resources/prospects
- Measures planned so far
- Third-party recommendations ignored so far
- Measures conducted so far
- Experiences with pediatricians and general practitioners
- Experiences with daycare facilities/nursery schools/schools
- Experiences with other places
- Experiences in conducting previous measures
- Potential contact persons/care providers

Although gaining 5 kg of weight might be okay for an adult, it can mean going from the 50th to >90th percentiles for a 5-year-old. Some parents also stated their need of information on the topic to determine if weight could be a problem.

## Problem Awareness

A key factor in the process of change is being aware that something is a problem. It takes us from the stage of precontemplation (not being aware of the problem and not taking any action concerning the problem) to the contemplation stage (being aware of the problem and thinking about addressing it). Even though there are also a lot of barriers to taking action, without problem awareness, there will be no change.

In the present model, three categories were derived that served as barriers to the development of problem awareness: "perception," "prioritization/relativization of the problem," and "references/norms." In the perception category, parents described not perceiving their child's weight as a problem or being "blind" of the problem concerning their own child. The following statements were examples:

> "… no one of us is overweight" (IM11) or "I would pay attention to it, if he was overweight" (IM15).

In the "prioritization/relativization of the problem" category, parents were minimizing the overweight/obesity of their children as well as underestimating the health risks that can follow. A very common relativization of parents was the thought that even if their children were overweight right now, they would "grow out" of it, which seemed to be confirmed by some doctors and other third parties (e.g., other parents). This reasoning continued in the "references/norms" category, where parents mainly used comparisons with other children and/or clothing sizes to relativize the weight of their child ("broader shoulders," "not as heavy as the heaviest child of his/her age," "not as long as wide," "can still wear normal pants," and "does not need special clothing sizes") or found it difficult to determine if the weight of their child was too much.

> "Most of her friends are the total opposite. These small, really, really, thin girls. It is therefore difficult to compare her to most of the others. She is relatively tall for her age. You notice she is sturdy in comparison to a lot of the others. But that's what I say, direct comparisons are often to the really, really thin girls and that is really difficult to compare." (IM12)
> "You see other children at the playground or at the swimming pool and think: My child is in fact way too thin." (IM11)

Overall, the described strategies to determine overweight/obesity of their children reported by parents often included references

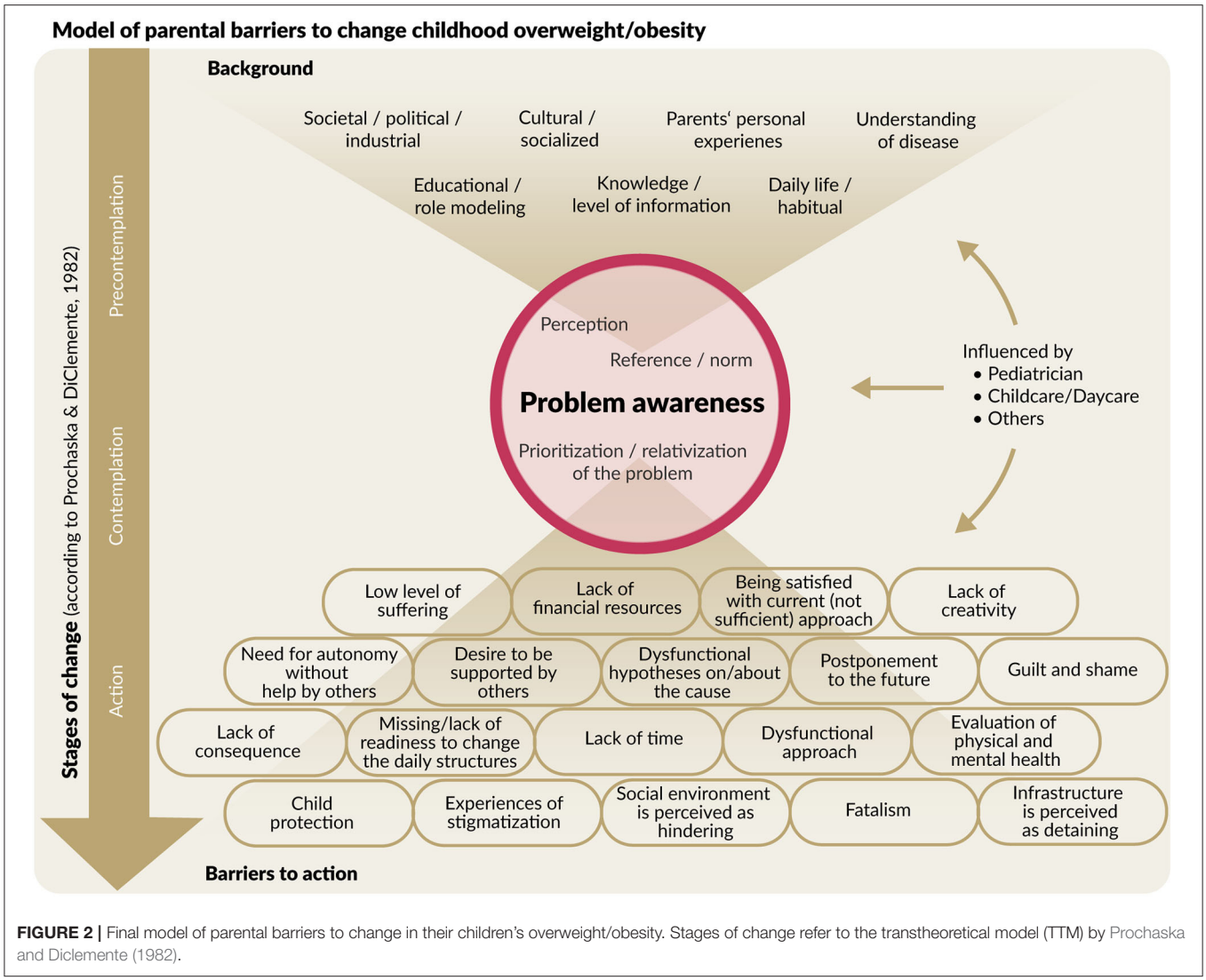


**FIGURE 2 |** Final model of parental barriers to change in their children's overweight/obesity. Stages of change refer to the transtheoretical model (TTM) by Prochaska and Diclemente (1982).

and comparisons to others. Weighing their child or other objective measures were rarely reported. Word choice of parents for describing the weight of their children was often relativizing ("not really overweight," "not dramatic," "of heavy build," and "minimally overweight"). The description of seemingly thin children, however, was negatively biased and perceived as a bigger problem than overweight.

## Barriers to Action

In this category, parents' barriers to actively doing something to change the overweight/obesity of their children are represented. These barriers imply problem awareness of overweight/obesity in childhood and refer to aspects why action was not possible or is going wrong. The complete list of identified barriers can be found in **Figure 2**. Some are exemplarily illustrated in the following.

## Dysfunctional Hypotheses About the Cause

Although interviewed parents named poor nutrition and insufficient exercise as the main causes of overweight/obesity in general, a great deal reported physique and height as the cause of overweight/obesity of their respective children. In succession, they did not deem it necessary to change their families' nutrition and/or exercise level.

## Dysfunctional Approach

In this category, parents or other caregivers take inadequate action that hinders change. Most described barriers thereby refer to actions concerning the nutrition of the child. Monitoring the intake of sweets was a frequent measure and frequently the only one taken for better nutrition. Other aspects included having no control about other caregivers, giving inadequate snacks as a standard, using food as a reward, or simply monitoring the weight as a sole measure.

> "They always get candy at their grandparents' house. [Name of child] has a sensitive stomach, if she really eats too much candy, it happens that she throws up. [. . . ] I asked my father to stop doing this. Or giving her just one piece." (IM20)
> "We waited for this [weight normalization]." (IF3)

### Social Environment and Infrastructure

These categories refer to the continuous availability of food around environments that families frequently visit (e.g., an ice cream store is right next to their favorite playground) or the living/care situation (e.g., the family lives on the fourth floor and the child is not (yet) able to play in the yard by itself).

### Protection of the Child and Evaluation of Physical and Mental Health

Although action was taken, parents reported on limiting changes and not talking to their children about the measures taken in order to protect their mental health. Avoidance of shame, guilt, self-stigmatization, and the prevention of eating disorders were the reasons for parents to do so. Parents also reported on prohibiting the pediatrician or other third parties from speaking about weight, nutrition, and exercise in front of their children.

> Interviewer: "Has he [the pediatrician] tried to explain [daughter] the association between weight and nutrition before?" Mother: "Not directly, but I would have stopped that anyway." (IM21)
> "When I tell her, you can only eat this or that or you can only eat that much … I think that will make it even harder for the child and at her age, it really puts a strain on her." (IM11)

### Desire to Be Supported by Others

Prominent was also the desire to receive more support by others, especially professional support by, e.g., the pediatrician, the general practitioner (GP), and the daycare or childcare facility. The pediatrician was of particular interest, with parents hoping that he/she would take responsibility, talk to them about the weight of their children, and tell them what to do or, in case he/she does not know, refer them to the correct information center or the like. When conversations about weight management did take place, parents perceived them to be short and be held in passing. They instead would like to have detailed guidance on childhood weight development.

> "I would expect our pediatrician to help us and if he doesn't know how, that he refers us to the right place." (IM17)

### External Influences

Answers by parents throughout all stages of the model frequently reported on influences of third parties. These were predominately other parents or other family members (i.e., grandparents), the pediatrician, and the daycare or childcare facilities. These third parties had manifold influences on interviewed parents by either enforcing that parents are doing everything just fine and there are no problems, lack of taking responsibility and the expectancy of parents that third parties would say something if indeed the weight of their children was a problem. There were also great influences during the stage of problem awareness and action. Third parties are therefore represented in the model as contributing influences on all three stages.

## DISCUSSION

The present study is, to the best of our knowledge, the first qualitative study identifying barriers to behavior change in parents of preschool children with overweight/obesity that comprised a sample of parents with at least one of three identified risk characteristics for developing overweight/obesity. Among the main barriers this study identified is the underestimation of health risks caused by overweight/obesity in association with deficient problem awareness. The results are in line with past studies showing that parents frequently do not detect overweight/obesity of their children (Manios et al., 2009; Warschburger and Kröller, 2012; Rietmeijer-Mentink et al., 2013; Lundahl et al., 2014; Hochdorn et al., 2018), which hinders problem awareness.

The present study extends these findings by suggesting that despite being informed by the pediatrician about the overweight/obesity of their child, some parents do not develop problem awareness. This is supported by a study by Dawson et al. (2014) showing that parents were able to give an account of their child's elevated weight when being informed by the pediatrician about it. However, they could not recall much about further information on overweight/obesity or any advice provided by the pediatrician. Information about the problem by an expert seems therefore not sufficient to elicit problem awareness. Even after parents are aware of the child's overweight/obesity being a problem, there are many potential barriers left.

One of these barriers refers to the discrepancy between perceived causes of overweight/obesity in general and causes of their respective child's overweight/obesity in parents' interviews. Causes of overweight and obesity in general were primarily seen in nutrition and exercise/activity. Causes of the own child's overweight/obesity, however, were primarily seen in causes that parents have no influence on such as physique, height, or a "slow gastrointestinal tract." This implies that overweight/obesity in general might be changed since it originates from causes parents have an influence on. Overweight/obesity however might not seem changeable in the eyes of parents in case of their own children.

An important reason for trying to aim for change in addressing overweight and obesity in children is, however, that they are likely to persist into adulthood, especially for high-risk groups (Singh et al., 2008). The importance of prevention and early interventions is therefore commonly advised, e.g., in the German guidelines for diagnostics, treatment, and prevention of childhood overweight and obesity (Reinehr et al., 2008; Arbeitsgemeinschaft Adipositas Im Kindes-Und Jugendalter (Aga) et al., 2019). Regardless, parents in the present study frequently postponed this problem to the future or showed readiness to postpone it. A study by Eli et al. (2014) also showed parents being aware of their children's overweight/obesity but perceiving it as a problem of the future (namely, at school age) when factors such as bullying, social exclusion, and changes of mood and behavior could occur.

The findings of Eli et al. (2014) are therefore in line with our finding about parents being oblivious to the health risks of overweight/obesity. Parents seem more likely to take action only

when other areas of life such as social functioning or mood were affected by overweight/obesity. In sum, according to our findings, parents seem not necessarily in need of theoretical knowledge of factors for prevention and intervention such as nutrition and activity in general. They do however need support in evaluating the concrete weight status of their respective child, knowledge of whom to turn to for help, and specific and hands-on possibilities and guidance for change.

Concerning barriers to action, parents in the present study were missing concrete ideas as well as contact persons with which practical problems and barriers could be discussed. Physicians (GP or pediatrician) were the preferred professionals of parents for broaching the issue of overweight/obesity. Among the main wishes parents had for their pediatrician were for him/her to be their main contact person concerning their children's weight, him/her to address the weight issue, and him/her to give detailed guidance about options for action. Examinations and follow-ups should also be done by the pediatrician in the parents' eyes, i.e., accompanying the process of weight normalization. These wishes are in line with existing literature showing that the stage of change of parents depends on whether the physician describes the child's weight as a problem or not and if a concrete course of action was recommended (Rhee et al., 2005, 2014). In the present study, parents only differed in whether or not they favored the inclusion of the children themselves into the guidance by the pediatrician.

In order to fulfill these wishes of parents by the physician, it seems essential to provide specialized training courses concerning childhood overweight/obesity. A study about primary care clinicians' views of treating childhood obesity also points to a lack of resources and ill-equipped GPs and practice nurses concerning this topic (Walker et al., 2007). This training would not need to be exclusive to the pediatrician or GP but might include practice nurses or other health care professionals and could therefore enable individualized counseling (Sastre et al., 2019).

One possibility to strengthen the parents' readiness to change during individual counseling sessions, especially after identifying so many barriers to change, could be the use of conversation techniques that enhance motivation and willingness to change such as motivational interviewing (Miller and Rollnick, 2012; Junne et al., 2019). This technique originates in the area of substance abuse disorders and was developed to address highly ambivalent patients. It has since been widely applied for different mental disorders such as depression and eating disorders as well as for enhancing treatment commitment (e.g., medication adherence) in GP practices. A variety of studies showed the effect of motivational interviewing to enhance commitment and further readiness to change (Hettema et al., 2005; Rubak et al., 2005; Azami et al., 2020; Li et al., 2020).

The approach of such counseling sessions should be positive and resource based to avoid the mentioned barriers of shame, guilt, and self-stigmatization. Counseling topics could include nutrition and exercise, which have been frequently mentioned as causes of overweight/obesity. Other topics mentioned by parents of the current study when asked about important topics that should be addressed by counseling are body image, mood, impulsive eating, and stress eating. Other studies also identified family challenges and conflicts as well as poor sleep and advertising as relevant topics to address (Brogan et al., 2019).

Interestingly, advertising or media usage was not identified as barriers in the present study. In the literature, however, reduced activity was associated with more media consumption such as watching TV (Kleiser et al., 2009; Thundiyil et al., 2010). Media has also been shown to have negative influences through advertisements, especially in the food sector where there is an association between increasing advertisements for predominately energy-dense foods and food consumption of children (Boyland and Whalen, 2015). This might indicate an additional barrier to change that the interviewed parents of this study were not aware of and that might be addressed in individualized counseling sessions.

The present study has some limitations that should be mentioned. First of all, the cross-sectional design does not allow for sequential or even causal arrangement of barriers to change in childhood overweight/obesity. The established model however provides an overview of potential barriers to change at different stages of change. Furthermore, it remains to be determined if all of the identified barriers are of equal importance or frequency of occurrence. Future studies might be able to identify subgroups more likely to experience certain barriers and thus be able to address these barriers in an individualized way. The results of this study also inform a large cluster randomized controlled trial targeting families with overweight/obese children/adolescents [STARKIDS, Universal Trial Number (UTN): U1111-1254-9536].

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics committee of the medical faculty of the Eberhard Karls University of Tuebingen. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

KG, SZ, SE, and FJ contributed to the conception and design of the study. SD, FS, AH, and KZ substantially contributed to the acquisition of data for the study. SD and FS performed the analysis. KZ and AH wrote the first draft of the manuscript. All authors contributed to manuscript revision and read and approved the submitted version.

## FUNDING

This work was supported by the Baden Wuerttemberg Ministries of Science, Research and the Arts and of Social Affairs

and Integration through the Health Services Research Junior Academy Baden-Wuerttemberg (to FJ).

## ACKNOWLEDGMENTS

The authors acknowledge the support by the Deutsche Forschungsgemeinschaft (DGF) and the Open Access Publishing Fund of the University of Tübingen. The authors thank Irena Schank and Sebastian Martin Benito for their assistance during the study's administration.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.631678/full#supplementary-material

## REFERENCES

Arbeitsgemeinschaft Adipositas Im Kindes-Und Jugendalter (Aga), Deutsche Adipositas-Gesellschaft (Dag), and Deutsche Gesellschaft Für Kinder-Und Jugendmedizin (Dgkj) (2019). *S3-Leitlinie Therapie und Prävention der Adipositas im Kindes-und Jugendalter*. Düsseldorf: AWMF.

Azami, S., Nourizadeh, R., Mehrabi, E., Poursharifi, H., and Farshbaf-Khalili, A. (2020). Effect of motivational interviewing on dietary intake and weight changes among preconception women with overweight and obesity: a randomized controlled trial. *Crescent J. Med. Biol. Sci.* 7, 260–266.

Birch, L. L., and Ventura, A. K. (2009). Preventing childhood obesity: what works? *Int. J. Obes.* 33, 74–81. doi: 10.1038/ijo.2009.22

Boyland, E. J., and Whalen, R. (2015). Food advertising to children and its effects on diet: review of recent prevalence and impact data. *Pediatr. Diabetes* 16, 331–337. doi: 10.1111/pedi.12278

Brogan, A., Hevey, D., Wilson, C., Brinkley, A., O'malley, G., and Murphy, S. (2019). A network analysis of the causal attributions for obesity in children and adolescents and their parents. *Psychol. Health Med.* 24, 1063–1074. doi: 10.1080/13548506.2019.1620298

Dawson, A. M., Taylor, R. W., Williams, S. M., Taylor, B. J., and Brown, D. A. (2014). Do parents recall and understand children's weight status information after BMI screening? a randomised controlled trial. *BMJ Open* 4:e004481. doi: 10.1136/bmjopen-2013-004481

De Onis, M., Blössner, M., and Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *Am. J. Clin. Nutr.* 92, 1257–1264. doi: 10.3945/ajcn.2010.29786

Eagle, T. F., Sheetz, A., Gurm, R., Woodward, A. C., Kline-Rogers, E., Leibowitz, R., et al. (2012). Understanding childhood obesity in America: linkages between household income, community resources, and children's behaviors. *Am. Heart J.* 163, 836–843. doi: 10.1016/j.ahj.2012.02.025

Eck, K. M., Delaney, C. L., Leary, M. P., Famodou, O. A., Olfert, M. D., Shelnutt, K. P., et al. (2018). "My tummy tells me" cognitions, barriers, and supports of parents and school-age children for appropriate portion sizes. *Nutrients* 10:1040. doi: 10.3390/nu10081040

Effertz, T., Engel, S., Verheyen, F., and Linder, R. (2016). The costs and consequences of obesity in Germany: a new approach from a prevalence and life-cycle perspective. *Eur. J. Health Econ.* 17, 1141–1158. doi: 10.1007/s10198-015-0751-4

Eli, K., Howell, K., Fisher, P. A., and Nowicka, P. (2014). "A little on the heavy side": a qualitative analysis of parents' and grandparents' perceptions of preschoolers' body weights. *BMJ Open* 4:e006609. doi: 10.1136/bmjopen-2014-006609

Faith, M. S., Van Horn, L., Appel, L. J., Burke, L. E., Carson, J., a,.S., et al. (2012). Evaluating parents and adult caregivers as "agents of change" for treating obese children: evidence for parent behavior change strategies and research gaps: a scientific statement from the American Heart Association. *Circulation* 125, 1186–1207. doi: 10.1161/CIR.0b013e31824607ee

Furthner, D., Ehrenmüller, M., Biebl, A., Lanzersdorfer, R., Halmerbauer, G., Auer-Hackenberg, L., et al. (2017). Gender differences and the role of parental education, school types and migration on the body mass index of 2930 Austrian school children. *Wien. Klin. Wochenschr.* 129, 786–792. doi: 10.1007/s00508-017-1247-2

Giannisi, F., Pervanidou, P., Michalaki, E., Papanikolaou, K., Chrousos, G., and Yannakoulia, M. (2014). Parental readiness to implement life-style behaviour changes in relation to children's excess weight. *J. Paediatr. Child Health* 50, 476–481. doi: 10.1111/jpc.12500

Giel, K. E., Zipfel, S., Alizadeh, M., Schäffeler, N., Zahn, C., Wessel, D., et al. (2012). Stigmatization of obese individuals by human resource professionals: an experimental study. *BMC Public Health* 12:525. doi: 10.1186/1471-2458-12-525

Groenewald, T. (2004). A phenomenological research design illustrated. *Int. J. Qual. Methods* 3, 42–55. doi: 10.1177/160940690400300104

Heslehurst, N., Vieira, R., Akhter, Z., Bailey, H., Slack, E., Ngongalah, L., et al. (2019). The association between maternal body mass index and child obesity: a systematic review and meta-analysis. *PLoS Med.* 16:e1002817. doi: 10.1371/journal.pmed.1002817

Hettema, J., Steele, J., and Miller, W. R. (2005). Motivational interviewing. *Annu. Rev. Clin. Psychol.* 1, 91–111. doi: 10.1146/annurev.clinpsy.1.102803.143833

Hochdorn, A., Faleiros, V. P., Camargo, B. V., Bousfield, A. B. S., Wachelke, J. F. R., Quintão, I. P., et al. (2018). Obese children are thin in parents' eyes: a psychologically, socially, or culturally driven bias? *J. Health Psychol.* 23, 114–126. doi: 10.1177/1359105316676328

Junne, F., Ehehalt, S., Ziser, K., Reinehr, T., Wiegand, S., Mander, J., et al. (2019). Targeting parental motivation for change in childhood obesity: development and validation of the PURICA-S scale. *Int. J. Obes.* 43, 2291–2301. doi: 10.1038/s41366-019-0415-z

Junne, F., Kaplik, E., Erschens, R., Enzensberger, R., Fischer, C., Ziser, K., et al. (2016). Problembewusstsein bei Eltern von Vorschulkindern mit Übergewicht oder Adipositas. *Adipositas Ursachen Folgeerkrankungen Ther.* 10, 136–142. doi: 10.1055/s-0037-1617710

Kleiser, C., Schaffrath Rosario, A., Mensink, G. B. M., Prinz-Langenohl, R., and Kurth, B.-M. (2009). Potential determinants of obesity among children and adolescents in Germany: results from the cross-sectional KiGGS Study. *BMC Public Health* 9:46. doi: 10.1186/1471-2458-9-46

Klöckner, C. A., and Ofstad, S. P. (2017). Tailored information helps people progress towards reducing their beef consumption. *J. Environ. Psychol.* 50, 24–36. doi: 10.1016/j.jenvp.2017.01.006

Krebs, P., Norcross, J. C., Nicholson, J. M., and Prochaska, J. O. (2018). Stages of change and psychotherapy outcomes: a review and meta-analysis. *J. Clin. Psychol.* 74, 1964–1979. doi: 10.1002/jclp.22683

Kromeyer-Hauschild, K., Wabitsch, M., Kunze, D., Geller, F., Gei,ß, H. C., Hesse, V., et al. (2001). Perzentile für den Body-mass-Index für das Kindes-und Jugendalter unter Heranziehung verschiedener deutscher Stichproben. *Monatsschr. Kinderheilkd.* 149, 807–818. doi: 10.1007/s001120170107

Kurth, B.-M., and Schaffrath Rosario, A. (2007). Die Verbreitung von Übergewicht und Adipositas bei Kindern und Jugendlichen in Deutschland. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 50, 736–743. doi: 10.1007/s00103-007-0235-5

Li, X., Yang, S., Wang, Y., Yang, B., and Zhang, J. (2020). Effects of a transtheoretical model-based intervention and motivational interviewing on the management of depression in hospitalized patients with coronary heart disease: a randomized controlled trial. *BMC Public Health* 20, 1–12. doi: 10.1186/s12889-020-08568-x

Linder, K., Springer, F., Machann, J., Schick, F., Fritsche, A., Häring, H. U., et al. (2014). Relationships of body composition and liver fat content with insulin resistance in obesity-matched adolescents and adults. *Obesity* 22, 1325–1331. doi: 10.1002/oby.20685

Lundahl, A., Kidwell, K. M., and Nelson, T. D. (2014). Parental underestimates of child weight: a meta-analysis. *Pediatrics* 133, e689–e703. doi: 10.1542/peds.2013-2690

Manios, Y., Kondaki, K., Kourlaba, G., Vasilopoulou, E., and Grammatikaki, E. (2009). Maternal perceptions of their child's weight status: the GENESIS study. *Public Health Nutr.* 12, 1099–1105. doi: 10.1017/S1368980008004412

Marcus, B. H., Bock, B. C., Pinto, B. M., Forsyth, L., a, H., Roberts, M. B., et al. (1998). Efficacy of an individualized, motivationally-tailored physical activity intervention. *Ann. Behav. Med.* 20, 174–180. doi: 10.1007/BF02884958

Mayring, P. (2014). *Qualitative content analysis: theoretical foundation, basic procedures and software solution*. Klagenfurt. Available online at: https://www.ssoar.info/ssoar/bitstream/handle/document/39517/ssoar-2014-mayring-Qualitative_content_analysis_theoretical_foundation.pdf

Miller, W. R., and Rollnick, S. (2012). *Motivational Interviewing: Helping People Change*. New York, NY: Guilford Press.

Nepper, M. J., and Chai, W. (2016). Parents' barriers and strategies to promote healthy eating among school-age children. *Appetite* 103, 157–164. doi: 10.1016/j.appet.2016.04.012

Norcross, J. C., Krebs, P. M., and Prochaska, J. O. (2011). Stages of change. *J. Clin. Psychol.* 67, 143–154. doi: 10.1002/jclp.20758

Pocock, M., Trivedi, D., Wills, W., Bunn, F., and Magnusson, J. (2010). Parental perceptions regarding healthy behaviours for preventing overweight and obesity in young children: a systematic review of qualitative studies. *Obes. Rev.* 11, 338–353. doi: 10.1111/j.1467-789X.2009.00648.x

Prochaska, J. O., and Diclemente, C. C. (1982). Transtheoretical therapy: toward a more integrative model of change. *Psychother. Theory Res. Pract.* 19:276. doi: 10.1037/h0088437

Reinehr, T., Holl, R. W., and Wabitsch, M. (2008). The German Working Group of Obesity in Childhood and Adolescence (AGA): improving the quality of care for overweight and obese children in Germany. *Obes. Facts* 1, 26–32. doi: 10.1159/000113405

Rhee, K. E., De Lago, C. W., Arscott-Mills, T., and Mehta, S. D. (2005). Factors associated with parental readiness to make changes for overweight children. *Pediatrics* 116, e94–e101. doi: 10.1542/peds.2004-2479

Rhee, K. E., Mceachern, R., and Jelalian, E. (2014). Parent readiness to change differs for overweight child dietary and physical activity behaviors. *J. Acad. Nutr. Diet.* 114, 1601–1610. doi: 10.1016/j.jand.2014.04.029

Rietmeijer-Mentink, M., Paulis, W. D., Van Middelkoop, M., Bindels, P. J., and Van Der Wouden, J. C. (2013). Difference between parental perception and actual weight status of children: a systematic review. *Mater. Child Nutr.* 9, 3–22. doi: 10.1111/j.1740-8709.2012.00462.x

Rubak, S., Sandbæk, A., Lauritzen, T., and Christensen, B. (2005). Motivational interviewing: a systematic review and meta-analysis. *Br. J. Gen. Pract.* 55, 305–312.

Sastre, L. R., Matson, S., Gruber, K. J., and Haldeman, L. (2019). A qualitative study examining medical provider advice, barriers, and perceived effectiveness in addressing childhood obesity to patients and families from a low-income community health clinic. *SAGE Open Med.* 7, 1–9. doi: 10.1177/2050312119834117

Schienkiewitz, A., Brettschneider, A.-K., Damerow, S., and Rosario, A. S. (2018). Übergewicht und Adipositas im Kindes-und Jugendalter in Deutschland–Querschnittergebnisse aus KiGGS Welle 2 und Trends. *J. Health Monit.* 3, 16–23. doi: 10.1055/s-0038-1667742

Schmied, E. A., Chuang, E., Madanat, H., Moody, J., Ibarra, L., Ortiz, K., et al. (2018). A qualitative examination of parent engagement in a family-based childhood obesity program. *Health Promot. Pract.* 19, 905–914. doi: 10.1177/1524839918757487

Sealy, Y. M., and Farmer, G. L. (2011). Parents' stage of change for diet and physical activity: Influence on childhood obesity. *Soc. Work Health Care* 50, 274–291. doi: 10.1080/00981389.2010.529384

Shankaran, S., Bann, C., Das, A., Lester, B., Bada, H., Bauer, C. R., et al. (2011). Risk for obesity in adolescence starts in early childhood. *J. Perinatol.* 31, 711–716. doi: 10.1038/jp.2011.14

Sigmund, E., Sigmundov,á, D., Badura, P., and Geckov,á, A. M. (2018). Health-related parental indicators and their association with healthy weight and overweight/obese children's physical activity. *BMC Public Health* 18:676. doi: 10.1186/s12889-018-5582-7

Simmonds, M., Llewellyn, A., Owen, C. G., and Woolacott, N. (2016). Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obes. Rev.* 17, 95–107. doi: 10.1111/obr.12334

Singh, A. S., Mulder, C., Twisk, J. W., Van Mechelen, W., and Chinapaw, M. J. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes. Rev.* 9, 474–488. doi: 10.1111/j.1467-789X.2008.00475.x

Teng, H.-L., Yen, M., Fetzer, S., Sung, J.-M., and Hung, S.-Y. (2020). Tailoring health-promoting programs for patients with chronic kidney disease: randomized controlled trial. *West. J. Nurs. Res.* 43, 1–13. doi: 10.1177/0193945920942487

Thundiyil, J. G., Christiano-Smith, D., Greenberger, S., Cramm, K., Latimer-Pierson, J., and Modica, R. F. (2010). Trimming the fat: identification of risk factors associated with obesity in a pediatric emergency department. *Pediatr. Emerg. Care* 26, 709–715. doi: 10.1097/PEC.0b013e3181f39879

Verbi Software (2019). *MAXQDA 2020 [Computer Software]*. Available online at: https://www.maxqda.com/ (accessed November 18, 2020).

Walker, O., Strong, M., Atchinson, R., Saunders, J., and Abbott, J. (2007). A qualitative study of primary care clinicians' views of treating childhood obesity. *BMC Fam. Pract.* 8, 1–7. doi: 10.1186/1471-2296-8-50

Wardle, J., and Cooke, L. (2005). The impact of obesity on psychological well-being. *Best Pract. Res. Clin. Endocrinol. Metab.* 19, 421–440. doi: 10.1016/j.beem.2005.04.006

Warschburger, P., and Kröller, K. (2012). Childhood overweight and obesity: maternal perceptions of the time for engaging in child weight management. *BMC Public Health* 12:295. doi: 10.1186/1471-2458-12-295

World Health Organization (WHO) (2014). *Global Status Report on Noncommunicable Diseases 2014*. Geneva: World Health Organization.

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 22 April 2021
doi: 10.3389/fpsyg.2021.629786

# Weight Stigma Model on Quality of Life Among Children in Hong Kong: A Cross-Sectional Modeling Study

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OPEN ACCESS

**Edited by:**
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**Specialty section:**
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

**Received:** *16 November 2020*
**Accepted:** *12 March 2021*
**Published:** *22 April 2021*

**Citation:**
*Fan C-W, Liu C-h, Huang H-H, Lin C-Y and Pakpour AH (2021) Weight Stigma Model on Quality of Life Among Children in Hong Kong: A Cross-Sectional Modeling Study. Front. Psychol. 12:629786. doi: 10.3389/fpsyg.2021.629786*

We proposed a model to examine the relationship among different types of weight-related stigmas and their relationship to quality of life (QoL). We recruited 430 dyads of elementary school children [mean age = 10.07 years; $n_{boy}$ = 241 (56.0%); $n_{overweight}$ = 138 (32.1%)] and their parents. Parents completed QoL instruments about their children assessing generic QoL and weight-related QoL. Children completed QoL instruments assessing generic QoL and weight-related QoL and stigma scales assessing experienced weight stigma, weight-related self-stigma, and perceived weight stigma. Experienced weight stigma was significantly associated with perceived weight stigma, and in turn, perceived weight stigma was significantly associated with weight-related self-stigma. However, experienced weight stigma was not directly associated with weight-related self-stigma. In addition, experienced stigma was negatively associated with both child-rated and parent-rated QoL. Perceived weight stigma was associated only with parent-rated weight-related QoL but not child-rated QoL. Self-stigma was associated with child-rated QoL but not parent-rated QoL. Moreover, perceived weight stigma and weight-related self-stigma were significant mediators in the association between body weight and children's QoL; experienced weight stigma was not a significant mediator. The study findings can be used to inform healthcare providers about the relationship among different types of stigmas and their influence on child-rated and parent-rated QoL and help them develop interventions to address the global trend of overweight/obesity in youth and pediatric populations.

**Keywords: Asia, children, quality of life, structural equating modeling, weight-related stigma**

## INTRODUCTION

The trend in obesity in youth and pediatric populations significantly increased from 1999 to 2000 through 2015–2016 (Hales et al., 2017). It has reached epidemic levels in the United States (Sanyaolu et al., 2019). Apart from the United States, the rising global prevalence of obesity was also found in Africa and Asia (Güngör, 2014). Particularly among the Asian population, the risk may begin to increase at a lower body mass index (BMI) compared to other races and Hispanic-origin populations (Jafar et al., 2005; Zheng et al., 2011). Children with obesity are likely to stay with obesity into adulthood and have a greater risk of suffering from weight-related health problems (Sahoo et al., 2015). Many studies have shown the association between childhood obesity and physical (e.g., Type 2 diabetes, high blood pressure, heart disease, etc.) and psychosocial (e.g., depression, anxiety, socially isolating, etc.) problems (Bass and Eneli, 2015; Bacha and Gidding, 2016).

Overweight/obesity has been linked to impaired quality of life (QoL) or health-related QoL (HRQoL). QoL can be evaluated with generic and disease-specific assessment tools. The prior assessments contain general QoL items that apply to a wider variety of populations and can be used for comparison across various conditions. The later assessments contain items with specific characteristics particularly relevant to a disease or a health condition, which can be more responsive to minimal clinical changes (Zeller and Modi, 2009). Because generic and condition-specific (e.g., weight concerns) assessments evaluate different QoL perspectives, previous studies have recommended adopting both types of assessments to achieve a comprehensive understanding of QoL (Kolotkin et al., 2006; Tsiros et al., 2009; Vos et al., 2012). Moreover, prior studies have found that childhood overweight was negatively associated with a broad range of health indicators, including QoL (Swallen et al., 2005; Pinhas-Hamiel et al., 2006; Riazi et al., 2010; Wille et al., 2010; Al-Akour et al., 2011; Hamzaid et al., 2011; Kuhl et al., 2012; Pratt et al., 2012; Halfon et al., 2013; Jansen et al., 2013; Buttitta et al., 2014; Morrison et al., 2015; Rankin et al., 2016; Meixner et al., 2020). Therefore, understanding QoL is a key element essential for childhood obesity.

Unfortunately, impaired QoL is not solely due to overweight/obesity. Other psychosocial factors may cause QoL impairment for children. Specifically, weight stigma, which has been highly prevalent among child populations over decades (Puhl et al., 2008; McCormack et al., 2011; Puhl and Lessard, 2020; Fields et al., 2021), also contributes to lowered QoL. A recent study indicated that almost a quarter to a half of children had been bullied due to their body weight (Thompson et al., 2020). Similarly, Pakpour et al. (2019b) found that weight-related self-stigma was significantly associated with perceived weight stigma and QoL among 287 third to sixth graders, regardless of their weight status. Their results additionally showed that weight-related self-stigma was significantly associated with both generic QoL (assessed using Kid-KINDL) and weight-related QoL [assessed using Sizing Me Up (SMU)]. Moreover, its association with weight-related QoL was stronger than that with generic QoL. Therefore, healthcare providers importantly need to have in-depth knowledge of the mechanism between weight stigma and QoL.

Weight stigma is defined as "negative weight-related attitudes and beliefs that are manifested by stereotypes, bias, rejection, and prejudice" (Puhl and Latner, 2007, p. 558). It can be categorized into three different types on the personal level: experienced stigma, perceived stigma, and self-stigma (Alimoradi et al., 2020). Experienced stigma results when an individual receives actual discrimination toward himself or herself. Perceived stigma occurs when an individual believes how most people view the stigmatized group in general. Self-stigma occurs when an individual internalizes the stigma belief and accepts the discrimination toward his/her personal characteristic. Gmeiner and Warschburger (2020) confirmed the association between experienced weight stigma and weight-related self-stigma using a longitudinal study design on children. They found that experiencing more weight-related teasing is a risk factor for children to develop weight-related self-stigma.

The associations between weight stigma and QoL have been documented for the three types of weight stigma. Previous studies found that adolescents who experienced weight stigma had low levels of psychological QoL (Greenleaf et al., 2014). Similarly, children who experienced weight stigma reported poor psychological QoL (Gunnarsdottir et al., 2012) and overall HRQoL subsequently (Jensen et al., 2014). A meta-analysis shows that perceived weight stigma and weight-related self-stigma were negatively associated with psychological well-being (Alimoradi et al., 2020). The association between weight-related self-stigma and QoL was also verified by Pakpour et al. (2019b). Another previous study examining the relationship between stigma and psychological well-being found that the experienced stigma and self-stigma are more important than weight status in explaining psychological functioning in childhood (Zuba and Warschburger, 2017).

Moreover, a recent study proposed a mediation model to consider the relationship among weight status, experienced stigma, and HRQoL on 600 community children aged 8–11 years (Guardabassi et al., 2018). The results indicated that the increased weight-related experienced stigma, rather than weight status, negatively affected both global and domain-specific HRQoL in middle childhood (Guardabassi et al., 2018).

Although the association between weight-related stigma and QoL has been reported, no empirical evidence has shown how the different types of weight-related stigma contribute to the generic and weight-related QoL. Most studies have examined associations on one type of stigma at a time instead of considering a comprehensive profile of different types of weight-related stigma that might be associated with QoL. Given the lack of evidence about the relationship among different types of

**Abbreviations:** BMI, Body mass index; QoL, Quality of life; HRQoL, Health-related quality of life; NGO, Non-government organization; WBIS, Weight Bias Internalization Scale; WSSQ, Weight Self-Stigma Questionnaire; EWS, Experienced weight stigma; SMU, Sizing Me Up; STU, Sizing Them Up; HKD, Hong Kong Dollar; SEM, Structural equation modeling; DWLS, Diagonally weighted least squares; CFI, Comparative fit index; TLI, Tucker-Lewis index; RMSEA, Root mean square error of approximation; SRMR, Standardized root mean squared residual.

stigma in child populations and the need to understand the relationship between stigma and QoL, we propose a model that combines both aims to understand the mechanism behind weight stigma and QoL in child populations. In the current study, we first examine the relationships among all types of stigma (i.e., experienced stigma, perceived stigma, and self-stigma). Then, we examine how the different types of stigma link to parent-rated and children-rated generic and weight-related QoL. Accordingly, we hypothesized that (1) children's experienced stigma may be positively associated with their perceived stigma, and then the perceived stigma may be further positively associated with an internalized belief that links to children's self-stigma [aligning with Gmeiner and Warschburger (2020)]; (2) different types of weight stigma are negatively associated with both parent-rated and child-rated generic and weight-related QoL but in different levels [based on Pakpour et al. (2019b)]; (3) different types of weight stigma are mediators in the association between body weight and QoL (including both parent-rated and child-rated generic and weight-related QoL) in that body weight is positively associated with weight stigma, and subsequently, weight stigma is negatively associated with QoL [congruent with Guardabassi et al. (2018)].

# METHODS

## Participants and Procedures

The Human Subject Ethics Review Board in the Hong Kong Polytechnic University (Ref. No.: HSEARS20160824003) approved the study proposal before data collection commenced. Eligible participants (including both the children and one of their parents) who were interested in this study signed a written consent form before participating. Specifically, the authors contacted all the primary schools and some non-government organizations (NGOs) in Hong Kong to seek their willingness to collaborate in the study. Two primary schools and two NGOs agreed to collaborate. Then, teachers and staff in the schools or NGOs helped disseminate the study information to their students or members. After inviting 437 dyads of children and their parents through convenience sampling, 430 dyads participated in the study (response rate: 98.4%). Participants' parents completed the demographic information and two QoL instruments on their children. The children completed a set of self-reported questionnaires, including three weight stigma scales and two QoL instruments. For dyads of children and parents recruited from primary school, all the children completed the questionnaires in a classroom under their teachers' supervision. All the parents completed the questionnaires at home. For dyads of children and parents recruited from NGOs, children and parents completed the questionnaires in a quiet room in the NGOs under a research assistant's supervision without disturbance. Moreover, the children and their parents were separated when they completed the questionnaire.

Eligible participants were identified using the following inclusion criteria: (1) children between 8 and 12 years of age; (2) children were currently studying in a primary school in Hong Kong; (3) children were able to read and write Chinese; (4) children and their parents both agreed to participate in this study voluntarily. Children with any of the following conditions were excluded from the study: (1) having any neurological diseases (e.g., autism spectrum disorder and attention-deficit/hyperactivity disorder); (2) having impairments in cognition; (3) having any physical disability (e.g., amputation).

## Instruments

### Weight Bias Internalization Scale

The Weight Bias Internalization Scale (WBIS) is a commonly used instrument that measures the extent to which an individual endorses and accepts weight-based stereotypes (Pakpour et al., 2019b; Lin et al., 2020a). There are 11 items rated based on a 5-point Likert scale, where score 1 represents *strongly disagree* and score 5 represents *strongly agree* (Durso and Latner, 2008). A higher score indicates a higher level of weight-related self-stigma. The 11 items were constructed in a single domain representing weight-related self-stigma, which has been supported by confirmatory factor analysis (Pakpour et al., 2019b; Lin et al., 2020a). Moreover, the Chinese WBIS had satisfactory psychometric properties (Wong et al., 2019). The Cronbach's α of the WBIS in the present study was 0.88.

### Weight Self-Stigma Questionnaire

The Weight Self-Stigma Questionnaire (WSSQ) is another commonly used instrument that measures weight-related self-stigma. Specifically, the WSSQ contains two domains: one assesses weight-related self-stigma (or self-devaluation named by the developer), and another assesses perceived weight stigma (or fear of enacted stigma named by the developer) (Lillis et al., 2010). There are 12 items rated (the first six items assess weight-related self-stigma; the last six items assess perceived weight stigma) based on a 5-point Likert scale. Score 1 represents *strongly disagree*, and score 5 represents *strongly agree* (Lillis et al., 2010). A higher score indicates a higher level of weight-related self-stigma or perceived weight stigma. The Chinese WSSQ had satisfactory psychometric properties (Lin and Lee, 2017). The Cronbach's α of the WSSQ in the present study was 0.91.

### Experienced Weight Stigma

The Experienced Weight Stigma (EWS) uses 10 dichotomous items ("yes" scores 1, and "no" scores 0; sample item: people behave as if you are inferior because of your weight status) to construct a single construct of experienced stigma on weight bias received by an individual. A higher score indicates a higher level of experienced weight stigma. The EWS (including the Chinese version) had satisfactory psychometric properties (Cheng et al., 2018; Lin et al., 2020b). The Cronbach's α of the EWS in the present study was 0.80.

### Child- and Parent-Rated Kid-KINDL

The Kid-KINDL is a generic QoL assessment instrument for children aged 8–12 years. The Kid-KINDL includes a parallel child self-report and parent proxy report. Each Kid-KINDL report consists of 24 items embedded in six domains (physical well-being, emotional well-being, self-esteem, family, friends, and school functioning). Each domain has four items, and all items were rated on a 5-point Likert scale. The Likert scale was

then linearly transformed to a 0–100 scale to indicate the level of QoL. A higher Kid-KINDL score indicates a higher level of QoL (Ravens-Sieberer and Bullinger, 2000). The Chinese Kid-KINDL had satisfactory psychometric properties (Chan et al., 2014; Lin et al., 2014, 2017; Lin, 2018; Pakpour et al., 2019a). The Cronbach's α of the child-rated Kid-KIND in the present study was 0.81 and that of parent-rated Kid-KINDL was 0.76.

### Sizing Me Up and Sizing Them Up

SMU (child-rated report) and Sizing Them Up (STU) (parent-rated report) are weight-related QoL assessment instruments for children aged 5–18. SMU consists of 22 items embedded in five domains: emotional (four items), physical (five items), teasing experience (two items), positive attributes (six items), and social avoidance (five items). STU consists of 22 items embedded in six domains: emotional (seven items), physical (five items), teasing experience (three items), positive attributes (four items), mealtime disturbance (two items), and school (one item). All items were rated on a 4-point Likert scale. The Likert scale was then linearly transformed to a 0–100 scale to indicate the level of QoL. A higher SMU or STU score indicates a higher level of QoL (Modi and Zeller, 2008; Zeller and Modi, 2009). Both Chinese SMU and STU had satisfactory psychometric properties (Strong et al., 2017; Lin et al., 2018). The Cronbach's α of the SMU in the present study was 0.82 and that of STU was 0.81.

### Demographic Information

The participants' demographics were assessed using a parent-rated background information sheet to obtain the participants' age in years, gender (boy or girl), height in centimeters, weight in kilograms, health status (with or without chronic illness), subjective academic standing (good, moderate, or poor), exercise habit (yes or no), and monthly family income [below 5,000 Hong Kong Dollar (HKD), 5,000–9,999 HKD, 10,000-14,999 HKD, 15,000–19,999 HKD, 20,000−24,999 HKD, 25,000–29,999 HKD, 30,000–34,999 HKD, 35,000–39,999 HKD, 40,000–44,999 HKD, 45,000–50,000 HKD, or above 50,000 HKD]. The BMI was then calculated using the height and weight information provided in the background information sheet.

## Data Analysis

Structural equation modeling (SEM) using a diagonally weighted least squares (DWLS) estimator was applied to test our hypothesized theoretical structures. All types of weight stigma (including experienced weight stigma, perceived weight stigma, and weight-related self-stigma) are predictors of QoL; experienced and perceived weight stigma are predictors of weight-related self-stigma; and experienced weight stigma is a predictor of perceived weight stigma (see **Figure 1** for the conceptual model). Moreover, the experienced weight stigma was constructed using all EWS items; the perceived weight stigma using items 7–12 in the WSSQ; the weight-related self-stigma using all WBIS items and items 1–6 in the WSSQ; the QoL using different child-rated and parent-rated QoL instruments.

The hypothesized structure was tested in four models. Specifically, all models used the same weight stigma measures but different QoL measures: Model 1 used the child-rated Kid-KINDL; Model 2 used the parent-rated Kid-KINDL; Model 3 used the SMU; and Model 4 used the STU. Additionally, all models have adjusted for age, gender, and BMI. The following fit indices with suggested cutoff were used to determine whether our hypothesized models are supported: comparative fit index (CFI) and Tucker–Lewis index (TLI) >0.9; root mean square error of approximation (RMSEA) and standardized root mean squared residual (SRMR) <0.08. Moreover, a non-significant $\chi^2$ indicates a good fit between the data and model; however, given that the $\chi^2$ index is notorious in its oversensitivity to sample size (i.e., $\chi^2$ easily will be significant in a large sample size such as the size in the present study) (Wu et al., 2015), the fit between the data and model depends on CFI, TLI, RMSEA, and SRMR more.

Referencing the findings of Guardabassi et al. (2018), several mediation models were conducted to explore the mediated effects in different weight stigma types. More specifically, Hayes' Process macro (Model 4) was then carried out to understand the mediated effects (Hayes, 2018) of different types of weight stigma on the association between body weight and QoL. In the Hayes' Process macro, 5,000 bootstrapping samples were generated to examine whether each type of weight stigma is a significant mediator in the association between body weight and QoL. The lower limit of confidence interval (LLCI) and upper limit of confidence interval (ULCI) at 95% were used to examine whether the mediated effect is significant. Specifically, when LLCI and ULCI do not cover 0, the mediated effect is significant. Moreover, age and gender were controlled in all the mediation models.

Moreover, given our sample's relatively wide age range, Pearson correlation coefficients were used to examine the bivariate associations between studied variables, including age, gender, experienced weight stigma, perceived weight stigma, weight-related self-stigma, and all the QoL.

The SEM was conducted by the lavaan package (http://lavaan.ugent.be/) in the R program. Descriptive correlational analyses and Hayes' mediation models were conducted by the IBM SPSS 20.0 (IBM Corp., Armonk, NY).

## RESULTS

The mean (SD) age of the children was 10.07 (1.42), and the genders were generally equally distributed (56% of males). Most children reported having no chronic disease (94.0%) and no exercise habits (93.3%). Moreover, their academic standing was normally distributed (**Table 1**).

**Table 2** demonstrates the mean and SD of the participants' instrument scores, including weight-related self-stigma, perceived stigma, experienced stigma, and each domain of the QoL instrument. **Table 3** further presents the factor loadings of all items embedded in their belonging constructs. In brief, all the loadings are significant and weighted substantially for each construct. Moreover, **Table 4** presents the correlation coefficients in every two studied variables (i.e., age, gender, BMI, three types of weight stigma, and child-rated and parent-rated QoL in generic and weight-specific instruments).

All the SEM models had satisfactory fit indices (**Figure 1**). Additionally, experienced weight stigma was significantly associated with perceived weight stigma, and in turn, perceived weight stigma was significantly associated with weight-related

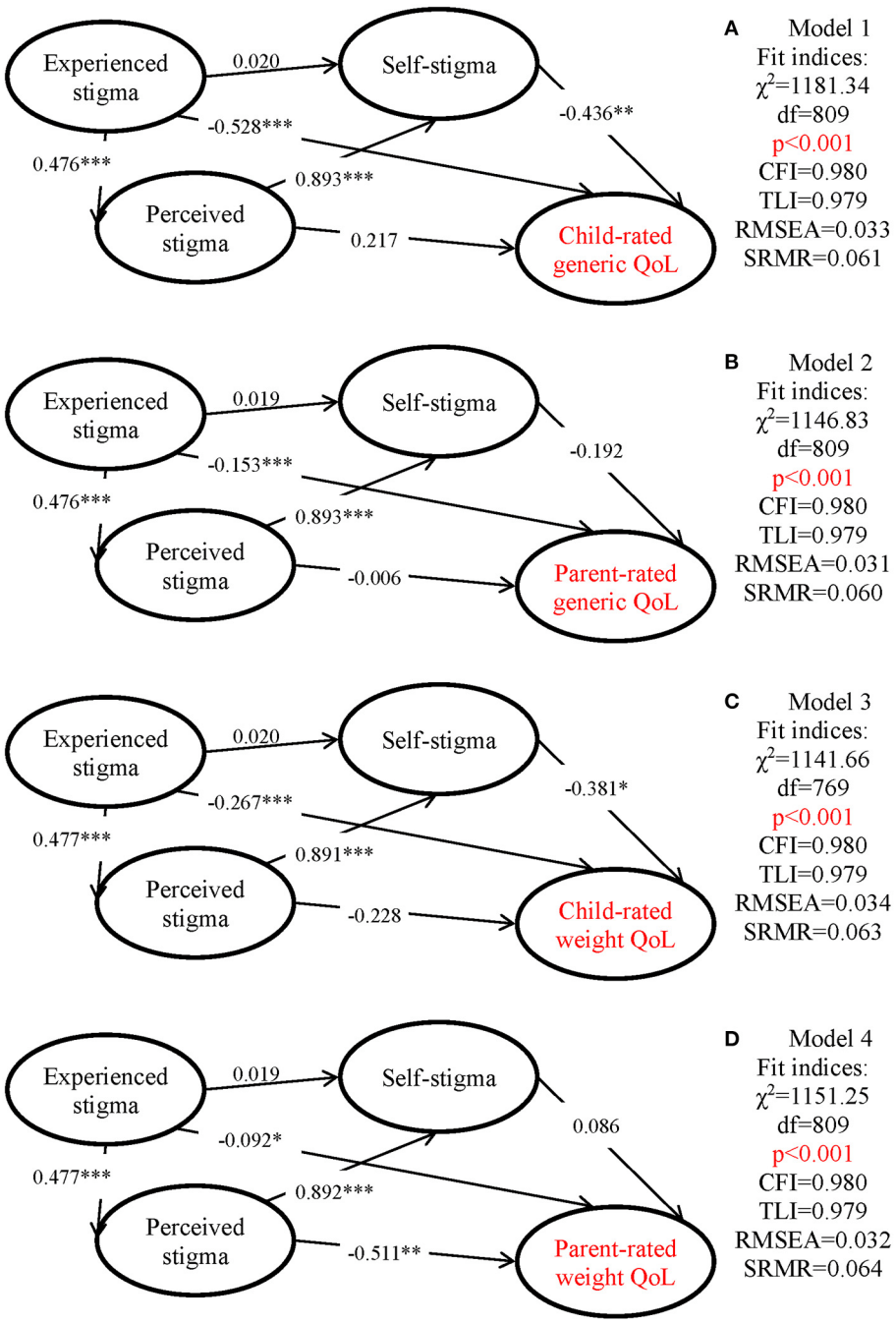


**FIGURE 1 |** Proposed models evaluating different types of weight bias on quality of life (QoL) with standardized path coefficients. **(A)** Model 1: QoL assessed using child-reported generic instrument (Kid-KINDL). **(B)** Model 2: QoL assessed using parent-reported generic instrument (Kid-KINDL). **(C)** QoL assessed using child-reported weight-related instrument (Sizing Me Up). **(D)** QoL assessed using parent-reported weight-related instrument (Sizing Them Up). All models controlled age, gender, and body mass index. CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

self-stigma. However, experienced weight stigma did not directly associate with weight-related self-stigma.

The mediation models (**Table 5**) showed that experienced weight stigma was not a significant mediator in the association between body weight and children's QoL whether child-rated, parent-rated, weight-related, or generic. The other two types of weight stigma (perceived weight stigma and weight-related self-stigma) were significant mediators in the association between

**TABLE 1 |** Participant characteristics.

| | Mean (SD) | *n* (%) |
|---|---|---|
| **Age (years)** | 10.07 (1.42) | |
| **Gender** | | |
| Male | | 241 (56.0) |
| Female | | 189 (44.0) |
| **Body mass index (kg/m$^2$)** | 18.47 (4.16) | |
| **Health status** | | |
| Without chronic illness | | 404 (94.0) |
| With chronic illness | | 24 (5.6) |
| Missing | | 2 (0.4) |
| **Subjective academic standing** | | |
| Good | | 87 (20.2) |
| Moderate | | 261 (60.7) |
| Poor | | 71 (16.5) |
| Missing | | 11 (2.6) |
| **Exercise habit** | | |
| Yes | | 23 (5.3) |
| No | | 401 (93.3) |
| Missing | | 6 (1.4) |
| **Monthly family income** | | |
| <25,000 HKD | | 261 (60.7) |
| >25,000 HKD | | 148 (34.4) |
| Missing | | 21 (4.9) |

*HKD, Hong Kong Dollar. 1 USD ≈ 7.8 HKD.*

**TABLE 2 |** Weight bias and quality of life among participants.

| | Mean (SD) | Range (min–max) | Possible range |
|---|---|---|---|
| **WBIS score** | 23.22 (8.33) | 39 (11–50) | 11–55 |
| **WSSQ Q1–6 score**[a] | 12.51 (4.70) | 24 (6–30) | 6–30 |
| **WSSQ Q7–12 score**[b] | 10.94 (4.88) | 24 (6–30) | 6–30 |
| **EWS score** | 1.5 (2.13) | 9 (0–9) | 0–10 |
| **Child-rated KINDL** | | | |
| Physical | 71.06 (16.72) | 93.75 (6.25–100) | 0–100 |
| Emotional | 74.74 (17.38) | 93.75 (6.25–100) | 0–100 |
| Self-esteem | 44.83 (22.16) | 100 (0–100) | 0–100 |
| Family | 66.49 (17.86) | 100 (0–100) | 0–100 |
| Friend | 69.90 (18.72) | 93.75 (6.25–100) | 0–100 |
| School | 54.22 (18.74) | 100 (0–100) | 0–100 |
| **Parent-rated KINDL** | | | |
| Physical | 73.31 (14.55) | 75 (25–100) | 0–100 |
| Emotional | 72.66 (14.24) | 75 (25–100) | 0–100 |
| Self-esteem | 51.52 (17.48) | 100 (0–100) | 0–100 |
| Family | 70.81 (14.85) | 87.5 (12.5–100) | 0–100 |
| Friend | 68.97 (14.34) | 81.25 (18.75–100) | 0–100 |
| School | 65.48 (14.85) | 87.5 (12.5–100) | 0–100 |
| **Sizing Me Up** | | | |
| Emotional | 87.82 (17.98) | 100 (0–100) | 0–100 |
| Physical | 89.80 (15.75) | 93.33 (6.67–100) | 0–100 |
| Teasing experience | 87.93 (18.06) | 100 (0–100) | 0–100 |
| Positive attributes | 38.82 (21.49) | 100 (0–100) | 0–100 |
| Social avoidance | 90.96 (13.71) | 73.33 (26.67–100) | 0–100 |
| **Sizing Them Up** | | | |
| Emotional | 91.18 (11.03) | 52.38 (47.62–100) | 0–100 |
| Physical | 94.86 (9.14) | 53.33 (46.67–100) | 0–100 |
| Teasing experience | 94.41 (11.48) | 66.67 (33.33–100) | 0–100 |
| Positive attributes | 50.93 (19.25) | 100 (0–100) | 0–100 |
| Mealtime disturbance | 85.94 (16.48) | 83.33 (16.67–100) | 0–100 |
| School | 98.45 (8.37) | 100 (0–100) | 0–100 |

*WBIS, Weight Bias Internalization Scale; WSSQ, Weight Self-Stigma Questionnaire; EWS, Experienced Weight Stigma. KINDL is a generic quality of life instrument; Sizing Me Up and Sizing Them Up are weight-related quality of life instruments.*
[a] *Indicates self-devaluation domain (i.e., similar to self-stigma).*
[b] *Indicates fear of enacted domain (i.e., similar to perceived stigma).*

body weight and children's QoL whether child-rated, parent-rated, weight-related, or generic.

# DISCUSSION

Although weight-related stigma and QoL research are prevalent in the literature, no studies have examined the different types of weight-related stigma and their combined effects on different types of QoL. The current study used psychometrically sound assessments on 430 dyads of 8- to 12-year-old children and their parents to construct four models investigating different types of weight-related stigma on children's QoL. Congruent with the first hypothesis, children's experienced stigma was positively associated with their perceived stigma, and then the perceived stigma was further positively associated with children's self-stigma. Aligning with the second hypothesis, the experienced stigma was the primary stigma that negatively associated with both child-rated and parent-rated generic QoL and weight-related QoL. Perceived weight stigma was associated with only parent-rated weight-related QoL but not any of child-rated QoL. Self-stigma associated with both child-rated generic QoL and weight-based QoL but not any of parent-rated QoL. Consistent with the third hypothesis, perceived weight stigma and weight-related self-stigma were significant mediators in the association between body weight and QoL; however, experienced weight stigma was not. Further explanations are illustrated below.

## Experienced Weight Stigma, Perceived Weight Stigma, and Weight-Related Self-Stigma

Congruent with Gmeiner's and Warschburger's (2020) previous evidence, the present study found that children's experienced weight stigma was positively associated with their perceived weight stigma, and perceived stigma was, in turn, associated with their weight-related self-stigma. Gmeiner and Warschburger (2020) conducted a longitudinal study and found that when children experienced more weight-related teasing, they have increased weight-related self-stigma. This association also agrees with the previous framework on how self-stigma is formed in people with mental illness. People with mental illness first experience unfriendly treatment (i.e., experienced stigma), then

**TABLE 3 |** Factor loadings of all instrument items in each proposed model.

| Construct | Item | Factor loading | | | |
|---|---|---|---|---|---|
| | | Model 1 | Model 2 | Model 3 | Model 4 |
| Weight-related self-stigma | WBIS1 | 0.212 | 0.200 | 0.200 | 0.197 |
| | WBIS2 | 0.694 | 0.687 | 0.689 | 0.683 |
| | WBIS3 | 0.739 | 0.738 | 0.733 | 0.735 |
| | WBIS4 | 0.486 | 0.489 | 0.492 | 0.494 |
| | WBIS5 | 0.783 | 0.784 | 0.782 | 0.780 |
| | WBIS6 | 0.767 | 0.768 | 0.779 | 0.771 |
| | WBIS7 | 0.586 | 0.600 | 0.595 | 0.590 |
| | WBIS8 | 0.714 | 0.709 | 0.711 | 0.705 |
| | WBIS9 | 0.503 | 0.505 | 0.516 | 0.518 |
| | WBIS10 | 0.723 | 0.721 | 0.720 | 0.721 |
| | WBIS11 | 0.686 | 0.676 | 0.675 | 0.669 |
| | WSSQ1 | 0.572 | 0.572 | 0.557 | 0.565 |
| | WSSQ2 | 0.725 | 0.729 | 0.722 | 0.736 |
| | WSSQ3 | 0.794 | 0.798 | 0.797 | 0.802 |
| | WSSQ4 | 0.678 | 0.673 | 0.667 | 0.675 |
| | WSSQ5 | 0.209 | 0.228 | 0.219 | 0.223 |
| | WSSQ6 | 0.629 | 0.634 | 0.636 | 0.640 |
| Perceived weight stigma | WSSQ7 | 0.728 | 0.726 | 0.711 | 0.719 |
| | WSSQ8 | 0.817 | 0.810 | 0.820 | 0.811 |
| | WSSQ9 | 0.627 | 0.629 | 0.628 | 0.627 |
| | WSSQ10 | 0.704 | 0.709 | 0.711 | 0.711 |
| | WSSQ11 | 0.787 | 0.786 | 0.788 | 0.789 |
| | WSSQ12 | 0.794 | 0.797 | 0.801 | 0.806 |
| Experienced weight stigma | EWS1 | 0.609 | 0.625 | 0.627 | 0.633 |
| | EWS2 | 0.642 | 0.640 | 0.639 | 0.634 |
| | EWS3 | 0.320 | 0.323 | 0.337 | 0.305 |
| | EWS4 | 0.591 | 0.578 | 0.585 | 0.594 |
| | EWS5 | 0.667 | 0.661 | 0.655 | 0.660 |
| | EWS6 | 0.315 | 0.336 | 0.346 | 0.337 |
| | EWS7 | 0.422 | 0.423 | 0.403 | 0.418 |
| | EWS8 | 0.587 | 0.586 | 0.592 | 0.590 |
| | EWS9 | 0.536 | 0.531 | 0.520 | 0.529 |
| | EWS10 | 0.597 | 0.587 | 0.594 | 0.586 |
| Quality of life | Child KINDL_Phy | 0.634 | – | – | – |
| | Child KINDL_Emo | 0.694 | – | – | – |
| | Child KINDL_SE | 0.375 | – | – | – |
| | Child KINDL_Fam | 0.513 | – | – | – |
| | Child KINDL_Fri | 0.579 | – | – | – |
| | Child KINDL_Sch | 0.603 | – | – | – |
| | Parent KINDL_Phy | – | 0.637 | – | – |
| | Parent KINDL_Emo | – | 0.719 | – | – |
| | Parent KINDL_SE | – | 0.319 | – | – |
| | Parent KINDL_Fam | – | 0.622 | – | – |
| | Parent KINDL_Fri | – | 0.629 | – | – |
| | Parent KINDL_Sch | – | 0.536 | – | – |
| | SMU_Emo | – | – | 0.780 | – |
| | SMU_Phy | – | – | 0.764 | – |
| | SMU_Tease | – | – | 0.673 | – |
| | SMU_Pos | – | – | 0.142 | – |
| | SMU_Soc | – | – | 0.768 | – |
| | STU_Emo | – | – | – | 0.772 |
| | STU_Phy | – | – | – | 0.664 |
| | STU_Tease | – | – | – | 0.673 |
| | STU_Pos | – | – | – | 0.280 |
| | STU_Meal | – | – | – | 0.425 |
| | STU_Sch | – | – | – | 0.231 |

*WBIS, Weight Bias Internalization Scale; WSSQ, Weight Self-Stigma Questionnaire; EWS, Experienced Weight Stigma; KINDL, generic quality of life questionnaire; SMU, Sizing Me Up; STU, Sizing Them Up; Phy, physical; Emo, emotional; SE, self-esteem; Fam, family; Fri, friend; Sch, school; Tease, teasing experience; Pos, positive attributes; Soc, social avoidance; Meal, mealtime disturbance.*

*Model 1 applies child-rated KINDL in the model; Model 2 applies parent-rated KINDL in the model; Model 3 applies child-rated Sizing Me Up in the model; Model 4 applies parent-rated Sizing Them Up in the model.*

become aware that the stigma is due to their characteristics (i.e., perceived stigma). After recognizing the stigma, they may accept and endorse the biased attitudes and treatments they experienced and develop self-stigma (Lin et al., 2016). Thus, our findings echo and support this framework that children with weight concerns may develop weight-related self-stigma *via* the same pathways; that is, weight-related self-stigma is developed from experienced stigma and perceived stigma.

## Experienced Weight Stigma and Quality of Life

Among the three types of weight-related stigma, experienced stigma played a critical role and was negatively associated with both child-rated and parent-rated QoL (in both generic and weight-related QoL). Such a result is consistent with previous findings that experienced stigma is associated with lower psychological QoL (Greenleaf et al., 2014) and poor psychological functioning (Gunnarsdottir et al., 2012; Zuba and Warschburger, 2017), and it especially severely affected the youth population (Pont et al., 2017). Multiple studies found that individuals who experience weight stigma have poorer long-term weight loss outcomes than those who do not experience stigma (Carels et al., 2009; Wott and Carels, 2010; Gudzune et al., 2014). Additionally, experienced stigma contributes to problematic consequences such as unhealthy eating behaviors, social isolation, avoidance of health care services, decreased exercise, and impaired QoL (Pont et al., 2017).

Furthermore, a study reviewed 15 prospective cohort studies and found that children with obesity were about five times more likely to be with obesity in adulthood than those who were not with obesity (Simmonds et al., 2016). Therefore, once manifested, children who experience weight-related stigma may remain such uncomfortable feelings until adulthood, hence increasing the risk

**TABLE 4 |** Pearson correlation matrix in the studied variables.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|---|
| **1. Age** | – | | | | | | | | |
| **2. Gender** | −0.04 | – | | | | | | | |
| **3. BMI** | 0.13** | −0.01 | – | | | | | | |
| **4. EWS** | −0.06 | −0.05 | 0.05 | – | | | | | |
| **5. PWS** | −0.12* | 0.02 | 0.16** | 0.40*** | – | | | | |
| **6. WSS** | −0.10* | 0.06 | 0.25*** | 0.39*** | 0.81*** | – | | | |
| **7. Child-rated Kid-KINDL** | −0.07 | −0.01 | −0.05 | −0.47*** | −0.33*** | −0.38*** | – | | |
| **8. Parent-rated Kid-KINDL** | −0.09 | −0.004 | −0.13** | −0.17*** | −0.19*** | −0.21*** | 0.37*** | – | |
| **9. Sizing Me Up** | 0.01 | 0.01 | −0.25*** | 0.43*** | −0.56*** | −0.60*** | 0.49*** | 0.33*** | – |
| **10. Sizing Them Up** | 0.08 | −0.02 | −0.26*** | −0.21*** | −0.38*** | −0.34*** | 0.13** | 0.48*** | 0.45*** |

*EWS, experienced weight stigma; PWE, perceived weight stigma; WSS, weight-related self-stigma.*
**p < 0.05; **p < 0.01; ***p < 0.001.*

**TABLE 5 |** Mediation models testing the indirect effect of different types of weight stigma in the association between body weight and quality of life.

| Mediator | Coefficient (Bootstrapping SE) | Bootstrapping LLCI | Bootstrapping ULCI |
|---|---|---|---|
| **Dependent variable: Child-rated Kid-KINDL** | | | |
| EWS | −0.08 (0.06) | −0.21 | 0.04 |
| PWS | −0.18 (0.06) | −0.33 | −0.08 |
| WSS | −0.32 (0.09) | −0.51 | −0.17 |
| **Dependent variable: Parent-proxy Kid-KINDL** | | | |
| EWS | −0.25 (0.11) | −0.07 | 0.13 |
| PWS | −0.08 (0.04) | −0.16 | −0.03 |
| WSS | −0.14 (0.04) | −0.24 | −0.06 |
| **Dependent variable: Sizing Me Up** | | | |
| EWS | −0.07 (0.06) | −0.18 | 0.03 |
| PWS | −0.26 (0.10) | −0.48 | −0.10 |
| WSS | −0.42 (0.11) | −0.65 | −0.24 |
| **Dependent variable: Sizing Them Up** | | | |
| EWS | −0.02 (0.02) | −0.07 | 0.01 |
| PWS | −0.12 (0.05) | −0.23 | −0.04 |
| WSS | −0.15 (0.04) | −0.25 | −0.08 |

*Age and gender were controlled in all the mediation models. Hayes' Process macro (Model 4) was used; each mediation model generated 5,000 bootstrapping samples.*
*EWS, experienced weight stigma; PWE, perceived weight stigma; WSS, weight-related self-stigma; LLCI, 95% lower limit of confidence interval; ULCI, 95% upper limit of confidence interval.*

of developing chronically psychological distress and lowered QoL (Parker and Aggleton, 2003; Palad et al., 2019).

However, experienced weight stigma was found to be a non-significant mediator in the association between body weight and QoL, which is inconsistent with findings by Guardabassi et al. (2018). Closely scrutinizing the assessments used in their study, they adopted the Perception of Teasing Scale, which had 11 items rated on a 5-point Likert scale, to evaluate children's experienced stigma (Guardabassi et al., 2018). Our study used the EWS questionnaire, which collected children's experienced stigma with a dichotomous classification (Yes/No). Therefore, EWS potentially did not capture all the different experienced weight stigma levels, which might reduce the power of experienced stigma to serve as a significant mediator. Nevertheless, our non-significant result is consistent with that of a previous study on an American adult population, in which experienced stigma was not a significant mediator of the relationship between BMI and psychical and psychological health (Hunger and Major, 2015). Future studies may need to examine further whether our postulation that the use of different instruments on experienced weight stigma really matters in the mediational relationship.

## Perceived Weight Stigma and Quality of Life

In the current study, we found that perceived weight stigma was associated with neither child-rated generic QoL nor weight-related QoL, but only parent-rated weight-related QoL. Perceived weight stigma is highly influenced by social environments (Puhl and Heuer, 2010). For example, children may perceive that their own body image aligns with social media exposure and parental behaviors and perceptions (Robinson et al., 2017). The investigation by Puhl et al. (2016) on parental perceptions of weight-based stigma showed that "being overweight" was perceived as the most common and substantial concern that parents perceived for their children being stigmatized regardless of their weight status. Interestingly, a multinational study indicated that about 70% of participants ($n = 2{,}866$) across four countries (i.e., United States, Canada, Iceland, and Australia) perceived weight-related stigma as the most common and serious problem in child populations (Puhl et al., 2016). Robinson et al. (2017) found that parents' perception of their children as overweight increases the likelihood that children will negatively view and recognize their body size. Additionally, compared with parents without concern for their children's weight, parents who had concerns were identified with significantly lower perceived self-efficacy (Klupt et al., 2020), which may unavoidably influence the children's own weight-related

perceptions. Therefore, it is essential to understand the parent's influence on profound perceptions when considering why the perceived stigma is positively correlated with parent-rated weight-related QoL.

In contrast, a previous study indicated that children might have different sensitivity in perceived stigma; some might be more vulnerable to weight-related oppression than others (Puhl and Heuer, 2009). A review (Mak et al., 2007) further showed that the stigmatized individuals' QoL and mental health would only be affected if they perceive the negative stereotypes or discrimination toward them as legitimate. More recent studies discussed weight bias as an important social justice issue to be addressed in research, policy, and practice (Cardinal et al., 2014; Nutter et al., 2016). Therefore, given that the social atmosphere has been established to consider the influence of weight bias on social inequity, stigmatized children are more likely to show righteous anger toward perceived stigma when the negative acts are viewed as not legitimate, resulting in a non-significant difference in their QoL (Mak et al., 2007).

The mediation model in our analysis further showed that perceived stigma is a significant mediator between body weight and QoL. This finding aligns with that of a previous study that the relationship between higher BMI and poorer psychological health is indirect, mediated by increased perceived weight stigma in an American adult population (Hunger and Major, 2015). This pattern is also consistent with other recent evidence using data from three large samples of predominantly US and UK adults that weight status and depressive symptoms were in part explained by the subjects' perceived weight stigma (Robinson et al., 2017).

## Weight-Related Self-Stigma and Quality of Life

Our results showed that weight-related self-stigma was associated with both child-rated generic QoL and weight-based QoL but not any parent-rated QoL. Consistent with previous studies' findings showing the relationship between self-stigma and QoL among an adult population (Latner et al., 2013; Kahan and Puhl, 2017), the present study demonstrated the significant association between self-stigma and QoL, thus filling the literature gap (Pearl and Puhl, 2018). In a systematic review that examined associations between self-stigma and different QoL domains, the results showed significant negative relationships between self-stigma and psychological domains of QoL (Pearl and Puhl, 2018). Another study examined the potential moderating role of self-stigma in the association between BMI and QoL (Latner et al., 2014) in 81 women. The results indicated a strong association between BMI and QoL's physical domains only exists for individuals with high self-stigma but not for individuals with low self-stigma. Zuba and Warschburger (2017) conducted a longitudinal study to examine self-stigma in children aged 7–11 years old with various weight statuses. The results suggested that self-stigma mediated the relationship between BMI and emotional problems, and self-stigma is more important than weight status in explaining psychological functioning. The present study's results are consistent with those of Wong et al. (2019) that children with obesity had significantly higher self-stigma and lower QoL than children without obesity. Additionally, underlying parental attitudes may increase the risk of children's lowered esteem and results in children's self-stigma and lowered QoL (Lydecker et al., 2018). Therefore, it highlighted the unique role of self-stigma on QoL.

Additionally, we found that weight-related self-stigma was a significant mediator in the association between body weight and children's QoL. Several studies have conducted mediational analyses to investigate the association between self-stigma and QOL in an adult population. For example, Palmeira et al. (2019) examined the effectiveness of a group intervention on 53 women with overweight and obesity. They found that self-stigma was an important mediator of QoL changes. Another study on 1,158 German adults found that self-stigma significantly predicted lower QoL, and they identified self-compassion as a major psychological resource that mediated the self-stigma process (Hilbert et al., 2015). Another study recruited 87 adults from a weight loss clinic and found that self-stigma was a significant predictor of HRQoL and mediated the relationship between BMI and HRQoL (Lillis et al., 2011). Also, Pearl et al. (2014) found that self-stigma mediated the relationship between depression and QoL.

The discrepancy between child-rated and parent-rated QoL was found in the literature concerning the perceived stigma and self-stigma being inconsistently associated with child-rated and parent-rated QoL. A review article examined 19 studies that included four QoL instruments. The results confirmed that there were differences in parent–child agreement across domains for different QoL measurements (Upton et al., 2008). Another study further found that parents of healthy children tended to report higher QoL than their children did. In contrast, parents of children with health conditions tended to underestimate their children's QoL (Tsiros et al., 2009), particularly among parents of young children with obesity (Ruiter et al., 2020). Also, cross-sectional community studies from Spain (Herranz Barbero et al., 2013), Australia (Wake et al., 2002), Taiwan (Lin et al., 2013; Su et al., 2013), and Hong Kong (Fung, 2018) have examined the discrepancy between child-rated and parent-rated QoL in children. The results supported that parents seemed to be optimistic when rating the QoL of their children with obesity and tended to overestimate their QoL. However, another study conducted by Jafari et al. (2016) found the opposite—that Iranian parents of children with obesity rated the child's QoL significantly lower than their children did. Therefore, considering the inconsistency between child-rated and parent-rated QoL is critical. It is suggested that clinicians do not use parent-proxy assessment alone to evaluate the QoL for children with obesity or overweight because parents may overestimate or underestimate their children's difficulties.

## Limitations, Strengths, and Future Directions

The study has several limitations. First, the children and their parents in the study voluntarily participated, which may have biased our results. Second, all questionnaires used in the current study were self-reported. Although we attempted to maximize

participants' honest responses, inevitably, social desirability and recall bias might have influenced the study results. Third, the assessment used to collect the children's experienced stigma used a dichotomous classification; therefore, it may be unable to well-capture the different levels of experienced weight stigma. This possible deficiency should be considered when interpreting the findings. Fourth, the study design's correlational nature cannot draw conclusions about the causal relationship among the different types of weight-related stigma and QoL. Last, the study used a convenience sampling and only enrolled participants from Hong Kong, which limited its generalizability to other geographic locations.

Despite these limitations, the study has several strengths. First, to the best of our knowledge, this study is the first to simultaneously examine the associations between different types of weight stigma and different types of QoL. The present findings concur with prior evidence to demonstrate the associations between weight stigma and QoL. The three types of weight stigma correlated with each other and made specific contributions to the QoL when the effects of other types of weight stigma were taken into consideration. Second, the weight stigma's mediated effects were clearly demonstrated and supported by the present study's results. Third, the present study focused on a unique population, i.e., children, to supplement the weight stigma research in this specific population.

The limitations and strengths of the present study suggest several avenues for more in-depth studies in the future. First, given the present study's cross-sectional design, the proposed mediational models showed little evidence of their causal relationships. Therefore, adopting a longitudinal design in future studies is warranted to corroborate the present study's proposed mediational models. Second, the association between weight stigma and QoL is supported, but it is unclear whether reducing weight stigma can improve QoL in a pediatric population. Therefore, future studies are needed to test such treatment effects.

## CONCLUSION

In conclusion, the study findings support that the experienced stigma is associated with perceived stigma, and the perceived stigma is associated with self-stigma. Additionally, all types of weight-related stigma are associated with children's QoL, while different types of stigma have varied levels of effects on child-rated and parent-rated QoL. Most importantly, the present study found that perceived weight stigma and weight-related self-stigma (but not experienced weight stigma) significantly mediate the relation between body weight and children's QoL.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Human Subject Ethics Review Board in the Hong Kong Polytechnic University (Ref No: HSEARS20160824003) approved the study proposal before data collection commenced. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

C-WF, C-hL, and C-YL created and organized the study. C-YL collected the data. H-HH analyzed the data. C-WF, AP, C-hL, and C-YL wrote the first draft and analyzed and interpreted the data. AP, C-YL, C-hL, H-HH, and C-WF critically reviewed the manuscript and provided constructive comments. All authors contributed to the article and approved the submitted version.

## FUNDING

This research was supported partly by the startup fund in the Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong. This research was supported in part by Higher Education Sprout Project, Ministry of Education to the Headquarters of University Advancement at National Cheng Kung University (NCKU).

## ACKNOWLEDGMENTS

We thank the assistance from the following organizations: HKTA Wun Tsuen Ng Lai Wo Memorial School, Buddhist Wong Cheuk Um Primary School, Hong Kong Playground Association, Hin Keng Children & Youth Centre of Hong Kong Playground Association.

## REFERENCES

Al-Akour, N. A., Khader, Y. S., Khassawneh, M. Y., and Bawadi, H. (2011). Health-related quality of life of adolescents with overweight or obesity in the north of Jordan. *Child Care Health Dev.* 38, 237–243. doi: 10.1111/j.1365-2214.2011.01248.x

Alimoradi, Z., Golboni, F., Griffiths, M. D., Broström, A., Lin, C. Y., and Pakpour, A. H. (2020). Weight-related stigma and psychological distress: a systematic review and meta-analysis. *Clin. Nutrition* 39, 2001–2013. doi: 10.1016/j.clnu.2019.10.016

Bacha, F., and Gidding, S. S. (2016). Cardiac abnormalities in youth with obesity and Type 2 Diabetes. *Curr. Diab. Rep*. 16:62. doi: 10.1007/s11892-016-0750-6

Bass, R., and Eneli, I. (2015). Severe childhood obesity: an under-recognized and growing health problem. *Postgrad. Med. J.* 91, 639–645. doi: 10.1136/postgradmedj-2014-133033

Buttitta, M., Iliescu, C., Rousseau, A., and Guerrien, A. (2014). Quality of life in overweight and obese children and adolescents: a literature review. *Quality Life Res.* 23, 1117–1139. doi: 10.1007/s11136-013-0568-5

Cardinal, B. J., Whitney, A. R., Narimatsi, M., Hubert, N., and Souza, B. J. (2014). Obesity bias in the gym: an under-recognized social justice, diversity, and inclusivity issue. *J. Phys. Educ. Recreation Dance* 85, 3–6. doi: 10.1080/07303084.2014.927668

Carels, R. A., Young, K. M., Wott, C. B., Harper, J., Gumble, A., and Oehlof, M. W., et al. (2009). Weight bias and weight loss treatment

outcomes in treatment-seeking adults. *Annals Behav. Med.* 37, 350–355. doi: 10.1007/s12160-009-9109-4

Chan, P. L., Ng, S. S., and Chan, D. Y. (2014). Psychometric properties of the Chinese version of the Kid-KINDL-R questionnaire for measuring the health-related quality of life of school-aged children. *Hong Kong J. Occup. Ther.* 24, 28–34. doi: 10.1016/j.hkjot.2014.05.001

Cheng, M. Y., Wang, S. M., Lam, Y. Y., Luk, H. T., Man, Y. C., and Lin, C. Y. (2018). The relationships between weight bias, perceived weight stigma, eating behavior, and psychological distress among undergraduate students in Hong Kong. *J. Nervous Mental Dis.* 206, 705–710. doi: 10.1097/NMD.0000000000000869

Durso, L. E., and Latner, J. D. (2008). Understanding self-directed stigma: development of the weight bias internalization scale. *Obesity* 16, S80–S86. doi: 10.1038/oby.2008.448

Fields, L. C., Brown, C., Skelton, J. A., Cain, K. S., and Cohen, G. M. (2021). Internalized weight bias, teasing, and self-esteem in children with overweight or obesity. *Childhood Obesity* 17, 43–50. doi: 10.1089/chi.2020.0150

Fung, X. C. C. (2018). Child–parent agreement on quality of life of overweight children: discrepancies between raters. *Soc. Health Behav.* 1, 37–41. doi: 10.4103/SHB.SHB_35_18

Gmeiner, M. S., and Warschburger, P. (2020). Intrapersonal predictors of weight bias internalization among elementary school children: a prospective analysis. *BMC Pediatr.* 20:408. doi: 10.1186/s12887-020-02264-w

Greenleaf, C., Petrie, T. A., and Martin, S. B. (2014). Relationship of weight-based teasing and adolescents' psychological well-being and physical health. *J. Sch. Health* 84, 49–55. doi: 10.1111/josh.12118

Guardabassi, V., Mirisola, A., and Tomasetto, C. (2018). How is weight stigma related to children's health-related quality of life? A model comparison approach. *Quality Life Res.* 27, 173–183. doi: 10.1007/s11136-017-1701-7

Gudzune, K. A., Bennett, W. L., Cooper, L. A., and Bleich, S. N. (2014). Perceived judgment about weight can negatively influence weight loss: a cross-sectional study of overweight and obese patients. *Preventive Med.* 62, 103–107. doi: 10.1016/j.ypmed.2014.02.001

Güngör, N. K. (2014). Overweight and obesity in children and adolescents. *J. Clin. Res. Pediatr. Endocrinol.* 6, 129–143. doi: 10.4274/jcrpe.1471

Gunnarsdottir, T., Njardvik, U., Olafsdottir, A. S., Craighead, L. W., and Bjarnason, R. (2012). Teasing and social rejection among obese children enrolling in family-based behavioural treatment: effects on psychological adjustment and academic competencies. *Int. J. Obes.* 36, 35–44. doi: 10.1038/ijo.2011.181

Hales, C. M., Carroll, M. D., Fryar, C. D., and Ogden, C. L. (2017). Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief 288*, 1–8. Available online at: https://www.cdc.gov/nchs/data/databriefs/db288.pdf (accessed August 28, 2020).

Halfon, N., Larson, K., and Slusser, W. (2013). Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17. *Acad. Pediatr.* 13, 6–13. doi: 10.1016/j.acap.2012.10.007

Hamzaid, H., Talib, R. A., Azizi, N. H., Maamor, N., Reilly, J. J., and Wafa, S. W. (2011). Quality of life of obese children in Malaysia. *Int. J. Pediatr. Obesity* 6, 450–454. doi: 10.3109/17477166.2011.590206

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Rocess Analysis.* 2nd Ed. New York, NY: The Guilford Press.

Herranz Barbero, A., López de Mesa, R., and Azcona San Julián, C. (2013). Parent and child perception about the health-related quality of life by weight status at Navarra, Spain. *Arch. Argent. Pediatr.* 111, 508–515. doi: 10.5546/aap.2013.eng.508

Hilbert, A., Braehler, E., Schmidt, R., Löwe, B., Häuser, W., and Zenger, M. (2015). Self-Compassion as a resource in the self-stigma process of overweight and obese individuals. *Obes. Facts* 8, 293–301. doi: 10.1159/000438681

Hunger, J. M., and Major, B. (2015). Weight stigma mediates the association between BMI and self-reported health. *Health Psychol.* 34, 172–175. doi: 10.1037/hea0000106

Jafar, T. H., Islam, M., Poulter, N., Hatcher, J., Schmid, C. H., and Levey, A. S., et al. (2005). Children in South Asia have higher body mass-adjusted blood pressure levels than white children in the United States: a comparative study. *Circulation* 111, 1291–1297. doi: 10.1161/01.CIR.0000157699.87728.F1

Jafari, P., Allahyari, E., Salarzadeh, M., and Bagheri, Z. (2016). Item-level informant discrepancies across obese-overweight children and their parents on the PedsQL$^{TM}$ 4.0 instrument: an iterative hybrid ordinal logistic regression. *Quality Life Res.* 25, 25–33. doi: 10.1007/s11136-015-1046-z

Jansen, P. W., Mensah, F. K., Clifford, S., Nicholson, J. M., and Wake, M. (2013). Bidirectional associations between overweight and health-related quality of life from 4-11 years: longitudinal study of Australian children. *Int. J. Obes.* 37, 1307–1313. doi: 10.1038/ijo.2013.71

Jensen, C. D., Cushing, C. C., and Elledge, A. R. (2014). Associations between teasing, quality of life, and physical activity among preadolescent children. *J. Pediatr. Psychol.* 39, 65–73. doi: 10.1093/jpepsy/jst086

Kahan, S., and Puhl, R. M. (2017). The damaging effects of weight bias internalization. *Obesity* 25, 280–281. doi: 10.1002/oby.21772

Klupt, K. A., Oreskovich, S. M., Bernard-Genest, J., Patel, B. P., Chu, L., and Dettmer, E., et al. (2020). Careful conversations: an educational video to support parents in communicating about weight with their children. *BMC Pediatr.* 20:397. doi: 10.1186/s12887-020-02284-6

Kolotkin, R. L., Zeller, M., Modi, A. C., Samsa, G. P., Quinlan, N. P., and Yanovski, J. A., et al. (2006). Assessing weight-related quality of life in adolescents. *Obesity* 14, 448–457. doi: 10.1038/oby.2006.59

Kuhl, E. S., Rausch, J. R., Varni, J. W., and Stark, L. J. (2012). Impaired health-related quality of life in preschoolers with obesity. *J. Pediatr. Psychol.* 37, 1148–1156. doi: 10.1093/jpepsy/jss090

Latner, J. D., Barile, J. P., Durso, L. E., and O'Brien, K. S. (2014). Weight and health-related quality of life: the moderating role of weight discrimination and internalized weight bias. *Eat. Behav.* 15, 586–590. doi: 10.1016/j.eatbeh.2014.08.014

Latner, J. D., Durso, L. E., and Mond, J. M. (2013). Health and health-related quality of life among treatment-seeking overweight and obese adults: associations with internalized weight bias. *J. Eat. Disorders* 1:3. doi: 10.1186/2050-2974-1-3

Lillis, J., Levin, M. E., and Hayes, S. C. (2011). Exploring the relationship between body mass index and health-related quality of life: a pilot study of the impact of weight self-stigma and experiential avoidance. *J. Health Psychol.* 16, 722–727. doi: 10.1177/1359105310388321

Lillis, J., Luoma, J. B., Levin, M. E., and Hayes, S. C. (2010). Measuring weight self-stigma: the weight self-stigma questionnaire. *Obesity* 18, 971–976. doi: 10.1038/oby.2009.353

Lin, C.-Y. (2018). Comparing quality of life instruments: sizing Them Up versus PedsQL and Kid-KINDL. *Soc. Health Behav.* 1, 42–47. doi: 10.4103/SHB.SHB_25_18

Lin, C.-Y., Chang, C.-C., Wu, T.-H., and Wang, J.-D. (2016). Dynamic changes of self-stigma, quality of life, somatic complaints, and depression among people with schizophrenia: a pilot study applying kernel smoothers. *Stigma Health* 1, 29–43. doi: 10.1037/sah0000014

Lin, C.-Y., Luh, W.-M., Cheng, C.-P., Yang, A.-L., and Ma, H.-I. (2014). Evaluating the wording effect and psychometric properties of the Kid-KINDL: using the multitrait-multimethod approach. *Eur. J. Psychol. Assessment* 30, 100–109. doi: 10.1027/1015-5759/a000175

Lin, C. Y., Imani, V., Cheung, P., and Pakpour, A. H. (2020a). Psychometric testing on two weight stigma instruments in Iran: weight Self-Stigma Questionnaire and Weight Bias Internalized Scale. *Eating Weight Disorders* 25, 889–901. doi: 10.1007/s40519-019-00699-4

Lin, C. Y., Strong, C., Latner, J. D., Lin, Y. C., Tsai, M. C., and Cheung, P. (2020b). Mediated effects of eating disturbances in the association of perceived weight stigma and emotional distress. *Eating Weight Disorders* 25, 509–518. doi: 10.1007/s40519-019-00641-8

Lin, C. Y., Strong, C., Tsai, M. C., and Lee, C. T. (2017). Raters interpret positively and negatively worded items similarly in a quality of life instrument for children. *Inquiry* 54:46958017696724. doi: 10.1177/0046958017696724

Lin, C. Y., Su, C. T., Wang, J. D., and Ma, H. I. (2013). Self-rated and parent-rated quality of life (QoL) for community-based obese and overweight children. *Acta Paediatr.* 102, e114–e119. doi: 10.1111/apa.12108

Lin, K. P., and Lee, M. L. (2017). Validating a Chinese version of the Weight Self-stigma Questionnaire for use with obese adults. *Int. J. Nursing Pract.* 23:e12537. doi: 10.1111/ijn.12537

Lin, Y. C., Strong, C., Tsai, M. C., Lin, C. Y., and Fung, X. (2018). Validating Sizing Them Up: a parent-proxy weight-related quality-of-life measure, with community-based children. *Int. J. Clin. Health Psychol.* 18, 81–89. doi: 10.1016/j.ijchp.2017.10.001

Lydecker, J. A., O'Brien, E., and Grilo, C. M. (2018). Parents have both implicit and explicit biases against children with obesity. *J. Behav. Med.* 41, 784–791. doi: 10.1007/s10865-018-9929-4

Mak, W. W., Poon, C. Y., Pun, L. Y., and Cheung, S. F. (2007). Meta-analysis of stigma and mental health. *Soc. Sci. Med.* 65, 245–261. doi: 10.1016/j.socscimed.2007.03.015

McCormack, L. A., Laska, M. N., Gray, C., Veblen-Mortenson, S., Barr-Anderson, D., and Story, M. (2011). Weight-related teasing in a racially diverse sample of sixth-grade children. *J. Am. Diet. Assoc.* 111, 431–436. doi: 10.1016/j.jada.2010.11.021

Meixner, L., Cohrdes, C., Schienkiewitz, A., and Mensink, G. (2020). Health-related quality of life in children and adolescents with overweight and obesity: results from the German KIGGS survey. *BMC Public Health* 20:1722. doi: 10.1186/s12889-020-09834-8

Modi, A. C., and Zeller, M. H. (2008). Validation of a parent-proxy, obesity-specific quality-of-life measure: sizing them up. *Obesity* 16, 2624–2633. doi: 10.1038/oby.2008.416

Morrison, K. M., Shin, S., Tarnopolsky, M., and Taylor, V. H. (2015). Association of depression & health-related quality of life with body composition in children and youth with obesity. *J. Affect. Disord.* 172, 18–23. doi: 10.1016/j.jad.2014.09.014

Nutter, S., Russell-Mayhew, S., Alberga, A. S., Arthur, N., Kassan, A., and Lund, D. E., et al. (2016). Positioning of weight bias: MOVING towards social justice. *J. Obes.* 2016:3753650. doi: 10.1155/2016/3753650

Pakpour, A. H., Chen, C. Y., Lin, C. Y., Strong, C., Tsai, M. C., and Lin, Y. C. (2019a). The relationship between children's overweight and quality of life: a comparison of Sizing Me Up, PedsQL and Kid-KINDL. *Int. J. Clin. Health Psychol.* 19, 49–56. doi: 10.1016/j.ijchp.2018.06.002

Pakpour, A. H., Tsai, M. C., Lin, Y. C., Strong, C., Latner, J. D., and Fung, X., et al. (2019b). Psychometric properties and measurement invariance of the Weight Self-Stigma Questionnaire and Weight Bias Internalization Scale in children and adolescents. *Int. J. Clin. Health Psychol.* 19, 150–159. doi: 10.1016/j.ijchp.2019.03.001

Palad, C. J., Yarlagadda, S., and Stanford, F. C. (2019). Weight stigma and its impact on pediatric care. *Curr. Opin. Endocrinol. Diabetes Obes.* 26, 19–24. doi: 10.1097/MED.0000000000000453

Palmeira, L., Cunha, M., and Pinto-Gouveia, J. (2019). Processes of change in quality of life, weight self-stigma, body mass index, and emotional eating after an acceptance-, mindfulness- and compassion-based group intervention (Kg-Free) for women with overweight and obesity. *J. Health Psychol.* 24, 1056–1069. doi: 10.1177/1359105316686668

Parker, R., and Aggleton, P. (2003). HIV and AIDS-related stigma and discrimination: a conceptual framework and implications for action. *Soc. Sci. Med.* 57, 13–24. doi: 10.1016/S0277-9536(02)00304-0

Pearl, R. L., and Puhl, R. M. (2018). Weight bias internalization and health: a systematic review. *Obesity Reviews* 19, 1141–1163. doi: 10.1111/obr.12701

Pearl, R. L., White, M. A., and Grilo, C. M. (2014). Weight bias internalization, depression, and self-reported health among overweight binge eating disorder patients. *Obesity* 22, E142–E148. doi: 10.1002/oby.20617

Pinhas-Hamiel, O., Singer, S., Pilpel, N., Fradkin, A., Modan, D., and Reichman, B. (2006). Health-related quality of life among children and adolescents: Associations with obesity. *Int. J. Obes.* 30, 267–272. doi: 10.1038/sj.ijo.0803107

Pont, S. J., Puhl, R., Cook, S. R., Slusser, W., and SECTION ON OBESITY and OBESITY SOCIETY. (2017). Stigma experienced by children and adolescents with obesity. *Pediatrics* 140:e20173034. doi: 10.1542/peds.2017-3034

Pratt, K. J., Lamson, A. L., Swanson, M. S., Lazorick, S., and Collier, D. N. (2012). The importance of assessing for depression with HRQOL in treatment-seeking obese youth and their caregivers. *Quality Life Res.* 21, 1367–1377. doi: 10.1007/s11136-011-0042-1

Puhl, R. M., Andreyeva, T., and Brownell, K. D. (2008). Perceptions of weight discrimination: prevalence and comparison to race and gender discrimination in America. *Int. J. Obes.* 32, 992–1000. doi: 10.1038/ijo.2008.22

Puhl, R. M., and Heuer, C. A. (2009). The stigma of obesity: a review and update. *Obesity* 17, 941–964. doi: 10.1038/oby.2008.636

Puhl, R. M., and Heuer, C. A. (2010). Obesity stigma: important considerations for public health. *Am. J. Public Health* 100, 1019–1028. doi: 10.2105/AJPH.2009.159491

Puhl, R. M., and Latner, J. D. (2007). Stigma, obesity, and the health of the nation's children. *Psychol. Bull* 133, 557–580. doi: 10.1037/0033-2909.133.4.557

Puhl, R. M., Latner, J. D., O'Brien, K., Luedicke, J., Forhan, M., and Danielsdottir, S. (2016). Cross-national perspectives about weight-based bullying in youth: nature, extent, and remedies. *Pediatr. Obes.* 11, 241–250. doi: 10.1111/ijpo.12051

Puhl, R. M., and Lessard, L. M. (2020). Weight stigma in youth: prevalence, consequences, and considerations for clinical practice. *Curr. Obes. Rep.* 9, 402–411. doi: 10.1007/s13679-020-00408-8

Rankin, J., Matthews, L., Cobley, S., Han, A., Sanders, R., and Wiltshire, H. D., et al. (2016). Psychological consequences of childhood obesity: psychiatric comorbidity and prevention. *Adolesc. Health Med. Ther.* 7, 125–146. doi: 10.2147/AHMT.S101631

Ravens-Sieberer, U., and Bullinger, M. (2000). KINDL$^R$ questionnaire for measuring health-related quality of life in children and adolescents revised version manual. Available online at: https://www.kindl.org/app/download/6175836884/ManEnglish.pdf?t=1338645880 (accessed August 2020).

Riazi, A., Shakoor, S., Dundas, I., Eiser, C., and McKenzie, S. A. (2010). Health-related quality of life in a clinical sample of obese children and adolescents. *Health Qual. Life Outcomes* 8:134. doi: 10.1186/1477-7525-8-134

Robinson, E., Sutin, A., and Daly, M. (2017). Perceived weight discrimination mediates the prospective relation between obesity and depressive symptoms in U.S. and U.K. adults. *Health Psychol.* 36, 112–121. doi: 10.1037/hea0000426

Ruiter, E., Saat, J., Molleman, G., Fransen, G., van der Velden, K., and van Jaarsveld, C., et al. (2020). Parents' underestimation of their child's weight status. Moderating factors and change over time: A cross-sectional study. *PLoS ONE* 15:e0227761. doi: 10.1371/journal.pone.0227761

Sahoo, K., Sahoo, B., Choudhury, A. K., Sofi, N. Y., Kumar, R., and Bhadoria, A. S. (2015). Childhood obesity: causes and consequences. *J. Family Med. Primary Care* 4, 187–192. doi: 10.4103/2249-4863.154628

Sanyaolu, A., Okorie, C., Qi, X., Locke, J., and Rehman, S. (2019). Childhood and adolescent obesity in the United States: a public health concern. *Global Pediatric Health* 6:2333794X19891305. doi: 10.1177/2333794X19891305

Simmonds, M., Llewellyn, A., Owen, C. G., and Woolacott, N. (2016). Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obesity Rev.* 17, 95–107. doi: 10.1111/obr.12334

Strong, C., Lin, Y. C., Tsai, M. C., and Lin, C. Y. (2017). Factor structure of Sizing Me Up, a self-reported weight-related quality of life instrument, in community children across weight status. *Childhood Obesity* 13, 111–119. doi: 10.1089/chi.2016.0259

Su, C. T., Wang, J. D., and Lin, C. Y. (2013). Child-rated versus parent-rated quality of life of community-based obese children across gender and grade. *Health Qual. Life Outcomes* 11:206. doi: 10.1186/1477-7525-11-206

Swallen, K. C., Reither, E. N., Haas, S. A., and Meier, A. M. (2005). Overweight, obesity, and health-related quality of life among adolescents: the national longitudinal study of adolescent health. *Pediatrics* 115, 340–347. doi: 10.1542/peds.2004-0678

Thompson, I., Hong, J. S., Lee, J. M., Prys, N. A., Morgan, J. T., and Udo-Inyang, I. (2020). A review of the empirical research on weight-based bullying and peer victimisation published between 2006 and 2016. *Educ. Rev.* 72, 88–110. doi: 10.1080/00131911.2018.1483894

Tsiros, M. D., Olds, T., Buckley, J. D., Grimshaw, P., Brennan, L., and Walkley, J., et al. (2009). Health-related quality of life in obese children and adolescents. *Int. J. Obes.* 33, 387–400. doi: 10.1038/ijo.2009.42

Upton, P., Lawford, J., and Eiser, C. (2008). Parent-child agreement across child health-related quality of life instruments: a review of the literature. *Quality Life Res.* 17, 895–913. doi: 10.1007/s11136-008-9350-5

Vos, R. C., Huisman, S. D., Houdijk, E. C., Pijl, H., and Wit, J. M. (2012). The effect of family-based multidisciplinary cognitive-behavioral treatment on health-related quality of life in childhood obesity. *Quality Life Res.* 21, 1587–1594. doi: 10.1007/s11136-011-0079-1

Wake, M., Salmon, L., Waters, E., Wright, M., and Hesketh, K. (2002). Parent-reported health status of overweight and obese Australian primary school children: a cross-sectional population survey. *Int. J. Obesity Related Metabolic Disorders* 26, 717–724. doi: 10.1038/sj.ijo.0801974

Wille, N., Bullinger, M., Holl, R., Hoffmeister, U., Mann, R., and Goldapp, C., et al. (2010). Health-related quality of life in overweight and obese

youths: results of a multicenter study. *Health Quality Life Outcomes* 8:36. doi: 10.1186/1477-7525-8-36

Wong, P. C., Hsieh, Y.-P., Ng, H. H., Kong, S. F., Chan, K. L., and Au, T. Y. A., et al. (2019). Investigating the self-stigma and quality of life for overweight/obese children in Hong Kong: a preliminary study. *Child Indicators Research,* 12, 1065–1082. doi: 10.1007/s12187-018-9573-0

Wott, C. B., and Carels, R. A. (2010). Overt weight stigma, psychological distress, and weight loss treatment outcomes. *J. Health Psychol.* 15, 608–614. doi: 10.1177/1359105309355339

Wu, T.-H., Chang, C.-C., Chen, C.-Y., Wang, J.-D., and Lin, C.-Y. (2015). Further psychometric evaluation of the Self-Stigma Scale-Short: Measurement invariance across mental illness and gender. *PLoS ONE* 10:e0117592. doi: 10.1371/journal.pone.0117592

Zeller, M. H., and Modi, A. C. (2009). Development and initial validation of an obesity-specific quality-of-life measure for children: sizing me up. *Obesity* 17, 1171–1177. doi: 10.1038/oby.2009.47

Zheng, W., McLerran, D. F., Rolland, B., Zhang, X., Inoue, M., and Matsuo, K., et al. (2011). Association between body-mass index and risk of death in more than 1 million Asians. *New Engl. J. Med.* 364, 719–729. doi: 10.1056/NEJMoa1010679

Zuba, A., and Warschburger, P. (2017). The role of weight teasing and weight bias internalization in psychological functioning: a prospective study among school-aged children. *Eur. Child Adolesc. Psychiatry* 26, 1245–1255. doi: 10.1007/s00787-017-0982-2

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

BRIEF RESEARCH REPORT
published: 09 August 2021
doi: 10.3389/fpsyg.2021.717886

# The Role of Acceptance in Eating Behaviors—Spanish Validation of Food Craving Acceptance and Action Questionnaire (FAAQ-S)

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**Background:** The Food Craving Acceptance and Action Questionnaire (FAAQ) was developed to measure food craving acceptance, but has not yet been adapted to Spanish. The aim of this study was to validate the FAAQ to the Spanish population and to analyze its psychometric properties.

**Method:** Two studies were conducted. In the first study, the sample consisted of 224 undergraduate students who participated in the comprehension of the Spanish version and the Confirmatory Factor Analysis (CFA). The second sample consisted of 378 participants from a community sample who completed the refined version of the FAAQ and similar and dissimilar measures.

**Results:** Study (1) The CFA was conducted, showing an inadequate fit of the model (CFI = 0.74, RMSEA = 0.18). Therefore, FAAQ was refined and it was administered to the community sample. Study (2) After an exploratory factor analysis, two factors were obtained as in the original FAAQ, Acceptance (30.92% variance explained) and Willingness (36.05%). The internal consistency was adequate for both subscales ($\omega$ = 0.88 and $\omega$ = 0.87, respectively). Correlation between the factors was $r$ = 0.07, which provides evidence that Acceptance and Willingness are different constructs. Correlations of Acceptance with similar variables ($r$ between −0.30 and −0.52) were stronger than the dissimilar measures ($r$ between −0.26 and 0.24). This did not occur for the Willingness subscale, since correlations were low in all cases ($r$ between −0.22 and 0.25).

**Conclusions:** Spanish version of the FAAQ showed evidence of its reliability and validity, and may be a measure to provide a better understanding of how acceptance of thoughts and emotions concerning food and willingness impact eating management behaviors.

**Keywords: eating behaviors, validation, acceptance, food craving, psychological flexibility**

OPEN ACCESS

***Edited by:***
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***Specialty section:***
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *31 May 2021*
***Accepted:*** *05 July 2021*
***Published:*** *09 August 2021*

***Citation:***
*Manchón J, Quiles M and López-Roig S (2021) The Role of Acceptance in Eating Behaviors—Spanish Validation of Food Craving Acceptance and Action Questionnaire (FAAQ-S). Front. Psychol. 12:717886. doi: 10.3389/fpsyg.2021.717886*

## INTRODUCTION

Currently, one of the main studied variables to improve the understanding and treatment of eating disorders is food cravings. Food cravings are defined as an intense desire to eat a specific food (Weingarten and Elston, 1991). They are related to binge eating and a wide range of eating disorder pathology (Chao et al., 2016), such as bulimia nervosa (Van den Eynde et al., 2012), and binge eating disorder. Food cravings are also related to obesity and constitute an obstacle to weight loss (Coffino et al., 2018).

Food cravings are often experienced as unwanted. It has been suggested that food cravings may involve intrusive thoughts, and therefore individuals may choose to engage in ingesting food to avoid this unpleasant sensation (Fahrenkamp et al., 2019). In this sense, it seems that the theoretical approach of psychological flexibility from the Acceptance and Commitment Therapy (ACT) could be interesting in the explanation of food cravings and eating behavior (Juarascio et al., 2011). According to this approach, the existence of problematic behavioral patterns could be explained by their rigidity, or lack of psychological flexibility, caused by the attempts to avoid experiencing emotions, sensations, or thoughts perceived as distressing (Hayes et al., 2006). ACT and acceptance-based interventions propose that the acceptance of these internal phenomena and the willingness to experience them while continuing to engage in values-driven behaviors are critical to correctly addressing eating behaviors. Increasing the acceptance and willingness to experience food cravings will allow for the behavioral control necessary to overcome these hedonic drives (Martin et al., 2017) which makes ACT and acceptance-based interventions suitable for addressing eating disorders and weight loss in individuals with obesity.

Although there are general psychological flexibility measures such as the Acceptance and Action Questionnaire II (AAQ-II, Bond et al., 2011), it has been recommended that domain-specific psychological flexibility measures should be used for evaluating particular behaviors (Ong et al., 2019). In order to assess the acceptance and willingness to experience food cravings, the Food Craving Acceptance and Action Questionnaire (FAAQ, Juarascio et al., 2011) was developed. The FAAQ was designed to measure psychological flexibility in a food rich environment, by assessing acceptance of distressing food cravings and willingness to engage in healthy eating even when experiencing food cravings. In the original validation, the FAAQ appeared to be a valid and reliable measure. FAAQ has shown treatment sensitivity and predictive validity detecting pre-post treatment changes and predicting weight loss (Ong et al., 2019). Greater increases in FAAQ appeared to be related to greater weight loss. Interestingly, this correlation was not found with the psychological flexibility as measured by AAQ-II, reflecting the importance of having a domain-specific psychological flexibility instrument (Schumacher et al., 2019).

In the literature, the acceptance of food cravings has been addressed primarily in the understanding of obesity and as a mediator of the acceptance-based behavioral treatment (ABT) in weight loss programs (Forman and Butryn, 2015). In this sense, it has been found that the acceptance of food craving explained food cravings both with direct effect, as well as indirect effect through thought suppression and emotional eating (Coffino et al., 2018). In another study, weight loss maintainers showed greater willingness to ignore food cravings than weight-stable individuals with obesity (Phelan et al., 2020).

The FAAQ has been used to study treatment response in ABT interventions, which contain acceptance strategies as a key element for weight loss. Acceptance-based strategies are able to change eating behavior in the presence of cravings, reducing the consumption of highly palatable foods and decreasing the occurrence of cravings. These strategies appear to be more effective than standard strategies such as cognitive restructuring (Karekla et al., 2020). In weight loss interventions, when compared with standard behavioral treatment (SBT), participants who received ABT lost more weight (Forman et al., 2016) and were about twice as likely to maintain their weight loss after 3 years (Forman et al., 2019). In these studies, food craving acceptance mediated the effect of condition on weight loss and weight regain after treatment. Moreover, it has also been suggested that food craving acceptance may be a moderator of weight loss (Martin et al., 2017). In another ABT intervention for binge eating disorder, it appeared that there were changes in willingness to experiment food cravings related to a reduction in eating pathology (Juarascio et al., 2017).

Although the FAAQ has been used mainly in ACT and ABT interventions, psychological flexibility can be a mechanism of change in numerous types of interventions. An increase in food cravings acceptance was observed whether an ABT or SBT intervention was delivered, although this change occurred to a greater extent in ABT (Schumacher et al., 2019). Ultimately, the FAAQ allows the study of a useful variable for the explanation of eating behavior, providing additional insights that are not present in other variables such as emotional eating or binge eating.

To date, no version of the FAAQ is available in Spanish. The AAQ-II questionnaire is available in Spanish (Ruiz et al., 2013), but there is no validated domain-specific measure such as FAAQ. Moreover, there are instruments that assess state and trait food craving (Spanish versions of the State and Trait Food Cravings Questionnaires, Cepeda-Benito et al., 2000) that could be complemented by the FAAQ. Recent studies showed an increase in the risk of developing eating disorders in the country (e.g., Garrido and Sala, 2015; Parra-Fernández et al., 2018). FAAQ could help in its research by providing a novel variable for a better understanding of this phenomenon. In addition, it could help in the study of the effectiveness of ACT interventions that are already being implemented (Marco et al., 2018). Therefore, the aim of this study is to adapt the Spanish version of Food Craving Acceptance and Action Questionnaire and to analyze its psychometric properties. It is expected to reproduce the two-factor structure (acceptance and willingness), and that the FAAQ in its Spanish version will be a reliable and valid measure.

# METHOD

## Participants

In this work, two studies were conducted with their respective samples. The characteristics of both samples are included in **Table 1**. Sample 1 consisted of 232 undergraduate students and Sample 2 consisted of 378 participants from a community sample.

Regarding the calculation of the sample size, for Sample 1 it was taken into account that a Confirmatory Factor Analysis (CFA) would be performed. In accordance with a 20:1 *N:q* ratio, and considering that the data were ordinal, the minimum sample size required was 200 cases (Kyriazos, 2018).

In Sample 2, it was taken into account that an Exploratory Factor Analysis (EFA) would be performed. We expected to find

**TABLE 1 |** Study samples characteristics.

| | Sample 1 | Sample 2 |
|---|---|---|
| Mean age in years (*SD*) | 22.31 (3.85) | 31.77 (14.46) |
| Age range | 18–45 | 18–73 |
| Gender | 75.9% women | 70.9% women |
| Mean BMI in kg/m$^2$ (*SD*) | 22.41 (3.43) | 23.25 (4.26) |
| BMI range | 16.4–35.2 | 16.1–49.6 |
| **BMI classification** | | |
| % Underweight | 8.6% | 9.6% |
| % Normal weight | 72.0% | 61.9% |
| % Overweight | 15.5% | 22.4% |
| % Obese | 3.9% | 6.1% |

communalities greater than 0.40 with a two-factor structure, having a minimum of 4 items per factor, so the minimum sample size required was 200 cases (Lloret-Segura et al., 2014).

## Instruments

The Food Craving Acceptance and Action Questionnaire (FAAQ; Juarascio et al., 2011). It was constructed to measure the acceptance of food cravings. The original version was based on the Chronic Pain Acceptance Questionnaire (CPAQ; McCracken et al., 2004). The final version consisted of 10 items that were scored on a Likert-type scale with a range from 1 (Almost never true) to 6 (Always true). The final score is calculated by summing the 10 items after reversing the scores of negative items (3, 4, 6, 7, and 9). Higher scores suggest greater acceptance of food cravings. The internal consistency of the questionnaire was measured on several occasions in the original study, obtaining, as a result, Cronbach's $\alpha = 0.66$, $\alpha = 0.68$, and $\alpha = 0.93$. Regarding its factorial structure, two factors emerged explaining 62.48% of the variance. The first factor, Willingness, was comprised by items 1, 2, 3, 5, 8 and 10, with a range of factor saturations between 0.59 and 0.82, and an internal consistency of Cronbach's $\alpha = 0.82$. Willingness reports the extent to which a person may engage in behaviors consistent with one's own values for weight management and healthy eating despite the fact that it may cause unpleasant thoughts and feelings such as cravings. The second factor, Acceptance, was comprised by items 4, 6, 7, and 9 with a range of factor saturations between 0.74 and 0.87, and an internal consistency of Cronbach's $\alpha = 0.60$. Acceptance reflects the degree to which a person is open to experiencing cravings, emotions, and physiological experiences associated with food without attempts to control, alter, suppress, or avoid these experiences.

The Acceptance and Action Questionnaire—II (AAQ-II; Bond et al., 2011; Spanish version by Ruiz et al., 2013). It is a general measure of psychological flexibility. In this study, the internal consistency was Cronbach's $\alpha = 0.93$.

The Three-Factor Eating Questionnaire R-18 (TFEQ-R18; Stunkard and Messick, 1985; Spanish version by Jáuregui-Lobera et al., 2014). This scale measures three factors of eating behaviors, these being cognitive restraint, uncontrolled eating and emotional eating. In this study, the internal consistency was Cronbach's $\alpha = 0.89$.

The Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983; Spanish version by Terol-Cantero et al., 2007). It consists of 14 items in two subscales measuring anxiety and depression, and a total score that evaluates global psychological distress. In this study, the internal consistencies were Cronbach's $\alpha = 0.72$ and $\alpha = 0.84$ for the anxiety and depression subscales.

The Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1979; Spanish version by Atienza et al., 2000). This instrument assesses self-esteem, understood as feelings of personal worth and self-respect. In this study, the internal consistency was Cronbach's $\alpha = 0.91$.

### Body Mass Index

This index (kg/m$^2$) was obtained from self-reported weight (kg) and height (m).

## Procedure

First, the Research Ethics Committee of the university approved the project and the data collection.

The translation and cultural adaptation procedure was based on López-Roig and Pastor (2016). Two of the authors translated the FAAQ items independently. The two resulting versions were compared for consensus. Later, the back-translation was carried out by two bilingual speakers (Spanish and English). These translations were compared with the original version to resolve possible errors in the adaptation. Once this procedure was completed, 30 undergraduate students completed the questionnaire in order to guarantee the comprehension of the items. After analyzing the students' opinions, minor wording changes were made to three of the items, while item 5 was rephrased because it showed comprehension difficulties.

For the first study, the questionnaires were administered in the university classrooms during academic hours, with prior agreement with the lecturers. Students were asked to complete the questionnaire after reading the participant information sheet. If they agreed to participate, they signed the informed consent and completed the self-administered questionnaire. No financial or academic compensation of any kind was offered. Missing values were imputed by calculating the median of the item in the sample, in those cases in which missing values did not exceed the 20% of the items in the instrument. Otherwise, all the questionnaire scores were removed.

For the second study, the questionnaires were administered online due to COVID-19 restrictions. The paper-and-pencil or online administration of the questionnaires does not seem to imply differences in scores, as shown in previous studies (e.g., Van de Looij-Jansen and De Wilde, 2008; Ward et al., 2014). Sampling was carried out by sharing a link on social networks (WhatsApp, Instagram, and email) to general population. The participant information sheet and the consent form were available prior to the study. If they agreed to participate, they signed the informed consent and completed the questionnaires. No economic compensation of any kind was offered. The response to the items was mandatory to submit the questionnaires, so there were no missing values.

## Data Analysis

The statistical computing R environment 4.0.1 was used for the data analyses. First, a CFA was conducted in order to replicate the factorial structure found by Juarascio et al. (2011) with the data from the Sample 1. For this purpose, the lavaan package (Rosseel, 2012) was used. The method of parameter estimation was DWLS (diagonally weighted least squares) since data were ordinal and non-normally distributed (Li, 2015). The indices used for testing the model fit and the expected values were the chi-square test, the comparative fit index (CFI $>$ 0.95), the Tucker-Lewis index (TLI $>$ 0.95), the root mean square error of approximation (RMSEA $<$ 0.06), and the standardized root mean-square residual (SRMR $<$ 0.08). These criteria (Hu and Bentler, 1999), however, should be taken with caution since the DWLS estimation tends to overestimate the model fit and yield lower RMSEA values (Xia and Yang, 2019). Particular attention was paid to the SRMR since it is a robust indicator regardless of the method of estimation (Shi and Maydeu-Olivares, 2020). R's psych package (Revelle, 2020) was used to perform the descriptive analyses, internal consistency values (Cronbach's α and McDonald's ω coefficients), Pearson correlations, Fisher's *Z* transformation to compare correlations and EFA in Sample 2. For the EFA, the KMO index was calculated, which must exceed 0.80 to show an adequate fit (Lloret-Segura et al., 2014).

# RESULTS

## Study 1

First, a CFA was performed following the original validation. Therefore, the items were divided into the factors of Acceptance and Willingness. The model fit was not adequate, presenting unacceptable estimates of error ($\chi^2_{[34]} = 384.99$, $p < 0.001$; CFI = 0.74, TLI = 0.66, RMSEA = 0.18 [0.16 ∼0.20 CI 90%], SRMR = 0.17). According to the analysis, the Acceptance factor presented an adequate structure with parameter estimates between 0.58 and 0.75. This was not the case for the Willingness factor, that ranged between 0.01 (item 8) and 0.78 (item 3). The parameter estimates can be found in **Table 2**.

In order to detect possible problems in the items, internal consistency and item-factor correlations were obtained (**Table 2**). The internal consistency of the scale was α = 0.69 (ω = 0.73), and it increased to α = 0.76 (ω = 0.77) when item 5 was removed. Regarding the internal consistency of the factors, they were α = 0.79 (ω = 0.80) for Acceptance and α = 0.53 (ω = 0.63) for Willingness. In order to obtain an acceptable internal consistency in Willingness (α = 0.80, ω = 0.81), it was necessary to remove items 3, 5, and 2. At this point, the CFA was repeated without items 2, 3, and 5, yielding unacceptable results in RMSEA and SRMR ($\chi^2_{[13]} = 48.42$, $p < 0.001$; CFI = 0.95, TLI = 0.92; RMSEA = 0.10 [0.07 ∼0.12 CI 90%], SRMR = 0.08).

In view of the results of the CFA and the internal consistency in the Willingness subscale, the questionnaire was modified. For this purpose, it was decided to adapt several items from the CPAQ (McCracken et al., 2004).

## Study 2

First, it was decided to drop item 5 when refining the questionnaire. This item presented comprehension problems and had a negative item-total correlation that affected the internal consistency of the scale. In second place, based on the CPAQ (McCracken et al., 2004), and following (Juarascio et al., 2011) item construction process, four items of the CPAQ were adapted by changing the reference to chronic pain to healthy eating or dieting. These were the items 5 ("I am committing to healthy eating habits no matter how unpleasant or demanding I may find it"), 11 ("It's okay to experience unpleasant feelings while dieting"), 12 ("I can maintain my commitment to healthy eating even when I am involved with other responsibilities"), and 13 ("When I start to feel like giving up my healthy eating habits, I find a way to continue to do them"). Prior to administering the questionnaire, the process of translation, back-translation and comprehension of these four items was repeated.

An EFA was performed reproducing the conditions of the original validation by Juarascio et al. (2011). Therefore, the EFA was performed with generalized least squares and oblique rotation. In a first phase of analysis, a three-factor solution was obtained (KMO = 0.84; 65.32% variance explained). However, the factor loadings of items 2, 5, and 11 were very similar in all three factors. They were close to 0 in items 2 and 11, and between 0.43 and 0.52 in the case of the item 5. The EFA was repeated removing these three items. This second analysis showed a two-factor solution, explaining 66.97% of the variance (KMO = 0.82). It was therefore decided to exclude these three items. The Acceptance factor explained 30.92% of the variance, while Willingness explained the 36.05%. The factor loadings of the items, as well as their mean scores and standard deviations of the final solution are shown in **Table 3**. It should be noted that the item 3, originally allocated in the Willingness factor, appeared in the Acceptance factor. Therefore, Acceptance contained items 3, 4, 6, 7, and 9. The remaining original items of the Willingness factor (1, 8, and 10), as well as two of the new items (12 and 13) loaded together. After analyzing item 3, it theoretically reflected contents congruent with Acceptance.

Once the final factorial solution was obtained, internal consistency and item-factor correlations were calculated. For the Willingness factor, the internal consistency was α = 0.88 (ω = 0.88) and its item-factor correlations were between 0.68 and 0.75. In the case of Acceptance, the internal consistency was α = 0.86 (ω = 0.87) and its item-factor correlations were between 0.62 and 0.71. The internal consistency for the total score was α = 0.80 (ω = 0.80), and the item-scale correlations were between 0.33 and 0.57. The correlation between Acceptance and Willingness was nearly zero ($r = 0.07$). As for the correlations with the total score, Acceptance showed a correlation of $r = 0.77$, and $r = 0.69$ in the case of Willingness.

Next, a correlation analysis (**Table 4**) was performed to examine convergent and discriminant validity, following the considerations employed by Juarascio et al. (2011). The authors made a comparison between the sums of similar constructs vs. different variables, so the hypothesized result was that the sum of correlations of similar constructs would be greater than that of

**TABLE 2 |** Descriptive statistics of the items, item-factor correlations, CFA parameter estimates, and internal consistency.

| | *M* (*SD*) | Item-factor *r* | CFA parameter estimates | α | ω |
|---|---|---|---|---|---|
| *Willingness* | | | | 0.53 | 0.63 |
| FAAQ1 | 3.75 (1.36) | 0.45 | 0.10 | | |
| FAAQ2 | 4.06 (1.34) | 0.30 | −0.42 | | |
| FAAQ3 | 3.97 (1.56) | −0.02 | −0.78 | | |
| FAAQ5 | 3.70 (1.49) | 0.01 | 0.41 | | |
| FAAQ8 | 3.92 (1.38) | 0.57 | 0.01 | | |
| FAAQ10 | 4.21 (1.37) | 0.54 | −0.04 | | |
| *Acceptance* | | | | 0.79 | 0.80 |
| FAAQ4 | 4.46 (1.45) | 0.59 | 0.75 | | |
| FAAQ6 | 3.29 (1.61) | 0.51 | 0.58 | | |
| FAAQ7 | 4.12 (1.66) | 0.67 | 0.72 | | |
| FAAQ9 | 3.92 (1.66) | 0.66 | 0.74 | | |

**TABLE 3 |** Exploratory factor analysis loadings and descriptive statistics of the refined version of the FAAQ.

| Items | Factor 1 Willingness | Factor 2 Acceptance | *M* (*SD*) |
|---|---|---|---|
| 1. Sigo una alimentación saludable aun cuando tengo el deseo de comer en exceso o de escoger alimentos no sanos.<br>*I continue to eat a healthy diet, even when I have the desire to overeat or make poor eating choices.* | **0.75** | −0.05 | 3.73 (1.44) |
| 3. Es necesario que controle mis impulsos por comer para cuidar mi alimentación.<br>*It's necessary for me to control my food urges in order to control my eating.* | −0.02 | **0.78** | 3.78 (1.65) |
| 4. Necesito concentrarme en eliminar mi impulso por comer de manera no saludable.<br>*I need to concentrate on getting rid of my urges to eat unhealthily.* | 0.24 | **0.80** | 4.24 (1.68) |
| 6. Controlar mis impulsos por comer poco saludable es tan importante como controlar mi alimentación.<br>*Controlling my urges to eat unhealthily is just as important as controlling my eating.* | −0.12 | **0.68** | 3.38 (1.66) |
| 7. Mis pensamientos y sentimientos con respecto a la comida deben cambiar antes de poder hacer cambios en mi alimentación o dieta.<br>*My thoughts and feelings about food must change before I can make changes in my eating.* | 0.16 | **0.77** | 3.99 (1.69) |
| 8. A pesar de tener antojos por alimentos poco saludables, sigo comiendo sano.<br>*Despite my cravings for unhealthy foods, I continue to eat healthily.* | **0.82** | −0.02 | 3.89 (1.44) |
| 9. Antes de poder hacer un cambio alimentario importante, tengo que tener cierto control sobre mis impulsos alimentarios.<br>*Before I can make any important dietary changes, I have to get some control over my food urges.* | 0.02 | **0.77** | 3.65 (1.67) |
| 10. Aunque tenga el deseo de comer algo poco saludable, soy capaz de comer sano.<br>*Even if I have the desire to eat something unhealthy, I can still eat healthily.* | **0.75** | 0.09 | 4.21 (1.43) |
| 12. Puedo mantener mi compromiso de comer sano incluso cuando estoy ocupado/a con otras responsabilidades.<br>*"I can maintain my commitment to healthy eating even when I am involved with other responsibilities."* | **0.78** | 0.12 | 3.99 (1.46) |
| 13. Cuando empiezo a sentir deseos por abandonar mis hábitos alimentarios saludables, encuentro una manera de continuar realizándolos.<br>*"When I start to feel like giving up my healthy eating habits, I find a way to continue to do them."* | **0.79** | 0.10 | 3.78 (1.42) |

*Note: The English items in italics are the original items. The English items in quotation marks are the translation of the new items generated in Spanish. The numbers in bold indicate the inclusion in that factor.*

different variables. The difference in the sum of correlations was observed in the Total score ($\Sigma r = |0.36|$ in similar variables vs. $\Sigma r = |0.25|$ in discriminant constructs, $Z = 1.66$, $p < 0.05$) and in Acceptance ($\Sigma r = |0.44|$ vs. $\Sigma r = |0.23|$, $Z = 3.25$, $p < 0.01$). No such differences were found in the Willingness factor ($\Sigma r = |0.17|$ vs. $\Sigma r = |0.15|$, $Z = 0.28$, $p = 0.39$).

**TABLE 4 |** Correlations between the FAAQ and other variables.

| | FAAQ Total | FAAQ Acceptance | FAAQ Willingness |
|---|---|---|---|
| *Similar* | | | |
| AAQ-II | −0.30** | −0.30** | −0.14** |
| TFEQ Desinhibition | −0.47** | −0.51** | −0.17** |
| TFEQ Emotional eating | −0.52** | −0.52** | −0.21** |
| TFEQ Restraint | −0.18** | −0.47** | 0.25** |
| BMI | −0.27** | −0.34** | −0.05 |
| *Dissimilar* | | | |
| HADS Total | −0.28** | −0.25** | −0.16** |
| HADS Anxiety | −0.14** | −0.16** | −0.05 |
| HADS Depression | −0.32** | −0.26** | −0.22** |
| RSE | 0.28** | 0.24** | 0.16** |

*AAQ-II, Acceptance and Action Questionnaire—II; TFEQ, Three Factor Eating Questionnaire; BMI, Body Mass Index; HADS, Hospital Anxiety and Depression Scale; RSE, Rosenberg Self-Esteem Scale; **statistically significant at $p < 0.01$.*

## DISCUSSION

The purpose of this work was the adaptation of the Food Craving Acceptance and Action Questionnaire to the Spanish population. After the two studies presented, it can be stated that the FAAQ appeared to be a reliable and valid instrument. With this work, we intended to provide an instrument for the evaluation of the acceptance of food cravings for its use in Spain.

First, the CFA was performed, which showed an inadequate factor solution. Moreover, internal consistency problems were detected in half of the items of Willingness (2, 3, and 5), but their exclusion from the model failed to provide a satisfactory factorial structure. Overall, the CFA and the reliability results allowed to identify weaknesses in the Willingness factor. Interestingly, Willingness showed better results in the original work by Juarascio et al. (2011) in terms of internal consistency, while in this case Acceptance showed adequate psychometric properties in both the CFA and reliability.

As commented above, it was decided to drop item 5. This item presented comprehension problems and had a negative item-total correlation that affected the internal consistency of the scale. A possible explanation for these results can be found in the translation and subsequent difficulties in the comprehension of the item.

After the new items based on the CPAQ were included, an EFA was carried out in which five items were retained in both factors. Item 2, which showed psychometric deficiencies in both studies, was definitely discarded. In the case of item 3, it appeared as part of the Acceptance factor. As mentioned above, the content of this item refers to the control of food urges. This same content is reflected in other items of Acceptance, and therefore item 3 had theoretical consistency with the rest of the items. Considering the addition of new items, the EFA yielded two factors that showed adequate internal consistency and factor structure. This addition solved the performance of Willingness, while Acceptance continued to show adequate psychometric properties. The new items could also explain that Acceptance and Willingness appear to be orthogonal factors since the correlation between them was near to zero. This result differs from the original questionnaire (Juarascio et al., 2011).

Given this factorial solution, the Acceptance items content referred to the elimination, control, or modification of thoughts or urges related to food craving. This content would correspond with the lack of acceptance as explained in the literature (Hayes et al., 2006), emphasizing that these experiences are perceived as unwanted (Fahrenkamp et al., 2019).

Also, Willingness items would be closer to ACT's values variable, which involves giving purpose to behaviors. Through the work on values, individuals focus on increasing the ability to live a meaningful life together with the discomfort of challenges (Dahl, 2015). The Willingness factor would indicate a disposition or commitment to maintain healthy eating in spite of the appearance of urges to eat (Martin et al., 2017). It might be interesting to study the correlation between FAAQ and other instruments such as the Valuing Questionnaire (Smout et al., 2014) since higher correlations than the aforementioned in this paper might appear.

Regarding convergent and divergent validity, the results pointed to Acceptance having a statistically greater relationship with similar variables than with theoretically dissimilar variables. This did not occur with the Willingness factor. In this case, a contrast was found with the results of Juarascio et al. (2011). In their results, it was the opposite for the two factors. In our view, the fact that Willingness did not present the expected correlations does not undermine the validity of the FAAQ. Rather, it would suggest that it is a different construct, and this can be supported by the null correlation between factors.

Correlations with BMI were significant with FAAQ total score and Acceptance. This relation is meaningful since in an ABT weight loss intervention it was found that the change through the intervention in FAAQ scores mediated the intervention effect at 24 months in weight loss (Forman et al., 2019). This implies that the FAAQ might be of high interest for future research in weight management.

With respect to the correlation with the AAQ-II, it was of moderate intensity, which confirms the relevance of having a domain-specific measure of psychological flexibility as mentioned above (Ong et al., 2019).

Regarding its limitations, first, the CFA sample consisted only of undergraduate students. Since it was a homogeneous sample, there may have been bias in the results. Although the sample size was adequate in both studies according to the statistical requirements, it would be advisable to include larger samples in future studies. The FAAQ should also be tested in a clinical sample. As reported by Juarascio et al. (2011) and Ong et al. (2019), FAAQ was able to detect clinical changes in weight loss, so it should be proven to be useful for that purpose. In addition, the samples were mostly composed of women, so more men should be included in future studies. In relation to other psychometric analyses, it would be convenient to test temporal stability and measurement invariance (e.g., gender).

The FAAQ has shown adequate psychometric properties in its Spanish version. The use of third-wave psychological therapies such as ACT for eating disorders in Spain (Marco et al., 2018)

make it necessary to have valid and reliable measures of their related variables. This measure may help to better understand the relationship between acceptance and problematic eating behaviors such as binge eating or emotional eating, and to better understand the mechanisms of action of the efficacy of weight management interventions in the Spanish research context.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because participants of this study did not agree for their data to be shared publicly, so supporting data is not available. Requests to access the datasets should be directed to Maria Quiles, mj.quiles@umh.es.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Oficina de Investigación Responsable from Miguel Hernández University of Elche. The patients/participants provided their written informed consent to participate in this study. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

JM, MQ, and SL-R designed the study and carried out the process of adaptation into Spanish. JM and MQ collected the data and wrote the manuscript. JM analyzed the data. SL-R gave feedback on the manuscript. All authors approved the final version.

## FUNDING

The authors would like to thank the Ministry of Science, Innovation, and Universities of Spain for their grant [FPU17/00206]. The funding source had no involvement in this study.

## REFERENCES

Atienza, F. L., Moreno, Y., and Balaguer, I. (2000). Análisis de la dimensionalidad de la Escala de Autoestima de Rosenberg en una muestra de adolescentes valencianos. *Rev. Psicol. Univ. Tarraconensis* 22, 29–42.

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., et al. (2011). Preliminary psychometric properties of the acceptance and action questionnaire-ii: a revised measure of psychological inflexibility and experiential avoidance. *Behav. Ther.* 42, 676–688. doi: 10.1016/j.beth.2011.03.007

Cepeda-Benito, A., Gleaves, D. H., Fernández, M. C., Vila, J., Williams, T. L., and Reynoso, J. (2000). The development and validation of Spanish versions of the State and trait food craving questionnaires. *Behav. Res. Ther.* 38, 1125–1138. doi: 10.1016/S0005-7967(99)00141-2

Chao, A. M., Grilo, C. M., and Sinha, R. (2016). Food cravings, binge eating, and eating disorder psychopathology: exploring the moderating roles of gender and race. *Eat. Behav.* 21, 41–47. doi: 10.1016/j.eatbeh.2015.12.007

Coffino, J. A., Heiss, S., and Hormes, J. M. (2018). Targeting acceptance in the management of food craving: the mediating roles of eating styles and thought suppression. *Eat. Behav.* 29, 132–136. doi: 10.1016/j.eatbeh.2018.04.002

Dahl, J. (2015). Valuing in ACT. *Curr. Opin. Psychol.* 2, 43–46. doi: 10.1016/j.copsyc.2015.03.001

Fahrenkamp, A. J., Darling, K. E., Ruzicka, E. B., and Sato, A. F. (2019). Food cravings and eating: the role of experiential avoidance. *Int. J. Environ. Res. Public Health* 16:1181. doi: 10.3390/ijerph16071181

Forman, E. M., and Butryn, M. L. (2015). A new look at the science of weight control: how acceptance and commitment strategies can address the challenge of self-regulation. *Appetite* 84, 171–180. doi: 10.1016/j.appet.2014.10.004

Forman, E. M., Butryn, M. L., Manasse, S. M., Crosby, R. D., Goldstein, S. P., Wyckoff, E. P., et al. (2016). Acceptance-based vs. standard behavioral treatment for obesity: results from the mind your health randomized controlled trial. *Obesity* 24, 2050–2056. doi: 10.1002/oby.21601

Forman, E. M., Manasse, S. M., Butryn, M. L., Crosby, R. D., Dallal, D. H., and Crochiere, R. J. (2019). Long-term follow-up of the mind your health project: acceptance-based versus standard behavioral treatment for obesity. *Obesity* 27, 565–571. doi: 10.1002/oby.22412

Garrido, V., and Sala, J. (2015). Eating disorder risk and psychopathological dimensions. *UB J. Psychol.* 45, 87–99. Available online at: https://revistes.ub.edu/index.php/Anuario-psicologia/article/view/12022/14796

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., and Lillis, J. (2006). Acceptance and commitment therapy: model, processes and outcomes. *Behav. Res. Ther.* 44, 1–25. doi: 10.1016/j.brat.2005.06.006

Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Eq. Model. Multidiscipl. J.* 6, 1–55. doi: 10.1080/10705519909540118

Jáuregui-Lobera, I., García-Cruz, P., Carbonero-Carreño, R., Magallares, A., and Ruiz-Prieto, I. (2014). Psychometric properties of spanish version of the three-factor eating questionnaire-r18 (TFEQ-SP) and its relationship with some eating- and body image-related variables. *Nutrients* 6, 5619–5635. doi: 10.3390/nu6125619

Juarascio, A., Forman, E., Timko, C. A., Butryn, M., and Goodwin, C. (2011). The development and validation of the food craving acceptance and action questionnaire (FAAQ). *Eat. Behav.* 12, 182–187. doi: 10.1016/j.eatbeh.2011.04.008

Juarascio, A. S., Manasse, S. M., Espel, H. M., Schumacher, L. M., Kerrigan, S., and Forman, E. M. (2017). A pilot study of an acceptance-based behavioral treatment for binge eating disorder. *J. Contextual Behav. Sci.* 6, 1–7. doi: 10.1016/j.jcbs.2016.12.003

Karekla, M., Georgiou, N., Panayiotou, G., Sandoz, E. K., Kurz, A. S., and Constantinou, M. (2020). Cognitive restructuring vs. defusion: Impact on craving, healthy and unhealthy food intake. *Eat. Behav.* 37:101385. doi: 10.1016/j.eatbeh.2020.101385

Kyriazos, T. A. (2018). Applied Psychometrics: Sample size and sample power considerations in factor analysis (EFA, CFA) and SEM in General. *Psychology* 9, 2207–2230. doi: 10.4236/psych.2018.98126

Li, C. (2015). Confirmatory factor analysis with ordinal data: comparing robust maximum likelihood and diagonally weighted least squares. *Behav. Res. Methods* 48, 936–949. doi: 10.3758/s13428-015-0619-7

Lloret-Segura, S., Ferreras-Traver, A., Hernández-Baeza, A., and Tomás-Marco, I. (2014). El análisis factorial exploratorio de los ítems: una guía práctica, revisada y actualizada. *Anales de Psicología* 30, 1151–1169. doi: 10.6018/analesps.30.3.199361

López-Roig, S., and Pastor, M. Á. (2016). "Cultural adaptation of measures," in *Psychological Assessment—Science and Practice: Assessment in Health Psychology,* eds Y. Benyamini, M. Johnston, and E. C. Karademas (Bostan, MA: Hogrefe Publishing), 265–277.

Marco, M., Quiles, Y., and Quiles, M. J. (2018). Acceptance and commitment therapy for eating disorders: a pilot study with adolescent patients. *Informació Psicològica*, 116, 18–31. doi: 10.14638/IPSIC.2018.116.2

Martin, L. M., Espel-Huynh, H. M., Marando-Blanck, S., Evans, B. C., Forman, E. M., Butryn, M. L., et al. (2017). Trusting homeostatic cues versus accepting hedonic cues: A randomized controlled trial comparing two distinct mindfulness-based intervention components. *J. Contextual Behav. Sci.* 6, 409–417. doi: 10.1016/j.jcbs.2017.09.002

McCracken, L. M., Vowles, K. E., and Eccleston, C. (2004). Acceptance of chronic pain: component analysis and a revised assessment method. *Pain* 107, 159–166. doi: 10.1016/j.pain.2003.10.012

Ong, C. W., Lee, E. B., Levin, M. E., and Twohig, M. P. (2019). A review of AAQ variants and other context-specific measures of psychological flexibility. *J. Contextual Behav. Sci.* 12, 329–346. doi: 10.1016/j.jcbs.2019.02.007

Parra-Fernández, M. L., Rodríguez-Cano, T., Onieva-Zafra, M. D., Pérez-Haro, M. J., Casero-Alonso, V., Fernández-Martínez, E., et al. (2018). Prevalence of orthorexia nervosa in university students and its relationship with psychopathological aspects of eating behaviour disorders. *BMC Psychiatry* 18:364. doi: 10.1186/s12888-018-1943-0

Phelan, S., Halfman, T., Pinto, A. M., and Foster, G. D. (2020). Behavioral and psychological strategies of long-term weight loss maintainers in a widely available weight management program. *Obesity* 28, 421–428. doi: 10.1002/oby.22685

Revelle, W. (2020). *psych: Procedures for Psychological, Psychometric, and Personality Research*. Evanston, IL: Northwestern University. Available online at: https://CRAN.R-project.org/package=psych

Rosenberg, M. (1979). Conceiving the Self. New York, NY: Basic Books.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *J. Statistic. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02

Ruiz, F. J., Langer Herrera, A. I., Luciano, C., Cangas, A. J., and Beltrán, I. (2013). Measuring experiential avoidance and psychological inflexibility: the Spanish version of the Acceptance and Action Questionnaire—II. *Psicothema* 25, 123–129. doi: 10.1037/t65412-000

Schumacher, L. M., Godfrey, K. M., Forman, E. M., and Butryn, M. L. (2019). Change in domain-specific but not general psychological flexibility relates to greater weight loss in acceptance-based behavioral treatment for obesity. *J. Contextual Behav. Sci.* 12, 59–65. doi: 10.1016/j.jcbs.2019.01.008

Shi, D., and Maydeu-Olivares, A. (2020). The Effect of Estimation Methods on SEM Fit Indices. *Educat. Psychol. Measure.* 80, 421–445. doi: 10.1177/0013164419885164

Smout, M., Davies, M., Burns, N., and Christie, A. (2014). Development of the valuing questionnaire (VQ). *J. Contextual Behav. Sci.* 3, 164–172. doi: 10.1016/j.jcbs.2014.06.001

Stunkard, A. J., and Messick, S. (1985). The Three-Factor Eating Questionnaire to measure dietary restraint, disinhibition and hunger. *J. Psychosom. Res.* 29, 71–83. doi: 10.1016/0022-3999(85)90010-8

Terol-Cantero, M. C., López-Roig, S., Rodríguez-Marín, J., Martín-Aragón, M., Pastor, M. A., and Reig, M. T. (2007). Propiedades psicométricas de la Escala Hospitalaria de Ansiedad y Depresión (HAD) en población española. *Ansiedad Estrés* 13, 163–176.

Van de Looij-Jansen, P. M., and De Wilde, E. J. (2008). Comparison of Web-Based versus paper-and-pencil self-administered questionnaire: effects on health indicators in dutch adolescents. *Health Serv. Res.* 43, 1708–1721. doi: 10.1111/j.1475-6773.2008.00860.x

Van den Eynde, F., Koskina, A., Syrad, H., Guillaume, S., Broadbent, H., Campbell, I. C., et al. (2012). State and trait food craving in people with bulimic eating disorders. *Eat. Behav.* 13, 414–417. doi: 10.1016/j.eatbeh.2012.07.007

Ward, P., Clark, T., Zabriskie, R., and Morris, T. (2014). Paper/Pencil vs. online data collection. *J. Leis. Res.* 46, 84–105. doi: 10.1080/00222216.2014.11950314

Weingarten, H. P., and Elston, D. (1991). Food cravings in a college population. *Appetite* 17, 167–175. doi: 10.1016/0195-6663(91)90019-O

Xia, Y., and Yang, Y. (2019). RMSEA, CFI, and TLI in structural equation modeling with ordered categorical data: the story they tell depends on the estimation methods. *Behav. Res. Methods* 51, 409–428. doi: 10.3758/s13428-018-1055-2

Zigmond, A. S., and Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatr Scand.* 67, 361–370. doi: 10.1111/j.1600-0447.1983.tb09716.x

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 18 August 2021
doi: 10.3389/fpsyg.2021.713070

# From Deficits in Emotional Intelligence to Eating Disorder Symptoms: A Sequential Path Analysis Approach Through Self-Esteem and Anxiety

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Past studies have reported emotional intelligence (EI) as a relevant factor in development and maintenance of eating disorders (ED), as well as in increasing self-esteem and reducing anxiety. Similarly, research has showed that anxiety and self-esteem are positively and negatively associated to ED criteria, respectively. However, no prior studies have yet tested the multiple intervening roles of both self-esteem and anxiety as potential mediators of the association between EI and ED symptomatology. The present study aims to bridge these gaps by testing a sequential path model. Specifically, we examine the potential sequential mediation effects of self-esteem-anxiety on the link between EI and ED. A sample composed of 516 Spanish undergraduate students and community adults completed measures of EI, self-esteem, anxiety, and ED symptomatology. The results show that high levels of EI were positively associated with self-esteem and negatively associated with anxiety and ED symptoms. Anxiety was positively associated to ED symptoms, while self-esteem levels were negatively linked to ED symptoms. Moreover, path analyses showed that self-esteem and anxiety fully mediated the relationship between EI and ED symptoms in sequence. These findings suggest that EI plays a key role in reducing symptomatology of ED through increased self-esteem and reduced anxiety symptoms, providing novel evidence regarding psychological mechanisms through which EI contributes to a reduction of ED symptomatology. Implications for assessing and improving these psychological resources in ED preventive programs are discussed.

**Keywords: emotional intelligence, eating disorders, anxiety, self-esteem, path analysis**

OPEN ACCESS

***Edited by:***
*Atsushi Oshio, Waseda University, Japan*

***Reviewed by:***
*Stefania Cella, University of Campania Luigi Vanvitelli, Italy*
*Sylvie Berthoz, Institut National de la Santé et de la Recherche Médicale (INSERM), France*

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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *21 May 2021*
***Accepted:*** *23 July 2021*
***Published:*** *18 August 2021*

***Citation:***
*Peláez-Fernández MA, Romero-Mesa J and Extremera N (2021) From Deficits in Emotional Intelligence to Eating Disorder Symptoms: A Sequential Path Analysis Approach Through Self-Esteem and Anxiety. Front. Psychol. 12:713070. doi: 10.3389/fpsyg.2021.713070*

## INTRODUCTION

Eating disorders (ED) are persistent disturbances of eating or eating-related behaviors that result in significant impairments in psychosocial functioning and physical health (American Psychiatric Association (APA), 2013). In the last two decades, the worldwide prevalence of ED has increased from 3.5 to 7.8% (Galmiche et al., 2019), and the rate remains significantly higher among females (American Psychiatric Association (APA), 2013). Anxiety disorders and depression are among the most common comorbid diagnoses in ED (Godart et al., 2002, 2007).

Theoretical background and empirical evidence have supported the idea that deficits in the processing and managing of emotions play a key role in the development and maintenance of ED (Polivy and Herman, 1993) and that difficulties with the regulation of emotions are related with ED psychopathology (Corstorphine, 2006; Fox, 2009; Haynos and Fruzzetti, 2011; Lavender et al., 2015; Rowsell et al., 2016). For example, some meta-analytic findings have confirmed that high levels of negative emotionality increase the risk of eating pathology (Stice, 2002). Accordingly, consistent with the transdiagnostic cognitive-behavioral model for ED (Fairburn et al., 2003), mood changes (along with external events) play a relevant role in both the maintenance and relapse of ED. In fact, a broad form of enhanced cognitive-behavioral therapy (CBT-Eb; Fairburn et al., 2009), including mood intolerance, clinical perfectionism, low self-esteem, and interpersonal difficulties, along with the well-established cognitive-behavioral therapy (CBT) for ED (National Institute for Clinical Excellence (NICE), 2004; Wilson, 2005) have shown better results compared to CBT alone, both for ED patients with minor and subclinical symptoms and for those with more relevant psychopathology symptoms (CBT-Eb; Fairburn et al., 2009). Similarly, the cognitive-emotional-behavioral therapy (CEBT) (Corstorphine, 2006), including assessment of emotions and emotional management techniques, has been shown to improve participants' emotional eating behaviors, as well as their self-esteem, depression, and anxiety (Campbell, 2012).

## Emotional Intelligence and Eating Disorders

Emotional intelligence (EI) is a relatively new construct related to emotions that comprises a set of basic emotional skills. From an ability perspective, EI is defined as "the ability of people to perceive, use, understand and manage emotions" (Mayer and Salovey, 1997; p. 532). This EI theoretical framework involves four basic emotional dimensions: emotional perception and expression, emotional facilitation, emotional understanding, and emotional regulation. From this perspective, emotional regulation is defined as the ability to manage both positive and negative emotions in themselves and in others, integrating emotion and cognition effectively (Mayer et al., 2016). These emotional skills can be developed in clinical settings through systematic and comprehensive EI training (Mayer et al., 2000; Kotsou et al., 2018).

In the last decade, an emerging line of research has typically shown the significant relationship between EI and ED symptoms. For example, some prior research has found that individuals with some EI deficits are more prone to display disordered eating attitudes and behaviors (Costarelli et al., 2009; Pettit et al., 2009; Filaire et al., 2010; Zysberg and Rubanov, 2010; Hambrook et al., 2012; Zavala and López, 2012; Zysberg, 2013; Zysberg and Tell, 2013; Gardner et al., 2014; Koch and Pollatos, 2015; Cuesta et al., 2017; Peres et al., 2018; Foye et al., 2019). In addition, recent systematic reviews have reported that these abilities are relevant factors in both the development and maintenance of ED (Romero-Mesa et al., 2020; Giusti et al., 2021). These findings provide some preliminary support for the role of emotions in disordered eating attitudes with a view to the prevention and management of ED and point to the potential use of EI measures to identify individuals at risk of ED.

## Self-Esteem and Anxiety as Mediators

Beyond this direct association between EI and ED symptoms, other potential underlying processes have been theorized through which EI might impact ED symptoms. Two of these individual psychological mechanisms considered to be relevant mediators might be self-esteem and anxiety. A growing body of research has supported the theory that deficits in emotional skills are significant predictors of reduced self-esteem domains (Fernández-Berrocal et al., 2006; Hasanvand and Khaledian, 2012; Bibi et al., 2016). Likewise, it has been found that people with high levels of anxiety typically report difficulty in accurately perceiving, using, understanding, and managing their own emotions (Fernández-Berrocal et al., 2006; Connor and Slear, 2009; Kousha et al., 2018). Taken together, these findings suggest that people with high levels of EI feel more security and less stress and also believe in their abilities, showing higher feelings of self-worth, goodness, and self-respect.

On the other hand, there is some theoretical and empirical support that self-esteem and anxiety are risk factors for ED symptoms. As mentioned above, improving self-esteem in combination with other components resulted in a more effective treatment for ED patients compared to CBT therapy alone. In addition, several studies have consistently corroborated a negative relationship between self-esteem and ED criteria (Silverstone, 1990, 1992; Silvera et al., 1998). Besides, numerous studies have found that high levels of anxiety are a well-recognized symptom in individuals with ED (Arnow et al., 1995; Levinson and Rodebaugh, 2012; Menatti et al., 2015) and that anxiety worsens the ED psychopathology (Brand-Gothelf et al., 2014). Given the high comorbidity between ED and anxiety disorders and the fact that both disorders share the same components (evaluative, affective, and somatic; Kaye et al., 2004), the robust relationship between ED and anxiety is not surprising.

Along with the individual role of self-esteem and anxiety in ED symptomatology, several studies have tested the combined role of self-esteem and anxiety on ED. For example, a recent study found that self-esteem (together with mood dysregulation) moderated the association between levels of anxiety/depression and greater deterioration of ED (Sander et al., 2021). In addition, Aloi and Segura-García (2016) found that low self-esteem had an indirect effect on the risk of developing an ED through the mediating action of anxiety.

There is also evidence that anxiety and self-esteem (considered independently) play a relevant mediating role between EI and ED symptoms. For example, prior findings have found that social anxiety mediated the relationship between EI and ED risk (Li, 2018). Thus, Hambrook et al. (2012) found that self-reported anxiety levels mediated the observed relationship between EI and anorexia nervosa (AN).

## Purpose of the Present Research

In sum, there is empirical support for the link between EI, higher self-esteem, and reduced anxiety, as well as between levels of self-esteem and anxiety and ED symptomatology. It has also been pointed out that individuals with higher EI use their ability to maintain a global feeling of self-worth when appropriate and effectively manage a distressed mood when faced with negative events that are considered key in the development of ED symptoms. Hence, the assessment of self-esteem and anxiety as potential mediators in the association between EI and the symptomatology of ED seems to be justified (Hambrook et al., 2012; Li, 2018). However, most of these studies only examined the role of a single mediator in the linkage EI-ED symptomatology and have rarely evaluated effects of the mediators concurrently. Specifically, and to the best of our knowledge, no prior research has examined the cumulative effect of self-esteem and anxiety on the relationship between EI and ED symptomatology. Including these mediators in the serial model would help unveil the underlying mechanisms through which EI influences ED and would also help clinicians and educators to focus on the factors with the most clinical relevance for the prevention and treatment of ED symptomatology. Therefore, the purpose of the present study is 2-fold: first, we sought to examine the relations between EI, self-esteem, anxiety, and ED symptomatology. Second, we sought to determine whether self-esteem and anxiety mediated the relation between EI and ED symptoms in sequence. Since prior studies have found that individuals with higher self-esteem are more likely to have lower levels of anxiety (Sowislo and Orth, 2013), and that self-esteem has an indirect effect on ED risk, as mediated by anxiety (Aloi and Segura-García, 2016), we expected that both mediators might act in this sequence; that is, individuals with high positive cognitions about themselves would have lower levels of anxiety, which in turn would lead them to an amelioration of ED symptomatology. Overall, considering prior research on the significant associations between EI, self-esteem, anxiety and ED symptoms, we developed the following research hypotheses:

**Hypothesis 1.** EI is positively associated with higher self-esteem and negatively linked to anxiety and ED symptoms.
**Hypothesis 2.** (Single mediation). EI predicts higher levels of self-esteem and lower levels of anxiety. These variables, in turn, independently predict lower levels of ED symptomatology.
**Hypothesis 3.** (Sequential mediation). Self-esteem and anxiety might serve as mediators in a sequential mediation model between EI and ED symptoms; that is, EI positively predicts self-esteem, leading to lower levels of anxiety, further decreasing ED symptomatology.

# MATERIALS AND METHODS

## Participants

The study sample consisted of 516 Spanish undergraduate students and community adults (319 females and 197 males) located in Southern Spain. Their ages ranged from 18 to 77 years, with a mean age of 38.89 years ($SD = 14.76$) (see **Table 1**). Given that the prevalence of ED in elderly women (aged 65–94 = 3.25%) has been found to be comparable to young women (Conceição et al., 2017) and that, according to a systematic review, late-life onset ED do continue to occur in the elderly (Lapid et al., 2010), we have not excluded older people from our study.

**TABLE 1** | Sample distribution by age and sex.

| Age intervals | Men | Female | Total |
|---|---|---|---|
| 18–29 | 48 | 129 | 177 |
| 30–39 | 34 | 43 | 77 |
| 40–49 | 35 | 55 | 90 |
| 50–59 | 62 | 79 | 141 |
| 60–69 | 17 | 11 | 28 |
| 70 and older | 1 | 2 | 3 |
| Total | 197 | 319 | 516 |

The educational level in the present sample was as follows: 15 (2.9%) had no formal education, 73 (14.1%) had a primary-level education, 120 (23.3%) had not completed secondary school, 57 (11.0%) had completed secondary school, 186 (36.0%) had completed University Studies, and 65 (12.6%) had post-graduate studies.

The percentage of at-risk participants (i.e., those scoring $\geq 20$ in the EAT-26) was 6.2% (32 out of 516).

## Procedure

University and community participants were solicited using non-probabilistic convenience sampling techniques via an online survey format. A student-recruited sampling methodology was used following guidelines by Wheeler et al. (2014), which allowed us to access a community sample from a University setting. The community participants were recruited with the assistance of students enrolled in a psychology course at university, who were asked to recruit at minimum two adults over the age of 30 through their personal network and then administer the online version of the questionnaires to them. The online survey was designed so that incomplete questionnaires could not be saved, which allowed only the whole completed questionnaires to be received. Student participants earned points for their participation in the study. Before getting to the online survey, participants were informed that the survey was about eating habits and emotions, and that their participation was entirely voluntary. All participants provided written informed consent according to the Declaration of Helsinki. The procedure was approved by the ethics committee of the University of Málaga (104-2020-H). The administration procedure lasted for ∼30 min. The sample was obtained from May 2019 to November 2020. The percentage of participation among students was of 78.28%.

## Instruments

The following well-validated measures were used.

### Wong Law Emotional Intelligence Scale

The Wong Law Emotional Intelligence Scale (WLEIS; Wong and Law, 2002), in its Spanish version (WLEIS-S; Extremera et al.,

2019), was selected as a self-reported ability EI scale based on the theoretical framework of Mayer and Salovey (1997). The WLEIS is a short and cost-free EI measure that consists of 16 items that measure four EI aspects: appraisal of one's own emotions, appraisal of others' emotions, use of emotion, and regulation of emotion, e.g., "I always tell myself I am a competent person." Questions are scored on a 7-point scale ranging from totally disagree to totally agree. Total scores range from 16 to 112. Higher scores indicate a higher level of EI (Extremera et al., 2019). In this study, Cronbach's alpha was 0.91.

### Eating Attitudes Test

The Spanish version of the Eating Attitudes Test (EAT-26; Garner et al., 1982; Rivas et al., 2010) was used as a measure of risk of ED and the presence of disordered eating attitudes. The EAT-26 is a non-clinical self-report 26-item measure; e.g., "feel extremely guilty after eating." It includes three subscales that measure: (1) diet and concern for thinness, (2) bulimia and concern for food, and (3) oral control. Questions are scored on a 6-point scale ranging from "always" scoring 3, "most often" scoring 2, "often" scoring 1, "sometimes" scoring 0, "rarely" scoring 0, and "never" scores as 0. Only one of its items scores reversely. The range of the total score is 0–78. A total score $\geq$ 20 often indicates a risk of ED. A higher score indicates a higher risk of ED. The Spanish version has shown satisfactory reliability (Rivas et al., 2010). Cronbach's alpha was 0.80.

### Rosenberg Self-Esteem Scale

The Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965), in its Spanish version (RSES; Martín-Albo et al., 2007), was selected as a self-reported scale for direct evaluation of global self-esteem. The RSE contains brief statements that reflect general feelings about oneself. It consists of 10 items that are answered on a 4-point Likert scale (from totally agree to totally disagree); e.g., "I wish I could have more respect for myself." For correction, the scores of five of its items must be inverted. The total score ranges from 10 to 40. Scores $\geq$ 30 indicate optimal self-esteem, between 26 and 29 indicate average self-esteem (needs improvement), and scores $\leq$ 25 points indicate significant self-esteem problems (Martín-Albo et al., 2007). Cronbach's alpha was 0.78.

### Depression Anxiety Stress Scales

The self-reported anxiety dimension of the Spanish version of the Depression Anxiety Stress Scale (DASS-21; Lovibond and Lovibond, 1995; Bados et al., 2005) was used. It consists of 7 items with a Likert-type response format with four alternatives, which are ordered on a scale from 0 to 3 points; e.g., "I felt scared without any good reason." The score varies between 0 and 21 points. The recommended cut-off scores for severity labels are: 0–7 = normal; 8–9 = mild; 10–14 = moderate; 15–19 = severe; 20+ = extremely severe. Cronbach's alpha in this study was 0.82.

## Analytical Strategy

After calculating descriptive statistics and computing the bivariate correlation between EI, self-esteem, anxiety, and ED symptoms, the SPSS macro PROCESS (Hayes, 2018) was used to conduct multiple mediation analyses for testing the potential mediating role of self-esteem and anxiety in the linkage between EI-ED symptomatology. A bootstrapping method with 5,000 esteem resamples was used to calculate overall indirect effects and specific indirect effects. The direct and indirect effects are considered to be statistically significant if 95% of the bootstrap confidence intervals do not contain zero. Thus, this procedure enables multiple mediators to be examined and determines the independent effect of each mediator while controlling for the other. Preliminary ANOVA and *t*-tests showed differences according to age and sex, respectively, in ED symptoms, self-esteem and anxiety. Female participants scored significantly higher than males in ED symptoms and anxiety, and lower in self-esteem (all $ps < 0.01$); younger participants scored marginally significantly higher than older ones in ED symptoms and anxiety ($ps < 0.10$) and significantly lower in self-esteem ($p < 0.001$). Therefore, sex and age were entered as covariates to control any potential confounding effects.

# RESULTS

## Descriptive Data and Correlations

Descriptive statistics, response ranges, normative data, reliability coefficients, and correlations among the study variables are presented in **Table 2**. The column "Response ranges" indicates the minimum and maximum possible scores in the questionnaires. The column "Normative data M (SD)" indicates means and standard deviations from normative data. For EI, self-esteem, and anxiety, normative data correspond to the information provided by Spanish adaptations of the questionnaires. For the EAT-26, since the Spanish adaptation of EAT-26 was performed with adolescents, we have included the data from Johnson and Bedford (2004), who employed a Canadian sample comparable to ours (men and women, age range 18–94). As **Table 2** shows, EI was positively correlated to self-esteem and negatively associated to anxiety. As expected, self-esteem was significantly and negatively associated with ED symptoms, while anxiety levels showed significant and positive associations with symptoms of ED. Finally, EI was negative and significantly linked to ED symptomatology.

## Serial Mediational Analysis

We examined whether the relationship between EI and ED symptoms was sequentially mediated by self-esteem and anxiety. Both age and sex were added as control variables. Results of the mediation analyses are presented in **Table 3**.

As shown in **Figure 1**, the three hypothetical mediating effects were supported. First, the specific indirect effects of EI on ED symptoms through self-esteem [EI $\rightarrow$ Self-esteem $\rightarrow$ ED symptoms] were supported (B = −0.09, *SE* = 0.03; 95% CI = −0.15, −0.04). Second, anxiety was found to mediate the association between EI and ED symptoms [EI $\rightarrow$ Anxiety $\rightarrow$ ED symptoms] (B = −0.03, *SE* = 0.01; 95% CI = −0.066, −0.009). Third, the sequential pathway of EI $\rightarrow$ Self-esteem $\rightarrow$ Anxiety $\rightarrow$ ED symptoms, was significant (B = −0.02, *SE* = 0.01; 95% CI = −0.031, −0.005). Accordingly, higher levels of EI were serially associated with higher self-esteem, lower anxiety, and finally lower ED symptoms. Thus, the residual direct pathway between

**TABLE 2 |** Descriptive statistics, response ranges, normative data, reliability, and bivariate correlations.

| | M (*SD*) | Response ranges | Normative data M (SD) | α | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| 1. Emotional intelligence | 5.15 (0.92) | 1–7 | 5.02 (0.96) | 0.91 | | | |
| 2. Anxiety | 3.45 (3.66) | 0–3 | 6.02 (5.61) | 0.82 | −0.33** | | |
| 3. Self-esteem | 29.29 (4.62) | 1–4 | 31.83 (4.23) | 0.78 | 0.51** | −0.34** | |
| 4. Symptoms of eating disorders | 6.24 (7.11) | 0–3 | 7.40 (6.92) | 0.80 | −0.18** | 0.24** | −0.27** |

***p < 0.01.*
*M, Mean; SD, Standard Deviation; α, Cronbach's alpha.*

**TABLE 3 |** Testing the pathways of the serial mediation model.

| | | 95% bias-corrected CI | |
|---|---|---|---|
| **Mediation analysis path** | ***b*** | **Lower** | **Upper** |
| Total effect | −0.16[a] | −1.905 | −0.604 |
| Direct effect | −0.03 | −0.957 | 0.505 |
| Total indirect effect | −0.14[a] | −0.195 | −0.081 |
| EI→Self-esteem→ ED symptoms | −0.09[a] | −0.145 | −0.035 |
| EI→Anxiety →ED symptoms | −0.03[a] | −0.066 | −0.009 |
| EI→Self-esteem→Anxiety→ED symptoms | −0.02[a] | −0.031 | −0.005 |
| Model $F_{(5,\ 510)} = 12.09$; $p < 0.001$; $R = 0.33$; $R^2$ adj = 0.11 | | | |

*All paths were estimated while controlling for age and sex; Standardized regression coefficients shown for each path.*
*EI, Emotional Intelligence; ED, Eating Disorders.*
[a]*Empirical 95% confidence interval does not include zero.*

EI and ED symptoms was no longer significant (b = −0.03, $p = 0.578$). Therefore, self-esteem and anxiety fully mediated the link between EI and ED symptoms. This final serial mediation model was significant, accounting for 11% of the variance in ED symptoms [$R^2$ adj = 0.11; $F_{(5,\ 510)} = 12.08$; $p < 0.001$].

## DISCUSSION

The present study examined whether self-esteem and anxiety, which previous literature confirm as relevant variables related to ED symptomatology, mediated the relationship between EI and ED symptomatology within a Spanish college student and community sample.

The results of path analyses showed that self-esteemand anxiety play a fully sequential mediating role between EI and ED symptomatology, suggesting that EI was positively linked to higher self-esteem and lower anxiety, which in turn predicted lower levels of ED symptoms. The findings support the notion that EI decreases ED symptoms indirectly, suggesting that higher self-esteem and decreased anxiety may be possible underlying mechanisms through which emotional abilities contribute to reducing ED symptoms. These results are consistent with previous studies that found a mediating role for anxiety in the relationship between EI and ED (Hambrook et al., 2012; Li, 2018). Moreover, the serial mediation was also significant, suggesting that EI is associated with greater self-esteem, which subsequently reduces anxiety, thus predicting lower ED symptoms. These findings agree with previous meta-analytic research corroborating the robust effect of negative feelings of self-worth on anxiety (Sowislo and Orth, 2013). Our results are also consistent with past studies showing that anxiety mediates the role of self-esteem on the development of ED symptoms (Aloi and Segura-García, 2016) and contributes to the current literature by extending our understanding of the mechanism that underlies the linkage of EI and ED symptomatology.

The present study extends the understanding of the role of EI, self-esteem, and anxiety on ED symptoms in several ways. It provides further support for researchers who argue that low levels of self-esteem (Silverstone, 1990, 1992; Silvera et al., 1998) and high levels of anxiety (Arnow et al., 1995; Kaye et al., 2004; Levinson and Rodebaugh, 2012; Menatti et al., 2015) are significantly associated with ED symptoms. Our findings reinforce these models by suggesting that deficits in EI might lead to reduced levels of self-esteem and high levels of anxiety, which are associated with higher ED symptoms. Our data also support the transdiagnostic CBT model for ED (Fairburn et al., 2003), which includes mood changes as independent variables that affect ED symptomatology, as well as the suitability of including treatment for emotional abilities and low self-esteem, as did the broad form of enhanced CBT (CBT-Eb; Fairburn et al., 2009). Our results also support the suitability of CEBT (Corstorphine, 2006) for the treatment of ED, as this extended version of CBT incorporates the assessment as well as emotion-management techniques. Accordingly, the findings of this study have theoretical implications, as they suggest that alterations in self-esteem might be partially responsible for the mood changes that trigger dysfunctional eating behaviors (transdiagnostic CBT model; Fairburn et al., 2003). These findings also have practical implications for the prevention and treatment of ED. The inclusion of programs on EI training, self-esteem promotion, and anxiety management in school curricula could minimize the acquisition and maintenance of ED in the child-adolescent population. Likewise, clinicians could incorporate EI training and psychoeducation on how emotions relate to ED symptoms, which could help patients increase their ability to understand and manage their emotional states. Therapists could also include specific strategies for anxiety management along with the other components of CBT-Eb (Fairburn et al., 2009) and CEBT (Corstorphine, 2006). All of this could lead to promising and possibly more effective treatments for both ED patients and those at risk of ED. Even less complex ED interventions focused only on increasing emotional competences would enhance individuals' self-esteem, thereby reducing anxiety symptoms, which in turn would lead to an amelioration of ED symptomatology. Moreover,

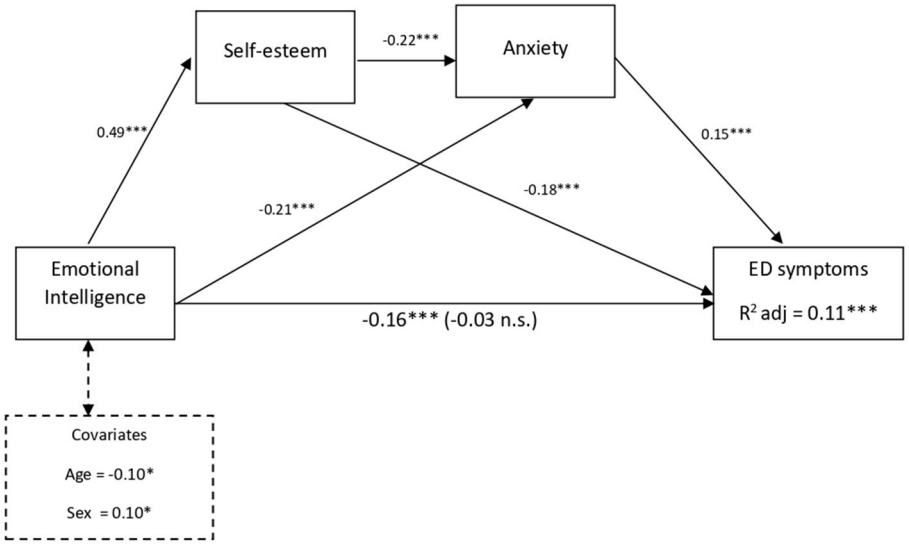


**FIGURE 1 |** Multiple mediation model for the effect of EI and ED symptoms *via* self-esteem and anxiety controlling for age and sex as covariates. Total effect (c-path) is given in parentheses; standardized coefficients; $^{*}p < 0.05$; $^{***}p < 0.001$.

if interventions focused on EI training were reinforced with specific interventions that worked to enhance self-esteem and managing anxiety, the effects of EI on ED symptomatology could be optimized.

The findings of this research should be interpreted in the context of its limitations. Our study used a cross-sectional design, which precludes any causal inference. The order of the variables included in the serial model is based on empirical evidence (Sowislo and Orth, 2013; Aloi and Segura-García, 2016); however, the cross-sectional design of our study precludes causal assumptions. Further research in this area should incorporate longitudinal designs that allow for the study of causal directions between study variables. Also, we used non-clinical and non-representative convenience samples, so it is not possible to generalize these results to clinical samples with diagnoses of ED or to more stratified random samples. Comparing these results with a clinical sample and using cross-validation and random sampling would help confirm whether there are essential differences in the deficits and dynamics of personal resources associated with ED symptoms. Therefore, future studies should incorporate both clinical and non-clinical samples.

Despite its limitations, this research revealed that adults with higher levels of EI (compared to those with low EI) are more likely to have higher levels of self-esteem, which would lead to lower levels of anxiety, which in turn would lead to lower ED symptomatology. These findings open the door to future research concerning the role of emotional competences in ED symptoms; it might be fundamental to consider both levels of self-esteem and anxiety when working with adults who display both deficits in EI and ED symptoms. Also, this research supports the relevance of including training to improve EI skills, foster self-esteem, and reduce anxiety symptoms as a specific treatment for ED or even as additional components of the CBT-Eb.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Research Ethics Committee of the University of Málaga (104-2020-H). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

MP-F, JR-M, and NE created and organized the study. MP-F and JR-M collected the data. MP-F and NE analyzed the data, critically reviewed the manuscript, and provided constructive comments. JR-M wrote the first draft. MP-F wrote the reviewed draft. All authors contributed to the article and approved the submitted version.

## FUNDING

This research has been supported and funded in part by research projects from the University of Málaga and Junta de Andalucía/FEDER (UMA18-FEDERJA-147) and PAIDI Group CTS-1048 (Junta de Andalucía). This work was also supported by the Spanish Ministry of Education and Vocational Training (FPU16/02238).

## REFERENCES


Aloi, M., and Segura-García, C. (2016). Anxiety and depression mediate the role of low self-esteem and low self-directedness in the development of eating disorders. *Int. J. Adolesc. Med. Health*. 31:84. doi: 10.1515/ijamh-20 16-0084

American Psychiatric Association (APA) (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. Washington, DC: American Psychiatric Pub.

Arnow, B., Kenardy, J., and Agras, W. S. (1995). The emotional eating scale: the development of a measure to assess coping with negative affect by eating. *Int. J. Eat. Disord*. 18, 79–90. doi: 10.1002/1098-108X(199507)18:13.0.CO;2-V

Bados, A., Solanas, A., and Andrés, R. (2005). Psychometric properties of the Spanish version of Depression, Anxiety and Stress Scales (DASS). *Psicothema* 17, 679–683.

Bibi, S., Saqlain, S., and Mussawar, B. (2016). Relationship between emotional intelligence and self-esteem among Pakistani University Students. *J. Psychol. Psychother*. 6:279. doi: 10.4172/2161-0487.1000279

Brand-Gothelf, A., Leor, S., Apter, A., and Fennig, S. (2014). The impact of comorbid depressive and anxiety disorders on severity of anorexia nervosa in adolescent girls. *J. Nerv. Ment. Dis.* 202, 759–762. doi: 10.1097/NMD.0000000000000194

Campbell, H. (2012). Managing emotional eating. *Mental Health Pract.* 15:8. doi: 10.7748/mhp2012.05.15.8.34.c9101

Conceição, E. M., Gomes, F. V., Vaz, A. R., Pinto-Bastos, A., and Machado, P. P. (2017). Prevalence of eating disorders and picking/nibbling in elderly women. *Int. J. Eat. Disord.* 50, 793–800. doi: 10.1002/eat.22700

Connor, B., and Slear, S. (2009). Emotional intelligence and anxiety; emotional intelligence and resiliency. *Int. J. Learn.* 16, 249–260. doi: 10.18848/1447-9494/CGP/v16i01/46089

Corstorphine, E. (2006). Cognitive-emotional-behavioural therapy for the eating disorders: working with beliefs about emotions. *Eur. Eat. Disord. Rev*. 14, 448–461. doi: 10.1002/erv.747

Costarelli, V., Demerzi, M., and Stamou, D. (2009). Disordered eating attitudes in relation to body image and emotional intelligence in young women. *J. Hum. Nutr. Diet*. 22, 239–245. doi: 10.1111/j.1365-277X.2009.00949.x

Cuesta, C., González, I., and García, L. M. (2017). The role of trait emotional intelligence in body dissatisfaction and eating disorder symptoms in preadolescents and adolescents. *Pers. Individ. Differ.* 126, 1–6. doi: 10.1016/j.paid.2017.12.021

Extremera, N., Rey, L., and Sánchez-Álvarez, N. (2019). Validation of the Spanish version of the Wong Law Emotional Intelligence Scale (WLEIS-S). *Psicothema* 31, 94–100. doi: 10.7334/psicothema2018.147

Fairburn, C. G., Cooper, Z., Doll, H., O'Connor, M., Bohn, K., Hawker, D., et al. (2009). Transdiagnostic cognitive-behavioral therapy for patients with eating disorders: a two-site trial with 60-week follow-up. *Am. J. Psychiatry* 166, 311–319. doi: 10.1176/appi.ajp.2008.08040608

Fairburn, C. G., Cooper, Z., and Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: a "transdiagnostic" theory and treatment. *Behav. Res. Ther*. 41, 509–528. doi: 10.1016/s0005-7967(02)00088-8

Fernández-Berrocal, P., Alcaide, R., Extremera, N., and Pizarro, D. (2006). The role of emotional intelligence in anxiety and depression among adolescents. *Individ. Differ. Res*. 4, 16–27.

Filaire, E., Larue, J., and Rouvieux, M. (2010). Eating behaviours in relation to emotional intelligence. *Int. J. Sports Med.* 32, 309–315. doi: 10.1055/s-0030-1269913

Fox, J. (2009). A qualitative exploration of the perception of emotions in anorexia nervosa: a basic emotion and developmental perspective. *Clin. Psychol. Psychother*. 16, 276–302. doi: 10.1002/cpp.631

Foye, U., Hazlett, D. E., and Irving, P. (2019). Exploring the role of emotional intelligence on disorder eating. *Eat. Weight Disord.* 24, 299–306. doi: 10.1007/s4051 9-018-0629-4

Galmiche, M., Déchelotte, P., Lambert, G., and Tavolacci, M. P. (2019). Prevalence of eating disorders over the 2000–2018 period: a systematic review literature. *Am. J. Clin. Nutr.* 109, 1402–1413. doi: 10.1093/ajcn/nqy342

Gardner, K. J., Quinton, S., and Qualter, P. (2014). The role of trait and ability emotional intelligence in bulimic symptoms. *Eat. Behav*. 15, 237–240. doi: 10.1016/j.eatbe h.2014.02.002

Garner, D. M., Olmsted, M. P., Bohr, Y., and Garfinkel, P. E. (1982). The eating attitudes test: psychometric features and clinical correlates. *Psychol. Med*. 12, 871–878. doi: 10.1017/s0033291700049163

Giusti, E. M., Manna, C., Scolari, M., Mestre, J. M., Prevendar, T., Castelnuovo, G., et al. (2021). The relationship between emotional intelligence, obesity and eating disorder in children and adolescents: a systematic mapping review. *Int. J. Environ. Res. Public Health*. 18:2054. doi: 10.3390/ijerph18042054

Godart, N. T., Flament, M. F., Perdereau, F., and Jeammet, P. (2002). Comorbidity between eating disorders and anxiety disorders: A review. *Int. J. Eat. Disord.* 2, 253–270. doi: 10.1002/eat.10096

Godart, N. T., Perdereau, F., Rein, Z., Berthoz, S., Wallier, J., Jeammet, P., et al. (2007). Comorbidity studies of eating disorders and mood disorders. Critical review of the literature. *J. Affect. Disord.* 97, 37–49. doi: 10.1016/j.jad.2006.06.023

Hambrook, D., Brown, G., and Tchanturia, K. (2012). Emotional intelligence in anorexia nervosa: is anxiety a missing piece of the puzzle? *Psych. Res*. 200, 12–19. doi: 10.1016/j.psych res.2012.05.017

Hasanvand, B., and Khaledian, M. (2012). The relationship of emotional intelligence with self-esteem and academic progress. *Int. J. Psychol. Behav. Sci.* 2, 231–236. doi: 10.5923/j.ijpbs.20120206.06

Hayes,. A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis Second Edition: A Regression-Based Approach*. New York, NY: The Guilford Press

Haynos, A. F., and Fruzzetti, A. E. (2011). Anorexia nervosa as a disorder of emotion dysregulation: evidence and treatment implications. *Clin. Psychol. Sci. Pract.* 18, 183–202. doi: 10.1111/j.1468-2850.2011.01250.x

Johnson, C. S., and Bedford, J. (2004). Eating attitudes across age and gender groups: a Canadian study. *Eat Weight Disord.* 9, 16–23.

Kaye, W. H., Bulik, C. M., Thornton, L., Barbarich, N., and Masters, K. (2004). Comorbidity of anxiety disorders with anorexia and bulimia nervosa. *Am. J. Psychiatry* 161, 2215–2221. doi: 10.1176/appi.ajp.161.12.2215

Koch, A., and Pollatos, O. (2015). Reduced facial emotion recognition in overweight and obese children. *J. Psychosomat. Res*. 79, 635–639. doi: 10.1016/j.jpsychores.2015.06.005

Kotsou, I., Mikolajczak, M., Heeren, A., Grégoire, J., and Leys, C. (2018). Improving emotional intelligence: a systematic review of existing workand future challenges. *Emotion Rev.* 11, 151–165. doi: 10.1177/17540739177 35902

Kousha, M., Bagheri, H. A., and Heydarzadeh, A. (2018). Emotional intelligence and anxiety, stress, and depression in Iranian resident physicians. *J. Family Med. Prim. Care.* 7, 420–424. doi: 10.4103/jfmpc.jfmpc_154_17

Lapid, M. I., Prom, M. C., Burton, M. C., McAlpine, D. E., Sutor, B., and Rummans, T. A. (2010). Eating disorders in the elderly. *Int. Psychogeriatr.* 22:523. doi: 10.1017/S1041610210000104

Lavender, J., Wonderlich, S., Engel, S., Gordon, K., Kaye, W., and Mitchell, J. (2015). Dimensions of emotion dysregulation in anorexia nervosa and bulimia nervosa: A conceptual review of the empirical literature. *Clin Psychol Rev*. 40, 111–122. doi: 10.1016/j.cpr.2015.05.010

Levinson, C. A., and Rodebaugh, T. L. (2012). Social anxiety and eating disorder comorbidity: The role of negative social evaluation fears. *Eat. Behav*. 13, 27–35. doi: 10.1016/j.eatbeh.2011.11.006

Li,. Y. (2018). Social anxiety and eating disorder risk among Chinese adolescents: the role of emotional intelligence. *Sch. Ment. Health*. 10, 264–274. doi: 10.1007/s12310-018-9257-4

Lovibond, P. F., and Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck. Depression and anxiety inventories. *Behav. Res. Ther.* 33, 335–343. doi: 10.1016/0005-7967(94)00075-u

Martín-Albo, J., Núñez, J. L., Navarro, J. G., and Grijalvo, F. (2007). The rosenberg self-esteem scale: translation and validation in University students. *Span. J. Psychol.* 10, 458–467. doi: 10.1017/S1138741600006727

Mayer, J. D., Caruso, D. R., and Salovey, P. (2016). The ability model of emotional intelligence: principles and updates. *Emot. Rev.* 8, 290–300. doi: 10.1177/1754073916639667

Mayer, J. D., and Salovey, P. (1997). "What is emotional intelligence?" in *Emotional Development and Emotional Intelligence: Implications for Educators*, eds P. Salovey and D. Sluyter (New York, NY: Basic Books).

Mayer, J. D., Salovey, P., and Caruso, D. (2000). "Models of emotional intelligence," in *Handbook of Intelligence*, ed R. J. Sternberg (New York, NY: Cambridge).

Menatti, A. R., Hopkins, L. B., DeBoer, L., Weeks, J. W., and Heimberg, R. G. (2015). Social anxiety and associations with eating psychopathology: mediating effects of fears of evaluation. *Body Image* 14, 20–28. doi: 10.1016/j.bodyim.2015.02.003

National Institute for Clinical Excellence (NICE) (2004). *Eating Disorders—Core Interventions in the Treatment and Management of anoreXia Nervosa, Bulimia Nervosa and Related Eating Disorders*. Available online at: http://www.nice.org.uk (accessed October 9, 2009).

Peres,. V., Corcos, M., Robin, M., and Pham-Scottez, A. (2018). Emotional intelligence, empathy and alexithymia in anorexia nervosa during adolescence. *Eat. Weight Disord.* 25, 1–8. doi: 10.1007/s4051 9-018-0482-5

Pettit, M. L., Jacobs, S. C., Page, K. S., and Porras, C. V. (2009). An assessment of perceived emotional intelligence and eating attitudes among college students. *Am. J. Health Educ*. 41, 46–52. doi: 10.1080/19325 037.2010.10599126

Polivy, J., and Herman, C. P. (1993). *Etiology of Binge Eating: Psychological Mechanisms*. London: Guilford Press.

Rivas, T., Bersabé, R., Jiménez, M., and Berrocal, C. (2010). The Eating Attitudes Test (EAT-26): reliability and validity in Spanish female samples. *Span. J. Psychol*. 13, 1044–1056. doi: 10.1017/S1138741600002687

Romero-Mesa, J., Peláez-Fernández, M. A., and Extremera, N. (2020). Emotional intelligence and eating disorders: a systematic review. *Eat. Weight Disord.* 26, 1287–1301. doi: 10.1007/s40519-020-00968-7

Rosenberg, M. (1965). *Society and the Adolescent Self-Image*. Princeton, NJ: Princeton University Press

Rowsell, M., MacDonald, D. E., and Carter, J. C. (2016). Emotion regulation difficulties in anorexia nervosa: associations with improvements in eating psychopathology. *J. Eat. Disord*. 4:17. doi: 10.1186/s40337-016-0108-0

Sander, J., Moessner, M., and Bauer, S. (2021). Depression, anxiety and eating disorder-related impairment: moderators in female adolescents and young adults. *Int. J. Environ. Res. Public Health* 18:2779. doi: 10.3390/ijerph180 52779

Silvera, D. H., Bergersen, T. D., Bjørgum, L., Perry, J. A., Rosenvinge, J. H., and Holte, A. (1998). Analyzing the relation between self-esteem and eating disorders: differential effects of self-liking and self-competence. *Eat. Weight Disord*. 3, 95–99. doi: 10.1007/BF03339995

Silverstone, P. H. (1990). Low self-esteem in eating disordered patients in the absence of depression. *Psychol. Rep*. 67, 276–278. doi: 10.2466/pr0.1990.67.1.276

Silverstone, P. H. (1992). Is chronic low self-esteem the cause of eating disorders? *Med. Hypotheses*. 39, 311–315. doi: 10.1016/0306-9877(92)90054-g

Sowislo, J. F., and Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychol. Bull* 139:213. doi: 10.1037/a0028931

Stice, E. (2002). Risk and maintenance factors for eating pathology: A meta-analytic review. *Psychol. Bull.* 128, 825–848. doi: 10.1037/0033-2909.128.5.825

Wheeler, A. R., Shanine, K. K., Leon, M. R., and Whitman, M. V. (2014). Student-recruited samples in organizational research: A review, analysis, and guidelines for future research. *J. Occup. Organ. Psychol.* 87, 1–26. doi: 10.1111/joop.12042

Wilson, G. T. (2005). Psychological treatment of eating disorders. *Annu. Rev. Clin. Psychol.* 1, 439–465. doi: 10.1097/YCO.0b013e328365a30e

Wong, C. S., and Law, K. S. (2002). The effects of leader and follower emotional intelligence on performance and attitude: An exploratory study. *Leadersh. Q.* 13, 243–274. doi: 10.1016/ S1048-9843(02)00099-1

Zavala, M. A., and López, I. (2012). Adolescentes en situación de riesgo psicosocial? 'Qué papel juega la inteligencia emocional? *Behav. Psychol.* 20, 59–75.

Zysberg, L. (2013). Emotional intelligence, personality, and gender as factors in disordered eating patterns. *J. Health Psychol*. 19, 1035–1042. doi: 10.1177/135910531348315

Zysberg, L., and Rubanov, A. (2010). Emotional intelligence and emotional eating patterns: a new insight into the antecedents of eating disorders? *J. Nutr. Educ. Behav*. 42, 345–348. doi: 10.1016/j.jneb.2009.08.009

Zysberg, L., and Tell, E. (2013). Emotional intelligence, perceived control, and eating disorders. *SAGE Open* 3, 1–7. doi: 10.1177/215824401350028

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

BRIEF RESEARCH REPORT
published: 23 August 2021
doi: 10.3389/fpsyg.2021.723732

# The Role of Negative Affect in Emotional Processing of Food-Related Images in Eating Disorders and Obesity

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The aim of the present study was to analyze differences in the emotional processing (valence, arousal, and dominance) of food-related information in patients with eating disorders (ED), patients with obesity, and healthy women. Moreover, the mediator role of negative affect and the moderating role of the diagnostic group (ED vs. non-ED) were analyzed. Method: The sample consisted of 94 women (39 with eating disorders, 19 with obesity, and 36 healthy participants). Measures: International Affective Picture System (IAPS) food picture exposure task; Self-Assessment Manikin Analog-Visual Scale (SAM) appraising Arousal, Valence, and Dominance; Eating Attitudes Test (EAT-26); Positive and Negative Affect Schedule (PANAS). Results: Patients with purging symptomatology rated food images as more unpleasant than healthy women. Patients with purging and restrictive eating symptomatology showed higher levels of arousal and less dominance over the emotions experienced, compared to patients with obesity and healthy women. The mediation analysis showed that negative affect mediated the relationship between eating symptomatology (EAT-26) and the Valence of food images, as well as the control over the emotions experienced when viewing food images (Dominance). For the moderation analysis participants were regrouped into two groups (ED patients vs. non-ED patients). The direct relationship between eating symptomatology and food image valence was moderated by the diagnostic group. However, the group did not moderate the direct relationship between the EAT-26 and dominance over experienced emotions, or the indirect effect on eating symptomatology through negative affect. These results show the relevance of negative affect in the emotional processing of food-related information, and they support an eating disorder-disordered eating dimensional perspective.

**Keywords: eating disorders, obesity, emotional processing, food-related images, negative affect**

OPEN ACCESS

***Edited by:***
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***Reviewed by:***
*Eva Pereda-Pereda, University of the Basque Country, Spain*
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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *11 June 2021*
***Accepted:*** *29 July 2021*
***Published:*** *23 August 2021*

***Citation:***
*Sierra I, Senín-Calderón C, Roncero M and Perpiñá C (2021) The Role of Negative Affect in Emotional Processing of Food-Related Images in Eating Disorders and Obesity. Front. Psychol. 12:723732. doi: 10.3389/fpsyg.2021.723732*

## INTRODUCTION

Eating Disorders (ED) and obesity share multiple biological and environmental risk factors (Haines et al., 2010), and they are associated with maladaptive eating styles, such as restrained eating (i.e., dieting intentions) or emotional eating (Baños et al., 2014), which may be relevant in their development and maintenance (Krug et al., 2013). Moreover, ED and obesity can occur

simultaneously or increase in severity over time (da Luz et al., 2018). Individuals with either of these two conditions present altered functioning patterns, including unhealthy behaviors to lose weight or maintain the lost weight (Krug et al., 2013; Segura-Serralta et al., 2020). In this regard, these disorders have increasingly been considered two poles on the same continuum of problems related to eating and weight (Perpiñá and Roncero, 2016; Segura-Serralta et al., 2020). Recent research on the difficulties in their treatment outcomes highlights the role of cognitive, neuropsychological, and emotional factors. Individuals with weight- and eating-related problems show impaired cognitive flexibility and decision-making abilities (Fagundo et al., 2012; Segura-Serralta et al., 2019). The biases in these executive functions are characterized by making decisions based on the short-term consequences (e.g., relief of anxiety), despite long-term negative consequences, and by not learning from previous decisions to modify current behavior (Brogan et al., 2010; Aloi et al., 2015; Perpiñá and Roncero, 2016). In sum, the disorders on the continuum of weight-related problems show a tendency toward decision-making based on immediate rewards (Davis et al., 2010; Aloi et al., 2015; Mallorquí-Bagué et al., 2016).

From an evolutionary standpoint, food is a universally rewarding stimulus that is important for survival (Toepel et al., 2009). Images of food capture the attention (Nummenmaa et al., 2011; Cunningham and Egeth, 2018) and are prioritized during the neural processing (Meule et al., 2013), activating brain areas related to reward, salience, and cognitive control (Dagher, 2012; Tang et al., 2012; Spence et al., 2016). However, food stimuli can be especially rewarding for people with eating symptomatology (Bodell and Keel, 2015; Simon et al., 2016), and they can produce an increase in avoidance behaviors of food-related stimuli (Soussignan et al., 2010; Erdur et al., 2017). On the one hand, patients with binge-eating symptomatology rate food as more enjoyable (Drobes et al., 2001), interesting, exciting (Mauler et al., 2006), and appetizing, favoring food de-inhibition (Carter et al., 2006). However, in turn, these patients rate food stimuli as more aversive and fearful than neutral stimuli (Mauler et al., 2006), due to concerns about the effects of eating on their weight and figure (Giel et al., 2011a), thus favoring dietary restraint. These ambivalent (approach-avoidance) responses to food may indicate that food is processed as a threat to the achievement or maintenance of the ideal of beauty and thinness, apart from being a highly appetitive stimulus (Boutelle et al., 2017). On the other hand, restrictive patients value food more negatively, which increases their anxiety and fear (Giel et al., 2011b), makes them less sensitive to the hedonic and motivational components of food (Racine et al., 2018), and supports their ability to endure long periods of fasting (Friederich et al., 2013). Finally, patients with obesity show increased reactivity to food stimuli (Boswell and Kober, 2016). Taken together, these studies lead to considering negative affect (NA) as an important explanatory factor for biases in the emotional processing of food-related information in patients with ED and weight problems. NA has been postulated as a factor that increases the probability of suffering from eating symptomatology or altered eating (Stice, 2002). The theoretical approach of the affect regulation model (Haedt-Matt and Keel, 2011) indicates that there is a causal relationship between NA and overeating, primarily in restrictive and purgative patients (Tice et al., 2001; Cardi et al., 2015). Similarly, patients with obesity use food as an emotion regulation and stress coping mechanism (Leehr et al., 2015).

Currently, few studies provide data on the differential emotional processing of food images between patients with ED and patients with obesity, taking into account the role that NA may play in this processing. Knowing the similarities and differences of this emotional processing in ED and obesity may provide significant data that can improve the understanding of the commonalities between them, which in turn will help in their therapeutic approach. Thus, the main aim of the present study was to analyze differences in the emotional processing (valence, arousal, and dominance) of food-related information in patients with ED, patients with obesity, and healthy women. The second aim was to study the relationship between eating symptomatology and emotional processing of food-related information, analyzing the mediator role of NA. Finally, the third aim was to analyze whether the diagnostic group (ED vs. non-ED) moderates the indirect effect between the eating symptomatology through negative affect, and whether the group moderates the direct effect between eating symptomatology and emotional processing (see **Figure 1**).

# METHODS

## Participants and Procedure

The sample consisted of 94 female participants, 39 with a diagnosis of ED, 19 with obesity, and 36 healthy women. In order to simplify the analysis of the composition of the patient groups, and in accordance with the studies carried out so far to find differences between restrictive symptomatology and binge-purge symptomatology, the sample was regrouped according to the symptomatology. Thus, the clinical sample was classified into three groups: restrictive group, formed by patients with restrictive anorexia nervosa or unspecified eating disorder-anorexia nervosa (mean age = 23.48; $SD$ = 9.27; $n$ = 21); the binge-purge group was formed by patients with purgative anorexia nervosa, purgative bulimia nervosa, or unspecified eating disorder-bulimia nervosa (mean age = 25.50; $SD$ = 9.11; $n$ = 18); and the obesity group consisted of women with a BMI > 30 (mean age = 46.68; $SD$ = 13.44; $n$ = 19). The healthy comparison group consisted of women without any mental disorder and a normative weight (BMI = 20–25) (mean age = 30.11; $SD$ = 12.34; $n$ = 36).

The clinical sample for this study was recruited in three hospitals in the Valencian Community (Spain). The control group was recruited in postgraduate courses at the University of Valencia. To be included in the study, patients with ED could not present psychotic comorbidity or substance abuse, and patients with obesity could not meet the criteria for binge-eating disorder or another mental disorder. The assessment was carried out in two individual sessions. In the first session, the inclusion and exclusion criteria were checked, and the selected International Affective Picture System (IAPS) images were shown to the participants on a laptop computer via the E-PRIME software for stimulus presentation. The study received the

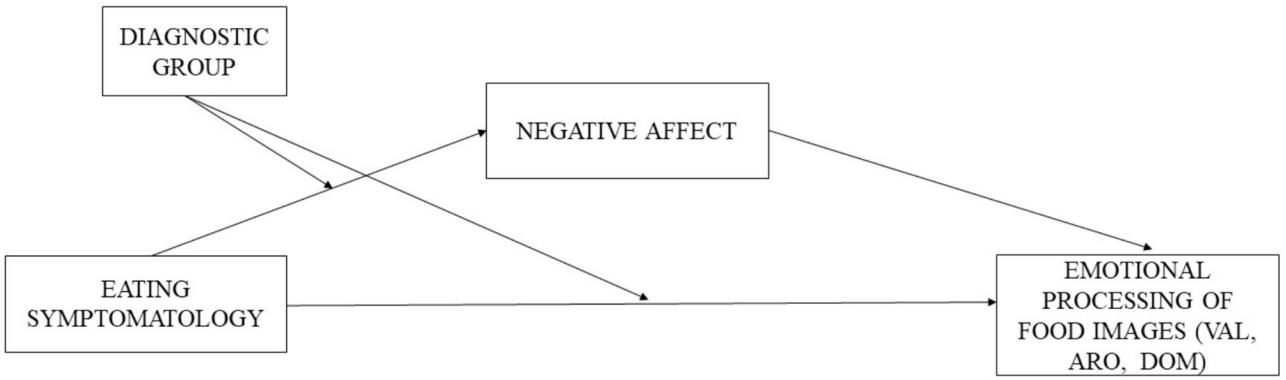


**FIGURE 1 |** Mediation model with group moderation (ED patients vs. non-ED patients) between the direct effect of eating symptomatology on emotional processing of food images (valence, arousal, and dominance) and between the indirect effect through negative affect. VAL, Valence; ARO, Arousal; DOM, Dominance.

approval of the ethics committees of the University of Valencia (H1409824786250) and of each hospital from the National Health System involved in the project. There was no compensation (e.g., economic or course credit) for participating in the study.

## Measures

### International Affective Picture System

Nine food images (no 2299, no 2702, no 2736, no 6250.2, no 7281, no 7285, no 7410, no 7450 and no 7480) were selected from the International Affective Picture System (IAPS; Lang et al., 2008).

### Self-Assessment Manikin

We used the Spanish adaptation (Moltó et al., 2013), with a 9-point Likert-type response scale to measure the emotional response in three dimensions rating IAPS images: affective Valence, Dominance, and Arousal. The Spanish adaptation has shown good test-retest reliability: 0.99 for affective valence, 0.97 for dominance, and 0.96 for arousal ($p \leq 0.0001$) (Lang, 1980; Moltó et al., 2013), and a good level of agreement in the three dimensions (Cohen's Kappas of 0.87, 0.86, and 0.75, respectively; $p \leq 0.0001$).

### Eating Attitudes Test

Self-report questionnaire that assesses attitudes toward food and eating symptomatology through 26 items rated on a 6-point Likert-type scale classified as 0 (never, rarely, sometimes), 1 (often), 2 (almost always), or 3 (always). The items are grouped into three factors: dieting or food restriction, bulimic behavior, and preoccupation with food and oral control (Garner and Garfinkel, 1979). The Spanish version adapted by Castro et al. (1991) was used. The internal consistency (Cronbach's α) for the sample in this study was 0.94 for the total scale.

### Positive and Negative Affect Schedule

Self-report measure that assesses positive and negative affect and is composed of 20 Likert-type items with responses ranging from "not at all" to "extremely" (Watson et al., 1988). The PANAS-PA assesses the ability to engage in pleasant activities, and the PANAS-NA assesses the presence of self-perceived distress. For the present study, the Spanish version by Sandín et al. (1999) was used, employing only the 10 items from the Negative Affect factor (e.g., sad, nervous, or upset). The internal consistency (Cronbach's α) for the sample in this study was 0.93.

## Data Analyses

Spearman correlations were performed between the variables in the proposed model. Then, a Kruskal–Wallis test was conducted between the groups (ED patients with restrictive and purging symptomatology, obesity, and healthy women) on the IAPS scores. Next, using the PROCESS macro for SPSS (Hayes, 2013), three mediation analyses (Model 4, Hayes, 2013) were performed with the whole sample, taking the total score on the EAT-26 as the predictor and the IAPS score (valence, dominance, and arousal) through negative affect (NA) as the mediator. Subsequently, a moderated mediation analysis (Model 8, Hayes, 2013) was performed where the group variable was included as a moderating variable in the relationship between the EAT-26 and the score on the IAPS, and in the relationship between the EAT-26 and negative affect. Indirect effects were calculated using the bootstrapping procedure with 10,000 subsamples. The indirect pathway is significant when the 95% CI does not include the value 0, and so it can be stated that mediation exists.

# RESULTS

## Preliminary Analysis

The associations between the variables studied were analyzed. Positive and statistically significant relationships were found between the total score on the EAT-26 and PANAS-NA ($r = 0.570$), as well as with emotional arousal (IAPS-Arousal) toward food-related images ($r = 0.210$). However, the association was statistically significant and negative between the EAT-26 and the appraisal (IAPS-Valence) of food images ($r = -0.349$), as well as the experienced degree of control over the elicited emotion (IAPS-Dominance) ($r = -0.483$).

## Between-Group Mean Comparisons of the Emotional Response to Food-Related Stimuli

A Kruskal–Wallis test was performed among the four groups of participants (patients with purgative symptomatology, patients with restrictive symptomatology, patients with obesity, and healthy women) on the emotional processing of food-related images. Statistically significant differences were observed for IAPS-Arousal and IAPS-Dominance, and a trend was observed for IAPS-Valence (see **Table 1**). Specifically, patients with purgative eating symptomatology rated food images more unpleasantly than controls. In addition, patients with purgative and restrictive eating pathology differed from patients with obesity and controls in that they reported a higher level of arousal when visualizing food images. Patients with restrictive eating pathology also differed from the healthy women in IAPS-Dominance. Moreover, patients with purging symptomatology differed from the patients with obesity and healthy women in IAPS-Dominance.

## Mediation Analysis

The results showed that the relationship between the eating psychopathology (EAT-26) and the rating of the food images (IAPS-Valence) was statistically significant across PANAS-NA, resulting in full mediation (completely standardized indirect effect= −0.20; 95% CI [−0.34, −0.08]). In the same way, a full mediation effect was also found between the EAT-26 and the control of emotions experienced when visualizing food images (IAPS-Dominance) through PANAS-NA (completely standardized indirect effect = −0.29; 95% CI [−0.44, −0.17]). Finally, there was no mediation effect in the relationship between the EAT-26 and IAPS-Arousal through PANAS-NA (completely standardized indirect effect = −0.03; 95% CI [−0.09, 0.16]. The results of the three mediation analyses are presented in **Table 2**.

## Moderated Mediation Analysis

On the Kruskal–Wallis test, differences were found between ED patients and non-ED patients on the IAPS dimensions. Therefore, the diagnostic group variable (ED patients vs. non-ED patients) was taken as a moderator of the direct effect between the EAT-26 and emotional processing (Valence and Dominance) and as a moderator of the indirect effect between these two variables through PANAS-NA. The group variable moderated the direct relationship between the EAT-26 and IAPS-Valence (conditional direct effect for ED patients vs. non-ED patients: $\beta = -0.03$, $SE = 0.01$, *95% CI* [−0.05, −0.01]; non-ED patients: $\beta = 0.01$, $SE = 0.02$, *95% CI* [−0.04, 0.06]) (see **Figure 2**), but it did not moderate the indirect effect (index of Moderated Mediation = −0.01, $SE = 0.01$, *95% CI* [−0.02, 0.01]). With regard to the direct relationship between the EAT-26 and IAPS-Dominance, there was no moderation effect of the group variable (conditional direct effect for ED patients: $\beta = -0.01$, $SE = 0.01$, *95% CI* [−0.03,

**TABLE 2 |** Regression coefficients and summary of the three mediation models.

| Variables | $B^a$ | *SE* | *t* | *CI 95%* | $R^2$ |
|---|---|---|---|---|---|
| Criterion: IAPS-Valence (*Y*) | | | | | 0.26 |
| PANAS-Negative affect (*M*) | −0.35 | 0.02 | −3.10* | [−0.08, −0.02] | |
| EAT-26 (*X*) | −0.22 | 0.01 | −1.98 | [−0.04, 0.01] | |
| Criterion: IAPS-Dominance (*Y*) | | | | | 0.37 |
| PANAS-Negative affect (*M*) | −0.50 | 0.02 | −4.83** | [−0.12, −0.05] | |
| EAT-26 (*X*) | −0.16 | 0.01 | −1.54 | [−0.04, 0.01] | |
| Criterion: IAPS-Arousal (*Y*) | | | | | 0.11 |
| PANAS-Negative affect (*M*) | 0.05 | 0.02 | 0.40 | [−0.03, 0.05] | |
| EAT-26 (*X*) | 0.30 | 0.01 | 2.41* | [0.01, 0.05] | |

*X, Predictor variable; Y, Criterion variable; M, Mediator variable. **p < 0.01, *p < 0.05.*
[a] *Standardized coefficients.*

**TABLE 1 |** Kruskal–Wallis test between membership groups on emotional processing score.

| IAPS | *n* | *M* | (*SD*) | *H* | *df* | *p* | *Post hoc* Dunnett (Cohen's *d*) |
|---|---|---|---|---|---|---|---|
| **Valence** | | | | | | | |
| (1) ED restrictive | 21 | 5.48 | 1.57 | 7.66 | 3 | 0.05 | – |
| (2) ED purgative | 18 | 5.02 | 2.27 | | | | 2 < 4 (0.89) |
| (3) Obesity | 19 | 5.91 | 1.00 | | | | – |
| (4) Healthy women | 36 | 6.39 | 1.02 | | | | – |
| **Arousal** | | | | | | | |
| (1) ED restrictive | 21 | 5.69 | 1.36 | 18.59 | 3 | <0.001 | 1 > 3 (0.80), 1 > 4 (0.94) |
| (2) ED purgative | 18 | 5.88 | 1.23 | | | | 2 > 3 (0.94), 2 > 4 (1.11) |
| (3) Obesity | 19 | 4.39 | 1.87 | | | | 3 < 1, 3 < 2 |
| (4) Healthy women | 36 | 4.38 | 1.40 | | | | 4 < 1, 4 < 2 |
| **Dominance** | | | | | | | |
| (1) ED restrictive | 21 | 4.78 | 1.79 | 29.03 | 3 | <0.001 | 1 < 4 (0.94) |
| (2) ED purgative | 18 | 3.74 | 1.31 | | | | 2 < 3 (1.51), 2 < 4 (1.78) |
| (3) Obesity | 19 | 5.90 | 1.53 | | | | 3 > 2 |
| (4) Healthy women | 36 | 5.37 | 1.44 | | | | 4 > 1, 4 > 2 |

*IAPS, International Affective Picture System; ED, eating disorders.*

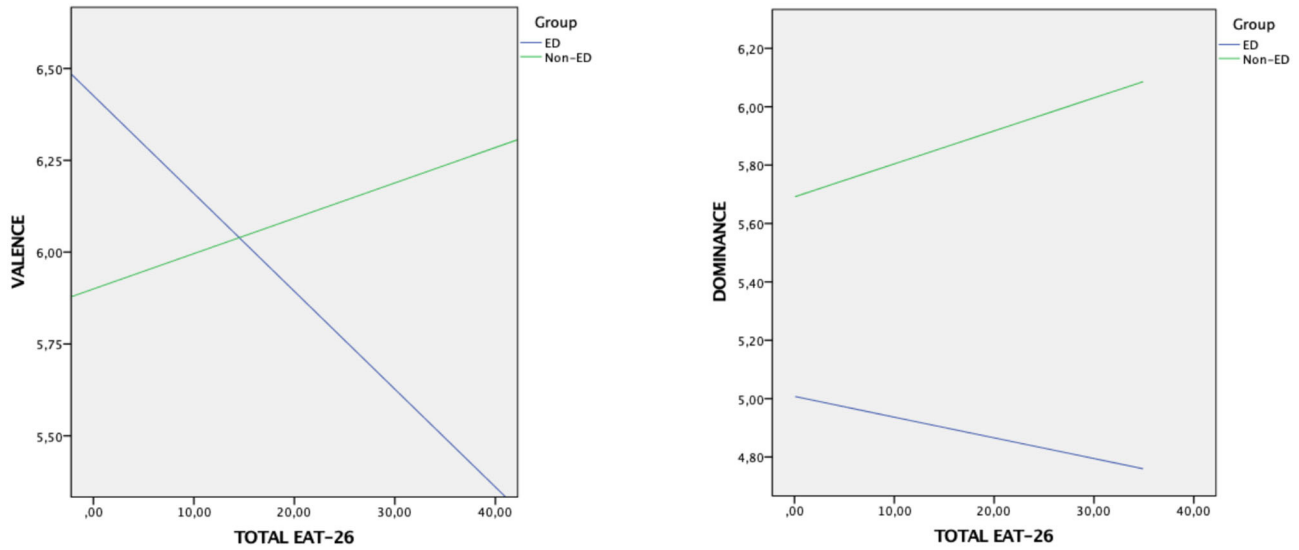


**FIGURE 2 |** Interaction effect of the moderator variable group on the emotional processing of food images (Valence, Dominance) according to the EAT-26 score.

0.02]; non-ED patients: $\beta = 0.01$, $SE = 0.03$, *95% CI* [−0.04, 0.06]) (see **Figure 2**), and no moderation effect between the EAT-26 and PANAS-NA (moderated mediation index: $\beta = -0.02$, $SE = 0.02$, *95% CI* [−0.03, 0.01]).

## DISCUSSION

The main purpose of this study was to analyze the differences in the emotional processing of food-related information in patients with ED, patients with obesity, and healthy women. We found that ED patients presented more dysfunctional emotional processing of food information, experiencing greater arousal (Arousal), less control over their emotions (Dominance), and less attraction to food images (Valence). Overall, these data are consistent with studies showing that ED patients present avoidance reactions to food (Erdur et al., 2017), react with fear and anxiety to these stimuli (Friederich et al., 2006, 2013; Giel et al., 2011b; Steinglass et al., 2012), and rate them as aversive and fearful (Mauler et al., 2006). However, our data differ from other studies reporting that these patients (compared to healthy participants) rate food as more rewarding (Bodell and Keel, 2015; Leehr et al., 2016; Simon et al., 2016), enjoyable (Drobes et al., 2001), and appetizing (Mauler et al., 2006). This ambivalence toward food could be explained by the existence of an approach-avoidance motivational conflict in people with ED (Wilson et al., 2020). Regarding the Valence, our results indicate that patients with binge-purge symptomatology explicitly rate the images as less pleasurable (Racine et al., 2018). These results, in general terms, are in line with those found by previous research indicating that, in these patients, the basic motivational value of food might change (Racine et al., 2018). In addition, patients with binge-purge symptomatology would be more emotionally affected, presenting a high emotional intolerance that leads them to ingest large amounts of food in response to negative emotions (van Strien et al., 2013). Therefore, it is understandable that information related to food, both through images and direct experiences, would produce a loss of dominance, security, or control over the emotions they experience.

Regarding the group of people with obesity, our results indicate that their emotional processing would lie at an intermediate point between patients with ED and healthy women, showing some similarities with both groups. In reality, the presence of particular characteristics in the processing of food-related information has been studied less in obesity than in ED (Castellanos et al., 2009). Nevertheless, studies carried out to date point out that generalized exposure to food stimuli increases physiological reactivity in patients with obesity, influencing their eating behavior and weight gain (Boswell and Kober, 2016). Our results support models based on a transdiagnostic view of disordered eating and ED, validating the entire spectrum of EDs and including obesity (Aloi et al., 2015). Hence, ED and eating problems would be found on the same continuum, with similar difficulties and impairments, making it possible to use similar treatments for both EDs and obesity (Segura-Serralta et al., 2020).

In relation to the second objective, NA mediated the relationship between eating symptomatology (EAT-26) and the emotional processing of food images in terms of Dominance and Valence. However, our results show that, in the relationship between eating symptomatology and Arousal, NA does not seem to play a role. These data are related to a large number of studies indicating that NA predicts the occurrence of ED (Jacobi et al., 2011; Michopoulos et al., 2015; Vannucci et al., 2015), and they support the causal relationship between NA and eating symptomatology, mainly in restrictive and binge-purge patients (Cardi et al., 2015). In a study by Ciscar et al. (2019), the authors observed that all the clinical groups (restrictive patients, binge-purge patients, and patients with obesity) were characterized

by high NA and low positive affect. Studies indicate that NA and less cognitive control lead to restrictive or binge eating as a regulatory strategy in the presence of negative emotions (Macht, 2008; Mallorquí-Bagué et al., 2017). In fact, patients with binge-purge symptomatology present higher rates of binge eating and purging on situations characterized by higher NA (Crosby et al., 2009). Something similar occurs in restrictive patients, who seem to show an association between restriction and NA (Engel et al., 2005; Lavender et al., 2016). This makes sense based on the theoretical approaches of the affect regulation model (Haedt-Matt and Keel, 2011), which postulates that NA triggers emotional eating and, at the same time, eating symptomatology is reinforced by the feeling of control over hunger or relief from NA (O'Hara et al., 2015). In patients with obesity, research indicates that obesity is related to the presence of higher NA (Pasco et al., 2013). Loeber et al. (2018) investigated deficits in inhibition of the eating response to food and non-food stimuli in women with obesity. They observed that NA triggered loss of control, concluding that emotional self-control foundered when the women experienced NA (Heatherton and Wagner, 2011; Chester et al., 2016), and that food was used as a strategy to regulate their emotions and cope with stress (Devlin, 2007).

Third, we analyzed whether this relationship between eating symptomatology and NA is moderated by the diagnostic group (ED vs. non-ED). Our results indicate that having a diagnosis of ED influences the assessment of the images, depending on the severity of the eating symptomatology present. That is, patients with greater eating symptomatology gave a worse rating to the food images, but this was not the case in the group of non-patients. Moreover, the relationship between eating symptomatology and NA was not moderated by the diagnostic group, so that this relationship does not depend on the presence of an ED diagnosis. These data seem to point to a dimensional continuum for the relationship between eating symptomatology and negative affect, which is consistent with studies conducted with non-clinical samples showing that participants without ED ate more after experiencing NA (Macht, 2008). Similarly, eating in response to negative emotions is not exclusive to ED and eating problems; populations with depression (Dingemans et al., 2015), anxiety (Dalrymple et al., 2018), and fatigue (Constant et al., 2018) have been observed to use food as an emotional regulation strategy. It appears that people who show a strong sensitivity to food cues along with low emotional control are more likely to overeat (Nederkoorn et al., 2010; Lawrence et al., 2012).

In summary, our results indicate, first, that ED patients have a different emotional processing of food-relevant information compared to healthy women. Their emotional processing is characterized by more negative appraisals, less emotional dominance, and a higher level of arousal, whereas patients with obesity would be in an intermediate position, showing similarities with both ED and healthy women. Second, the results show that NA has a mediator role between eating symptomatology and emotional processing, negatively affecting the appraisal of food stimuli and producing less dominance over the emotions they produce. Third and finally, the ED diagnosis has a decisive influence on the negative appraisal of food images, but the effect of NA on the relationship between eating symptomatology and Valence and Dominance does not depend on the diagnosis.

This study has several limitations. First, it is a cross-sectional study with a proposed tentative model that does not allow us to draw causal inferences. In addition, the groups only contain women because a large percentage of ED patients are women. Moreover, based on our results, it would be interesting to analyze the differences in the emotional processing of food stimuli between patients who are in the recovery phase and those who are not, including some variables that were not controlled, such as the duration of the disease and levels of depression and alexithymia. Future studies should replicate the present analysis with a larger sample of patients with restrictive and purging eating disorders subtypes. Nevertheless, to our knowledge, the present study is the first to compare the emotional processing of food images in a wide variety of ED and disordered eating including obesity, differentiating between restrictive, and binge-purge symptomatology.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Valencia. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

CP and MR designed the study. IS prepared the first draft of the manuscript. CS-C performed the statistical analyses. All authors reviewed the manuscript.

## FUNDING

This study was supported by the Ministerio de Economía y Competitividad (MINECO) and the Fondo Europeo de Desarrollo Regional (FEDER) through the research project (PSI2014-51920-R).

## REFERENCES

Aloi, M., Rania, M., Caroleo, M., Bruni, A., Palmieri, A., Cauteruccio, M. A., et al. (2015). Decision making, central coherence and set-shifting: a comparison between binge eating disorder, anorexia nervosa and healthy controls. *BMC Psychiatry* 15:6. doi: 10.1186/s12888-015-0395-z

Baños, R. M., Cebolla, A., Moragrega, I., Van Strien, T., Fernández-Aranda, F., Agüera, Z., et al. (2014). Relationship between eating styles and temperament

in an anorexia nervosa, healthy control, and morbid obesity female sample. *Appetite* 76, 76–83. doi: 10.1016/j.appet.2014.01.012

Bodell, L. P., and Keel, P. K. (2015). Weight suppression in bulimia nervosa: associations with biology and behavior. *J. Abnorm. Psychol.* 124, 994–1002. doi: 10.1037/abn0000077

Boswell, R. G., and Kober, H. (2016). Food cue reactivity and craving predict eating and weight gain: a meta-analytic review. *Obes. Rev.* 17, 159–177. doi: 10.1111/obr.12354

Boutelle, K. N., Knatz, S., Carlson, J., Bergmann, K., and Peterson, C. B. (2017). An open trial targeting food cue reactivity and satiety sensitivity in overweight and obese binge eaters. *Cogn. Behav. Pract.* 24, 363–373. doi: 10.1016/j.cbpra.2016.08.003

Brogan, A., Hevey, D., and Pignatti, R. (2010). Anorexia, bulimia, and obesity: shared decision making deficits on the Iowa Gambling Task (IGT). *J. Int. Neuropsychol. Soc.* 16, 711–715. doi: 10.1017/S1355617710000354

Cardi, V., Leppanen, J., and Treasure, J. (2015). The effects of negative and positive mood induction on eating behaviour: a meta-analysis of laboratory studies in the healthy population and eating and weight disorders. *Neurosci. Biobehav. Rev.* 57, 299–309. doi: 10.1016/j.neubiorev.2015.08.011

Carter, F. A., McIntosh, V. V., Joyce, P. R., Frampton, C. M., and Bulik, C. M. (2006). Cue reactivity in bulimia nervosa: a useful self-report approach. *Int. J. Eating Disord.* 39, 694–699. doi: 10.1002/eat.20331

Castellanos, E. H., Charboneau, E., Dietrich, M. S., Park, S., Bradley, B. P., Mogg, K., et al. (2009). Obese adults have visual attention bias for food cue images: evidence for altered reward system function. *Int. J. Obes.* 33, 1063–1073. doi: 10.1038/ijo.2009.138

Castro, J., Toro, J., Salamero, M., and Guimerá, E. (1991). The eating attitudes test: validation of the Spanish version. *Eval. Psicol.* 7, 175–190.

Chester, R., Jerosch-Herold, C., Lewis, J., and Shepstone, L. (2016). Psychological factors are associated with the outcome of physiotherapy for people with shoulder pain: a multicentre longitudinal cohort study. *Br. J. Sports Med.* 52, 269–275. doi: 10.1136/bjsports-2016-096084

Ciscar, S., Perpiñá, C., Blasco, L., and Segura, M. (2019). Executive functioning, affect and eating self-regulation in eating disorders and obesity. *Rev. Argentina Psicol. Clín.* 28, 1–11.

Constant, A., Gautier, Y., Coquery, N., Thibault, R., Moirand, R., and Val-Laillet, D. (2018). Emotional overeating is common and negatively associated with alcohol use in normal-weight female University students. *Appetite* 129, 186–191. doi: 10.1016/j.appet.2018.07.012

Crosby, R. D., Wonderlich, S. A., Engel, S. G., Simonich, H., Smyth, J., and Mitchell, J. E. (2009). Daily mood patterns and bulimic behaviors in the natural environment. *Behav. Res. Ther.* 47, 181–188. doi: 10.1016/j.brat.2008.11.006

Cunningham, C. A., and Egeth, H. E. (2018). The capture of attention by entirely irrelevant pictures of calorie-dense foods. *Psychon. Bull. Rev.* 25, 586–595. doi: 10.3758/s13423-017-1375-8

da Luz, F., Hay, P., Touyz, S., and Sainsbury, A. (2018). Obesity with comorbid eating disorders: Associated health risks and treatment approaches. *Nutrients* 10:829. doi: 10.3390/nu10070829

Dagher, A. (2012). Functional brain imaging of appetite. *Trends Endocrinol. Metab.* 23, 250–260. doi: 10.1016/j.tem.2012.02.009

Dalrymple, K. L., Clark, H., Chelminski, I., and Zimmerman, M. (2018). The interaction between mindfulness, emotion regulation, and social anxiety and its association with emotional eating in bariatric surgery candidates. *Mindfulness* 9, 1780–1793. doi: 10.1007/s12671-018-0921-4

Davis, C., Patte, K., Curtis, C., and Reid, C. (2010). Immediate pleasures and future consequences. A neuropsychological study of binge eating and obesity. *Appetite* 54, 208–213. doi: 10.1016/j.appet.2009.11.002

Devlin, M. J. (2007). Is there a place for obesity in DSM-V? *Int. J. Eat. Disord.* 40, S83–S88. doi: 10.1002/eat.20430

Dingemans, A. E., Visser, H., Paul, L., and van Furth, E. F. (2015). Set-shifting abilities, mood and loss of control over eating in binge eating disorder: an experimental study. *Psychiatry Res.* 230, 242–248. doi: 10.1016/j.psychres.2015.09.001

Drobes, D. J., Miller, E. J., Hillman, C. H., Bradley, M. M., Cuthbert, B. N., and Lang, P. J. (2001). Food deprivation and emotional reactions to food cues: implications for eating disorders. *Biol. Psychol.* 57, 153–177. doi: 10.1016/S0301-0511(01)00093-X

Engel, S. G., Wonderlich, S. A., Crosby, R. D., Wright, T. L., Mitchell, J. E., Crow, S. J., et al. (2005). A study of patients with anorexia nervosa using ecologic momentary assessment. *Int. J. Eating Disord.* 38, 335–339. doi: 10.1002/eat.20184

Erdur, L., Weber, C., Zimmermann-Viehoff, F., Rose, M., and Deter, H. C. (2017). Affective responses in different stages of anorexia nervosa: Results from a startle-reflex paradigm. *Eur. Eating Disord. Rev.* 25, 114–122. doi: 10.1002/erv.2502

Fagundo, A. B., de la Torre, R., Jiménez-Murcia, S., Agüera, Z., Granero, R., Tárrega, S., et al. (2012). Executive functions profile in extreme eating/qeight conditions: from anorexia nervosa to obesity. *PLoS One* 7:e43382. doi: 10.1371/journal.pone.0043382

Friederich, H. C., Kumari, V., Uher, R., Riga, M., Schmidt, U., Campbell, I. C., et al. (2006). Differential motivational responses to food and pleasurable cues in anorexia and bulimia nervosa: a startle reflex paradigm. *Psychol. Med.* 36, 1327–1335. doi: 10.1017/S0033291706008129

Friederich, H. C., Wu, M., Simon, J. J., and Herzog, W. (2013). Neurocircuit function in eating disorders. *Int. J. Eating Disord.* 46, 425–432. doi: 10.1002/eat.22099

Garner, D. M., and Garfinkel, P. E. (1979). The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychol. Med.* 9, 273–279. doi: 10.1017/S0033291700030762

Giel, K. E., Friederich, H. C., Teufel, M., Hautzinger, M., Enck, P., and Zipfel, S. (2011a). Attentional processing of food pictures in individuals with anorexia nervosa: an eye-tracking study. *Biol. Psychiatry* 69, 661–667. doi: 10.1016/j.biopsych.2010.09.047

Giel, K. E., Teufel, M., Friederich, H. C., Hautzinger, M., Enck, P., and Zipfel, S. (2011b). Processing of pictorial food stimuli in patients with eating disorders-A systematic review. *Int. J. Eating Disord.* 44, 105–117. doi: 10.1002/eat.20785

Haedt-Matt, A. A., and Keel, P. K. (2011). Revisiting the affect regulation model of binge eating: a meta-analysis of studies using ecological momentary assessment. *Psychol. Bull.* 137, 660–681. doi: 10.1037/a0023660

Haines, J., Kleinman, K. P., Rifas-Shiman, S. L., Field, A. E., and Austin, S. B. (2010). Examination of shared risk and protective dactors for overweight and disordered eating among adolescents. *Arch. Pediatr. Adolesc. Med.* 164, 336–343. doi: 10.1001/archpediatrics.2010.19

Hayes, A. F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis*. New York, NY: The Guilford Press.

Heatherton, T. F., and Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends Cogn. Sci.* 15, 132–139. doi: 10.1016/j.tics.2010.12.005

Jacobi, C., Fittig, E., Bryson, S. W., Wilfley, D., Kraemer, H. C., and Taylor, C. B. (2011). Who is really at risk? Identifying risk factors for subthreshold and full syndrome eating disorders in a high-risk sample. *Psychol. Med.* 41, 1939–1949. doi: 10.1017/S0033291710002631

Krug, I., Penelo, E., Fernandez-Aranda, F., Anderluh, M., Bellodi, L., Cellini, E., et al. (2013). Low social interactions in eating disorder patients in childhood and adulthood: a multi-centre European case control study. *J. Health Psychol.* 18, 26–37. doi: 10.1177/1359105311435946

Lang, P. J. (1980). "Behavioral treatment and bio-behavioral assessment: computer applications," in *Technology in Mental Health Care Delivery Systems*, eds. J. B. Sidowski, J. H. Johnson, and T. A. Williams (Ablex), 119–137.

Lang, P. J., Bradley, M. M., and y Cuthbert, B. N. (2008). *International Affective Picture System (IAPS): Afective Ratings of Pictures and Instruction Manual.* Technical Report A-7. Gainesville, FL: The Center for Research in Psychophysiology, University of Florida.

Lavender, J. M., Mason, T. B., Utzinger, L. M., Wonderlich, S. A., Crosby, R. D., Engel, S. G., et al. (2016). Examining affect and perfectionism in relation to eating disorder symptoms among women with anorexia nervosa. *Psychiatry Res.* 241, 267–272. doi: 10.1016/j.psychres.2016.04.122

Lawrence, N. S., Hinton, E. C., Parkinson, J. A., and Lawrence, A. D. (2012). Nucleus accumbens response to food cues predicts subsequent snack consumption in women and increased body mass index in those with reduced self-control. *Neuroimage* 63, 415–422. doi: 10.1016/j.neuroimage.2012.06.070

Leehr, E. J., Krohmer, K., Schag, K., Dresler, T., Zipfel, S., and Giel, K. E. (2015). Emotion regulation model in binge eating disorder and obesity–a systematic review. *Neurosci. Biobehav. Rev.* 49, 125–134. doi: 10.1016/j.neubiorev.2014.12.008

Leehr, E. J., Schag, K., Brinkmann, A., Ehlis, A. C., Fallgatter, A. J., Zipfel, S., et al. (2016). Alleged approach-avoidance conflict for food stimuli in binge eating disorder. *PLoS One* 11:e0152271. doi: 10.1371/journal.pone.0152271

Loeber, S., Rustemeier, M., Paslakis, G., Pietrowsky, R., Müller, A., and Herpertz, S. (2018). Mood and restrained eating moderate food-associated response inhibition in obese individuals with binge eating disorder. *Psychiatry Res.* 264, 346–353. doi: 10.1016/j.psychres.2018.03.081

Macht, M. (2008). How emotions affect eating: a five-way model. *Appetite* 50, 1–11. doi: 10.1016/j.appet.2007.07.002

Mallorquí-Bagué, N., Fagundo, A. B., Jimenez-Murcia, S., de la Torre, R., Baños, R. M., Botella, C., et al. (2016). Decision making impairment: a shared vulnerability in obesity, gambling disorder and substance use disorders? *PLoS One* 11:e0163901. doi: 10.1371/journal.pone.0163901

Mallorquí-Bagué, N., Vintró-Alcaraz, C., Sánchez, I., Riesco, N., Agüera, Z., Granero, R., et al. (2017). Emotion regulation as a transdiagnostic feature among eating disorders: cross-sectional and longitudinal approach. *Eur. Eating Disord. Rev.* 26, 53–61. doi: 10.1002/erv.2570

Mauler, B. I., Hamm, A. O., Weike, A. I., and Tuschen-Caffier, B. (2006). Affect regulation and food intake in bulimia nervosa: emotional responding to food cues after deprivation and subsequent eating. *J. Abnorm. Psychol.* 115, 567–579. doi: 10.1037/0021-843X.115.3.567

Meule, A., Kübler, A., and Blechert, J. (2013). Time course of electrocortical food-cue responses during cognitive regulation of craving. *Front. Psychol.* 4:669. doi: 10.3389/fpsyg.2013.00669

Michopoulos, V., Powers, A., Moore, C., Villarreal, S., Ressler, K. J., and Bradley, B. (2015). The mediating role of emotion dysregulation and depression on the relationship between childhood trauma exposure and emotional eating. *Appetite* 91, 129–136. doi: 10.1016/j.appet.2015.03.036

Moltó, J., Segarra, P., López, R., Esteller, N., Fonfría, A., Pastor, M. C., et al. (2013). Adaptación eapañola del ≪International Affective Picture System≫ (IAPS). Tercera parte. *Anal. Psicol.* 29, 965–984. doi: 10.6018/analesps.29.3.153591

Nederkoorn, C., Houben, K., Hofmann, W., Roefs, A., and Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychol.* 29, 389–393. doi: 10.1037/a0019921

Nummenmaa, L., Hietanen, J. K., Calvo, M. G., and Hyönä, J. (2011). Food catches the eye but not for everyone: a BMI-contingent attentional bias in rapid detection of nutriments. *PLoS One* 6:e19215. doi: 10.1371/journal.pone.0019215

O'Hara, C. B., Campbell, I. C., and Schmidt, U. (2015). A reward-centred model of anorexia nervosa: a focussed narrative review of the neurological and psychophysiological literature. *Neurosci. Biobehav. Rev.* 52, 131–152. doi: 10.1016/j.neubiorev.2015.02.012

Pasco, J. A., Williams, L. J., Jacka, F. N., Brennan, S. L., and Berk, M. (2013). Obesity and the relationship with positive and negative affect. *Aust. N. Zeal. J. Psychiatry* 47, 477–482. doi: 10.1177/0004867413483371

Perpiñá, C., and Roncero, M. (2016). Similarities and differences between eating disorders and obese patients in a virtual environment for normalizing eating patterns. *Compr. Psychiatry* 67, 39–45. doi: 10.1016/j.comppsych.2016.02.012

Racine, S. E., Hebert, K. R., and Benning, S. D. (2018). Emotional reactivity and appraisal of food in relation to eating disorder cognitions and behaviours: evidence to support the motivational conflict hypothesis. *Eur. Eating Disord. Rev.* 26, 3–10. doi: 10.1002/erv.2567

Sandín, B., Chorot, R., Lostao, L., Joiner, T. E., Santed, M. A., and Valiente, R. M. (1999). Escalas PANAS de afecto positivo y negativo: Validación factorial y convergencia transcultural. *Psicothema* 11, 37–51.

Segura-Serralta, M., Ciscar, S., Blasco, L., Oltra-Cucarella, J., Roncero, M., Espert, R., et al. (2020). Contribution of executive functions to eating behaviours in obesity and eating disorders. *Behav. Cogn. Psychother.* 48, 725–733. doi: 10.1017/S1352465820000260

Segura-Serralta, M., Perpiñá, C., Císcar, S., Blasco, L., Espert, R., Romero-Escobar, C., et al. (2019). Executive functions and emotion regulation in obesity and eating disorders. *Nutr. Hosp.* 36, 167–172. doi: 10.20960/nh.02016

Simon, J. J., Skunde, M., Walther, S., Bendszus, M., Herzog, W., and Friederich, H. C. (2016). Neural signature of food reward processing in bulimic-type eating disorders. *Soc. Cogn. Affect. Neurosci.* 11, 1393–1401. doi: 10.1093/scan/nsw049

Soussignan, R., Jiang, T., Rigaud, D., Royet, J. P., and Schaal, B. (2010). Subliminal fear priming potentiates negative facial reactions to food pictures in women with anorexia nervosa. *Psychol. Med.* 40, 503–514. doi: 10.1017/S0033291709990377

Spence, C., Okajima, K., Cheok, A. D., Petit, O., and Michel, C. (2016). Eating with our eyes: from visual hunger to digital satiation. *Brain Cogn.* 110, 53–63. doi: 10.1016/j.bandc.2015.08.006

Steinglass, J., Albano, A. M., Simpson, H. B., Carpenter, K., Schebendach, J., and Attia, E. (2012). Fear of food as a treatment target: exposure and response prevention for anorexia nervosa in an open series. *Int. J. Eating Disord.* 45, 615–621. doi: 10.1002/eat.20936

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol. Bull.* 128, 825–848. doi: 10.1037/0033-2909.128.5.825

Tang, D., Fellows, L., Small, D., and Dagher, A. (2012). Food and drug cues activate similar brain regions: a meta-analysis of functional MRI studies. *Physiol. Behav.* 106, 317–324. doi: 10.1016/j.physbeh.2012.03.009

Tice, D. M., Bratslavsky, E., and Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: if you feel bad, do it! *J. Pers. Soc. Psychol.* 80, 53–67. doi: 10.1037/0022-3514.80.1.53

Toepel, U., Knebel, J. F., Hudry, J., le Coutre, J., and Murray, M. M. (2009). The brain tracks the energetic value in food images. *Neuroimage* 44, 967–974. doi: 10.1016/j.neuroimage.2008.10.005

van Strien, T., Cebolla, A., Etchemendy, E., Gutiérrez-Maldonado, J., Ferrer-García, M., Botella, C., et al. (2013). Emotional eating and food intake after sadness and joy. *Appetite* 66, 20–25. doi: 10.1016/j.appet.2013.02.016

Vannucci, A., Nelson, E. E., Bongiorno, D. M., Pine, D. S., Yanovski, J. A., and Tanofsky-Kraff, M. (2015). Behavioral and neurodevelopmental precursors to binge-type eating disorders: support for the role of negative valence systems. *Psychol. Med.* 45, 2921–2936. doi: 10.1017/S003329171500104X

Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Pers. Soc. Psychol.* 54, 1063–1070. doi: 10.1037/0022-3514.54.6.1063

Wilson, S., Benning, S. D., and Racine, S. E. (2020). Examining the role of thin-ideal internalization in the relationship between reactions to high- and low-calorie food and eating pathology. *Appetite* doi: 10.31234/osf.io/yr5ej

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frontiers in Psychology

BRIEF RESEARCH REPORT
published: 09 September 2021
doi: 10.3389/fpsyg.2021.714414

# Toward a Biological, Psychological and Familial Approach of Eating Disorders at Onset: Case-Control ANOBAS Study

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OPEN ACCESS

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**Reviewed by:**
*Zaida Aguera, University of Barcelona, Spain*
*Cristina Segura-Garcia, University of Magna Graecia, Italy*

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**Specialty section:**
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

**Received:** *25 May 2021*
**Accepted:** *20 August 2021*
**Published:** *09 September 2021*

**Citation:**
*Sepúlveda AR, Moreno-Encinas A, Martínez-Huertas JA, Anastasiadou D, Nova E, Marcos A, Gómez-Martínez S, Villa-Asensi JR, Mollejo E and Graell M (2021) Toward a Biological, Psychological and Familial Approach of Eating Disorders at Onset: Case-Control ANOBAS Study. Front. Psychol. 12:714414. doi: 10.3389/fpsyg.2021.714414*

Eating disorders (ED) are considered as heterogeneous disorders with a complex multifactor etiology that involves biological and environmental interaction.

**Objective:** The aim was to identify specific ED bio-psychological-familial correlates at illness onset.

**Methods:** A case-control (1:1) design was applied, which studied 50 adolescents diagnosed with ED at onset (12–17 years old) and their families, paired by age and parents' socio-educational level with three control samples (40 with an affective disorder, 40 with asthma, and 50 with no pathology) and their respective families. Biological, psychological, and familial correlates were assessed using interviews, standardized questionnaires, and a blood test.

**Results:** After performing conditional logistic regression models for each type of variable, those correlates that showed to be specific for ED were included in a global exploratory model ($R^2 = 0.44$). The specific correlates identified associated to the onset of an ED were triiodothyronine (T3) as the main specific biological correlate; patients' drive for thinness, perfectionism and anxiety as the main psychological correlates; and fathers' emotional over-involvement and depression, and mothers' anxiety as the main familial correlates.

**Conclusion:** To our knowledge, this is the first study to use three specific control groups assessed through standardized interviews, and to collect a wide variety of data at the illness onset. This study design has allowed to explore which correlates, among those measured, were specific to EDs; finding that perfectionism and family emotional over-involvement, as well as the T3 hormone were relevant to discern ED cases at the illness onset from other adolescents with or without a concurrent pathology.

**Keywords: eating disorders, case-control study, biological correlates, psychological correlates, familial correlates**

## INTRODUCTION

Eating disorders (ED) are severe psychiatric disorders characterized by pathological attitudes and behaviors related to food. All of them share a common major characteristic: the over-evaluation of shape and weight, and their control. Other common traits are body dissatisfaction and a persistent desire for thinness, which are present throughout the course of the illness [American Psychiatric Association (APA), 2013]. EDs usually begin in early adolescence, being the most frequent diagnosis among adolescents in mental health inpatient units and the third most common chronic illness in female adolescents (Nicholls et al., 2011). Although previous studies have expanded our knowledge about risk factors associated with ED, few have been able to answer whether those risk factors were general or specific to ED psychopathology (Fairburn et al., 1999; Pike et al., 2008; Machado et al., 2014; Gonçalves et al., 2016).

Regarding biological variables, pubertal status, excess body fat mass, and fluctuations in weight are factors associated with ED (Bakalar et al., 2015). Changes in biological variables have been broadly related to homeostatic adaptations to malnutrition, although previous studies have also proposed that some of these, such as appetite-regulating hormones, also contribute to the development and maintenance of different behaviors related to ED (Monteleone and Maj, 2013; Misra and Klibanski, 2014). Peripheral signals, such as fat mass derived hormones and gastrointestinal peptides may act on the central nervous system to influence eating behaviors, energy balance, and mood. In addition, the interactions between leptin, cortisol, and cytokine levels appear to be important mediators in an ED onset and its course, but their true relevance as primary or secondary alterations is mostly unknown (Elegido et al., 2017).

Regarding psychological variables, multiple studies have identified perfectionism as one of the most relevant risk factors of this population (Culbert et al., 2015). Another well-known risk factor for ED is negative affectivity (Dakanalis et al., 2017) which has been shown to persist even after recovery (Klump et al., 2000). However, whereas Fairburn et al. (1999) and Stice (2002) identified perfectionism and negative affectivity as specific risk factors for ED, another study considered perfectionism as a correlate and negative affectivity as a non-specific risk factor (Jacobi et al., 2004). Body dissatisfaction was also found to be an important predictor of ED (Stice et al., 2011; Jacobi and Fittig, 2012). Related to it, shape and weight concern has been confirmed as one of the most potent factors for the onset of an ED (Keel and Forney, 2013).

On the other hand, different familial factors have been identified, such as familial pressure and discord (Fairburn et al., 1999; Pike et al., 2008), teasing (Neumark-Sztainer et al., 2007), negative perception of parental attitudes (Kluck, 2010; Parks et al., 2017), high expressed emotion, and family history of ED (Sepúlveda et al., 2012, 2014; Hilbert et al., 2014). Furthermore, other authors (Le Grange et al., 2010; Machado et al., 2014) have found that familial factors, except family history of ED, were non-specific factors as they were related to increased risk of general psychopathology. Moreover, one of the inherent difficulties of research on familial risk factors of ED is the overrepresentation of mothers' data, as analyzing the contribution of each parent separately could improve the knowledge about the whole family system (Anastasiadou et al., 2014; Gonçalves et al., 2016).

Previous ED etiological models have agreed that the etiology is complex, and includes biological, psychological, and socioenvironmental factors interacting at the onset and maintenance of the ED (Treasure et al., 2008, 2020). The aim of this article was to identify specific biological, psychological, and familial ED correlates associated with the onset of the disorder. Following the Kraemer et al. (1997)'s risk factors classification, correlates are the kind of factors that cannot demonstrate precedence over the outcome. To evaluate the specificity of these correlates, three control samples were chosen: affective disorders (AD group), asthma pathology (AP group), and a non-pathological group (NP group). EDs present high comorbidity with affective disorders (Ferreiro et al., 2011), suggesting that common and specific ED factors could be pointed out. Asthma sufferers present similarities on the familial level, as both disorders are considered chronic psychosomatic diseases, present severe attacks, which can be life-threatening, and pose high demands of care representing a significant impact on the physical and psychological wellbeing of the families (Theodoratou-Bekou et al., 2012; Verkleij et al., 2015). A control group without pathology was selected in order to control the role of the adolescence as an important risk factor for an ED (Keel and Forney, 2013). Consistent with the scientific literature, we hypothesized that some biological correlates (biochemical, neuroendocrine, and immunological), some psychological correlates (attitudes and behaviors related to eating psychopathology, body dissatisfaction, perfectionism and anxious, depressive, and obsessive symptomatology), and some familial correlates (family functioning, expressed emotion and anxious, depressive, and obsessive symptomatology) were specific correlates associated with the onset of an ED. We also hypothesized that an exploratory bio-psycho-familiar model based on these specific correlates would allow to identify the ED group.

## MATERIALS AND METHODS

### Design and Procedure

The current research follows a cross-sectional case-control design, using an ED group as the case group and matching with three control groups by sex and age of the patients and socioeconomic status of the parents, following the Hollingshead Redlich Scale (Hollingshead and Redlich, 1953). A complete sample description of the ANOBAS protocol and a detailed explanation of the suitability of the study control groups is provided in Sepulveda et al. (2021).

The recruitment was carried out during 4 years. Firstly, the ED sample was recruited at the outpatient Eating Disorders Unit at the Niño Jesús University Children's Hospital in Madrid, Spain. The samples for the three control groups was then recruited, in order to match the characteristics of each ED adolescent (1:1). The AD sample was recruited at different Mental Health Centers in the Community of Madrid. In both psychiatric groups, patients

had been diagnosed by mental health professionals. In addition, AP participants were recruited at the Pneumology Department at the Niño Jesús University Children's Hospital and the NP group was recruited at different schools in the Community of Madrid. Short telephone interviews were conducted to confirm the sociodemographic variables, and once informed written consent was obtained from adolescents and their parents, the cases were matched. The first assessment included a socio-demographic interview, a semi-structured psychiatric interview to confirm the previous diagnoses and to assess new possible comorbid psychiatric diagnoses, and a battery of questionnaires for both parents and daughters. Participants had 1 week to complete the questionnaires. This assessment was followed by a full blood test. The blood sample was collected at the Niño Jesús University Children's Hospital and evaluated by the Immunonutrition Group at the Institute of Food Science, Technology and Nutrition (ICTAN-CSIC). Fasting venous blood samples were collected between 8 and 9 AM from patients and controls in an EDTA-K3E Vacutainer (BD Biosciences) tubes. Plasma was obtained by centrifugation during 15 min at 1,300 *g* and 4°C. Aliquots were frozen at −80°C until analysis.

Confidentiality was guaranteed for all the participants. The study received ethical approval by the Hospital Ethics Committee (Ref. Code, R-0009/10), and the corresponding University Research Ethics Committee (UAM, CEI 25-673).

## Participants

The sample was made up by 180 females, with ages between 12 and 17 years, and their parents. Four groups were recruited: 50 adolescents diagnosed with an ED at onset of the illness, 40 adolescents diagnosed with an affective disorder at onset (AD group), 40 adolescents diagnosed with severe asthma pathology (AP group), and 50 adolescents without a pathology (NP group). Depending on the sample, data was collected from between 30 and 40 fathers, and 40 and 50 mothers.

Exclusion criteria for all groups were to suffer any metabolic conditions known to influence Body Mass Index (BMI) or a psychotic disorder, and for the three control groups, to present an ED or a BMI above 30 or below 17.5. Inclusion criteria for the ED and AD group were to present an early stage of the illness at first diagnosis (a year or less of illness duration). Inclusion criteria for the AD group were to present a diagnosis of an affective disorder without ED diagnosis. Inclusion criteria for the AP group were to have been diagnosed before the age of 7 with asthma and to have visited at least three times an emergency service, which allowed us to select more severe asthma cases. Overall, nine participants were excluded from the study after the assessment because of co-occurrence of ED and AD ($n = 2$), co-occurrence of ED or AP ($n = 2$), presence of psychosis ($n = 1$), presence of a metabolic disorder ($n = 1$), and ED pathology in the NP group ($n = 3$). All of the excluded participants were not considered for matching.

Regarding the sample size, taking into account weight concerns assessed through the Eating Disorders Inventory (Garner, 1991), considered as one of the most well-supported risk factor for ED, a mean effect size of AUC = 0.746 was found in one of the main reviews about risk factors in this pathology (Jacobi et al., 2004). Based on that mean effect size, the Cohen's *d* was calculated ($d = 0.936$). The G*Power program was used in order to calculate the sample size needed to detect this effect, obtaining an estimated sample size per group of 27. Based on these suggestions, a sample size of 40 or 50 was considered enough to reach good effect sizes.

## Measures

### Diagnostic Assessment

Current and lifetime psychiatric disorders were evaluated with the Kiddie-Schedule for Affective Disorders and Schizophrenia Interview (K-SADS-PL; Kaufman et al., 1997); a semi-structured interview developed to diagnose children and adolescents using DSM-IV diagnoses. Diagnoses were adapted to the DSM-5 [American Psychiatric Association (APA), 2013].

### Biological Assessment

A physical examination and laboratory analysis of blood markers related to nutritional and immunological status were assessed, including the following types of variables:

(a) Anthropometric variables: weight, height, and BMI.
(b) Biochemical variables: alkaline phosphatase, total cholesterol, ferritin, vitamin B12, with automated analyzer using colorimetric and nephelometric techniques and by electric potential using a selective electrode (Na, K).
(c) Neuroendocrine and Immunological variables: free tetra-iodothyronine (T4), tri-iodothyronine (T3), cortisol, estradiol, insulin like growth factor-1 (IGF1), IGF-binding protein-3 (IGFBP3), complement component 3 (C3), tumor necrosis factor α (TNF-α), leptin, soluble leptin receptor, adiponectin, by RIA, ELISA, and xMAP Technology for immunoassay of multiple analyses (Millipore).

Blood collected in EDTA-K3 vacumtainers was used for a lymphocyte subset analysis. Immediately after collection, 1 mL of blood was mixed with an equal volume (1 mL) of preservative solution and refrigerated for 2–6 days for processing and flow cytometry analysis. Unfortunately, due to budget limitations, the asthma group did not have their immunological variables measured.

### Psychological Correlates Assessment

Each adolescent completed a battery of different instruments, which have shown adequate psychometric validity in Spanish adolescent samples (in the current study Cronbach α ranged between 0.81 and 0.98). Attitudes and behaviors related to eating psychopathology were assessed with the Eating Disorders Inventory-II (EDI-II; Garner, 1991). Body dissatisfaction was evaluated with the Body Shape Questionnaire (BSQ; Cooper et al., 1987). Depression was assessed with the Child Depression Inventory (CDI; Kovacs, 1992); anxiety with the State-Trait Anxiety Inventory for Children (STAIC; Spielberger et al., 1973) and obsessiveness with the Leyton Obsessional Inventory-Child Version (LOI-CV; Berg et al., 1986). Lastly, we used the Child Adolescent Perfectionism Scale (CAPS; Flett et al., 2000) to evaluate perfectionism.

### Familial Correlates Assessment

The parents of each participant completed a battery of five questionnaires. These measures have shown adequate psychometric validity across Spanish populations (in the current study Cronbach α ranged between 0.78 and 0.92). To evaluate the psychological well-being of the parents we used the Beck Depression Inventory (BDI; Beck et al., 1961) to assess depressive symptoms, the State-Trait Anxiety Inventory (STAI, Spielberger et al., 1970) to assess the level of anxiety, and the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) to assess obsessive-compulsive symptoms. Regarding family functioning variables, we used the Family Adaptability and Cohesion Scale (FACES-II; Olson et al., 1982) to assess adaptability and cohesion, and the Family Questionnaire (FQ; Wiedemann et al., 2002) to evaluate critical comments (CC) and emotional over-involvement (EOI).

## Data Analysis

All the statistical analyses were performed with R software.

Firstly, conditional logistic regressions were conducted for each risk factor using the *survival* package. Conditional logistic regressions compare each ED participant with her matching case-control participant from the AD, AP, and NP groups. More specifically, each ED participant was compared with a strata of her matching case-control AD, AP, and NP participants. Conditional logistic regressions were then conducted for each group of biological, psychological, and familial correlates where a stepwise model selection was applied to select the most relevant correlates in the model using the AIC indices of the *MASS* package. The statistical significance of individual correlates was corrected using Holm–Bonferroni correction for multiple comparisons. All the variables were standardized and no multicollinearity was observed, neither in biological, familial nor psychological models.

Secondly, the same conditional logistic regressions procedure was followed to estimate an exploratory bio-psycho-familial model. In this case, the complexity and the computational burden of the statistical model forced us to impute missing values by the mean of each group (missing patterns were isolated to specific cases, but listwise deletion inherent to conditional logistic regressions would considerably reduce the number of observations). In the bio-psycho-familial model, we only included those correlates that were previously conserved by stepwise model selections using the AIC indices. All the variables were standardized to estimate the bio-psycho-familial model because they had different score ranges. Finally, a stepwise model selection was applied in this model in order to determine the most relevant correlates to discriminate between ED and the control groups (AD, AP, and NP participants).

# RESULTS

## Sociodemographic Characteristics of the Participants

Participants' sociodemographics are described in **Table 1**, in which each control sample is compared with the ED sample. Given the design, no differences were found for participants'

**TABLE 1 |** Descriptive analyses of the sociodemographic characteristics of the participants, and mixed-effects results to test the differences between case-control with individual matching.

| | ED (*N* = 50) | AD (*N* = 40) | AP (*N* = 40) | NP (*N* = 50) | Differences between groups |
|---|---|---|---|---|---|
| | M (SD)/% | M (SD)/% | M (SD)/% | M (SD)/% | β (*SE*) |
| **Adolescents** | | | | | |
| Age (years) | 14.68 (1.39) | 15.10 (1.55) | 14.73 (1.74) | 14.66 (1.32) | 0.00 (0.03) |
| Body mass index | 16.07 (1.74) | 22.41 (2.95) | 21.24 (2.87) | 21.18 (2.66) | 6.89 (2.77)** |
| Length of illness (months) | 10.32 (7.41) | 11.70 (6.02) | – | – | 1.14 (1.28) |
| Diagnosis | AN-R: 70%<br>AN-P: 16%<br>FEDNEC: 14% | MDD: 90%<br>Dysthymia: 7.5%<br>Adjustment-disorder: 2.5% | | | – |
| History of previous psychiatric disorder | 14.00% | 52.50% | 25.00% | 8.00% | −0.04 (0.03) |
| **Parents** | | | | | |
| Father's age (years) | 47.54 (4.79) | 48.32 (4.89) | 46.67 (4.50) | 51.02 (4.44) | 0.95 (0.30)** |
| Mother's age (years) | 45.55 (3.62) | 45.73 (4.83) | 45.55 (4.15) | 48.30 (3.54) | 0.84 (0.25)** |
| Father's psychiatric antecedent | 14.00% | 20.00% | 10.00% | 09.00% | 0.02 (0.02) |
| Mother's psychiatric antecedent | 36.00% | 50.00% | 28.00% | 26.00% | −0.05 (0.03) |
| Socioeconomic status | | | | | 0.05 (0.02) |
| Low | 20.00% | 27.50% | 20.00% | 14.00% | |
| Middle | 12.00% | 25.00% | 20.00% | 14.00% | |
| High | 68.00% | 47.50% | 60.00% | 72.00% | |

*ED, eating disorders; AD, affective disorder; AP, asthma pathology; NP, non-pathology group; N, sample size; M, mean; SD, standard deviation. AN-R, anorexia nervosa-restricting type; AN-P, anorexia nervosa-purging type; FED-NEC, feeding or eating disorder not elsewhere classified; MDD, major depressive disorder. Statistical differences between groups were estimated through mixed effects models.* β, *fixed effect; SE, standard error.*

***p < 0.01.*

age and socioeconomic status of the parents. In addition, no differences were found between the psychiatric groups (ED and AD) for illness duration. We only found statistically significant differences between the groups controlling by their case-control matching in the patients' BMI. ED participants presented the following diagnoses: anorexia nervosa (AN) restrictive subtype (70%); AN purgative subtype (16%) and other specified feeding and eating disorder (14%). AD participants presented the following diagnoses: major depressive disorder (90%); dysthymia (7.5%); adjustment disorder with depressive symptoms (2.5%).

## Examining Biological Correlates for Eating Disorders

Conditional logistic regressions were computed for each biological correlate (see **Table 2**). Results showed that higher values of vitamin B12, IGFBP3, total cholesterol, and adiponectin were relevant to differentiate the ED group with the control groups. On the other hand, the reduced values of T3 and IGF-1 were also relevant to differentiate the ED group with the control groups.

A conditional logistic regression was estimated using all of the biological correlates (except leptin, soluble leptin receptor, adiponectin, and TNF-α because they were not collected in the AP group) as covariates. Stepwise model selection showed that the most relevant variables to differentiate the ED group with the control groups were T3, free T4, IGF-1, IGFBP3, and total cholesterol.

## Examining Psychological Correlates for Eating Disorders

Conditional logistic regressions were computed for each psychological correlate (see **Table 3**). Results showed that the ED group reported more drive for thinness, body dissatisfaction (BSQ) and self-directed perfectionism than control groups.

Also, a conditional logistic regression was estimated using all of the psychological correlates as covariates. A stepwise model selection showed that patients with ED reported more drive for thinness, anxiety-state, obsessive symptoms, and self-oriented perfectionism. However, patients with ED reported less body dissatisfaction, trait-anxiety, and socially prescribed perfectionism than the control groups.

## Examining Familial Correlates for Eating Disorders

Conditional logistic regressions were computed for each familial correlate (see **Table 4**). Results showed that the ED group was more exposed to both fathers' and mothers' emotional over-involvement and mothers' anxiety-state compared to the control groups.

**TABLE 2 |** Descriptive analyses and conditional logistic regressions for biological correlates.

| | Descriptive analyses | | | | Conditional logistic regression | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ED (*N* = 50) | AD (*N* = 40) | AP (*N* = 40) | NP (*N* = 50) | Individual correlate | | | Stepwise model selection | | |
| | M (SD) | M (SD) | M (SD) | M (SD) | OR | 95% IC | *z* | OR | 95% IC | *z* |
| Alkaline phosphatase (IU/L) | 65.30 (34.81) | 71.03 (23.80) | 93.53 (52.05) | 90.87 (52.96) | 0.40 | 0.20–0.79 | −2.63[a] | – | – | – |
| T3 (ng/mL) | 1.00 (0.20) | 1.23 (0.17) | 1.28 (0.16) | 1.26 (0.17) | 0.55 | 0.39–0.78 | −3.32** | 0.32 | 0.19–1.00 | −2.68** |
| Free T4 (ng/dL) | 0.82 (0.09) | 0.87 (0.07) | 0.92 (0.08) | 0.91 (0.09) | 0.74 | 0.54–1.01 | −1.88[a] | 0.43 | 0.14–0.74 | −1.96* |
| Cortisol (μg/dL) | 16.86 (5.67) | 11.04 (4.15) | 9.11 (3.92) | 14.46 (4.75) | 1.09 | 0.79–1.52 | 0.53 | – | – | – |
| Estradiol (pg/mL) | 24.65 (39.12) | 98.69 (87.38) | 91.70 (76.25) | 80.61 (65.83) | 1.41 | 1.00–1.98 | 1.97[a] | – | – | – |
| C3 (mg/dL) | 83.13 (16.43) | 100.77 (18.38) | 94.10 (13.85) | 97.74 (16.15) | 1.05 | 0.76–1.45 | 0.32 | – | – | – |
| Ferritin (ng/mL) | 77.42 (49.26) | 28.50 (19.96) | 36.27 (22.67) | 28.31 (21.87) | 1.53 | 1.08–2.16 | 2.40[a] | – | – | – |
| Vitamin B12 (pg/mL) | 525.50 (189.91) | 408.11 (177.44) | 399.73 (157.41) | 423.32 (134.84) | 1.94 | 1.29–2.91 | 3.17** | – | – | – |
| IGF-1 (ng/mL) | 269.32 (153.41) | 352.59 (99.54) | 387.83 (116.78) | 375.22 (88.76) | 0.37 | 0.22–0.60 | −3.95** | 0.40 | 0.16–0.98 | −2.00* |
| IGFBP3 (μg/mL) | 5.06 (1.02) | 5.00 (0.78) | 5.00 (0.72) | 4.83 (0.70) | 1.59 | 1.13–2.25 | 2.66** | 4.94 | 1.75–13.95 | 3.02** |
| Total cholesterol (mg/dL) | 179.46 (41.79) | 148.14 (24.64) | 146.42 (28.83) | 154.85 (26.75) | 2.50 | 1.55–4.02 | 3.76** | 2.98 | 1.28–6.93 | 2.54* |
| Leptin (pg/mL) | 1930.30 (2470.39) | 6394.81 (3693.47) | – | 7498.77 (4903.02) | 0.81 | 0.56–1.19 | −1.06 | | | |
| Soluble leptin receptor (ng/mL) | 3.08 (0.44) | 3.74 (0.24) | – | 3.79 (0.28) | 0.65 | 0.46–0.92 | −2.44[a] | | | |
| Adiponectin (μg/mL) | 35.37 (15.82) | 23.86 (18.03) | – | 20.33 (7.77) | 3.24 | 2.09–5.02 | 5.26** | | | |
| TNF-α (pg/mL) | 3.42 (3.03) | 3.34 (0.77) | – | 4.42 (1.80) | 1.19 | 0.89–1.60 | 1.17 | | | |

*ED, eating disorders; AD, affective disorder; AP, asthma pathology; NP, non-pathology group; N, sample size; M, mean; SD, standard deviation; OR, odds ratio; Individual correlate, conditional logistic regression for each variable; Stepwise model selection, selected correlates for the model using AIC indices (empty cells mean that the variable was excluded in the model; gray cells mean that the variable was not included in the initial model).*

[a]*z-value is statistically significant, but its statistical significance was corrected for multiple comparisons.*

**p < 0.05; **p < 0.01.*

*Statistical significance of individual correlates was corrected using Holm–Bonferroni correction for multiple comparisons. Some biological variables were not recollected for the AP group.*

**TABLE 3 |** Descriptive analyses and conditional logistic regressions for psychological correlates.

| | Descriptive analyses | | | | Conditional logistic regression | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ED (*N* = 50) | AD (*N* = 40) | AP (*N* = 40) | NP (*N* = 50) | Individual correlate | | | Stepwise model selection | | |
| | M (SD) | M (SD) | M (SD) | M (SD) | OR | 95% IC | *z* | OR | 95% IC | *z* |
| Drive for thinness (EDI-II) | 8.29 (6.92) | 6.70 (6.79) | 2.48 (3.66) | 1.83 (4.13) | 2.07 | 1.42–3.02 | 3.80** | 16.17 | 2.78–94.06 | 3.10** |
| Bulimia (EDI-II) | 0.93 (1.80) | 2.05 (3.80) | 0.63 (1.23) | 0.48 (1.24) | 0.96 | 0.68–1.36 | −0.23 | – | – | – |
| Body dissatisfaction (EDI-II) | 9.39 (6.75) | 11.05 (8.36) | 5.75 (6.30) | 3.81 (5.51) | 1.37 | 1.00–1.87 | 1.97[a] | – | – | – |
| Ineffectiveness (EDI-II) | 5.62 (5.89) | 12.46 (8.27) | 2.23 (3.84) | 1.63 (3.56) | 1.09 | 0.80–1.49 | 0.53 | 0.42 | 0.14–1.31 | −1.50 |
| Perfectionism (EDI-II) | 4.06 (3.70) | 6.35 (4.64) | 4.03 (3.29) | 3.50 (3.36) | 0.86 | 0.60–1.24 | −0.81 | – | – | – |
| Interpersonal distrust (EDI-II) | 4.20 (3.90) | 7.43 (4.64) | 1.68 (1.61) | 2.21 (2.93) | 1.19 | 0.86–1.64 | 1.06 | – | – | – |
| Interoceptive awareness (EDI) | 6.27 (5.72) | 11.14 (6.52) | 3.20 (4.24) | 2.23 (4.18) | 1.22 | 0.88–1.68 | 1.20 | – | – | – |
| Maturity fears (EDI-II) | 8.10 (4.40) | 9.27 (5.63) | 6.78 (3.69) | 7.50 (4.77) | 1.13 | 0.82–1.57 | 0.73 | – | – | – |
| Body dissatisfaction (BSQ) | 94.49 (45.16) | 101.75 (47.52) | 59.08 (24.79) | 62.28 (27.04) | 1.56 | 1.13–2.15 | 2.67** | 0.14 | 0.03–0.69 | −2.43* |
| Depression (CDI) | 14.36 (8.98) | 23.48 (8.51) | 7.90 (4.16) | 8.33 (5.18) | 1.13 | 0.85–1.51 | 0.82 | – | – | – |
| Anxiety-state (STAIC-S) | 35.20 (10.64) | 39.10 (8.37) | 27.48 (5.75) | 26.58 (6.54) | 1.46 | 1.06–2.00 | 2.33[a] | 5.07 | 1.54–16.64 | 2.67** |
| Anxiety-trait (STAIC-T) | 38.80 (10.28) | 45.53 (7.60) | 32.20 (6.57) | 32.00 (7.49) | 1.24 | 0.91–1.70 | 1.35 | 0.18 | 0.03–0.91 | −2.07* |
| Obsessive symptoms (LOI) | 9.10 (4.67) | 10.00 (3.30) | 6.83 (3.62) | 7.40 (3.80) | 1.34 | 0.94–1.90 | 1.63 | 2.34 | 0.90–6.11 | 1.74[t] |
| Self-oriented perfectionism (CAPS) | 39.11 (10.95) | 36.74 (8.31) | 34.33 (8.71) | 32.96 (7.81) | 1.64 | 1.15–2.34 | 2.71** | 5.03 | 1.72–14.69 | 2.95** |
| Socially prescribed perfectionism (CAPS) | 21.60 (8.97) | 28.82 (8.38) | 23.62 (7.82) | 24.29 (7.83) | 0.64 | 0.44–0.93 | −2.35[a] | 0.26 | 0.13–0.55 | −3.59** |

*ED, eating disorders; AD, affective disorder; AP, asthma pathology; NP, non-pathology group; N, sample size; M, mean; SD, standard deviation; OR, odds ratio; Individual correlate, conditional logistic regression for each variable. Stepwise model selection, selected correlates for the model using AIC indices (empty cells mean that the variable was excluded in the model).*

[a] *z-value is statistically significant, but its statistical significance was corrected for multiple comparisons.*

[t] $p < 0.10$.

*$p < 0.05$; **$p < 0.01$.

*Statistical significance of individual correlates was corrected using Holm–Bonferroni correction for multiple comparisons.*

A conditional logistic regression was then estimated using all the familial correlates as covariates. A stepwise model selection showed that patients with an ED were more exposed to fathers' EOI, mothers' EOI, and mother's anxiety-state. However, patients with ED were less exposed to fathers' criticism and mothers' criticism, fathers' depression, and mothers' trait-anxiety than the control groups.

## An Exploratory Bio-Psycho-Familial Model of Specific Correlates for Eating Disorders

Once all the relevant variables were selected in the previous analyses, a bio-psycho-familial model was estimated (see **Table 5**). The complexity and thus the computational burden of the full model forced us to remove total cholesterol, IGFBP3, and mothers' state-anxiety from the full model. The most relevant variables of this full model were selected by a stepwise model selection using the AIC indices. This model was composed by biological, psychological and familial correlates that explained a considerable part of the variance of the dependent variable ($R^2 = 0.44$). In the case of biological correlates, the reduction in T3 was relevant to differentiate between case-control groups. In the case of familial correlates, we found that the ED group was more exposed to fathers' emotional over-involvement, and less exposed to fathers' depression and mothers' trait-anxiety, compared to control groups. In the case of psychological correlates, we found that the ED group reported more drive for thinness and self-oriented perfectionism, and that they reported less trait-anxiety and socially prescribed perfectionism, compared to the control groups.

# DISCUSSION

To our knowledge, this is the first study to use three specific control groups, with standardized interviews for all the participants, collecting wide variety of data that included the capture of family functioning from both parents' perspectives. Furthermore, ED patients were recruited at the onset of their illness, something that helped us to identify specific correlates associated with the development of an ED, in order to generate an exploratory bio-psychological-familial model.

Regarding biological variables, the biochemical variables vitamin B12 and total cholesterol, as well as the neuroendocrine variables T3, IGF1, IGFBP, and adiponectin, were relevant to differentiate the ED group with the control groups. However, when all the biological variables were considered conjointly, all these variables except vitamin B12 and adiponectin, appeared with free T4 to be the most relevant specific correlates associated

**TABLE 4 |** Descriptive analyses and conditional logistic regressions for family correlates.

| | Descriptive analyses | | | | Conditional logistic regression | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ED (*N* = 50) | AD (*N* = 40) | AP (*N* = 40) | NP (*N* = 50) | Individual correlate | | | Stepwise model selection | | |
| | M (SD) | M (SD) | M (SD) | M (SD) | OR | 95% IC | *z* | OR | 95% IC | *z* |
| **Father** | | | | | | | | | | |
| EE: criticism (FQ-CC) | 19.89 (3.77) | 22.41 (4.96) | 19.70 (5.28) | 18.03 (4.53) | 1.09 | 0.70–1.70 | 0.40 | 0.39 | 0.17–0.89 | −2.25* |
| EE: emotional over-involvement (FQ-EOI) | 26.66 (3.83) | 26.30 (5.26) | 19.91 (4.70) | 18.51 (3.77) | 3.29 | 1.82–5.92 | 3.96** | 7.94 | 2.72–23.19 | 3.79** |
| Cohesion (FACES) | 66.75 (9.70) | 58.67 (7.70) | 68.04 (6.66) | 64.33 (7.48) | 1.28 | 0.88–1.87 | 1.28 | – | – | – |
| Adaptability (FACES) | 52.95 (5.78) | 50.26 (6.54) | 52.04 (6.53) | 51.26 (6.26) | 1.26 | 0.86–1.86 | 1.19 | – | – | – |
| Depression (BDI) | 5.34 (4.21) | 10.89 (11.04) | 4.68 (4.13) | 3.59 (2.85) | 0.96 | 0.66–1.40 | −0.20 | 0.23 | 0.06–0.80 | −2.32* |
| Anxiety-state (STAI-S) | 21.16 (9.07) | 24.0 (13.21) | 14.32 (9.75) | 13.28 (6.66) | 1.54 | 1.08–2.21 | 2.36[a] | 2.12 | 0.84–5.34 | 1.59 |
| Anxiety-trait (STAI-T) | 14.56 (5.96) | 20.04 (12.19) | 15.16 (7.60) | 11.41 (6.25) | 1.02 | 0.72–1.47 | 0.13 | – | – | – |
| Obsessive symptoms (OCI-R) | 11.39 (8.24) | 15.19 (12.03) | 12.20 (9.65) | 11.56 (6.68) | 0.94 | 0.63–1.42 | −0.28 | – | – | – |
| **Mother** | | | | | | | | | | |
| EE: criticism (FQ-CC) | 18.73 (4.26) | 22.73 (5.87) | 20.11 (5.25) | 18.35 (4.58) | 0.78 | 0.55–1.11 | −1.36 | 0.20 | 0.07–0.58 | −2.93** |
| EE: emotional over-involvement (FQ-EOI) | 25.92 (3.25) | 26.30 (5.71) | 21.16 (4.19) | 17.79 (3.19) | 2.20 | 1.50–3.22 | 4.01** | 5.52 | 1.96–15.54 | 3.24** |
| Cohesion (FACES) | 67.33 (9.57) | 63.19 (8.67) | 70.11 (6.91) | 66.75 (6.91) | 1.03 | 0.74–1.44 | 0.16 | 0.57 | 0.26–1.21 | −1.46 |
| Adaptability (FACES) | 52.83 (6.21) | 51.25 (7.94) | 52.24 (6.06) | 52.27 (4.83) | 1.17 | 0.83–1.65 | 0.88 | – | – | – |
| Depression (BDI) | 7.92 (3.71) | 11.32 (7.34) | 7.62 (7.30) | 5.29 (4.38) | 1.06 | 0.75–1.50 | 0.32 | 0.46 | 0.18–1.22 | −1.56 |
| Anxiety-state (STAI-S) | 26.75 (9.017) | 26.43 (11.49) | 17.51 (8.88) | 16.40 (7.95) | 2.00 | 1.37–2.91 | 3.62** | 6.09 | 2.12–17.53 | 3.35** |
| Anxiety-trait (STAI-T) | 17.50 (8.19) | 23.57 (10.37) | 18.74 (9.78) | 17.12 (8.82) | 0.79 | 0.55–1.15 | −1.23 | 0.17 | 0.05–0.56 | −2.92** |
| Obsessive symptoms (OCI-R) | 11.04 (10.87) | 15.95 (9.19) | 12.77 (8.38) | 11.34 (7.86) | 0.75 | 0.51–1.10 | −1.47 | – | – | – |

*ED, eating disorders; AD, affective disorder; AP, asthma pathology; NP, non-pathology group; EE, expressed emotion; N, sample size; M, mean; SD, standard deviation; OR, odds ratio; Individual correlate, conditional logistic regression for each variable; Stepwise model selection, selected correlates for the model using AIC indices (empty cells mean that the variable was excluded in the model).*

[a] *z-value is statistically significant, but its statistical significance was corrected for multiple comparisons.*

**p < 0.05; **p < 0.01.*

*Statistical significance of individual correlates was corrected using Holm–Bonferroni correction for multiple comparisons.*

with the onset of an ED. These are all endocrine variables directly related to energy availability for metabolic functions. T3 and Free T4 are usually low in AN patients in order to decrease energy requirements, while IGF-1 is a hormone produced in many cells in response to the growth hormone, it has widespread metabolic functions and is greatly involved in the adaptation to starvation (Misra and Klibanski, 2014). IGF-1 has been shown to decrease in acute stages of AN, IGFBP-1 is increases, and IGFBP-3 levels are less clear. The high levels of cholesterol has been related to the decrease of T3 and T4 (Matzkin et al., 2007; Himmerich et al., 2019). In addition, a trend toward the normalization of these molecules with anthropometrical recovery has been shown (Støving et al., 2007). Thus, it appears that these molecules are good correlates to identify ED patients with a low BMI who have been recently diagnosed, and are, thus, under the effects of maintained restrictive behaviors. However, their usefulness as a potential predictor is low since their alteration is believed to be secondary to malnutrition.

The psychological correlates that have shown to be specific correlates for ED were drive for thinness, body dissatisfaction, and self-oriented perfectionism. However, when all the psychological variables were considered conjointly, the role of body dissatisfaction was not maintained and other correlates, such as obsessive symptoms, anxiety, and socially prescribed perfectionism, appeared as important correlates. Whereas body dissatisfaction was found as an important predictor for ED (Stice et al., 2011), it could also act as a predictor for an affective disorder (Ferreiro et al., 2011; Bornioli et al., 2021). In addition, their prevalence is high in adolescence (Stice, 2002) and mainly in females (Al Sabbah et al., 2009), and it appears to not be a specific correlate. Furthermore, other researchers' findings underline the role of perfectionism in ED (Fairburn et al., 1999; Pike et al., 2008; Machado et al., 2014), similar to our findings. Nevertheless, an important difference was found between self-oriented perfectionism and socially prescribed perfectionism. Castro-Fornieles et al. (2007) found that self-oriented perfectionism was more specific for EDs and socially prescribed perfectionism appeared in similar levels in other psychiatric disorders.

On the other hand, emotional over-involvement of both parents and mother state-anxiety emerged as specific familial correlates for an ED. When all the familial variables were considered conjointly, the reduction of both parents' criticism, fathers' depression and mothers' trait-anxiety appeared as specific correlates for ED. These results may suggest that psychological

**TABLE 5 |** Conditional logistic regressions to determine a bio-psycho-familial model of correlates for eating disorders.

| | Conditional logistic regression | | | | | |
|---|---|---|---|---|---|---|
| | Full model | | | Stepwise model selection | | |
| | OR | 95% IC | *z* | OR | 95% IC | *z* |
| **Biological correlates** | | | | | | |
| T3 | 0.84 | 0.70–1.02 | −1.77[t] | 0.87 | 0.78–0.98 | −2.40* |
| Free T4 | 0.93 | 0.78–1.11 | −0.77 | – | – | – |
| IGF-1 | 0.99 | 0.98–1.01 | −0.91 | – | – | – |
| **Familial correlates** | | | | | | |
| **Father** | | | | | | |
| Criticism | 0.77 | 0.38–1.56 | −0.72 | – | – | – |
| Emotional over-involvement | 5.38 | 0.93–31.22 | 1.88[t] | 2.74 | 1.24–6.04 | 2.50* |
| Depression | 0.34 | 0.10–1.09 | −1.82[t] | 0.50 | 0.25–0.98 | −2.02* |
| **Mother** | | | | | | |
| Criticism | 1.32 | 0.77–2.27 | 1.01 | – | – | – |
| Emotional over-involvement | 0.91 | 0.67–1.24 | −0.60 | – | – | – |
| Trait-anxiety | 0.70 | 0.45–1.07 | −1.65[t] | 0.82 | 0.67–0.98 | −1.99* |
| **Psychological correlates** | | | | | | |
| Drive for thinness | 1.40 | 0.95–2.07 | 1.68[t] | 1.38 | 1.05–1.80 | 2.35* |
| Body dissatisfaction | 1.00 | 0.95–1.05 | −0.02 | – | – | – |
| Trait-anxiety | 0.80 | 0.61–1.05 | −1.61 | 0.81 | 0.67–0.99 | −2.07* |
| Self-directed perfectionism | 1.30 | 1.00–1.70 | 1.95[t] | 1.21 | 1.03–1.43 | 2.31* |
| Socially prescribed perfectionism | 0.65 | 0.42–1.01 | −1.91[t] | 0.76 | 0.60–0.96 | −2.30* |

*OR, odds ratio; Full model, conditional logistic regression with all the variables; Stepwise model selection, selected correlates for the model using AIC indices ("–" means that the variable was excluded in the model).*
*[t]$p < 0.10$.*
**$p < 0.05$.*
*Given the complexity of the full model, missing data was imputed with the mean of each group to estimate both models.*

distress (characterized by severe depression and trait-anxiety) and high expressed emotion of family members may be associated with an ED, consistent with the review done by Zabala et al. (2009). Likewise, the difference in the dimensions of expressed emotion is in accordance with the tendency of higher levels of EE-EOI compared to EE-CC in families with an ED, a finding which was reported by Anastasiadou et al. (2016).

The exploratory bio-psychological-familial model showed that the increase of fathers' EOI, patients' drive of thinness and self-oriented perfectionism together with the decrease of T3, anxiety and socially prescribed perfectionism of the adolescents as well as the decrease of fathers' depression and mothers' anxiety were specifically associated to the onset of an ED. The fathers' EOI appeared as a robust specific correlate, in contrast to a recent systematic review which proposed that mothers were more emotionally over-involved than fathers, who tend to be more critical (Anastasiadou et al., 2014). However, in this review several studies did not include comparison groups. In our research, mothers of the AD group showed higher levels of emotional over-involvement as well as fathers for the AD group showed higher levels of criticism compared to parents with ED. It seems that in the ED group, fathers play an important role, which can differentiate this group from other control groups even better than mothers, suggesting that future research should include them in the assessment.

These results also contrast with the studies that have suggested that familial factors are non-specific factors for the onset of an ED (Le Grange et al., 2010; Herpertz-Dahlmann et al., 2011; Machado et al., 2014). Indeed, some authors have emphasized the possibility that these factors would be an accommodation to the illness rather than predisposing factors that explain it (Le Grange et al., 2010). Regardless of their role, expressed emotion is a potential prognostic indicator, that is stable in periods of up to 2 years and that predicts poor outcomes for treatment (Peris and Miklowitz, 2015). Further studies are needed in order to clarify the role of familial correlates in ED.

In addition, the decrease of fathers' levels of depression and mothers' trait anxiety followed a similar tendency as the adolescents' decreased in the trait-anxiety. Several studies have examined the similarities between the negative affectivity dimension and the factors measured by BDI or STAI scales, and have concluded that they should be considered as a measure of general negative affect (Balsamo et al., 2013). Therefore, our findings do not support the centrality of negative affectivity as a specific correlate for ED, in concordance with similar recent studies that have considered it as a general psychopathological risk factor (Jacobi and Fittig, 2012; Machado et al., 2014).

Lastly, two psychological variables, perfectionism and drive for thinness, and one biological variable, T3, appeared to be

specific correlates associated with the onset of an ED. The literature broadly supports the role of these variables. Indeed, a recent study has revealed that Free-T3 is a specific and sensitive correlate in distinguishing constitutional thinness and AN groups, showing significantly lower values in the latter with similar BMI between groups (Estour et al., 2017). Thus, although the low levels are thought to normalize with weight gain, evidence shows its relevance in AN patients and therefore, an early assessment in adolescents with a suspected ED is advisable.

The current study presents several limitations. Firstly, the cross-sectional case-control nature of the study does not allow inferring causality. However, Jacobi et al. (2004) suggested that using a case-control study is a good way to analyze correlates in a wide sample that can then be contrasted in a longitudinal study. Secondly, we only considered patients with a maximum of a 1-year course in order to reduce bias due to retrospective recall, although some of them had a history of a previous psychiatric disorders. Consequently, the involvement of other informants, such as parents, is important to contrast the information given by the adolescents. Thirdly, females with high socioeconomic status were predominant in this sample. Although it may be a limitation for the generalization of the results, high socioeconomic status is also frequent in EDs (Striegel-Moore and Bulik, 2007), and matching for parental socioeconomic status reduces differences in family experiences related to the availability of resources.

To summarize, this study proposes a complex model, which shows the importance of different correlates that are associated with the onset of an ED, although our findings require further research that can be contrasted in longitudinal studies and assessed in comparison with other control groups in order to confirm the specificity of the correlates. Most of the correlates found in this study are a replication of previously found risk factors in the literature, whereas the specificity and their relation have not been fully investigated. All of the participants have been assessed with reliable measures (blood test, clinical interview, and questionnaires). In our bio-psycho-familial model, eight correlates were specifically related to ED, therefore, the study confirms the importance of these three types of variables, which could be the target of future prevention and treatment interventions.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by approval was granted by the Ethic Committee of the Niño Jesús University Children's Hospital (Ref Code. R-0009/10) and by the Autonomous University of Madrid Ethic Research Committee (UAM, CEI 25-673). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

AS, EN, AM, JV-A, EM, and MG contributed to conception and design of the study. DA, SG-M, and AM organized the database. JMH performed the statistical analysis. AM wrote the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

## FUNDING

This work was supported by the Spanish Ministry of Science and Innovation (RYC-2009-05092 and PSI2011-23127) and the Education Ministry of Spain (FPU15/05783).

## ACKNOWLEDGMENTS

We express our gratitude to all the families, staff hospital, and psychiatrists from the Mental Health Centers who helped us in the recruitment process. Likewise, we are very grateful to the headmasters and teachers from this three Secondary Schools: IES La Estrella, IES Las Musas, and IES Alameda de Osuna, that facilitated the recruitment stage. We would finally like to express our gratitude to T. Alvarez, L. Gonzalez, and C. Bustos.

## REFERENCES

Al Sabbah, H., Vereecken, C. A., Elgar, F. J., Nansel, T., Aasvee, K., Abdeen, Z., et al. (2009). Body weight dissatisfaction and communication with parents among adolescents in 24 countries: international cross-sectional survey. *BMC Public Health* 9:52. doi: 10.1186/1471-2458-9-52

American Psychiatric Association (APA). (2013). *The Diagnostic and Statistical Manual of Mental Disorders*, 5th Edn. Arlington: American Psychiatric.

Anastasiadou, D., Medina-Pradas, C., Sepulveda, A. R., and Treasure, J. (2014). A systematic review of family caregiving in eating disorders. *Eat. Behav.* 15, 464–477. doi: 10.1016/j.eatbeh.2014.06.001

Anastasiadou, D., Sepulveda, A. R., Sánchez, J. C., Parks, M., Álvarez, T., and Graell, M. (2016). Family functioning and quality of life among families in eating disorders: a comparison with substance-related disorders and healthy controls. *Eur. Eat. Disord. Rev.* 24, 294–303. doi: 10.1002/erv.2440

Bakalar, J. L., Shank, L. M., Vannucci, A., Radin, R. M., and Tanofsky-Kraff, M. (2015). Recent Advances in Developmental and Risk Factor Research on Eating Disorders. *Curr. Psychiatry Rep.* 17:42. doi: 10.1007/s11920-015-0585-x

Balsamo, M., Romanelli, R., Innamorati, M., Ciccarese, G., Carlucci, L., and Saggino, A. (2013). The state-trait anxiety inventory: shadows and lights on its construct validity. *J. Psychopathol. Behav. Assess.* 35, 475–486. doi: 10.1007/s10862-013-9354-5

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., and Erbaugh, J. (1961). An inventory for measuring depression. *Arch. Gen. Psychiatry* 4, 561–571. doi: 10.1001/archpsyc.1961.01710120031004

Berg, C. J., Rapoport, J. L., and Flament, M. (1986). The Leyton Obsessional Inventory-Child Version. *J. Am. Acad. Child Psychiatry* 25, 84–91. doi: 10.1016/S0002-7138(09)60602-6

Bornioli, A., Lewis-Smith, H., Slater, A., and Bray, I. (2021). Body dissatisfaction predicts the onset of depression among adolescent females and males: a prospective study. *J. Epidemiol. Community Health* 75, 343–348. doi: 10.1136/jech-2019-213033

Castro-Fornieles, J., Gual, G., Lahortiga, F., Gila, A., Casulà, V., Fuhrmann, C., et al. (2007). Self-Oriented Perfectionism in Eating Disorders. *Int. J. Eat. Disord.* 40, 562–658.

Cooper, P., Taylor, M. J., Cooper, Z., and Fairbum, C. (1987). The development and validation of the body shape questionnaire. *Int. J. Eat. Disord.* 6, 485–494. doi: 10.1002/1098-108X(198707)6:4<485::AID-EAT2260060405<3.0.CO;2-O

Culbert, K. M., Racine, S. E., and Klump, K. L. (2015). Research Review: what we have learned about the causes of eating disorders - A synthesis of sociocultural, psychological, and biological research. *J. Child Psychol. Psychiatry Allied Discip.* 56, 1141–1164. doi: 10.1111/jcpp.12441

Dakanalis, A., Clerici, M., Bartoli, F., Caslini, M., Crocamo, C., Riva, G., et al. (2017). Risk and maintenance factors for young women' s DSM-5 eating disorders. *Arch. Womens. Ment. Health* 20, 721–731. doi: 10.1007/s00737-017-0761-6

Elegido, A., Graell, M., Andrés, P., Gheorghe, A., Marcos, A., and Nova, E. (2017). Increased naive CD4+ and B lymphocyte subsets are associated with body mass loss and drive relative lymphocytosis in anorexia nervosa patients. *Nutr. Res.* 39, 43–50. doi: 10.1016/j.nutres.2017.02.006

Estour, B., Marouani, N., Sigaud, T., Lang, F., Fakra, E., Ling, Y., et al. (2017). Differentiating constitutional thinness from anorexia nervosa in DSM 5 era. *Psychoneuroendocrinology* 84, 94–100. doi: 10.1016/j.psyneuen.2017.06.015

Fairburn, C. G., Cooper, Z., Doll, H. A., and Welch, S. L. (1999). Risk Factors for Anorexia Nervosa. *Arch. Gen. Psychiatry* 56, 468–476.

Ferreiro, F., Seoane, G., and Senra, C. (2011). A prospective study of risk factors for the development of depression and disordered eating in adolescents. *J. Clin. Child Adolesc. Psychol.* 40, 500–505. doi: 10.1080/15374416.2011.563465

Flett, G. L., Hewitt, P. L., Besser, A., Su, C., Vaillancourt, T., Boucher, D., et al. (2000). The Child-Adolescent Perfectionism Scale. *J. Psychoeduc. Assess.* 34, 634–652. doi: 10.1177/0734282916651381

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The Obsessive-Compulsive Inventory: development and validation of a short version. *Psychol. Assess.* 14:485. doi: 10.1037/1040-3590.14.4.485

Garner, D. M. (1991). *Eating Disorder Inventory-2 Professional Manual*. Odessa: Psychological Assessment Resources.

Gonçalves, S., Machado, B. C., Martins, C., Hoek, H. W., and MacHado, P. P. P. (2016). Retrospective Correlates for Bulimia Nervosa: a Matched Case-Control Study. *Eur. Eat. Disord. Rev.* 24, 197–205. doi: 10.1002/erv.2434

Herpertz-Dahlmann, B., Seitz, J., and Konrad, K. (2011). Aetiology of anorexia nervosa: from a "' psychosomatic family model "' to a neuropsychiatric disorder? *Eur. Arch. Psychiatry Clin. Neurosci.* 261, 177–181. doi: 10.1007/s00406-011-0246-y

Hilbert, A., Pike, K. M., Goldschmidt, A. B., Wilfley, D. E., Fairburn, C. G., Dohm, F. A., et al. (2014). Risk factors across the eating disorders. *Psychiatry Res.* 220, 500–506. doi: 10.1016/j.psychres.2014.05.054

Himmerich, H., Bentley, J., Kan, C., and Treasure, J. (2019). Factores de riesgo genéticos para los trastornos alimentarios: una actualización e información sobre la fisiopatología. *Rev. Toxicom.* 82, 3–18.

Hollingshead, A. B., and Redlich, F. C. (1953). Social Stratification and Psychiatric Disorders. *American Sociological Rev.* 18, 163–169.

Jacobi, C., and Fittig, E. (2012). *Psychosocial Risk Factors for Eating Disorders*. doi: 10.1093/oxfordhb/9780195373622.013.0008

Jacobi, C., Hayward, C., De Zwaan, M., Kraemer, H. C., and Agras, W. S. (2004). Coming to Terms With Risk Factors for Eating Disorders: application of Risk Terminology and Suggestions for a General Taxonomy. *Psychol. Bull.* 130, 19–65. doi: 10.1037/0033-2909.130.1.19

Kaufman, J., Birmaher, B., Brent, D., Rao, U. M. A., Flynn, C., Moreci, P., et al. (1997). Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. *J. Am. Acad. Child Adolesc. Psychiatry* 36, 980–998. doi: 10.1097/00004583-199707000-00021

Keel, P. K., and Forney, K. J. (2013). Psychosocial Risk Factors for Eating Disorders. *Int. J. Eat. Disord.* 46, 433–439.

Kluck, A. S. (2010). Family influence on disordered eating: the role of body image dissatisfaction. *Body Image* 7, 8–14. doi: 10.1016/j.bodyim.2009.09.009

Klump, K. L., Bulik, C. M., Pollice, C., Halmi, K. A., Fichter, M. M., Berrettini, W. H., et al. (2000). Temperament and character in women with anorexia nervosa. *J. Nervous Ment. Dis.* 188, 559–567.

Kovacs, M. (1992). *Children's Depression Inventory CDI Manua*. New York: Multi-Health Systems.

Kraemer, H. C., Kazdin, A. E., and Offord, D. E. (1997). Coming to Terms With the Terms of Risk. *Arch. Gen. Psychiatry* 54, 337–343. doi: 10.1001/archpsyc.1997.01830160065009

Le Grange, D., Lock, J., Loeb, K., and Nicholls, D. (2010). Academy for eating disorders position paper: the role of the family in eating disorders. *Int. J. Eat. Disord.* 43, 1–5. doi: 10.1002/eat.20751

Machado, B. C., Gonçalves, S. F., Martins, C., Hoek, H. W., and Machado, P. P. (2014). Risk factors and antecedent life events in the development of anorexia nervosa: a Portuguese case-control study. *Eur. Eat. Disord. Rev.* 22, 243–251. doi: 10.1002/erv.2286

Matzkin, V., Slobodianik, N., Pallaro, A., Bello, M., and Geissler, C. (2007). Risk factors for cardiovascular disease in patients with anorexia nervosa. *Int. J. Psychiatr. Nurs. Res.* 13, 1531–1545.

Misra, M., and Klibanski, A. (2014). Endocrine Consequences of Anorexia Nervosa Madhusmita. *Lancet Diabetes Endocrinol.* 2, 581–592. doi: 10.1016/S2213-8587(13)70180-3

Monteleone, P., and Maj, M. (2013). Dysfunctions of leptin, ghrelin, BDNF and endocannabinoids in eating disorders: beyond the homeostatic control of food intake. *Psychoneuroendocrinology* 38, 312–330. doi: 10.1016/j.psyneuen.2012.10.021

Neumark-Sztainer, D. R., Wall, M. M., Haines, J. I., Story, M. T., Sherwood, N. E., and van den Berg, P. A. (2007). Shared Risk and Protective Factors for Overweight and Disordered Eating in Adolescents. *Am. J. Prev. Med.* 33, 359–369. doi: 10.1016/j.amepre.2007.07.031

Nicholls, D. E., Lynn, R., and Viner, R. M. (2011). Childhood eating disorders: british national surveillance study. *Br. J. Psychiatry* 198, 295–301. doi: 10.1192/bjp.bp.110.081356

Olson, D. H., Portner, J., and Bell, R. Q. (1982). *FACES II: family Adaptability and Cohesion Evaluation Scales*. United States: University of Minnesota.

Parks, M., Anastasiadou, D., Sánchez, J. C., Graell, M., and Sepulveda, A. R. (2017). Experience of caregiving and coping strategies in caregivers of adolescents with an eating disorder: a comparative study. *Psychiatry Res.* 260, 241–247. doi: 10.1016/j.psychres.2017.11.064

Peris, T. S., and Miklowitz, D. J. (2015). Parental Expressed Emotion and Youth Psychopathology: new Directions for an Old Construct. *Child Psychiatry Hum. Dev.* 46, 863–873. doi: 10.1007/s10578-014-0526-7

Pike, K. M., Hilbert, A., Wilfley, D. E., Fairburn, C. G., Dohm, F. A., Walsh, B. T., et al. (2008). Toward an understanding of risk factors for anorexia nervosa: a case-control study. *Psychol. Med.* 38, 1443–1453. doi: 10.1017/S0033291707002310

Sepúlveda, A. R., Anastasiadou, D., Rodríguez, L., Almendros, C., Andrés, P., Vaz, F., et al. (2014). Spanish validation of the Family Questionnaire (FQ) in families of patients with an eating disorder. *Psicothema* 26, 321–327. doi: 10.7334/psicothema2013.310

Sepúlveda, A. R., Graell, M., Berbel, E., Anastasiodou, D., Botella, J., Carrobles, J. A., et al. (2012). Factors Associated with Emotional Wellbeing in Primary and Secondary Caregivers of Patients with Eating Disorders. *Eur. Eat. Dis. Rev.* 20, e78–84. doi: 10.1002/erv.1118

Sepulveda, A. R., Moreno-Encinas, A., Nova, E., Gomez, S., Carrobles, J. A., and Graell, M. (2021). Biological, psychological and familial specific correlates in eating disorders at onset: a control-case study protocol (ANOBAS). *Actas Esp. Psiquiatr.*

Spielberger, C. D., Edwards, C. D., Lushene, R. E., Montuori, J., and Platzek, A. (1973). *State-Trait Anxiety Inventory for Children*. Palo Alto: Consulting Psychologists Press.

Spielberger, C. D., Gorsuch, R., and Lushene, R. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto: Consulting Psychologist Press.

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol. Bull.* 128, 825–848. doi: 10.1037/0033-2909.128.5.825

Stice, E., Marti, C. N., and Durant, S. (2011). Risk factors for onset of eating disorders: evidence of multiple risk pathways from an 8-year prospective study. *Behav. Res. Ther.* 49, 622–627. doi: 10.1016/j.brat.2011.06.009

Støving, R. K., Chen, J. W., Glintborg, D., Brixen, K., Flyvbjerg, A., Hørder, K., et al. (2007). Bioactive Insulin-like Growth Factor (IGF) I and IGF-binding protein-1 in anorexia nervosa. *J. Clin. Endocrinol. Metab.* 92, 2323–2329. doi: 10.1210/jc.2006-1926

Striegel-Moore, R. H., and Bulik, C. M. (2007). Risk Factors for Eating Disorders. *Am. Psychol.* 62, 181–198. doi: 10.1037/0003-066X.62.3.181

Theodoratou-Bekou, M., Andreopoulou, O., Andriopoulou, P., and Wood, B. (2012). Stress-related asthma and family therapy: case study. *Ann. Gen. Psychiatry* 11, 1–10. doi: 10.1186/1744-859X-11-28

Treasure, J., Duarte, T. A., and Schmidt, U. (2020). Eating disorders. *Lancet* 395, 899–911. doi: 10.1016/S0140-6736(20)30059-3

Treasure, J., Sepúlveda, A. R., Macdonald, P., Whitaker, W., Lopez, C., Zabala, M., et al. (2008). The assessment of the family of people with eating disorders. *Eur. Eat. Dis. Rev.* 16, 247–255. doi: 10.1002/erv.859

Verkleij, M., Van De Griendt, E.-J., Colland, V., Van Loey, N., Beelen, A., and Geenen, R. (2015). Parenting Stress Related to Behavioral Problems and Disease Severity in Children with Problematic Severe Asthma. *J. Clin. Psychol. Med.* 22, 179–93. doi: 10.1007/s10880-015-9423-x

Wiedemann, G., Rayki, O., Feinstein, E., and Hahlweg, K. (2002). The Family Questionnaire: development and validation of a new self-report scale for assessing expressed emotion. *Psychiatry Res.* 109, 265–279. doi: 10.1016/S0165-1781(02)00023-9

Zabala, M. J., Macdonald, P., and Treasure, J. (2009). Appraisal of caregiving burden, expressed emotion and psychological distress in families of people with eating disorders: a systematic review. *Eur. Eat. Disord. Rev.* 17, 338–349. doi: 10.1002/erv.925

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frontiers in Psychology

METHODS
published: 22 October 2021
doi: 10.3389/fpsyg.2021.697916

# Adaptation and Implementation of an Intervention Programme on Spanish Carers and Adolescent Patients With an Eating Disorder: Study Protocol of a Randomized Controlled Trial

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OPEN ACCESS

**Edited by:**
*Ana Rosa Sepúlveda, Autonomous University of Madrid, Spain*

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**Specialty section:**
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

**Received:** *20 April 2021*
**Accepted:** *20 September 2021*
**Published:** *22 October 2021*

**Citation:**
*Quiles Y, Quiles MJ, León EM, Roncero M, Ruiz Á, España M, Romero C and Elvira V (2021) Adaptation and Implementation of an Intervention Programme on Spanish Carers and Adolescent Patients With an Eating Disorder: Study Protocol of a Randomized Controlled Trial. Front. Psychol. 12:697916. doi: 10.3389/fpsyg.2021.697916*

**Introduction:** One of the major problems with inpatient treatment of adolescent girls with an eating disorder (ED) is that the strategies learned during their hospital stay are not easily applied or maintained in their daily lives, and this has been related to high rates of relapse and readmission. The ECHOMANTRA programme was developed to optimize outcomes during and following inpatient or day-patient treatment. ECHOMANTRA is based on interventions for carers (Experienced Carers Helping Others, ECHO) and patients (Maudsley Model of Anorexia Nervosa Treatment for Adults, MANTRA) and is developed from the cognitive interpersonal model of anorexia (Schmidt and Treasure, 2006; Treasure and Schmidt, 2013). This study aims to describe the study protocol of a randomized controlled trial (RCT) for evaluating the efficacy of an adaptation of a novel intervention for patients and carers (ECHOMANTRA) to be implemented as an add-on to treatment-as-usual (TAU).

**Method:** In a multi−center pilot RCT, 80 female adolescent patients with a DSM-5 diagnosis of an ED and their carers will be invited to participate in the study. They will then be randomized to receive either the ECHOMANTRA intervention as an add-on to TAU or TAU alone. A repeated measures design will be conducted across four time points. Primary outcomes will be patient psychological well-being and eating disorder symptoms, and secondary outcomes will include body mass index, obsessive-compulsive symptoms, perfectionism, motivation to change and psychosocial adjustment. For carers, outcome variables will include psychological well-being, expressed emotion, accommodation and enabling behaviors, burden, and care skills.

**Discussion:** The results from this trial will establish the effectiveness of ECHOMANTRA and may reveal whether and to what extent this novel intervention can optimize outcomes during and following inpatient treatment. This study will also provide the adaptation of the ECHOMANTRA in the Spanish context for inpatient/day-care treatment.

**Keywords: eating disorders, adolescents, skills sharing, carer skills, randomized controlled trial**

## INTRODUCTION

Eating disorders (ED) are extremely complex multi-causal mental health illnesses, which have serious medical complications and especially affect adolescents and young women (López and Treasure, 2011). The most frequent diagnosis in adolescents is Other Specified Feeding and Eating Disorder (OSFED) followed by Anorexia Nervosa (AN) and finally Bulimia Nervosa (BN) (Swanson et al., 2011). These disorders are characterized by serious symptoms as well as a high degree of comorbidity and mortality (Nordbo et al., 2012; Saldaña et al., 2014; Fichter and Quadflieg, 2016); consequently, patients need to be hospitalized on many occasions. One of the major problems with hospital treatment is that although these patients learn strategies during their hospital stay, they have difficulty in being able to apply and maintain them in their daily lives. As a result, there is a high rate of relapses and readmissions, which have been related to resistance to treatment, low motivation to change, severe pretreatment caloric restriction, low body mass index and higher occupational and social stress (Fairburn, 2008; Kaplan et al., 2009; Grilo et al., 2012; Hoang et al., 2014; Morris et al., 2015; Vall and Wade, 2015). A recent meta-analysis study found that the risk of relapse is especially high during the first year after the end of treatment (Berends et al., 2018; Khalsa et al., 2017). High relapse rates reveal the need to optimize patient treatments after hospital admissions by supporting inpatient/day care and community transition through promising targeted psychological interventions (Bryan et al., 2021).

In response to this, Dr. Janet Treasure's team developed the ECHOMANTRA intervention programme, as a means of facilitating the transition from inpatient hospital treatment to daily life and to the community (Treasure and Schmidt, 2013; Treasure et al., 2015; Cardi et al., 2017). This programme is based on scientific evidence that demonstrates that interventions directed at these patients as well as their carers improve the outcomes in these patients' health. Involving the family in the treatment of ED is a key strategy in their recovery and it also strengthens patients' social networks and eliminates their isolation and loneliness, which contribute to maintaining the disorder (Levine, 2012; Treasure and Nazar, 2016; Sepúlveda et al., 2020). A study was recently published with the preliminary results of ECHOMANTRA intervention with AN inpatients and their carers in the United Kingdom (Adamson et al., 2019). A case series study was employed using a mixed-methods approach to measure the feasibility and efficacy of augmenting intensive hospital treatment with ECHOMANTRA. Results showed that patients' symptomatology improved after the ECHOMANTRA intervention and was maintained in the follow-up. In addition, there was a reduction in carer burden and an improvement in skills, so it was concluded that the efficiency of hospital attention for ED can be increased by preparing both patients and their carers for the transition after hospitalization.

ECHOMANTRA consists of an intervention programme for ED carers (ECHO; Experienced Carers Helping Others; Treasure et al., 2015) and another programme for patients (MANTRA, Schmidt et al., 2014). MANTRA is recommended for the treatment of adults outpatients with AN (National Institute for Health and Care Excellence [NICE], 2017). It is based on the Cognitive Interpersonal Maintenance model of AN (Schmidt et al., 2014), which was developed as a proposed theoretical framework that would synthesize the most important internal and interpersonal maintaining factors of this disorder. MANTRA intervenes in the emotional regulation and eating behavior of these patients, putting a special emphasis on behavior change strategies. This programme focuses on the steps that will help patients thrive in their transition from inpatient care to daily life as well as generating cognitive and behavior changes and strengthening relationships with their family and social groups. It is a flexible treatment programme which directly involves patients in the therapeutic process. To date, it has not been applied to adolescents with an ED; however, some of its characteristics might be especially beneficial to them. In fact, it has been published the study protocol of a recent research that analyses the feasibility, acceptability and efficacy of the MANTRA treatment programme for adolescents patients (Wittek et al., 2021). MANTRA includes content that is prevalent and important to address across the spectrum of ED and in adolescent patients.

The ECHO part of the intervention focuses on carers. Based on the Model of Carer Coping (Treasure et al., 2003), this part of the programme reveals the different aspects that influence coping which can be problematic for carers as they represent sources of psychological distress. The programme provides assistance, support and training for carers to enable them to cope with their role. It teaches them how to reduce and manage their expressed emotion and symptom accommodation, and to deal with difficult and problematic situations that arise. In addition, ECHO teaches skills for positive communication and behavior change so carers will be able to support their loved ones in their recovery. Different studies using the ECHO have shown that the intervention in both the adult and adolescent groups led to a moderate reduction in time spent caring and also in bed use. Moreover, through this programme there was a small to moderate improvement in the wellbeing of both carers and patients in the intervention group (Hibbs et al., 2015a; Magill et al., 2016; Hodsoll et al., 2017). Our

research group applied an intervention programme based on the ECHO to carers of ED patients in Spain. The results obtained showed that carers who participated in the programme improved their levels of well-being, reducing carer burden, psychological distress, and expressed emotion. In addition, only patients whose carers participated in the programme reduced their levels of anxiety, depression, and psychological distress while no change occurred in patients whose carers participated in the control group (Pérez-Pareja et al., 2014; Quiles Marcos et al., 2018). A recent review study analyzing the effectiveness of treatments for carers of ED patients concluded that ECHO also provides an intervention that can reduce service costs (Treasure et al., 2021).

The aim of this paper is to describe the study protocol of a randomized control trial (RCT) aimed at evaluating the efficacy of a novel intervention for patients and carers, called ECHOMANTRA, adapted to be used as an add-on to treatment-as-usual (TAU; inpatient treatment or intensive day-care treatment) compared to TAU alone.

## Hypotheses

- Patients from the experimental group (TAU + ECHOMANTRA) will show significantly greater improvements in health outcomes (body mass index, ED symptoms, psychological well-being, psychosocial adjustment, perfectionism, obsessive-compulsive symptoms, motivation to change), and other efficacy indicators as readmission, in comparison to patients from the control group.
- The efficacy of the combined intervention (TAU + ECHOMANTRA) will be stable in the short (6 months) and middle term (9 months).
- Carers from the experimental group will present a better psychological well-being and lower illness accommodation, expressed emotion and burden in comparison to carers from the control group.
- Carers from the experimental group will have more ED carer skills in comparison to carers from the control group.

# METHODS AND ANALYSES

This study has been registered on the ISRCTN registry (Trial Identifier: ISRCTN43554732). CONSORT 2010 for parallel group randomized trials (Schulz et al., 2010) is specifically observed in reporting this trial.

## Study Design and Procedure

This is a multi-center, pilot, randomized, controlled, blind, superiority study with two parallels groups. Assignment to the control or experimental group will carry out using a computer-generated randomized sequence, with1:1 treatment allocation. The research assistant at each center will conduct a semi-structured interview to evaluate participants and confirm fulfillment of the inclusion/exclusion criteria. Patients who are receiving ED treatment (either as inpatients or day-patients) and fulfill the inclusion criteria, will be invited to participate in the study together with a carer. By "carer" we refer to someone who usually takes care of the patient outside the hospital/day-center and lives with her. Patients and carers will receive detailed information on the study and will be asked for a written informed consent to be able to participate. After submitting the consent form, participants will be invited to complete the baseline questionnaires and will then be randomly assigned to either (1) ECHOMANTRA in addition to TAU or (2) TAU only (see **Figure 1**). The ECHOMANTRA-guided skills-sharing intervention will include materials and eight online sessions (one per week) for carers and patients, while treatment duration will be 8 weeks.

## Participants

### Patients

Patients will be recruited from three different specialist inpatient/day-patient eating disorder units (Eating Disorders Inpatient Unit at the San Juan Hospital; CREA, Centre for emotional and nutritional recovery, Eating Disorders Day Centre; ADANER, Association for the defense of AN and BN care, Eating Disorders Day Centre). This study will involve adolescent girls who have received an eating disorder diagnosis according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria (American Psychiatric Association, 2013), including diagnoses of AN, BN, and OSFED. The inclusion criteria will be as follows: (1) aged between 12 and 19, (2) no psychiatric comorbidity, (3) receiving treatment for ED in a specialist inpatient/day-patient ED unit, (4) a family member willing to participate in the study and (5) ability to manage an electronic device (e.g., mobile phone, computer, laptop or tablet) and the Internet in order to access the online sessions, (6) a native Spanish speaker or understands native level Spanish. Patients will be asked to nominate a carer to whom the researcher will invite to participate in the trial. One carer per patient will be permitted, and this should be a primary carer, somebody who usually takes care of the patient outside the hospital/day-center and lives with her.

### Carers

For carers/family members the inclusion criteria will be as follows: (1) living with the patient and (2) not suffering from a serious medical or psychiatric condition (this information will be assessed through a self-report) and (3) ability to access an electronic device (e.g., mobile phone, computer, laptop or tablet) and the Internet in order to access the online sessions and (4) a native Spanish speaker or understands native level Spanish.

## Randomization

After screening and consent, patients and their carers will be randomized as a dyad using a randomized computer-generated sequence. A full randomization procedure macro will be applied saving the "seed" (SEED = 13012021) to reproduce the exact selection. Randomization will be facilitated by S. L., a colleague from the Behavioral Sciences and Health Department, who will

be not involved in this study. Once the allocation has been assigned, no changes can be made. Those randomized to the intervention arm (ECHOMANTRA plus TAU) will have access to the intervention materials.

## Sample Size

An intention-to-treat method will be used to calculate sample size, considering the hypotheses for the primary outcome variables. Power calculations will be based on power determination for longitudinal designs with attrition (Hedeker et al., 1999), an alpha of 0.05, four assessment points (with baseline serving as a covariate), dropout rate of 40% and a fixed autoregressive coefficient of 0.40. A group size of 40 patients per group would provide 80% power with a bilateral $p < 0.05$ to detect a clinically significant change in eating pathology (overall Eating Disorder Examination Questionnaire, EDE-Q, of 0.45 points), assuming a standard deviation of one for the overall EDE-Q change scores (Hedeker et al., 1999), and also to detect a difference in mean weight gain of one Body Mass Index (BMI) point, which, based on previous research, would be clinically important to detect (Agras et al., 2000; Byrne et al., 2017). Therefore, if a sample loss of approximately 40% is taken into account, the participation of at least 70 participants per group will be required.

## Interventions/Treatment Arms

### Treatment as Usual

We have chosen not to use a standardized comparison treatment as this would require practical changes in different settings and resource management (including training, supervision and quality control), which will not be feasible. We have therefore chosen to allow centers to follow their own procedures for TAU. We will stratify our analyses by center, which will be adjusted accordingly for any bias.

For TAU inpatient care, the Eating Disorder Unit at the San Juan Hospital will provide a programme using a multidisciplinary team approach (dietician, psychologist, physician and nurse). It will include monitoring of physical risks, nutritional rehabilitation, education on healthy eating and nutrition patterns. Besides it will try to modify/improve thoughts, attitudes, behaviors and feelings that maintain the illness through psychological therapy. Once a patient has stabilized and reached a healthy body mass index, she is discharged. She is then either followed up to assess her progress and to facilitate transition to home or she is referred to a day care center.

Treatment-as-usual in the day care centers (ADANER and CREA) will involve multidisciplinary treatment including dietetic support, psychological interventions, school education, and when appropriate, sessions with psychiatrists. Patients will receive the following psychological interventions: weekly individual cognitive behavioral therapy for eating disorders (CBT-ED); and psychoeducational group therapy on nutrition, emotion management, body image, social skills and problem-solving strategies. Usually, patients attend every day of the week (from Monday to Friday) for an average of 6 h. They receive psychological intervention sessions and they also make the different meals of the day. Parents/carers can also access a fortnightly parent support group.

The TAU-only (control condition) group will have no access to the intervention materials or the ECHOMANTRA intervention sessions. At the end of the study, individuals randomized to the TAU-only condition will be offered the self-help components of the intervention.

### Treatment-as-Usual Plus Patient and Carer Skills-Sharing Intervention (ECHOMANTRA)

In the experimental group, the adaptation of the ECHOMANTRA programme will be implemented. The contents of the intervention will be translated into the Spanish language and adapted to a Spanish-speaking cultural context.

#### *Patients*

Based on the interpersonal model of AN, the "MANTRA" part of the ECHOMANTRA intervention addresses patients' modifiable characteristics, such as difficulties in emotional regulation, interpersonal relationships and eating. The intervention includes a workbook with an emphasis on specific behavioral change strategies. The workbook is organized into eight chapters that correspond to the contents of the eight sessions of the programme.

MANTRA will involved eight, weekly, individual online sessions lasting 60 min, which will be delivered by assistant psychologists trained by the first and principal authors of the study (YQ and MJQ). During the sessions, the trained psychologist will encourage patients to reflect on the information and exercises proposed in the workbook. They will also carry out a series of activities taken from the MANTRA programme to further develop the contents included in the corresponding chapter of the workbook.

Each session will be themed following the structure of the patient workbook. Specifically, the focus of each session will be as follows: the first and second sessions will be on psychoeducation and motivation to change; the third session will be on skills to develop acceptance and self-compassion; the fourth and fifth sessions will be on skills to improve social functioning and to explore thinking styles; the sixth session will be on emotion management; and the seventh and eighth sessions will be on planning for the transition through goal setting, use of social support and implementation intentions.

For a more detailed description of the exercises, see Schmidt et al. (2014).

#### *Carers*

Carers allocated to the intervention group will receive a carer workbook.

ECHO will involve eight, weekly, individual online sessions, lasting 60 min, which will be delivered by assistant psychologists trained by the first and principal authors of the study (YM and MJS). During the sessions, the trained psychologist will encourage discussion about the information and exercises proposed in the workbook. In addition, for a deeper understanding of the contents of each session presented in the workbook, carers will read and do activities from the book "Skills based caring for a loved one with an eating disorder: The

New Maudsley Method" (Treasure et al., 2011). (Spanish version: Los trastornos de la alimentación: guía práctica para cuidar de un ser querido Treasure et al., 2011). These sessions will also include some of the video-clips from the Digital Versatile Disc (DVD) for carers "How to Care for Someone with an Eating Disorder"[1]. This DVD includes practical strategies and techniques to help carers develop skills and knowledge to help their loved one move toward recovery and to look after their own wellbeing by following the "New Maudsley Approach."

This book and the DVD are designed to help carers develop self-reflective skills in order to develop confidence, compassion and the courage to take risks. Both resources will show them how to experiment with changes in their caring behavior so they can be more helpful to a loved one suffering from an eating disorder.

The workbook and online sessions will provide a skills training programme that includes training in stress management, communication (based on motivational interviewing techniques), strategies to reduce accommodation and expressed emotion and to increase extinction training and new habits at home *via* effective social support.

## Outcomes

### Patients

This study will consider primary and secondary outcomes measured at the four evaluation points: baseline (T0), post-intervention (T1), 3-month follow-up (T2) and 6-month follow-up (T3).

[1]http://www.succeedfoundation.org/work/pre_order_dvd

The following will be assessed as primary measures: ED symptomatology and psychological well-being. Secondary outcomes will include the following: body mass index (BMI), psychosocial adjustment, perfectionism, obsessive-compulsive symptomatology, motivation to change and hospital readmission. All outcomes and the instruments to be used are shown in **Table 1**.

#### *Clinical Assessment*

The health care providers at the day care center or the 24-h hospital unit will submit the following information on the patient: BMI from monthly clinical measurement and up to 9 months post-randomization, diagnosis, age at onset of disorder, evolution of illness over time (duration), admissions prior to current one, comorbidity and readmission after being discharged.

### Carers

For carers the following outcome measures will be considered: emotional state, expressed emotion, impact from and accommodation to eating symptoms, coping skills, and parents' perceived efficacy in dealing with the ED (see **Table 1**).

Patients and carers in the ECHOMANTRA-plus- TAU (treatment) arm will complete a "Participant Feedback Form." It is a self-report measure created *ad hoc* for completion at the end of the intervention. It will assess participants' experiences and satisfaction with the study. They will be asked to provide their views regarding: what they found beneficial and/or challenging, what they enjoyed and/or did not like, the transferability of

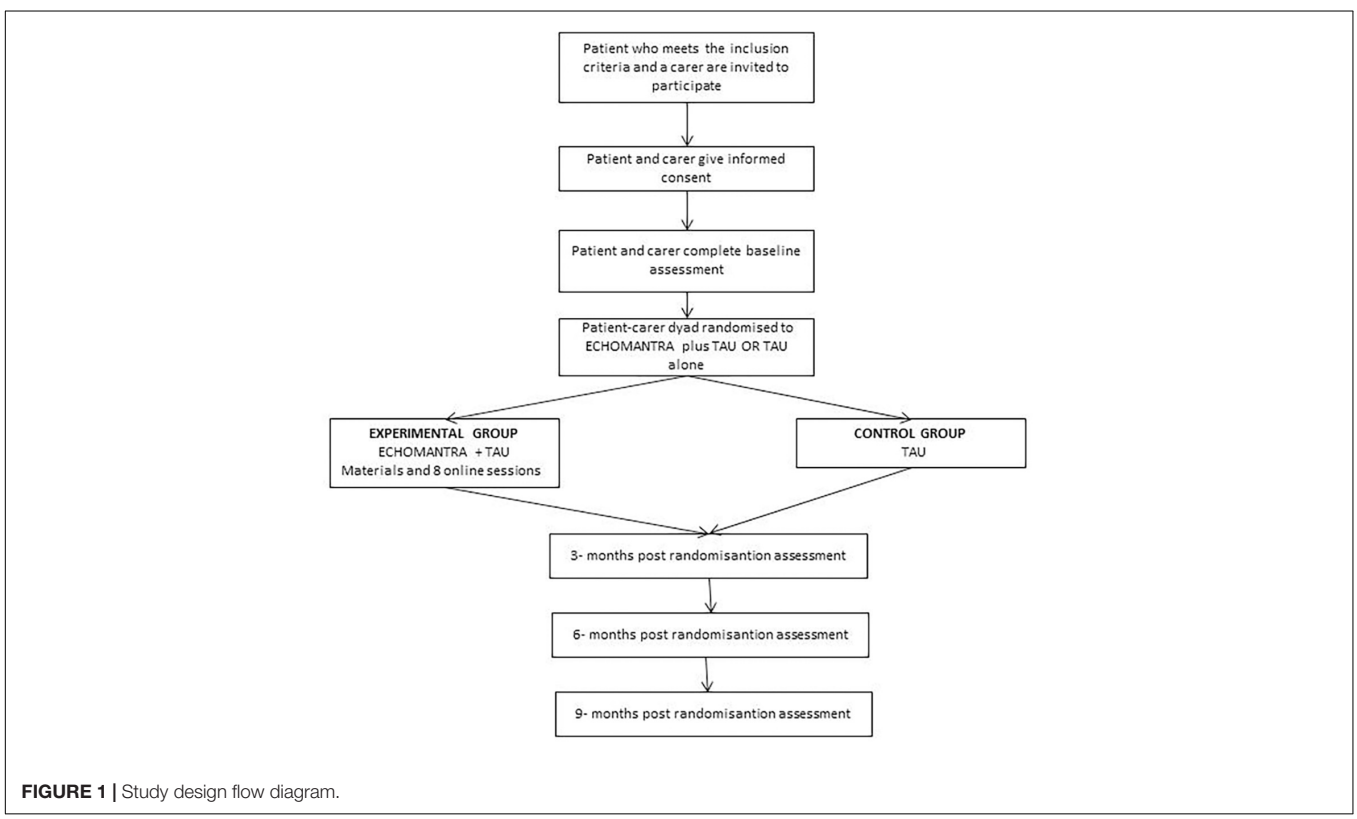


**FIGURE 1 |** Study design flow diagram.

**TABLE 1 |** Outcomes and measures/instruments.

| | Outcome | Measure/instrument | References |
|---|---|---|---|
| **PATIENTS** | | | |
| 1 | Body mass index | | |
| 2 | ED Symptomatology | Eating Disorder Examination (EDE-Q) | Fairburn and Beglin, 1994; Spanish Validation (SV): Peláez-Fernández et al., 2012 |
| 3 | Eating pattern | Daily food self-reporting | |
| 4 | Psychological well-being | Depression Anxiety and Stress Scales (DASS-21) | Lovibond and Lovibond, 1995; SV: Bados et al., 2005 |
| 5 | Psychosocial adjustment | Eating Disorders Quality of Life (EDQL) | Engel et al., 2006 |
| 6 | Perfectionism | Child and Adolescent Perfectionism Scale (CAPS) | Flett et al., 1997[1]; SV: Castro et al., 2004 |
| 7 | Obsessive-compulsive symptoms | Obsessive Compulsive Inventory-Revised (OCI-R) | Foa et al., 2002; SV: González et al., 2011 |
| 8 | Adherence to treatment | Drop-out rate, number of sessions completed and task completion between sessions. | |
| 9 | Motivation to change | Visual analogue scale that assesses confidence and importance in changing symptoms of ED (*ad hoc*) | |
| 10 | Admission | Number of readmissions to hospital during the intervention and follow-up periods. Record medical history | |
| 11 | Patient feedback form | Patients' satisfaction and experiences in the study. | |
| **CARERS** | | | |
| 1 | Psychological well-being | Depression Anxiety and Stress Scales (DASS-21) | Lovibond and Lovibond, 1995; SV: Bados et al., 2005 |
| 2 | Expressed emotion | Family Questionnaire | Wiedemann et al., 2002; SV: Sepúlveda et al., 2014 |
| 3 | Burden | Eating Disorders Symptom Impact Scale (EDSIS-S). | Sepúlveda et al., 2008; SV: Carral-Fernández et al., 2013 |
| 4 | Accommodation to illness | Accommodation to Illness Symptoms Scale (AESED). | Sepúlveda et al., 2009; Quiles Marcos et al., 2016 |
| 5 | Care skills | Caregiver skills scale. | Hibbs et al., 2015b; SV: Vintró-Alcaraz et al., 2018 |
| 6 | Parents' perception of efficacy | Parents vs anorexia. | Rhodes et al., 2005 |
| 7 | Carer feedback form | Carers' satisfaction and experiences in the study. | |

[1] *Flett, G. L., Hewitt, P. L., Boucher, D. J., Davidson, L. A. and Munro, Y. (1997). The child-adolescent perfectionism scale: development, validation, and association with adjustment. Unpublished manuscript.*

ECHOMANTRA skills to their routine, and their suggestions for further improvements to the intervention.

## Blinding

Given the nature of the study design, all participants and therapists will be aware of the treatment condition.

The person responsible for creating the sequence of randomization will not belong to the research team and will not have other role in this research project. The researcher responsible for making the analyses will be a specialist in statistical methodology and only will participate in this aspect of the study. The research assistant who administers the assessment at each time period will not deliver the intervention. The statistician will be blinded to the condition allocated to the patient and their carer.

## Statistical Analysis

Firstly, a covariance analysis (ANCOVA) will be carried out using the pre-test scores as a covariate to analyze the impact of the combined intervention. Secondly, a repeated measures analysis of variance will be used to analyze the short and medium-term efficacy of the combined intervention in comparison to the usual intervention between and within groups at different time points, and effect size values will also be considered. Stratification will be performed in the analyses by the admission center and "diagnosis" variable will be controlled. IBM SPSS Statistics 24.0 will be used for all the analyses (IBM Corp, 2016).

# DISCUSSION

The treatment of eating disorders should include patients and carers in order to improve patients' outcomes and adherence (Treasure and Nazar, 2016). In this sense, ECHOMANTRA is an intervention that can improve outcomes during and following intensive care for adolescents with AN (Cardi et al., 2017; Adamson et al., 2019). ECHOMANTRA should reduce patients' distress and eating disorder symptoms. For carers, outcomes

have been related to a reduction in distress and an improvement in their skills.

ECHOMANTRA is protocolized in eight sessions, so it can be replicated in different contexts, such as a day hospital or inpatient unit. It was designed to be affordable, scalable, and to potentially have a wide reach (Cardi et al., 2017). Treatment sessions will be developed online, which will allow both patients and family members to adapt their learning and improvement in therapeutic skills to their daily routine in order to increase engagement. This design will make it possible to overcome some of the obstacles that make it difficult for participants to adhere, especially carers.

This is a multi-center trial, which will take place in two different types of services (day hospital and inpatient unit). It will allow us to evaluate intervention effectiveness according to the therapeutic context and its impact on the generalizability of the data. Also, MANTRA was originally developed for adult AN patients. This study will examine the usefulness of the MANTRA treatment programme for adolescents with other EDs and not just AN, thereby enhancing current knowledge about potential treatments for these patients.

This trial has some limitations. Firstly, two questionnaires that will be used in this RCT, the EDQL and the "Parents vs Anorexia Questionnaire" are not validated in the Spanish population. As a result, our team will validate them. Another limitation is that not only AN patients will receive the MANTRA protocol, but it will also be received by BN and those with OSFED. Another limitation is the fact that we have translated all the original protocols into Spanish, and we will use them without a previous pilot study. Another limitation is the possible difficulties for both members of the dyad (patient and carer) to be involved in the intervention during all sessions. To facilitate the adherence of both, the schedule for each of the sessions will be agreed on individually with each of the participants. Finally, special attention will be paid to possible difficulties in maintaining adherence in the control group. To this end, they will be offered the self-help components of the intervention at the end of the study.

The strengths of this study will be the randomized control study design and protocolized therapist guidance during the intervention. Moreover, individualized interventions for patients and carers reinforce trial soundness.

Clinical implications will be related to improving psychological treatment for ED disorders. In our opinion, findings from the ECHOMANTRA trial will be able to optimize inpatient/day-patient treatment and improve our knowledge about the factors that maintain the illness for those with a severe and enduring ED. An additional benefit could be found in the assessment of MANTRA's effectiveness for BN and OSFED and not only for AN.

Finally, this paper outlines the protocol for a study that should improve treatment in ED patients. We have outlined the components of the ECHOMANTRA intervention and have clearly stated the research methodology as recommended in CONSORT 2010 guidelines (Schulz et al., 2010).

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of University Hospital of San Juan of Alicante, and Ethics Committee of University Miguel Hernández of Elche. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

YQ spearheaded the design of the trial protocol and development of intervention materials in collaboration with MQ, EL, MR, ÁR, ME, CR, and VE. All authors contributed to the article and approved the submitted version.

## FUNDING

This trial was funded by the Alicia Koplowitz Foundation.

## ACKNOWLEDGMENTS

The authors would like to thank all the patients, their carers, and staff at ADANER of Murcia, CREA and Eating Disorders Unit of University Hospital of San Juan of Alicante.

## REFERENCES

Adamson, J., Cardi, V., Kan, C., Harrison, A., Macdonald, P., and Treasure, J. (2019). Evaluation of a novel transition support intervention in an adult eating disorders service: ECHOMANTRA. *Int. Rev. Psychiatr.* 31, 382–390. doi: 10.1080/09540261.2019.1573721

Agras, W. S., Walsh, B. T., Fairburn, C. G., Wilson, G. T., and Kraemer, H. C. (2000). A multicenter comparison of cognitive behavioral therapy and interpersonal psychotherapy for bulimia nervosa. *Arch. Gen. Psychiatry.* 57, 459–466.

American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders, 5th Edn. Available online at: https://doi.org/10.1176/appi.books.9780890425596

Bados, A., Solanas, A., and Andrés, R. (2005). Psychometric properties of the Spanish version of depression, anxiety and stress scales (DASS). *Psicothema* 17, 679–683.

Berends, T., Boonstra, N., and van Elburg, A. (2018). Relapse in anorexia nervosa. *Curr. Opin. Psychiatry* 31, 445–455. doi: 10.1097/YCO.0000000000000453

Bryan, D. C., Cardi, V., Willmott, D., Teehan, E. E., Rowlands, K., and Treasure, J. (2021). A systematic review of interventions to support transitions from intensive treatment for adults with anorexia nervosa and/or their carers. *Eur. Eat. Disord. Rev*. 29, 1–16. doi: 10.1002/erv.2824

Byrne, S., Wade, T., Hay, P., Touyz, S., Fairburn, C. G., Treasure, J., et al. (2017). A randomised controlled trial of three psychological treatments for anorexia nervosa. *Psychol. Med*. 47:2823. doi: 10.1017/S0033291717001349

Cardi, V., Ambwani, S., Robinson, E., Albano, G., MacDonald, P., Aya, V., et al. (2017). Through Guidance Online from Peer and Carer Expertise (TRIANGLE): study Protocol. *Eur. Eat. Disord. Rev.* 25, 512–523.

Carral-Fernández, L., Sepulveda, A. R., del Barrio, A. G., Graell, M., and Treasure, J. (2013). The Spanish validation of an Eating Disorders Symptom Impact Scale (EDSIS) among caregivers. *Psychiatry Res.* 209, 626–631. doi: 10.1016/j.psychres.2013.02.019

Castro, J., Gila, A., Gual, P., Lahortiga, F., Saura, B., and Toro, J. (2004). Perfectionism dimensions in children and adolescents with anorexia nervosa. *J. Adolesc. Health* 35, 392–398. doi: 10.1016/j.jadohealth.2003.11.094

Engel, S. G., Wittrock, D. A., Crosby, R. D., Wonderlich, S. A., Mitchell, J. E., and Kolotkin, R. L. (2006). Development and psychometric validation of an eating disorder-specifichealth-related quality of life instrument. *Int. J. Eat. Disord.* 39, 62–71. doi: 10.1002/eat.20200

Fairburn, C. G. (2008). *Cognitive Behavior Therapy and Eating Disorders*. New York, NY: Guilford Press.

Fairburn, C. G., and Beglin, S. J. (1994). Assessment of eating disorders: interview or self-report questionnaire? *Int. J. Eat. Disord.* 16, 363–370.

Fichter, M. M., and Quadflieg, N. (2016). Mortality in eating disorders-results of a large prospective clinical longitudinal study. *Int J. Eat. Disord*. 49, 391–401. doi: 10.1002/eat.22501

Foa, E. B., Huppert, D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The Obsessive-compulsive inventory: development and validation of a short version. *Psychol. Assess.* 14, 485–496.

González, A. E. M., Piqueras, J. A., and Marzo, J. C. (2011). Validación del inventario de obsesiones y compulsiones revisado (OCI-R) para su uso en población adolescente española. *An. de Psycol.* 27, 763–773.

Grilo, C. M., Pagano, M. E., Stout, R. L., Markowitz, J. C., Ansell, E. B., Pinto, A., et al. (2012). Stressful life events predict eating disorder relapse following remission: six-year prospective outcomes. *Int. J. Eat. Disord.* 45, 185–192. doi: 10.1002/eat.20909

Hedeker, D., Gibbons, R. D., and Waternaux, C. (1999). Sample size estimation for longitudinal designs with attrition: comparing time-related contrasts between two groups. *J. Educ. Behav. Stat.* 24, 70–93. doi: 10.2307/1165262

Hibbs, R., Magill, N., Goddard, E., Rhind, C., Raenker, S., Macdonald, P., et al. (2015a). Clinical effectiveness of a skills training intervention for caregivers in improving patient and caregiver health following in-patient treatment for severe anorexia nervosa: pragmatic randomised controlled trial. *BJPsych Open* 1, 56–66. doi: 10.1192/bjpo.bp.115.000273

Hibbs, R., Rhind, C., Salerno, L., Lo Coco, G., Goddard, E., Schmidt, U., et al. (2015b). Development and validation of a scale to measure caregiver skills in eating disorders. *Int. J. Eat. Disor.* 48, 290–297. doi: 10.1002/eat.22362

Hoang, U., Goldacre, M., and James, A. (2014). Mortality following hospital discharge with a diagnosis or eating disorder: national record linkage study, Englan, 2001-2009. *Int. J. Eat. Disord.* 47, 507–515. doi: 10.1002/eat.22249

Hodsoll, J., Rhind, C., Micali, N., Hibbs, R., Goddard, E., Nazar, B. P., et al. (2017). A pilot, multicentre pragmatic randomised trial to explore the impact of carer skills training on carer and patient behaviours: testing the cognitive interpersonal model in adolescent anorexia nervosa. *Eur. Eat. Disord. Rev.* 25, 551–561.

IBM Corp (2016). *IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0*. Armonk, NY: IBM Corp.

Kaplan, A. S., Walsh, B. T., Olmsted, M., Attia, E., Carter, J. C., Devlin, M. J., et al. (2009). The slippery slope: prediction of successful weight maintenance in anorexia nervosa. *Psychcol. Med.* 39, 1037–1045. doi: 10.1017/S003329170800442X

Khalsa, S., Portnoff, L., McCurdy-McKinnon, D., and Feusner, J. (2017). What happens after treatment? A systematic review of relapse, remission, and recovery in anorexia nervosa. *J. Eat. Disord.* 5:20. doi: 10.1186/s40337-017-0145-3

Levine, M. P. (2012). Loneliness and eating disorders. *J. Psychol.* 146, 245–257. doi: 10.1080/00223980.2011.606435

López, C., and Treasure, J. (2011). Trastorno de la Conducta alimentaria: descripción y manejo. *Rev. Med. Clín. Condes* 22, 85–97.

Lovibond, P. F., and Lovibond, S. H. (1995). *Manual for the Depression Anxiety Stress Scales*. Sidney, NSW: Psychology Foundation of Australia.

Magill, N., Rhind, C., Hibbs, R., Goddard, E., Macdonald, P., Arcelus, J., et al. (2016). Two-year follow-up of a pragmatic randomised controlled trial examining the effect of adding a carer's skill training intervention in inpatients with anorexia nervosa. *Eur. Eat. Disord. Rev.* 24, 122–130.

Morris, J., Simpson, A. V., and Voy, S. J. (2015). Length of stay of inpatients with eating disorders. *Clin. Psychol. Psychother.* 22, 45–53. doi: 10.1002/cpp.1865

National Institute for Health and Care Excellence [NICE] (2017). *Eating Disorders: Recognition and Treatment, NICE guideline*. London: NICE.

Nordbo, R., Espeset, E., Gulliksen, K., Skardorud, F., Geller, J., and Holte, A. (2012). Reluctance to recover in anorexia nervosa. *Eur. Eat. Disord. Rev.* 20, 60–67.

Peláez-Fernández, M. A., Labrador, F. J., and Raich, R. M. (2012). Validation of Eating Disorder Examination Questionnaire (EDE-Q)-Spanish version–for screening eating disorders. *Spanish J. Psychol.* 15, 817–824. doi: 10.5209/rev_SJOP.2012.v15.n2.38893

Pérez-Pareja, B., Quiles, Y., Romero, C., Pamies-Aubalat, L., and Quiles, M. J. (2014). Malestar psicológico y emoción expresada en cuidadores de pacientes con un trastorno de la conducta alimentaria. *An. de Psycol.* 30, 37–45.

Quiles Marcos, Y., Quiles Sebastián, M. J., Escolano Herrera, M., Sanmartín, R., and Treasure, J. (2018). Testing carer skill training programs in Spanish carers of patients with eating disorders. *Psicothema* 30, 295–303. doi: 10.7334/psicothema2017.368

Quiles Marcos, Y., Quiles Sebastian, M. J., Pamies Aubalat, L., Sepulveda Garcia, A. R., and Treasure, J. (2016). The spanish validation of the accommodation and enabling scale for eating disorders among carers: a pilot study. *Eur. Eat. Disord. Rev.* 24, 62–68. doi: 10.1002/erv.2378

Rhodes, P., Baillie, A., Brown, J., and Madden, S. (2005), Parental efficacy in the family-based treatment of anorexia: preliminary development of the Parents Versus Anorexia Scale (PVA). *Eur. Eat. Dis. Rev*. 13, 399–405. doi: 10.1002/erv.661

Saldaña, E., Quiles, Y., Martín, N., y Salorio, M. J. (2014). La iracomo factor comórbido a los problemasinterpersonales y de desajusteemocional en pacientes con un trastorno de la conductaalimentaria. *ActasEspPsiquiatr*. 5, 228–233.

Schmidt, U., and Treasure, J. (2006). Anorexia nervosa: valued and visible. A cognitive-interpersonal maintenance model and its implications for research and practice. *Br. J. Clin. Psychol.* 45, 343–366. doi: 10.1348/014466505x53902

Schmidt, U., Wade, T. D., and Treasure, J. (2014). The Maudsley Model of Anorexia Nervosa Treatment for Adults (MANTRA): development, key features, and preliminary evidence. *J. Cogn. Psychother.* 28, 48–71. doi: 10.1891/0889-8391.28.1.48

Schulz, K. F., Altman, D. G., and Moher, D. (2010). CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *Ann. Int. Med.* 152, 726–732.

Sepúlveda, A. R., Anastasiadou, D., Rodríguez, L., Almendros, C., Andrés, P., Vaz, F., et al. (2014). Spanish validation of the Family Questionnaire (FQ) in families of patients with an eating disorder. *Psicothema* 321–327. doi: 10.7334/psicothema2013.310

Sepúlveda, A. R., Kyriacou, O., and Treasure, J. (2009). Development and validation of the accommodation and enabling scale for eating disorders (AESED) for caregivers in eating disorders. *BMC Health Serv. Res.* 9:171. doi: 10.1186/1472-6963-9-171

Sepúlveda, A., Moreno, A., and Beltran, L. (2020). Actualización de las intervenciones dirigidas al contexto familiar en los trastornos del comportamiento alimentario: El rol de los padres. *Revista de Psicoterapia* 31, 49–63. doi: 10.33898/rdp.v31i115.355

Sepúlveda, A. R., Whitney, J., Hankins, M., and Treasure, J. (2008). Development and validation of an Eating Disorders Symptom Impact Scale (EDSIS) for carers of people with eating disorders. *Health Qual. Life Outcomes* 6, 28–36. doi: 10.1186/1477-7525-6-28

Swanson, S. A., Crow, S. J., Le Grange, D., Swendsen, J., and Merikangas, K. R. (2011). Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. *Arch. Gen. Psychiatry* 68, 714–723. doi: 10.1001/archgenpsychiatry.2011.22

Treasure, J., and Nazar, B. P. (2016). Interventions for the Carers of Patients With Eating Disorder. *Curr. Psychiatry Rep.* 18:16. doi: 10.1007/s11920-015-0652-3

Treasure, J., and Schmidt, U. (2013). The cognitive-interpersonal maintenance model of anorexia nervosa revisited: a summary of the evidence for cognitive, socio-emotional and interpersonal predisposing and perpetuating factors. *J. Eat. Disord.* 1:13. doi: 10.1186/2050-2974-1-13

Treasure, J., Gavan, K., Todd, G., and Schmidt, U. (2003). Changing the environment in eating disorders: working with carers/families to improve motivation and facilitate change. *Eur. Eat. Disord. Rev.* 11, 25–37. doi: 10.1002/erv.485

Treasure, J., Parker, S., Oyeleye, O., and Harrison, A. (2021). The value of including families in the treatment of anorexia nervosa. *Eur. Eat. Disord. Rev*. 29, 393–401. doi: 10.1002/erv.2816

Treasure, J., Rhind, C., Macdonald, P., and Todd, G. (2015). Collaborative care: the new maudsley model. *Eat. Disord.* 23, 366–376. doi: 10.1080/10640266.2015.1044351

Treasure, J., Schmidt, U., and Crane, A. (2011). *Los trastornos de La Alimentación: Guía Práctica Para Cuidar De Un Ser Querido*. Bilbao: Desclée de Brouwer.

Vall, E., and Wade, T. D. (2015). Predictors of treatment outcome in individuals with eating disorders: a systematic review and meta-analysis. *Int. J. Eat. Disord.* 48, 946–971. doi: 10.1002/eat.22411

Vintró-Alcaraz, C., Mestre-Bach, G., Steward, T., Lozano-Madrid, M., Agüera, Z., Jiménez-Murcia, S., et al. (2018). Validation of the Caregiver Skills (CASK) scale in Catalonia: concordance between caregivers in attitudes and behaviours. *Eur. Eat. Disord. Rev.* 26, 329–336. doi: 10.1002/erv.2604

Wiedemann, G., Rayki, O., Feinstein, E., and Hahlweg, K. (2002). The family questionnaire: development and validation of a new self-report scale for assessing expressed emotion. *Psychiatry Res.* 109, 265–279. doi: 10.1016/s0165-1781(02)00023-9

Wittek, T., Truttmann, S., Zeiler, M., Philipp, J., Auer-Welsbach, E., Koubek, D., et al. (2021). The Maudsley model of anorexia nervosa treatment for adolescents and young adults (MANTRa): a study protocol for a multi-center cohort study. *J. Eat. Disord.* 9:33. doi: 10.1186/s40337-021-00387-8

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 19 November 2021
doi: 10.3389/fpsyg.2021.745857

# Do Emotion Dysregulation, Alexithymia and Personality Dimensions Explain the Association Between Attention-Deficit/Hyperactivity Disorder and Binge Eating Among Bariatric Surgery Candidates?

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**Background:** Addictive-like eating and attention-deficit/hyperactivity disorder (ADHD) are both common among persons seeking treatment for severe obesity. Given that ADHD and addictive-like eating, especially binge eating (BE) and food addiction (FA), are both strongly associated with personality dimensions and emotion dysregulation, it is possible emotional and personality characteristics contribute to the link between addictive-like eating behaviors and ADHD in people with severe obesity. This study aimed to investigate the psychological factors associated with BE and FA in bariatric surgery candidates, and to explore the mediational role of emotional factors (emotion dysregulation and alexithymia) and personality dimensions in the association between ADHD and BE.

**Method:** Two hundred and eighty-two ($n$ = 282) bariatric surgery candidates were recruited during the systematic preoperative psychiatric assessment (University Hospital of Tours, France). We assessed significant BE (Binge Eating Scale), probable adult ADHD (Wender Utah Render Scale and Adult ADHD Self-Report Scale), FA (Yale Food Addiction Scale 2.0, YFAS 2.0), emotion dysregulation (Difficulties in Emotion Regulation Scale-16), alexithymia (Toronto Alexithymia Scale-20) and personality dimensions (Big

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**Edited by:**
*Ana Rosa Sepúlveda, Autonomous University of Madrid, Spain*

**Reviewed by:**
*Tatiana Lacruz Gascón, Autonomous University of Madrid, Spain*
*Edoardo Pappaianni, Université de Genève, Switzerland*

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**Specialty section:**
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

**Received:** *22 July 2021*
**Accepted:** *27 October 2021*
**Published:** *19 November 2021*

**Citation:**
*El Archi S, Brunault P, De Luca A, Cortese S, Hankard R, Bourbao-Tournois C, Ballon N, Réveillère C and Barrault S (2021) Do Emotion Dysregulation, Alexithymia and Personality Dimensions Explain the Association Between Attention-Deficit/Hyperactivity Disorder and Binge Eating Among Bariatric Surgery Candidates? Front. Psychol. 12:745857. doi: 10.3389/fpsyg.2021.745857*

Five Inventory). Mediation analyses were performed using the PROCESS macro for IBM SPSS Statistics 22.

**Results:** Prevalence of probable adult ADHD, significant BE and FA were 8.2, 19.1, and 26.6%, respectively. Participants who screened positive for addictive-like eating showed higher prevalence of probable adult ADHD, as well as higher scores on adult and childhood ADHD symptoms. They also reported lower conscientiousness, but higher emotion dysregulation, higher alexithymia, and higher neuroticism. Only BE (as opposed to FA) was also associated with lower scores on agreeableness and openness. Analysis of the association between adult ADHD and BE suggests that emotion dysregulation, conscientiousness, agreeableness, and neuroticism are total mediators and alexithymia a partial mediator.

**Conclusion:** Our findings suggest a significant association between ADHD and addictive-like eating among bariatric surgery candidates, and also suggest a significant role of emotion dysregulation and personality dimensions in this association. For individuals with ADHD and obesity, eating may be a way to cope with negative emotions, potentially increasing the risk for addictive-like eating behavior.

**Keywords: addictive-like eating, binge eating disorder, ADHD, impulsivity, personality dimensions, emotion dysregulation, bariatric surgery, addictive disorders**

## INTRODUCTION

As reported in several reviews (Cortese et al., 2016; Nigg et al., 2016; Cortese and Tessari, 2017; Cortese, 2019; Ravi and Khan, 2020), Attention-Deficit/Hyperactivity Disorder (ADHD) is strongly associated with obesity, but the underlying mechanisms are still unclear (Hanć and Cortese, 2018). ADHD is a neurodevelopmental disorder defined as a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development (American Psychiatric Association [APA], 2013). It affects 5–7% of children (Polanczyk et al., 2007; Thomas et al., 2015) and 2.5% of adults (Song et al., 2021). Impairing symptoms persist in adulthood in approximately 65% of cases (Faraone et al., 2006). According to Cortese and Tessari (2017), there is an association between obesity and ADHD in both children and adults; individuals with ADHD show a higher prevalence of obesity, and individuals with obesity show a higher prevalence of ADHD, indicating that the relationship is bidirectional. Several hypotheses can be put forward to explain this association. Obesity and associated factors lead to ADHD symptoms, ADHD and obesity share common neurobiological dysfunction, and ADHD symptoms such as impulsivity and inattention contribute to obesity, and are associated with a disruption of the circadian rhythm (Cortese and Tessari, 2017; Ravi and Khan, 2020). Ravi and Khan (2020) hypothesize the association between ADHD and obesity may be caused by disordered eating, especially binge eating (BE). The link between obesity and ADHD is relevant as the management of ADHD, both pharmacological (Cortese, 2020) and non-pharmacological (Nimmo-Smith et al., 2020) may improve the outcome of obesity (Cortese and Castellanos, 2014).

According to the 5th version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), binge eating disorder (BED) is characterized by eating, in a discrete period of time (e.g., within any 2-h period), an amount of food that is definitely larger than what most people would eat in a similar period of time under similar circumstances. This episode is associated with a lack of control over eating, significant distress, eating much more rapidly than normal, and eating until feeling uncomfortably full. According to Vainik et al. (2019), uncontrolled eating is associated with three psychological traits recruiting three distinct neural circuits. The first component is "high reward sensitivity," linked to the dopamine circuit from the ventral tegmental area to the nucleus accumbens. This leads to repeated food intake to experience pleasant affect, and is especially correlated with the extraversion personality trait (Blain et al., 2020). The second component is "low cognitive control," linked to the anterior insula and prefrontal areas. It is defined as an inability to moderate the behavioral response to heightened reward sensitivity (Vainik et al., 2019), which is particularly impaired in individuals who overeat, increasing the risk of obesity. According to Davidson et al. (2019), "weaknesses in the ability to suppress the retrieval of memories or thoughts of food, or to shift attention away from those memories, thoughts or food-related environmental cues should be associated with a higher incidence of impulsive eating behavior and excess body weight." Moreover, Kollei et al. (2018) suggested that the effect of impaired impulse control on decision-making is associated with obesity and risk-taking, making it possible to distinguish between individuals with obesity who do and do not binge eat. For this reason, uncontrolled eating correlates positively with impulsiveness and negatively with conscientiousness, a personality trait associated

with self-management and impulse control (Vainik et al., 2019). The third component is high negative emotionality, linked to the amygdala, hippocampus and the hypothalamic-pituitary-adrenal axis. As with substance use disorder (Lyvers et al., 2019), several publications have highlighted the emotional factor of food intake and overeating as a maladaptive strategy to cope with negative effects. A review conducted by Dingemans et al. (2017) indicated associations between BE, low level of mood and depressive symptoms. They suggested that individuals with BE are particularly sensitive to negative stressors, are less able to tolerate negative mood, show emotional difficulties (e.g., alexithymia), and interpersonal problems, leading to anger and frustration. These observations highlight difficulties with emotion regulation. Indeed, individuals with BED seem to have difficulty coping with negative affectivity and tend to use maladaptive strategies such as emotion suppression rather than more efficient strategies such as reappraisal.

Around 60% of individuals with BED also meet criteria for food addiction (FA) (Gearhardt et al., 2012; Ivezaj et al., 2016). Some authors argue that assessment of BED and FA provide complementary information about eating behavior (Gearhardt et al., 2012). The concept of FA is in fact inspired by DSM-5 criteria for substance-related disorders. It involves not only a lack of control over eating but also preoccupation with food, food craving, tolerance, withdrawal, and persistence despite significant negative consequences.

Interestingly, ADHD is linked to addictive-like eating behavior, such as high reward sensitivity, low cognitive control and high negative emotionality. Individuals with ADHD symptomatology are particularly at risk of addictive-like eating (Nazar et al., 2016; Capusan et al., 2017; Romo et al., 2018; Brunault et al., 2019), but the exact nature of the relationship remains unclear. Ziobrowski et al. (2018) suggested that the association between ADHD and eating disorder may in part be due to psychiatric comorbidities. Given that ADHD is strongly associated with personality dimensions such as high neuroticism (Nigg et al., 2002) and emotion dysregulation (Corbisiero et al., 2013), and that BE and FA are also associated with emotion dysregulation (Brunault et al., 2016a; Dawes et al., 2016; Benzerouk et al., 2018; Kukk and Akkermann, 2020), emotional eating (Brunault et al., 2016a; Benzerouk et al., 2018) and depression (Gearhardt et al., 2012), we hypothesized that individuals with ADHD may develop more addictive-like eating behavior due to greater emotion dysregulation and negative affectivity (El Archi et al., 2020). Hence, addictive-like eating behavior may be a way for people with ADHD to cope with emotion dysregulation, potentially increasing the risk of BE, FA and severe obesity. Initial support to this hypothesis has been provided in a study reporting that emotion dysregulation may mediate the effects of negative affectivity on BE (Kukk and Akkermann, 2020). Further support comes from a previous review that suggested a mediational role of emotion dysregulation and negative affectivity in the ADHD-addictive-like eating relationship (El Archi et al., 2020), and from a previous study highlighting the mediational role of mood and feelings in the association between inattention symptoms of ADHD and risk of disordered eating (Martin et al., 2020). Overall, investigating the association between ADHD, emotional factors, personality dimensions, and disordered eating may lead to important clinical implications for the management of people at risk of addictive-like eating. One particular population of individuals with addictive-like eating is represented by patients who are candidate to bariatric surgery.

Bariatric surgery began in the middle of the twentieth century and involves the surgical treatment of severe obesity coupled with multidisciplinary care to help patients lose weight, leading to a reduction in overall mortality (Sjöström et al., 2007) and improving quality of life and body image (De Zwaan et al., 2014). While this intervention is well known and fully documented, weight loss failure at 10 years is estimated between 20 and 35% (Christou et al., 2006). Further knowledge about the factors associated with surgery outcomes is thus needed. BED and addictive-like eating are prevalent among patients undergoing surgical treatment for severe obesity, ranging, respectively, from 13 to 21% (Dawes et al., 2016) and from 16.5 to 41.7% (Meule et al., 2012; Brunault et al., 2016a; Benzerouk et al., 2018; Müller et al., 2018). According to a review conducted by Sarwer and Heinberg (2020), up to 50% of these patients reported preoperative disordered eating, particularly loss of control over eating. Findings about the impact of comorbidities on weight loss differ, with some studies reporting that preoperative mental illness and BE were not associated with lower weight loss (Friedman et al., 2019; Saiki et al., 2020), and others showing that these comorbidities affected postoperative outcomes (Marek et al., 2017; Müller et al., 2019; Sarwer and Heinberg, 2020). In a study with a sample of bariatric surgery patients, Williamson et al. (2018) found a significant ADHD by emotion self-regulation interaction on weight loss. Consequently, comorbid ADHD and low emotion self-regulation skills was associated with poor weight loss after bariatric surgery. These results confirm the need to investigate ADHD and associated factors in patients seeking bariatric surgery in order to ensure optimal weight loss by improving pre- and post-operative care. However, to the best of our knowledge, no studies have investigated the mediational role of psychological factors in the association between ADHD and addictive-like eating in a clinical population of bariatric surgery candidates.

The aim of this study was thus to investigate for the first time the association between adult ADHD and BE in the specific population of bariatric surgery candidates. More specifically, we aimed to explore the mediational role of emotional factors (emotion dysregulation and alexithymia) and personality dimensions in this association. Secondly, we investigated the sociodemographic, weight-related and psychological factors associated with adult ADHD and addictive-like eating (i.e., BE or FA) in this population.

We expected that BE and FA would be positively and significantly associated with emotion dysregulation and alexithymia, as well as with some specific personality dimensions (i.e., high neuroticism, high conscientiousness, and low extraversion). We also expected that these variables would have a mediation effect in the association between adult ADHD and BE. Secondly, we hypothesized that ADHD would be significantly associated with a higher prevalence of addictive-like eating.

We also expected that both ADHD and addictive-like-eating behavior would be associated with high levels of emotion dysregulation, alexithymia, and neuroticism and with low levels of extraversion and conscientiousness.

# MATERIALS AND METHODS

## Participants and Procedure

We included all consecutive bariatric surgery candidates seen in the Nutrition Department of the University Hospital of Tours, France between July 2016 and December 2020. All data were collected during the systematic preoperative psychiatric assessment. Participants' height and weight were directly measured to assess body mass index (BMI). They completed several self-administered questionnaires providing information about age, gender, marital and professional status, and assessing addictive-like eating behavior (BE and FA), childhood and adulthood ADHD symptoms, emotional factors (emotion dysregulation and alexithymia) and personality dimensions. Inclusion criteria were: age > 18 years, referral for a psychiatric assessment prior to bariatric surgery, and sufficient French reading proficiency. At the end of the self-administered battery, we asked participants to specify their level of comprehension of the questionnaires. The question was the following: "*How difficult was it for you to understand the questions*?" Not at all (0), A little (1), Sometimes (2), Often (3), Very often (4)." We excluded all participants who answered "often" or "very often." Thus, we excluded patients who had difficulty understanding the questionnaire ($n = 23$) or did not complete the questionnaire in its entirety ($n = 38$). Out of 343 eligible patients, we finally recruited 282 participants, of whom 76.6% ($n = 216$) were women, with a mean age of 43.1 ± 11.2 years and mean BMI of 45.4 ± 7.7 kg/m$^2$ (**Table 1**).

## Measures

### Binge Eating

The 16 items of the French version of the Binge Eating Scale (BES) assess behavior, thoughts emotional states and cognitive symptoms associated with significant BE in patients with obesity (Gormally et al., 1982; Brunault et al., 2016b). Each item is a group of 4 sentences describing increasing severity of behavioral manifestations in a specific eating situation; participants choose the statement that best matches their current situation. The total score is the sum of the scores for each item and ranges from 0 to 46. A threshold of 18 was applied to indicate significant BE behavior. In the current study, the internal consistency coefficient (Cronbach's alpha) was 0.87.

### Food Addiction

The Yale Food Addiction Scale 2.0 (YFAS 2.0) was created to assess and diagnose FA, by extrapolating the DSM-5 substance-related and addictive disorder criteria to food (Gearhardt et al., 2016). For the current study, we used the validated French version of the YFAS 2.0 (Brunault et al., 2017). This 35-item scale concerns food behavior over the previous 12 months and assesses the clinically significant impairment or distress associated with consumption of high fat/high sugar foods. Participants respond on a Likert scale ranging from "Never" (0) to "Every day" (7). Each item refers to one of the 11 criteria of addiction. The YFAS 2.0 total score is the number of positive FA criteria for a given individual (ranging from 0 to 11) (in the current study, Cronbach's alpha was 0.94). It is used as a dimensional and categorical variable. FA diagnosis is based on the presence of at least 2 positive criteria and clinically significant impairment or distress associated with food behavior. The severity of FA is measured by the number of positive criteria: 2 or 3 indicate mild FA, 4 or 5 indicate moderate FA, and 6 or more indicate severe FA. The French version of the YFAS 2.0 has good internal consistency: in the current study, the internal consistency coefficient for binary variables (Kuder-Richardson-20 coefficient) was 0.86.

### Attention-Deficit/Hyperactivity Disorder

#### *Childhood Attention-Deficit/Hyperactivity Disorder Symptoms*

The Wender Utah Render Scale-25 (WURS-25) retrospectively assesses childhood symptoms of ADHD and related problems (Ward et al., 1993). The French version of the WURS-25 (Caci et al., 2010) used in the current study has 25 items scored on a 5-point Likert scale from "not at all/very slightly" (0) to "very much" (4). The total score is the sum of the scores for the 25 items, giving a possible range of 0–100. This score increases with severity of childhood ADHD symptoms. A threshold of 46 was applied to identify participants with significant childhood ADHD symptoms. In the current study, Cronbach's alpha was 0.92.

#### *Adult Attention-Deficit/Hyperactivity Disorder Symptoms*

The Adult ADHD Self-Report Scale V1.1 (ASRS) is a self-report screening test of ADHD symptoms in adults, developed by the World Health Organization (Kessler et al., 2005). This widely used 6-item scale (available in several languages) assesses inattention (4 items) and hyperactivity/impulsivity (2 items). Each item is rated from "never" (0) to "very often" (4). The total score ranges from 0 to 24 and increases with severity of adult ADHD symptoms. High scores on 4 out of 6 items indicate significant adult ADHD symptoms. In the current study, we used the French version of the ASRS (Caci et al., 2008), with a Cronbach's alpha of 0.70.

Adult ADHD criteria state symptoms include disturbance in attention and or hyperactivity/impulsivity in both childhood (before 12 years old) and adulthood. Thus, in this study, we identified "probable adult ADHD" based on screening positive both for childhood ADHD symptoms (WURS-25 ≥ 46) and for adult ADHD symptoms (number of items with significant severity ≥ 4).

### Emotional Factors and Personality Dimensions

#### *Difficulties in Emotion Regulation*

The Difficulties in Emotion Regulation Scale (DERS) is a widely used questionnaire assessing emotion regulation difficulties. The previous version of the DERS had 36 items (Gratz and Roemer, 2004), measuring emotion regulation difficulties through 5 dimensions: non-acceptance of negative emotions, inability to engage in goal-directed behaviors when distressed, difficulty

**TABLE 1 |** Descriptive statistics of the whole sample and logistic regression depending on FA and significant BE status.

| Variables | Mean or % | SD or (n) | Significant binge eating | | | Food addiction | | |
|---|---|---|---|---|---|---|---|---|
| | | | OR | 95% CI for OR | | *OR* | 95% CI for OR | |
| | | | | Lower | Upper | | Lower | Upper |
| Age (years) | 43.11 | 11.22 | 1.002 | 0.976 | 1.029 | 1.003 | 0.979 | 1.027 |
| Gender (% female) | 76.6 | (116) | 0.844 | 0.426 | 1.671 | 1.308 | 0.684 | 2.500 |
| Marital status (% couple) | 27.7 | (78) | 1.839 | 0.874 | 3.871 | 1.279 | 0.695 | 2.354 |
| Professional status (% professional activity) | 61.3 | (173) | 1.186 | 0.645 | 2.180 | 1.436 | 0.837 | 2.463 |
| BMI (kg/m$^2$) | 45.42 | 7.74 | 1.007 | 0.970 | 1.045 | 1.034 | 1.001 | 1.068 |
| Significant BE[a] | 11.23 | 7.87 | – | – | – | 1.212 | 1.154 | 1.272 |
| Food addiction diagnosis[b] | 2.68 | 2.91 | 1.654 | 1.454 | 1.880 | – | – | – |
| Childhood ADHD symptoms[c] | 21.69 | 17.41 | 1.044 | 1.026 | 1.062 | 1.039 | 1.022 | 1.055 |
| Adult ADHD symptoms[d] | 1.28 | 1.35 | 1.708 | 1.373 | 2.125 | 1.605 | 1.314 | 1.959 |
| Probable adult ADHD | 8.2 | (23) | 3.759 | 1.550 | 9.116 | 4.131 | 1.726 | 9.883 |
| Emotion dysregulation[e] | 12.49 | 12.54 | 1.072 | 1.047 | 1.098 | 1.055 | 1.032 | 1.078 |
| Alexithymia[f] | 51.31 | 12.34 | 1.052 | 1.024 | 1.080 | 1.029 | 1.006 | 1.052 |
| **Personality dimensions[g]** | | | | | | | | |
| Extraversion | 26.13 | 6.75 | 0.956 | 0.914 | 1.001 | 0.966 | 0.928 | 1.005 |
| Agreeableness | 41.45 | 6.12 | 0.939 | 0.888 | 0.994 | 0.954 | 0.907 | 1.004 |
| Conscientiousness | 34.86 | 5.92 | 0.861 | 0.814 | 0.911 | 0.907 | 0.866 | 0.951 |
| Neuroticism | 23.08 | 6.51 | 1.115 | 1.059 | 1.175 | 1.103 | 1.042 | 1.167 |
| Openness | 34.54 | 5.83 | 0.922 | 0.875 | 0.971 | 0.993 | 0.957 | 1.031 |

[a]*Assessed by the BES (Binge Eating Scale).*
[b]*Assessed by the YFAS 2.0 (Yale Food Addiction Scale 2.0).*
[c]*Assessed by the WURS-25 (Wender Utah Render Scale-25).*
[d]*Assessed by the ASRS (Adult Self Report rating Scale).*
[e]*Assessed by the DERS-16 (Difficulties in Emotion Regulation Scale-16).*
[f]*Assessed by the TAS-20 (Toronto Alexithymia Scale-20).*
[g]*Assessed by the BFI: Big Five Inventory; SD, standard deviation; OR, odd ratio; CI, confidence interval; BMI, body mass index; ADHD, attention-deficit/hyperactivity disorder.*

controlling impulsive behaviors when distressed, limited access to emotion regulation strategies perceived as effective, and lack of emotional clarity. For the current study, we used the French adaptation of the DERS-16, which is the brief 1-factor version of this scale (Bjureberg et al., 2016). Participants answered items on a 5-point Likert scale ranging from "almost never" (1) to "almost always" (5). Scores range from 16 to 80, with higher scores reflecting greater emotion dysregulation. The French version of the DERS-16 used in the current study has excellent internal consistency: Cronbach's alpha was 0.94.

### *Alexithymia*

The Toronto Alexithymia Scale-20 (TAS-20) is a 20-item questionnaire assessing alexithymia (Parker et al., 1993). Participants indicate their degree of agreement with each item using a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). Higher total scores indicate greater severity of alexithymia. The French version of the TAS-20 (Loas et al., 1995) used in the current study has good internal consistency. In the current study, Cronbach's alpha was 0.78.

### *Personality Dimensions*

Based on the Big Five model of personality, the Big Five Inventory (BFI; John et al., 1991) evaluates 5 personality dimensions: openness (Originality, Open-mindedness; 10 items), conscientiousness (Constraint, Control of impulse; 9 items), extraversion (Energy, Enthusiasm; 8 items), agreeableness (Altruism, Affection; 10 items) and neuroticism (Negative affectivity, Nervousness; 8 items). Each of the 45 items is rated on a 5-point Likert scale ranging from "disagree Strongly" (1) to "agree Strongly" (5). In the current study, we used the French version of the BFI (Plaisant et al., 2010), with the following consistency coefficients: openness, Cronbach's alpha = 0.77; conscientiousness, Cronbach's alpha = 0.77; extraversion, Cronbach's alpha = 0.80; agreeableness, Cronbach's alpha = 0.65; neuroticism, Cronbach's alpha = 0.78.

## Data Analysis

Analyses were conducted using SPSS® version 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0., IBM Corporation, Armonk, NY, United States). All analyses were two-tailed; $p$-values $\leq 0.05$ were considered statistically significant. Descriptive statistics included percentages for ordinal variables and means and standard deviations for continuous variables. Spearman correlation analyses were conducted between childhood and adult ADHD and BE, FA, emotion dysregulation, alexithymia, and the 5 dimensions of the BFI. As recommended in case of multi-comparisons

**TABLE 2 |** Comparison between persons with vs. without probable adult ADHD.

| | Probable adult ADHD | | | | | |
|---|---|---|---|---|---|---|
| | With *n* = 23 | | Without *n* = 259 | | Statistics | |
| **Variables** | **Mean** | **SD** | **Mean** | **SD** | ***U*** | ***p*** |
| Age (years) | 40.7 | 12.3 | 43.4 | 11.1 | 2541.0 | 0.243 |
| BMI (kg/m$^2$) | 47.0 | 11.8 | 45.3 | 7.3 | 2946.5 | 0.932 |
| Significant BE[a] | 16.1 | 9.8 | 10.8 | 7.5 | 1977.0 | 0.007 |
| Food addiction[b] | 5.3 | 4.0 | 2.4 | 2.7 | 1761.5 | 0.001 |
| Childhood ADHD symptoms[c] | 59.5 | 11.5 | 18.3 | 13.4 | 21.0 | <0.001 |
| Adult ADHD symptoms[d] | 2.9 | 1.2 | 1.1 | 1.3 | 968.0 | <0.001 |
| Emotion dysregulation[e] | 30.5 | 14.7 | 10.9 | 11.0 | 755.5 | <0.001 |
| Alexithymia[f] | 57.4 | 14.5 | 50.8 | 12.0 | 2042.5 | 0.012 |
| **Personality dimensions[g]** | | | | | | |
| Extraversion | 23.7 | 7.1 | 26.3 | 6.7 | 2321.5 | 0.079 |
| Agreeableness | 37.4 | 6.6 | 41.8 | 6.0 | 1841.0 | 0.002 |
| Conscientiousness | 29.1 | 7.2 | 35.4 | 5.5 | 1480.5 | <0.001 |
| Neuroticism | 30.6 | 4.5 | 22.4 | 6.2 | 870.0 | <0.001 |
| Openness | 34.2 | 7.6 | 34.6 | 5.7 | 2735.0 | 0.515 |

[a]*Assessed by the BES (Binge Eating Scale).*
[b]*Assessed by the YFAS 2.0 (Yale Food Addiction Scale 2.0).*
[c]*Assessed by the WURS-25 (Wender Utah Render Scale-25).*
[d]*Assessed by the ASRS (Adult Self Report rating Scale).*
[e]*Assessed by the DERS-16 (Difficulties in Emotion Regulation Scale-16).*
[f]*Assessed by the TAS-20 (Toronto Alexithymia Scale-20).*
[g]*Assessed by the BFI, Big Five Inventory; SD, standard deviation; BMI, body mass index; ADHD, attention-deficit/hyperactivity disorder; BE, binge eating; U, statistic of Mann-Whitney test.*

(Curtin and Schulz, 1998), we adapted the threshold of significance ($\alpha' = \alpha / 2 = 0.0025$).

Our main objective was to identify the psychological factors that mediate the association between probable adult ADHD and significant BE. With this aim, we conducted logistic regression analysis to determine the variables associated with significant BE. Due to non-normal distribution of the data, simple. Mediation analyses (regression-based approach) were performed using the PROCESS macro (version 3.5.3) for IBM SPSS Statistics 22 (Hayes, 2012). Regression assumptions were confirmed: absence of outliers was verified, homoscedasticity was guaranteed through transformation of the dependent variables (square root) and verified by Levene's test of equality of errors variances, because of the non-normal distribution, we used bootstrapping (5,000 resamples), and we assessed collinearity between variables by making sure that variance inflation factor (VIF) was under 5 as recommended (James et al., 2013).

In the mediation model of the effect of X on Y through M, X was "probable adult ADHD" (dichotomous variable), Y was "significant BE" (BES score) and M was the mediator variable. We conducted 2 simple mediations with emotion dysregulation (DERS-16 scores) and alexithymia (TAS-20 scores) as M variables, and a multiple mediation with 5 M variables, namely the 5 BFI dimensions. Unstandardized regression coefficients were identified: path *a* was the effect of "probable adult ADHD" on M, path *b* was the effect of M on "significant BE," path *c* was the total effect of "probable adult ADHD" on "significant BE," and path *c'* was the direct effect of "probable adult ADHD" on "significant BE." The indirect effect of "probable adult ADHD" on "significant BE" was the product of *a* and *b*.

Secondly, we investigated the psychological factors associated with FA in our sample. The prevalence of FA within the whole sample was determined, as well as the prevalence of probable adult ADHD in the subgroup of participants with FA. We used logistic regressions to identify the sociodemographic, weight and psychological factors associated with FA and significant BE: age, gender, marital, and professional status, BMI, significant BE, ADHD symptomatology, emotion dysregulation, alexithymia, and personality dimensions.

# RESULTS

## Descriptive Statistics

**Table 1** presents descriptive data of the whole sample. Mean scores on the childhood and adult ADHD scales were 21.7 ± 17.4 and 1.3 ± 1.4, respectively, 9.9 and 45.7% of the participants showed significant childhood and adult ADHD symptoms, respectively, and 23 participants screened positive on both the childhood and the adult ADHD scales, with 8.2% of the participants showing probable adult ADHD. The mean BE score was 11.23 ± 7.87. The prevalence of significant BE was 19.1% ($n = 54$). Mean FA score was 2.68 ± 2.91, indicating mild severity. Prevalence of FA was 26.6% ($n = 75$). Forty-one participants (14.5%) showed both significant BE and FA.

## Addictive Like Eating (Binge Eating and Food Addiction) Associated With Attention-Deficit/Hyperactivity Disorder Symptoms in Bariatric Surgery Candidates

Both childhood and adult ADHD symptoms were positively correlated with BE ($r = 0.32$, $p < 0.001$ and $r = 0.38$, $p < 0.001$, respectively) and FA ($r = 0.33$, $p < 0.001$ and $r = 0.35$, $p < 0.001$, respectively).

The prevalence of probable adult ADHD was significantly higher for individuals with significant BE or FA than individuals without these addictive like eating behaviors (BE: 18.5 vs. 5.7%. $\chi^2 = 9.57$, $p = 0.002$; FA: 17.3 vs. 4.8%. $\chi^2 = 11.49$, $p = 0.001$). Bariatric surgery candidates with significant BE or FA had a higher risk of probable adult ADHD (BE: *odd ratio* (*OR)* = 3.759, *95% confidence interval (CI)*: 1.550–9.116; FA: OR = 4.131, 95% CI: 1726–9.883). The presence of probable adult ADHD was 24.4% ($n = 10$) among patients who showed both significant BE and FA.

## Associated Psychopathological Factors

According to the logistic regressions, significant BE was associated with higher scores on the scales assessing FA, childhood ADHD symptoms, adult ADHD symptoms, emotion dysregulation, alexithymia and neuroticism, and with lower scores on the agreeableness, conscientiousness and openness dimensions of the BFI. Odds ratios are presented in **Table 1**.

According to logistic regression, FA in bariatric surgery candidates was associated with higher BMI, and higher scores on childhood and adult ADHD scales, emotion dysregulation, alexithymia and the neuroticism dimension of the BFI. FA was also associated with lower scores on the conscientiousness dimension of the BFI. Odds ratios are presented in **Table 1**.

Bariatric surgery candidates with probable adult ADHD showed higher BE ($p = 0.007$), FA ($p = 0.001$), emotion dysregulation ($p < 0.001$), alexithymia ($p = 0.012$) and neuroticism ($p < 0.001$). They had lower scores for agreeableness ($p = 0.002$) and conscientiousness ($p < 0.001$). Details are presented in **Table 2**. Childhood and adult ADHD symptoms were also positively correlated with emotion dysregulation, alexithymia, and neuroticism, and negatively correlated with the conscientiousness, and agreeableness dimensions of the BFI. Extraversion was correlated only with adult ADHD. Details are presented in **Table 3**.

## Mediation Effect of Emotion Dysregulation, Alexithymia, and Personality Dimensions Between Probable Adult Attention-Deficit/Hyperactivity Disorder and Significant Binge Eating

Total effect of probable adult ADHD on significant BE was 0.723 (0.197–1.248; $p = 0.007$).

**TABLE 3 |** Spearman correlation matrix between ADHD variables and psychopathological variables.

| | WURS | ASRS |
|---|---|---|
| BES | 0.322*** | 0.381*** |
| YFAS 2.0 | 0.325*** | 0.347*** |
| WURS-25 | – | 0.476*** |
| ASRS | 0.476*** | – |
| DERS-16 | 0.552*** | 0.546*** |
| TAS-20 | 0.307*** | 0.277*** |
| BFI-O | – 0.084 | – 0.027 |
| BFI-C | 0.314*** | – 0.459*** |
| BFI-E | – 0.118 | – 0.205*** |
| BFI-A | – 0.294*** | – 0.225*** |
| BFI-N | 0.474*** | 0.387*** |

****$p \leq 0.001$; BES, binge eating scale; YFAS 2.0, Yale Food Addiction Scale 2.0; WURS-25, Wender Utah Render Scale-25; ASRS, Adult Self Report rating Scale; DERS-16, Difficulties in Emotion Regulation Scale-16; TAS-20, Toronto Alexithymia Scale-20; BFI, big five inventory (O, openness; C, conscientiousness; E, extraversion; A, agreeableness; N, neuroticism).*

### Mediation Effect of Emotion Dysregulation

Probable adult ADHD and emotion dysregulation significantly predicted BE scores [$F(2, 279) = 38.26$, $p < 0.001$; $R^2 = 0.22$]. The direct effect of probable adult ADHD on BE (*c*'-path) was non-significant ($p = 0.706$), but effects of probable adult ADHD on emotion dysregulation (*a*-path) and of emotion dysregulation on BE (*b*-path) were significant ($p < 0.001$). Details are presented in **Table 4** and **Figure 1**. Thus, simple mediation analysis suggests that emotion dysregulation has a total mediation effect on the association between probable adult ADHD and significant BE.

### Mediation Effects of Alexithymia

Probable adult ADHD and alexithymia significantly predicted BE scores [$F(2, 279) = 18.06$, $p < 0.001$; $R^2 = 0.11$]. The direct effect of probable adult ADHD on significant BE (*c*'-path) was significant ($p = 0.037$). Moreover, there were significant effects of probable adult ADHD on alexithymia (*a*-path, $p = 0.023$) and of alexithymia on BE (*b*-path, $p < 0.001$). Details are presented in **Table 4** and **Figure 2**. These results thus suggest that alexithymia is a partial mediator in the association between probable adult ADHD and significant BE.

### Mediation Effects of Personality Dimensions

Probable adult ADHD and the 5 dimensions of the BFI significantly predicted BE scores [$F(6, 275) = 14.88$, $p < 0.001$; $R^2 = 0.25$]. The c'-path direct effect was not significant: –0.022 (–0.53 to 0.49), $p = 0.933$.

Openness and extraversion showed a non-significant indirect effect (*a* × *b*-path) on the association between probable adult ADHD and significant BE. The effects of openness and extraversion on BE were not significant (*b*-path; –0.23, $p = 0.105$ and –0.04, $p = 0.710$, respectively), and probable adult ADHD did not predict these dimensions (*a*-path; –0.05 $p = 0.667$ and –0.27, $p = 0.061$, respectively).

Conscientiousness, agreeableness, and neuroticism showed a significant indirect effect (*a* × *b*-path) of probable adult ADHD on significant BE. They were predictable by probable

**TABLE 4 |** Mediation of the effects of probable adult ADHD on significant BE.

| Model | Mediators | | a | b | Indirect effect a × b (95% CI)[a] |
|---|---|---|---|---|---|
| 1 | DERS-16 | Emotion dysregulation | 2.52*** | 0.33*** | 0.82 (0.57; 1.12) |
| 2 | TAS-20 | Alexithymia | 0.44* | 0.42*** | 0.18 ( − 0.00; 0.40) |
| 3 | BFI-O | Openness | − 0.05 | − 0.23 | 0.74 ( − 0.06; 0.09) |
| | BFI-C | Conscientiousness | − 0.58*** | − 0.88*** | 0.51 (0.23; 0.88) |
| | BFI-E | Extraversion | − 0.27 | − 0.04 | 0.01 ( − 0.05; 0.08) |
| | BFI-A | Agreeableness | − 0.36*** | 0.33* | − 0.12 ( − 0.29; −0.01) |
| | BFI-N | Neuroticism | 0.83*** | 0.39*** | 0.33 (0.17; 3.53) |

[a]*Bias corrected bootstrap results for the indirect effect, number of resamples is 5,000. *p < 0.05; ***p < 0.001.*
*ADHD, attention-deficit hyperactivity disorder; BE, binge eating; DERS-16, Difficulties in Emotion Regulation Scale-16; TAS-20, Toronto Alexithymia Scale-20; BFI, big five inventory.*

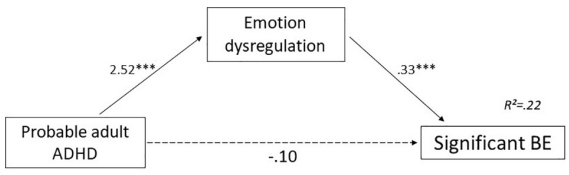


**FIGURE 1 |** Mediation effect of emotion dysregulation in the association between probable adult ADHD and significant BE. Unstandardized regression coefficient. ***$p < 0.001$. ADHD, attention-deficit/hyperactivity disorder; BE, binge eating. Dashed arrow: Non-significant effect. Black arrow: significant effect.

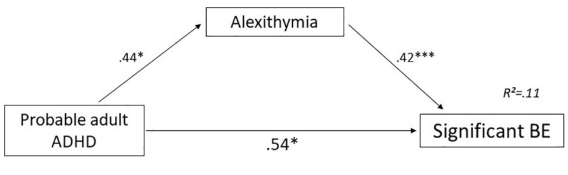


**FIGURE 2 |** Mediation effect of alexithymia in the association between probable adult ADHD and significant BE. Unstandardized regression coefficient. *$p < 0.05$; ***$p < 0.001$. ADHD: attention-deficit/hyperactivity disorder; BE, binge eating. Black arrow: Significant effect.

adult ADHD (*a*-path; –0.58 $p < 0.001$, –0.36, $p < 0.001$, and 0.83, $p < 0.001$, respectively) and had an effect on significant BE (*b*-path; –0.88, $p < 0.001$, 0.33, $p = 0.04$ and 0.39, $p < 0.001$, respectively). The results suggest a total mediational role of conscientiousness, agreeableness and neuroticism in the association between probable adult ADHD and significant BE. Details are presented in **Table 4** and **Figure 3**.

## DISCUSSION

This study investigated for the first time the association between ADHD and addictive-like eating in bariatric surgery candidates and investigate the possible involvement of emotion dysregulation and personality dimensions in this association. We found that BE and FA were strongly associated with ADHD as well as with specific personality dimensions (low conscientiousness and agreeableness and high neuroticism) and emotional factors (i.e., emotion dysregulation, alexithymia). We hypothesized that extraversion would have a negative effect on this association, and the results showed a non-significant effect. To the best of our knowledge, there is no published study suggesting the mediational role of emotional factors and personality dimensions in the association between ADHD and BE within a clinical population of bariatric surgery patients. The current study investigated these potential mediators, and the results suggest that emotion dysregulation, conscientiousness, agreeableness and neuroticism are total mediators in the association between ADHD and BE, and that alexithymia is a partial mediator.

The prevalence of probable adult ADHD in our sample of bariatric surgery candidates was estimated to be 8.2%. As expected, this is higher than in the general population (Song et al., 2021), estimated at around 2.55. Prevalence increased to 17.3–18.5% when the analysis included only patients with BE or FA. These results are consistent with prior studies conducted by Alfonsson et al. (2013) and Nielsen et al. (2017) with the same population, with estimated ADHD prevalence of 8.3 and 8.6% respectively. Most of the literature reports that disordered eating involving binging/purging behavior is associated with a higher prevalence of ADHD symptomatology, varying between 12 and 37.1% (El Archi et al., 2020).

Our results support the hypothesis of a positive correlation between ADHD and addictive-like eating. Studies have provided genetic, neurobiological and behavioral evidence of the association between ADHD symptoms and reward sensitivity (Luman et al., 2010; Carey et al., 2017). The combination of reward sensitivity, sensation seeking and difficulty with impulse control encourages instant gratification, despite the negative consequences. In this way, all behaviors involving positive sensations are risky in that they can lead to a desire to repeat a pleasurable experience and potentially addiction. This is heightened by high cue-reactivity shown by individuals with ADHD (Vollstädt-Klein et al., 2020). Previous publications have suggested that this pattern can also be observed in substance-use disorders such as problematic alcohol use (Vollstädt-Klein et al., 2020), and it seems to be compatible with food intake and addictive-like eating behavior.

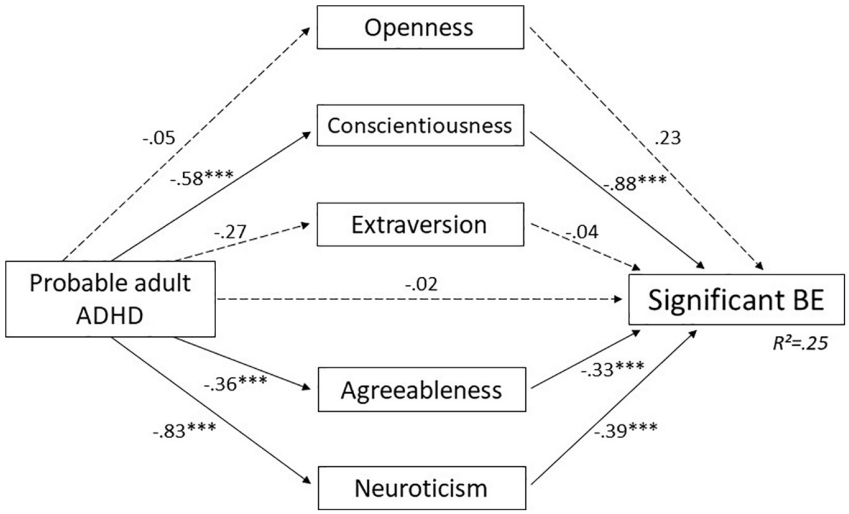


**FIGURE 3 |** Mediation effect of personality dimensions in the association between probable adult ADHD and significant BE. Unstandardized regression coefficient. ***$p < 0.001$. ADHD, attention- deficit/hyperactivity disorder; BE, binge eating. Dashed arrow: Non-significant effect. Black arrow: Significant effect.

Mediation analyses support the hypothesis that conscientiousness, agreeableness, and neuroticism are total mediators in the association between adult ADHD and BE; neuroticism had a positive effect in this association, while conscientiousness, and agreeableness had a negative effect. John and Srivastava (1999) described these three traits as follows: Conscientiousness involves socially prescribed impulse control that facilitates task- and goal-directed behavior, such as thinking before acting, delaying gratification, following norms and rules, and planning, organizing, and prioritizing tasks; agreeableness contrasts a prosocial and communal orientation toward others with antagonism, and includes traits such as altruism, tender-mindedness, trust, and modesty; and neuroticism contrasts emotional stability and even-temperedness with negative emotionality, such as feeling anxious, nervous, sad, and tense. Previous publications have shown that addictive disorders (both substance use disorders and gambling disorder) are particularly associated with high neuroticism and low conscientiousness and agreeableness (Dash et al., 2019), suggesting that poor social abilities, negative affect and impulsivity are vulnerability factors for addictive disorders. Moreover, personality traits seem to be involved in addictive disorders; Davis et al. (2015) observed that personality traits frequently found in individuals with ADHD, such as impulsivity, reward drive and neurotic traits, may underlie the positive association between ADHD symptomatology and addictive behaviors, suggesting that these personality traits drive their proneness to engage in immediately reinforcing activities. Impulsivity, defined as the tendency to act rashly when experiencing strong emotions (urgency) and high levels of delayed reward discounting, are associated with food addiction (VanderBroek-Stice et al., 2017). Moreover, food addiction seems to be a mediator between these impulsivity dimensions and obesity. According to previously cited authors (VanderBroek-Stice et al., 2017), individuals who tend to act rashly when feeling strong emotions may be more likely to engage in compulsive eating behavior. Moreover, according to Keller and Siegrist (2015), neuroticism and conscientiousness are, respectively, positively and negatively correlated with emotional eating, and to a lesser extent with food intake in response to external cues (external eating). They suggested that external eating and emotional eating are significantly and positively associated with sweet and savory food consumption. Both Neuroticism and Extraversion had a significant positive indirect effect on sweet and savory food consumption, whereas Conscientiousness had a significant negative indirect effect. Thus, personality traits seem to influence both eating style and the type of food eaten. This could explain our findings that neuroticism, agreeableness and conscientiousness mediate the association between ADHD and addictive-like eating, especially BE.

As expected, emotion dysregulation was a total mediator factor in the association between adult ADHD and BE. Indeed, in a study by Şahan et al. (2021), bariatric surgery candidates who screened positive for ADHD showed higher emotional eating and susceptibility to hunger than those who screened negative. Negative emotion is a trigger for food intake. Positive emotion seeking would increase when negative emotions occur, particularly if it is associated with emotion dysregulation. Our results suggest that emotion dysregulation of individuals with ADHD leads to difficulty coping with negative emotions and a tendency to avoid them. This may affect self-esteem, well-being, and social skills, increasing the risk of psychiatric comorbidities such as depression and anxiety disorders. On the other hand, we hypothesized negative emotions associated with distress may either lead to negative secondary emotional responses or may be avoided in favor of immediate positive emotion seeking and hence lead to addictive behavior and disordered eating.

Our results also suggest that alexithymia may be a partial mediator in the association between ADHD and BE. Alexithymia involves difficulty in identifying and describing emotions, including one's own. Some individuals with ADHD show

high alexithymia (Edel et al., 2010), with significantly less "acceptance of emotions," less "experience of self-control," more "experience of being flooded with emotions," more "experience of lack of emotions," and more "imaginative symbolization of emotions" (Edel et al., 2010). Moreover, women with morbid obesity scored higher on alexithymia (especially on difficulty identifying feelings) and suppression of emotions than the general population (Zijlstra et al., 2012). According to a meta-analysis conducted by Westwood et al. (2017), individuals with eating disorders have more difficulty identifying and describing emotions than those without eating disorders, suggesting that individuals with eating disorders have significant difficulty using adaptive and situationally appropriate emotion regulation strategies, such as impulse inhibition and behavioral control when distressed, emotional approach and tolerance, and particularly emotional awareness, clarity and acceptance. These difficulties share characteristics with alexithymia, and resorting to food intake or addictive behavior may be a way to deal with them (Marchetti et al., 2019). Our results are in the line with the literature which indicate that alexithymia should be included in the assessment of bariatric surgery candidates, particularly as it is associated with lower weight loss (Paone et al., 2019; Lai et al., 2021).

Our results propose clinical implications. Vulnerabilities shared by individuals with ADHD and people with addictive-like eating suggest that clinicians should pay close attention to ADHD and addictive-like eating comorbidity, both among individuals with ADHD in order to prevent BE and food addiction, and among those at high risk of disordered eating such as bariatric surgery candidates. Systematically screening bariatric surgery candidates for ADHD and addictive-like eating behavior will ensure provision of appropriate treatment. If future longitudinal studies will confirm the current transversal results of the role of emotion dysregulation, alexithymia, neuroticism, agreeableness, and conscientiousness in the association between adult ADHD and addictive-like eating, we could suggest specific psychological interventions. It could be possible to target emotion regulation by helping patients develop suitable coping strategies and flexibility, acceptance and recognition of their emotions in order to improve their management of negative affectivity, reduce their tendency to act rashly when experiencing a negative mood (negative urgency) and hence resort to compulsive eating. The total mediator role of low conscientiousness between adult ADHD and BE suggests the relevance of targeting impulsivity in therapy, encouraging delayed gratification and planning. This seems to be especially relevant for bariatric surgery candidates who show a high prevalence of ADHD symptomatology and addictive-like eating behaviors. Cognitive-behavioral therapy could be proposed, targeting emotion, cognitive distortions, behavioral compensatory skills and management of impulse control, as it has been shown to be the most effective long-term treatment of adult ADHD (López-Pinar et al., 2018). Mindfulness has also been shown to be effective in reducing BE and emotional eating by "cultivating awareness of internal experiences (e.g., emotions, physical sensations), facilitating self-acceptance, cognitive flexibility, compassion, and forgiveness, and generally improving one's ability to cope adaptively with emotions" (Katterman et al., 2014). As suggested by Martinez-Motta et al. (2020), mindfulness meditation could increase the psychological flexibility of bariatric surgery candidates, leading to a decrease in perceived stress and an increase in intuitive eating. These kinds of pre- and post-operative psychological interventions could help reduce compulsive behavior and hence weight loss failure.

This study has a number of limitations. First, mediational analyses were conducted through a cross-sectional study. This kind of descriptive design does not allow to identify causal links, as only a longitudinal design would provide a reliable causal link. This would be particularly interesting in order to investigate the effect of childhood ADHD on emotional skills development, and on eating behavior and severe obesity in adulthood. Secondly, all data were collected through self-administered questionnaires, including assessment of ADHD. Future studies should include structured clinical interviews to assess childhood and adult ADHD and addictive-like eating behavior. Self-administered questionnaires are not enough to diagnose ADHD and would not enable us to question finer points of ADHD DSM-5 criteria, to make sure symptoms have a significant impact in different areas of everyday life, to prevent failure to understand items and memory bias. Moreover, the questionnaires used in the current study did not distinguish between inattention and hyperactivity/impulsivity symptoms, which may have masked individual differences. Gender characteristics of the participants are representative of bariatric surgery candidates. And so, females are predominant in the sample. Especially because ADHD is more prevalent in male, there is a possible gender bias. To increase individualized caring, future studies could investigate gender differences. It should be noted that the concept of food addiction is still under debate, as can be seen from the recent articles by Gearhardt and Hebebrand putting forward the pros and cons of the concept of "food addiction" (De Luca and Brunault, 2021; Gearhardt and Hebebrand, 2021; Hebebrand and Gearhardt, 2021). However, these authors agree that certain foods may lead to addictive-like eating, that mechanisms involved in substance-related and addictive disorders contribute to overeating and obesity, and that the YFAS 2.0 has good psychometric properties, is widely used by clinician and researchers, and is the best psychosocial predictor of weight-loss failure (Gearhardt and Hebebrand, 2021; Hebebrand and Gearhardt, 2021). Future studies should also investigate the effect of psychological interventions targeting emotion regulation on weight loss success following bariatric surgery, and the possible links between abnormal eating patterns and alterations in sleep and arousal, which have also been found in the relationship between ADHD and severe obesity (Cortese et al., 2008a,b).

## CONCLUSION

The current study provides insight into the relationship between ADHD and addictive-like eating among bariatric surgery candidates and tested the hypothesis of a specific psychological mechanism that may explain this association. Identifying the

pre-surgical psychological factors associated with disordered eating in bariatric surgery candidates may help design more tailored-based interventions aimed at improving the outcome of bariatric surgery.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the institutional review board of the "Comité d'Éthique pour les Recherches Non-Interventionnelles" [CERNI] (Tours-Poitiers) in 2018 (no. 2018 048). All collected data were in line with the French recommendation regarding use of personal data, with the approval of the French Commission Nationale de l'Informatique et des Libertés (CNIL). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

AD, RH, and CB-T: data collection. SE: writing—original draft preparation. SE, PB, AD, SC, RH, CB-T, NB, CR, and SB: writing—review and editing. SB and PB: study design, concept, and supervision. All authors have read and agreed to the published version of the manuscript.

## FUNDING

This research was supported by a grant from the Maison des Sciences de l'Homme Val de Loire (MSH Val de Loire). The funding organization had no role in the design or conduct of the study, data collection, analysis, interpretation, preparation, and review and approval of the manuscript.

## ACKNOWLEDGMENTS

We thank Hélène Coillot for her advice about statistical analysis and Elizabeth Yates for revising the English version of the manuscript.

## REFERENCES

Alfonsson, S., Parling, T., and Ghaderi, A. (2013). Self-reported symptoms of adult attention deficit hyperactivity disorder among obese patients seeking bariatric surgery and its relation to alcohol consumption, disordered eating and gender. *Clin. Obes.* 3, 124–31. doi: 10.1111/cob.12025

American Psychiatric Association [APA] (2013). *Diagnostic and Statistical Manual of Mental Disorders* 5th Edn. United States: American Psychiatric Publishing.

Benzerouk, F., Gierski, F., Ducluzeau, P. H., Bourbao-Tournois, C., Gaubil-Kaladjian, I., Bertin, É, et al. (2018). Food addiction, in obese patients seeking bariatric surgery, is associated with higher prevalence of current mood and anxiety disorders and past mood disorders. *Psychiatry Res.* 267, 473–479. doi: 10.1016/j.psychres.2018.05.087

Bjureberg, J., Ljótsson, B., Tull, M. T., Hedman, E., Sahlin, H., Lundh, L. G., et al. (2016). Development and Validation of a Brief Version of the Difficulties in Emotion Regulation Scale: the DERS-16. *J. Psychopathol. Behav. Assess.* 38, 284–296. doi: 10.1007/s10862-015-9514-x

Blain, S. D., Sassenberg, T. A., Xi, M., Zhao, D., and DeYoung, C. G. (2020). Extraversion but not depression predicts reward sensitivity: revisiting the measurement of anhedonic phenotypes. *J. Pers. Soc. Psychol.* 121, e1–e18. doi: 10.1037/pspp0000371

Brunault, P., Courtois, R., Gearhardt, A. N., Gaillard, P., Journiac, K., Cathelain, S., et al. (2017). Validation of the French Version of the DSM-5 Yale Food Addiction Scale in a Nonclinical Sample. *Can. J. Psychiatry* 62, 199–210. doi: 10.1177/0706743716673320

Brunault, P., Ducluzeau, P. H., Bourbao-Tournois, C., Delbachian, I., Couet, C., Réveillère, C., et al. (2016a). Food Addiction in Bariatric Surgery Candidates: prevalence and Risk Factors. *Obes. Surg.* 26, 1650–1653. doi: 10.1007/s11695-016-2189-x

Brunault, P., Gaillard, P., Ballon, N., Couet, C., Isnard, P., Cook, S., et al. (2016b). Validation de la version française de la Binge Eating Scale : étude de sa structure factorielle, de sa consistance interne et de sa validité de construit en population clinique et non clinique. *Encephale* 42, 426–433. doi: 10.1016/j.encep.2016.02.009

Brunault, P., Frammery, J., Montaudon, P., De Luca, A., Hankard, R., Ducluzeau, P. H., et al. (2019). Adulthood and childhood ADHD in patients consulting for obesity is associated with food addiction and binge eating, but not sleep apnea syndrome. *Appetite* 136, 25–32. doi: 10.1016/j.appet.2019.01.013

Caci, H., Bayle, F. J., and Bouchez, J. (2008). Adult ADHD: translation and factor analysis of the ASRS-1.1. *Eur. Psychiatry* 23, S367–S368. doi: 10.1016/j.eurpsy.2008.01.1272

Caci, H. M., Bouchez, J., and Baylé, F. J. (2010). An aid for diagnosing attention-deficit/hyperactivity disorder at adulthood: psychometric properties of the French versions of two Wender Utah Rating Scales (WURS-25 and WURS-K). *Compr. Psychiatry* 51, 325–331. doi: 10.1016/j.comppsych.2009.05.006

Capusan, A. J., Yao, S., Kuja-Halkola, R., Bulik, C. M., Thornton, L. M., Bendtsen, P., et al. (2017). Genetic and environmental aspects in the association between attention-deficit hyperactivity disorder symptoms and binge-eating behavior in adults: a twin study. *Psychol. Med.* 47, 2866–2878. doi: 10.1017/S0033291717001416

Carey, C. E., Knodt, A. R., Conley, E. D., Hariri, A. R., and Bogdan, R. (2017). Reward-Related Ventral Striatum Activity Links Polygenic Risk for Attention-Deficit/Hyperactivity Disorder to Problematic Alcohol Use in Young Adulthood. *Biol. Psychiatry Cogn. Neurosci. Neuroimag.* 2, 180–187. doi: 10.1016/j.bpsc.2016.10.003

Christou, N. V., Look, D., and MacLean, L. D. (2006). Weight gain after short- and long-limb gastric bypass in patients followed for longer than 10 years. *Ann. Surg.* 244, 734–740. doi: 10.1097/01.sla.0000217592.04061.d5

Corbisiero, S., Stieglitz, R. D., Retz, W., and Rösler, M. (2013). Is emotional dysregulation part of the psychopathology of ADHD in adults? *Atten. Deficit Hyperact. Disord.* 5, 83–92. doi: 10.1007/s12402-012-0097-z

Cortese, S. (2019). The association between ADHD and obesity: intriguing, progressively more investigated, but still puzzling. *Brain Sci.* 9:256. doi: 10.3390/brainsci9100256

Cortese, S. (2020). Pharmacologic Treatment of Attention Deficit–Hyperactivity Disorder. *N. Engl. J. Med.* 383, 1050–1056. doi: 10.1056/nejmra1917069

Cortese, S., and Castellanos, F. X. (2014). The relationship between ADHD and obesity: implications for therapy. *Expert Rev. Neurother.* 14, 473–479. doi: 10.1586/14737175.2014.904748

Cortese, S., Konofal, E., Bernardina, B. D., Mouren, M. C., and Lecendreux, M. (2008a). Does excessive daytime sleepiness contribute to explaining the association between obesity and ADHD symptoms? *Med. Hypotheses* 70, 12–16. doi: 10.1016/j.mehy.2007.04.036

Cortese, S., Konofal, E., and Lecendreux, M. (2008b). Alertness and feeding behaviors in ADHD: does the hypocretin/orexin system play a role? *Med. Hypotheses* 71, 770–775. doi: 10.1016/j.mehy.2008.06.017

Cortese, S., Moreira-Maia, C. R., St Fleur, D., Morcillo-Peñalver, C., Rohde, L. A., and Faraone, S. V. (2016). Association between ADHD and obesity: a systematic review and meta-analysis. *Am. J. Psychiatry* 173, 34–43. doi: 10.1176/appi.ajp.2015.15020266

Cortese, S., and Tessari, L. (2017). Attention-Deficit/Hyperactivity Disorder (ADHD) and Obesity: update 2016. *Curr. Psychiatry Rep.* 19:4. doi: 10.1007/s11920-017-0754-1

Curtin, F., and Schulz, P. (1998). Multiple correlations and Bonferroni's correction. *Biol. Psychiatry* 44, 775–777. doi: 10.1016/S0006-3223(98)00043-2

Dash, G. F., Slutske, W. S., Martin, N. G., Statham, D. J., Agrawal, A., and Lynskey, M. T. (2019). Big Five Personality Traits and Alcohol, Nicotine, Cannabis, and Gambling Disorder Comorbidity. *Psychol. Addict. Behav.* 33:420. doi: 10.1037/adb0000468

Davidson, T. L., Jones, S., Roy, M., and Stevenson, R. J. (2019). The cognitive control of eating and body weight: it's more than what you "think.". *Front. Psychol.* 10:62. doi: 10.3389/fpsyg.2019.00062

Davis, C., Cohen, A., Davids, M., and Rabindranath, A. (2015). Attention-deficit/hyperactivity disorder in relation to addictive behaviors: a moderated-mediation analysis of personality risk factors and sex. *Front. Psychiatry* 6:47. doi: 10.3389/fpsyt.2015.00047

Dawes, A. J., Maggard-Gibbons, M., Maher, A. R., Booth, M. J., Miake-Lye, I., Beroes, J. M., et al. (2016). Mental health conditions among patients seeking and undergoing bariatric surgery a meta-analysis. *J. Am. Med. Assoc.* 315, 150–163. doi: 10.1001/jama.2015.18118

De Luca, A., and Brunault, P. (2021). Addictive-like eating: interindividual differences matter. *Am. J. Clin. Nutr.* 114, 393–394. doi: 10.1093/ajcn/nqab181

De Zwaan, M., Georgiadou, E., Stroh, C. E., Teufel, M., Köhler, H., Tengler, M., et al. (2014). Body image and quality of life in patients with and without body contouring surgery following bariatric surgery: a comparison of pre- and post-surgery groups. *Front Psychol.* 5:1310. doi: 10.3389/fpsyg.2014.01310

Dingemans, A., Danner, U., and Parks, M. (2017). Emotion regulation in binge eating disorder: a review. *Nutrients* 9:1274. doi: 10.3390/nu9111274

Edel, M. A., Rudel, A., Hubert, C., Scheele, D., Brüne, M., Juckel, G., et al. (2010). Alexithymia, emotion processing and social anxiety in adults with ADHD. *Eur. J. Med. Res.* 15, 403–409. doi: 10.1186/2047-783x-15-9-403

El Archi, S., Cortese, S., Ballon, N., Réveillère, C., De Luca, A., Barrault, S., et al. (2020). Negative affectivity and emotion dysregulation as mediators between adhd and disordered eating: a systematic review. *Nutrients* 12, 1–34. doi: 10.3390/nu12113292

Faraone, S. V., Biederman, J., and Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: a meta-analysis of follow-up studies. *Psychol. Med.* 36, 159–165. doi: 10.1017/S003329170500471X

Friedman, R., Vivan, M., and Kops, N. (2019). SAT-119 Effect of Binge Eating Diagnosed Prior to Bariatric Surgery on Weight Loss up to 2 Years after Surgery. *J. Endocr. Soc.* 3, SAT–119. doi: 10.1210/js.2019-sat-119

Gearhardt, A. N., Corbin, W. R., and Brownell, K. D. (2016). Development of the Yale Food Addiction Scale Version 2.0. *Psychol. Addict. Behav.* 30, 113–121. doi: 10.1037/adb0000136

Gearhardt, A. N., and Hebebrand, J. (2021). The concept of "food addiction" helps inform the understanding of overeating and obesity: debate Consensus. *Am. J. Clin. Nutr.* 113, 274–276. doi: 10.1093/ajcn/nqaa345

Gearhardt, A. N., White, M. A., Masheb, R. M., Morgan, P. T., Crosby, R. D., and Grilo, C. M. (2012). An examination of the food addiction construct in obese patients with binge eating disorder. *Int. J. Eat. Disord.* 45, 657–663. doi: 10.1002/eat.20957

Gormally, J., Black, S., Daston, S., and Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addict. Behav.* 7, 47–55. doi: 10.1016/0306-4603(82)90024-7

Gratz, K. L., and Roemer, L. (2004). Multidimensional Assessment of Emotion Regulation and Dysregulation: development, Factor Structure, and Initial Validation of the Difficulties in Emotion Regulation Scale. *J. Psychopathol. Behav.* 26, 41–54. doi: 10.1023/B:JOBA.0000007455.08539.94

Hanć, T., and Cortese, S. (2018). Attention deficit/hyperactivity-disorder and obesity: a review and model of current hypotheses explaining their comorbidity. *Neurosci. Biobehav. Rev.* 92, 16–28. doi: 10.1016/j.neubiorev.2018.05.017

Hayes, A. F. (2012). *PROCESS: a Versatile Computational Tool for Observed Variable Moderation, Mediation, and Conditional Process Modeling*. 1–39. Available online at: http://www.afhayes.com/public/process2012.pdf [Accessed May 12, 2021].

Hebebrand, J., and Gearhardt, A. N. (2021). The concept of "food addiction" helps inform the understanding of overeating and obesity: nO. *Am. J. Clin. Nutr.* 113, 268–273. doi: 10.1093/ajcn/nqaa344

Ivezaj, V., White, M. A., and Grilo, C. M. (2016). Examining binge-eating disorder and food addiction in adults with overweight and obesity. *Obesity* 24, 2064–2069. doi: 10.1002/oby.21607

James, G., Witten, D., Hastie, T., and Tibshirani, R. (2013). *An Introduction to Statistical Learning, with Applications in R*. New York: Springer. doi: 10.1007/978-1-4614-7138-7

John, O. P., Donahue, E. M., and Kentle, R. L. (1991). *The Big Five Inventory-Versions 4a and 54*. California: University of California, Berkeley. doi: 10.1037/t07550-000

John, O. P., and Srivastava, S. (1999). The Big Five trait taxonomy: history, measurement, and theoretical perspectives. *Handb. Personal. Theory Res.* 2, 102–138.

Katterman, S. N., Kleinman, B. M., Hood, M. M., Nackers, L. M., and Corsica, J. A. (2014). Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: a systematic review. *Eat. Behav.* 15, 197–204. doi: 10.1016/j.eatbeh.2014.01.005

Keller, C., and Siegrist, M. (2015). Does personality influence eating styles and food choices? Direct and indirect effects. *Appetite* 84, 128–138. doi: 10.1016/j.appet.2014.10.003

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., et al. (2005). The World Health Organization adult ADHD self-report scale (ASRS): a short screening scale for use in the general population. *Psychol. Med.* 35, 245–256. doi: 10.1017/S0033291704002892

Kollei, I., Rustemeier, M., Schroeder, S., Jongen, S., Herpertz, S., and Loeber, S. (2018). Cognitive control functions in individuals with obesity with and without binge-eating disorder. *Int. J. Eat. Disord.* 51, 233–240. doi: 10.1002/eat.22824

Kukk, K., and Akkermann, K. (2020). Emotion regulation difficulties and dietary restraint independently predict binge eating among men. *Eat. Weight Disord.* 25, 1553–1560. doi: 10.1007/s40519-019-00791-9

Lai, C., Aceto, P., Santucci, F. R., Pierro, L., Petrucci, I., Cacioppo, M., et al. (2021). Preoperative psychological characteristics affecting mid-term outcome after bariatric surgery: a follow-up study. *Eat. Weight Disord.* 26, 585–590. doi: 10.1007/s40519-020-00892-w

Loas, G., Fremaux, D., and Marchand, M. P. (1995). Etude de la structure factorielle et de la cohérence interne de la version française de l'échelle d'alexithymie de Toronto a 20 items (tas-20) chez un groupe de 183 sujets sains. *Encephale* 21, 117–122.

López-Pinar, C., Martínez-Sanchís, S., Carbonell-Vayá, E., Fenollar-Cortés, J., and Sánchez-Meca, J. (2018). Long-term efficacy of psychosocial treatments for adults with attention-deficit/hyperactivity disorder: a meta-analytic review. *Front. Psychol.* 9:638. doi: 10.3389/fpsyg.2018.00638

Luman, M., Tripp, G., and Scheres, A. (2010). Identifying the neurobiology of altered reinforcement sensitivity in ADHD: a review and research agenda. *Neurosci. Biobehav. Rev.* 34, 744–754. doi: 10.1016/j.neubiorev.2009.11.021

Lyvers, M., Boileau, M., and Thorberg, F. A. (2019). Personality and alcohol-related risk: neuroticism, extraversion, and alexithymia. *Am. J. Psychol.* 132, 451–465. doi: 10.5406/amerjpsyc.132.4.0451

Marchetti, D., Verrocchio, M. C., and Porcelli, P. (2019). Gambling problems and alexithymia: a systematic review. *Brain Sci.* 9:191. doi: 10.3390/brainsci9080191

Marek, R. J., Ben-Porath, Y. S., Dulmen, M. H. M., Ashton, K., and Heinberg, L. J. (2017). Using the presurgical psychological evaluation to predict 5-year weight loss outcomes in bariatric surgery patients. *Surg. Obes. Relat. Dis.* 13, 514–521. doi: 10.1016/j.soard.2016.11.008

Martin, E., Dourish, C. T., Hook, R., Chamberlain, S. R., and Higgs, S. (2020). *Associations Between Inattention and Impulsivity ADHD Symptoms and Disordered Eating Risk in a Community Sample of Young Adults*. United Kingdom: Cambridge University Press. doi: 10.1017/S0033291720004638

Martinez-Motta, P., Campa, A., George, V., and Castellanos, A. (2020). Protocol for Research on a Model Focused on Mindfulness Training to Support Weight Management after Bariatric Surgery. *Curr. Dev. Nutr.* 4, 1739–1739. doi: 10.1093/cdn/nzaa065_004

Meule, A., Heckel, D., and Kübler, A. (2012). Factor Structure and Item Analysis of the Yale Food Addiction Scale in Obese Candidates for Bariatric Surgery. *Eur. Eat. Disord. Rev.* 20, 419–422. doi: 10.1002/erv.2189

Müller, A., Leukefeld, C., Hase, C., Gruner-Labitzke, K., Mall, J. W., Köhler, H., et al. (2018). Food addiction and other addictive behaviours in bariatric surgery candidates. *Eur. Eat. Disord. Rev.* 26, 585–596. doi: 10.1002/erv.2629

Müller, M., Nett, P. C., Borbély, Y. M., Buri, C., Stirnimann, G., Laederach, K., et al. (2019). Mental Illness Has a Negative Impact on Weight Loss in Bariatric Patients: a 4-Year Follow-up. *J. Gastrointest. Surg.* 23, 232–238. doi: 10.1007/s11605-018-3903-x

Nazar, B. P., Bernardes, C., Peachey, G., Sergeant, J., Mattos, P., and Treasure, J. (2016). The risk of eating disorders comorbid with attention-deficit/hyperactivity disorder: A systematic review and meta-analysis. *Int. J. Eat. Disord.* 49, 1045–1057. doi: 10.1002/eat.22643

Nielsen, F., Georgiadou, E., Bartsch, M., Langenberg, S., Müller, A., and De Zwaan, M. (2017). Attention Deficit Hyperactivity Disorder Prevalence and Correlates Pre- and Post-Bariatric Surgery: a Comparative Cross-Sectional Study. *Obes. Facts* 10, 1–11. doi: 10.1159/000452999

Nigg, J. T., Blaskey, L. G., Huang-Pollock, C. L., Hinshaw, S. P., John, O. P., Willcutt, E. G., et al. (2002). Big five dimensions and ADHD symptoms: links between personality traits and clinical symptoms. *J. Pers. Soc. Psychol.* 83, 451–469. doi: 10.1037/0022-3514.83.2.451

Nigg, J. T., Johnstone, J. M., Musser, E. D., Long, H. G., Willoughby, M., and Shannon, J. (2016). Attention-deficit/hyperactivity disorder (ADHD) and being overweight/obesity: new data and meta-analysis. *Clin. Psychol. Rev.* 43, 67–79. doi: 10.1016/j.cpr.2015.11.005

Nimmo-Smith, V., Merwood, A., Hank, D., Brandling, J., Greenwood, R., Skinner, L., et al. (2020). Non-pharmacological interventions for adult ADHD: a systematic review. *Psychol. Med.* 50, 529–541. doi: 10.1017/S0033291720000069

Paone, E., Pierro, L., Damico, A., Aceto, P., Campanile, F. C., Silecchia, G., et al. (2019). Alexithymia and weight loss in obese patients underwent laparoscopic sleeve gastrectomy. *Eat. Weight Disord.* 24, 129–134. doi: 10.1007/s40519-017-0381-1

Parker, J. D. A., Bagby, R. M., Taylor, G. J., Endler, N. S., Schmitz, P., Parker, D. A., et al. (1993). Factorial validity of the 20-item Toronto Alexithymia Scale. *Eur. J. Pers.* 7, 221–232. Available online at: https://onlinelibrary.wiley.com/doi/abs/10.1002/per.2410070403?casa_token=kL1EneOf12cAAAAA:it0ZefWhMOSOsdJDjfYEPrqgyDjjfU0EBvBWDC0MzibOihv{\penalty-\@M}kytMH5W5UB6vfe1rcvlttaT8ZzhWfUBiI [Accessed April 18, 2021].

Plaisant, O., Courtois, R., Réveillère, C., Mendelsohn, G. A., and John, O. P. (2010). Validation par analyse factorielle du Big Five Inventory français (BFI-Fr). Analyse convergente avec le NEO-PI-R. *Ann. Med. Psychol.* 168, 97–106. doi: 10.1016/j.amp.2009.09.003

Polanczyk, G., De Lima, M. S., Horta, B. L., Biederman, J., and Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *Am. J. Psychiatry* 164, 942–948. doi: 10.1176/ajp.2007.164.6.942

Ravi, P., and Khan, S. (2020). Attention Deficit Hyperactivity Disorder: association With Obesity and Eating Disorders. *Cureus* 12:e12085. doi: 10.7759/cureus.12085

Romo, L., Ladner, J., Kotbagi, G., Morvan, Y., Saleh, D., Tavolacci, M. P., et al. (2018). Attention-deficit hyperactivity disorder and addictions (substance and behavioral): prevalence and characteristics in a multicenter study in France. *J. Behav. Addict.* 7, 743–751. doi: 10.1556/2006.7.2018.58

Şahan, E., Zengin Eroğlu, M., and Sertçelik, S. (2021). Eating behaviors, depression, and anxiety levels of pre bariatric surgery patients with obesity comorbid with or without Attention deficit and hyperactivity disorder: aDHD or Major Depression? Which is more related with eating behaviors? *Brain Behav.* 11:e01915. doi: 10.1002/brb3.1915

Saiki, A., Kanai, R., Nakamura, S., Tanaka, S., Oka, R., Watanabe, Y., et al. (2020). Impact of Mental Health Background and Nutrition Intake on Medium-Term Weight Loss in Japanese Patients Undergoing Laparoscopic Sleeve Gastrectomy. *Obes Facts* 13, 371–383. doi: 10.1159/000509342

Sarwer, D. B., and Heinberg, L. J. (2020). A review of the psychosocial aspects of clinically severe obesity and bariatric surgery. *Am. Psychol.* 75, 252–264. doi: 10.1037/amp0000550

Sjöström, L., Narbro, K., Sjöström, C. D., Karason, K., Larsson, B., Wedel, H., et al. (2007). Effects of Bariatric Surgery on Mortality in Swedish Obese Subjects. *N. Engl. J. Med.* 357, 741–752. doi: 10.1056/nejmoa066254

Song, P., Zha, M., Yang, Q., Zhang, Y., Li, X., and Rudan, I. (2021). The prevalence of adult attention-deficit hyperactivity disorder: a global systematic review and meta-analysis. *J. Glob. Health* 11, 1–9. doi: 10.7189/jogh.11.04009

Thomas, R., Sanders, S., Doust, J., Beller, E., and Glasziou, P. (2015). Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 135, e994–e1001. doi: 10.1542/peds.2014-3482

Vainik, U., García-García, I., and Dagher, A. (2019). Uncontrolled eating: a unifying heritable trait linked with obesity, overeating, personality and the brain. *Eur. J. Neurosci.* 50, 2430–2445. doi: 10.1111/ejn.14352

VanderBroek-Stice, L., Stojek, M. K., Beach, S. R. H., VanDellen, M. R., and MacKillop, J. (2017). Multidimensional assessment of impulsivity in relation to obesity and food addiction. *Appetite* 112, 59–68. doi: 10.1016/j.appet.2017.01.009

Vollstädt-Klein, S., Gerhardt, S., Lee, A., Strosche, A., Sharafi, G., Nuriyeva, R., et al. (2020). Interaction between behavioral inhibition and neural alcohol cue-reactivity in ADHD and alcohol use disorder. *Psychopharmacology* 237, 1691–1707. doi: 10.1007/s00213-020-05492-1

Ward, M. F., Wender, P. H., and Reimherr, F. W. (1993). The Wender Utah rating scale: an aid in the retrospective diagnosis of childhood attention deficit hyperactivity disorder. *Am. J. Psychiatry* 150, 885–890. doi: 10.1176/ajp.150.6.885

Westwood, H., Kerr-Gaffney, J., Stahl, D., and Tchanturia, K. (2017). Alexithymia in eating disorders: systematic review and meta-analyses of studies using the Toronto Alexithymia Scale. *J. Psychosom. Res.* 99, 66–81. doi: 10.1016/j.jpsychores.2017.06.007

Williamson, T. M., Campbell, T. S., Telfer, J. A., and Rash, J. A. (2018). Emotion Self-Regulation Moderates the Association Between Symptoms of ADHD and Weight Loss After Bariatric Surgery. *Obes. Surg.* 28, 1553–1561. doi: 10.1007/s11695-017-3037-3

Zijlstra, H., van Middendorp, H., Devaere, L., Larsen, J. K., van Ramshorst, B., and Geenen, R. (2012). Emotion processing and regulation in women with morbid obesity who apply for bariatric surgery. *Psychol. Heal.* 27, 1375–1387. doi: 10.1080/08870446.2011.600761

Ziobrowski, H., Brewerton, T. D., and Duncan, A. E. (2018). Associations between ADHD and eating disorders in relation to comorbid psychiatric disorders in a nationally representative sample. *Psychiatry Res.* 260, 53–59. doi: 10.1016/j.psychres.2017.11.026

**Conflict of Interest:** NB reports personal fees from Lundbeck, Astra-Zeneca and D&A Pharma, unrelated to the submitted work. PB reports personal fees and non-financial support from Lundbeck, personal fees from Astra-Zeneca and D&A Pharma, unrelated to the submitted work. SC declares honoraria and reimbursement for travel and accommodation expenses for lectures from the following non-profit associations: Association for Child and Adolescent Central Health (ACAMH), Canadian ADHD Alliance Resource (CADDRA), British Association of Pharmacology (BAP), and from Healthcare Convention for educational activity on ADHD.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 15 December 2021
doi: 10.3389/fpsyg.2021.716998

# The Effects of the COVID-19 Pandemic Lockdown on Eating, Body Image, and Social Media Habits Among Women With and Without Symptoms of Orthorexia Nervosa

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The COVID-19 pandemic is negatively impacting people's mental health worldwide. The current study examined the effects of COVID-19 lockdown on adult women's eating, body image, and social media habits. Furthermore, we compared individuals with and without signs of orthorexia nervosa, a proposed eating disorder. Participants were 143 women, aged 17–73 years ($M$ = 25.85, $SD$ = 8.12), recruited during a COVID-19 lockdown in Canada from May-June 2020. Participants completed self-report questionnaires on their eating, body image, and social media habits during the pandemic. The Eating Habits Questionnaire (EHQ) assessed symptoms of orthorexia nervosa. Compared to the period prior to lockdown, women with higher total orthorexia nervosa scores reported eating a lot more than usual, feeling greater pressure to diet and lose weight, thinking about food more often than usual, experiencing greater weight gain, and perceiving more pressure from social media specifically to lose weight and to exercise, compared to their healthy counterparts. We examined associations between individual EHQ subscales and perceived changes to eating and weight. Women who scored high on EHQ-Problems reported seeing more weight loss content on their social media than those who reported fewer orthorexia nervosa symptoms. Conversely, those who scored low on EHQ-Feelings reported feeling a lot less pressure to lose weight, somewhat less or a lot less pressure to lose weight or to exercise from social media specifically, and trended toward less laxative use during lockdown, compared to those who scored higher on orthorexia nervosa. And those who scored low on EHQ-Knowledge reported feeling somewhat less or a lot less pressure to lose weight than those who reported more orthorexia nervosa symptoms. Together, the findings suggest that women with symptoms of orthorexia nervosa are experiencing an exacerbation of disordered eating thoughts and behaviors during COVID-19, and that social media may be a contributing factor.

**Keywords: COVID-19, orthorexia nervosa, eating, social media, body image**

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***Edited by:***
*María Angeles Peláez-Fernández, University of Malaga, Spain*

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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *30 May 2021*
***Accepted:*** *10 November 2021*
***Published:*** *15 December 2021*

***Citation:***
*Gobin KC, Mills JS and McComb SE (2021) The Effects of the COVID-19 Pandemic Lockdown on Eating, Body Image, and Social Media Habits Among Women With and Without Symptoms of Orthorexia Nervosa. Front. Psychol. 12:716998. doi: 10.3389/fpsyg.2021.716998*

## INTRODUCTION

The ongoing COVID-19 pandemic has negatively impacted people's health worldwide. In addition to the toll the disease is having on people's physical health, lockdowns and social distancing restrictions aimed at curbing the spread of the virus are associated with adverse mental health outcomes. A meta-analysis by Salari et al. (2020) of 14 studies from nine different countries concluded that COVID-19 has increased the prevalence of mental health disorders globally. The COVID-19 outbreak in China in early 2020 led to an increase in anxiety, depression, self-harm, suicide attempts, especially among younger people (Qiu et al., 2020), and post-traumatic stress (Liu et al., 2020). The number of days a person spent in lockdown, proximity of positive cases, and having to relocate were associated with higher levels of psychological distress in the early part of the pandemic in Italy, including higher post-traumatic stress symptoms (Di Giuseppe et al., 2020). Some individuals in the general population are more at risk of experiencing negative mental health effects of the pandemic. A cross-cultural study of 2,787 adults by Prout et al. (2020) found that in addition to younger age, somatization tendencies and less reliance on adaptive defense mechanisms were associated with greater levels of distress during the pandemic. Novotný et al. (2020) found that a COVID-19 lockdown produced a surge in mental distress across age groups, but that increases in distress were more severe in women. The same study found that illness perception, feelings of loneliness, low levels of resilience and resilient coping, and several lifestyle components were associated with a significant increase in mental distress during a lockdown. Another study in the early months of the pandemic found that lower levels of mindfulness were positively correlated with higher levels of overall psychological distress (Conversano et al., 2020).

## COVID-19 and Diet-Related Lifestyle Changes

In addition to mental health, people's diet-related lifestyle behaviors have also been impacted by the pandemic. In many places in the world, there have been a series of lockdowns that include the closure of non-essential workplaces, schools, gyms, and dining. Accordingly, people are spending far more time than usual working, exercising, and eating at home. A study of Worldwide search trends on the internet revealed that during the pandemic people are searching for more information regarding food delivery, take away restaurant services, and nutritional supplements (Mayasari et al., 2020). A large study of adults in France during lockdown in April-May 2020 found that most respondents reported decreased physical activity, increased sedentary time, increased snacking, decreased consumption of fresh food, and increased consumption of sweets, cookies, and cakes during that period (Tanguy et al., 2021). At the same time, a sizeable proportion of respondents reported increased home cooking and increased physical activity (Tanguy et al., 2021). Other studies have also found that healthy eating increased during stay-at-home restrictions and time spent in physical activity decreased (Chopra et al., 2020; Flanagan et al., 2020). A study from Netherlands (Poelman et al., 2021) found that changes to eating behaviors and food purchases were moderated by age and body mass index (BMI). Younger, but not older, participants were likely to report changes to their eating during lockdown, with an equivalent number of younger participants saying that they were eating healthier vs. less healthy foods than usual. In the same study, individuals with obesity reported purchasing and eating more chips/snacks than usual during lockdown, as well as experiencing more anxiety and weight gain (Poelman et al., 2021).

There have also been notable changes in perceived weight changes during this pandemic, possibly attributed to increased food consumption. In April 2020, during lockdowns across Italy, a survey of individuals aged 12–86 years revealed that about half of respondents perceived having gained weight during lockdown (Renzo et al., 2020). Another study in Italy (Scarmozzino and Visioli, 2020) revealed that 52.9% of respondents reported an increase in their total food consumption during the duration of confinement. Specifically, there was an increase in self-reported consumption of "comfort food": 23.5% of individuals reported eating more salty snacks during lockdown, while 42.5% of individuals reported an increase in the amount of ice-cream, chocolate, or desserts consumed under lockdown. Approximately 20% of respondent reported an increase in their weight during lockdown (Scarmozzino and Visioli, 2020). A Chilean study of adults from the general population conducted during that country's month of strict lockdown to the start of the pandemic found that approximately half of adult women reported that their weight had changed during lockdown; more of them thought they had gained weight (38%) than lost weight (14%) (Reyes-Olavarría et al., 2020). Research from Poland during COVID-19 found that 43% of participants reported eating more meals than normal, 52% reported increased snacking, 30% reported weight gain, and 18% reported weight loss (Sidor and Rzymski, 2020). An American study of men and women similarly found mixed results in terms of weight change during the pandemic, but that weight gain was predicted by eating when bored (Zachary et al., 2020). In addition to boredom, there are several possible reasons for increased food consumption during the pandemic. Working or studying from home may lead to an absence of routines and disrupt normalized eating schedules, which, in turn, can increase snacking or binging (Todisco and Donini, 2020). And government recommendations to limit the frequency of grocery shopping and the perceived scarcity of certain food products may increase a focus on food and "stocking up," which could increase the frequency of binge eating (Waters et al., 2001; Rodgers et al., 2020).

As reviewed above, there is evidence that people's eating habits changed during the early part of the pandemic. Social media content reflects people's concern about possible weight gain due to diet-related lifestyle changes. Since the COVID-19 pandemic started, there has been a documented increase in "fatphobic" content on social media, such as hashtags referencing the "Quarantine 15" weight gain, suggesting widespread and unwanted weight gain (Pearl, 2020). Stigmatizing posts may cause increases in shape and weight concerns, dieting, excessive exercising, or purging behaviors among vulnerable individuals. Research has shown that there was a tremendous increase in

social media use in the first months of the pandemic (Kemp, 2020), which has previously been linked to negative body image and dieting behavior (Hogue and Mills, 2019).

## COVID-19 and Eating Disorders

It has been theorized that individuals with eating disorders (EDs) may be especially susceptible to greater levels of distress due to pandemic restrictions and an exacerbation of pre-existing ED symptoms prior to COVID-19 (Touyz et al., 2020). Changes to routine, reduced social contact and access to professional support/treatment for their disorder, along with food scarcity, may serve to worsen or trigger ED symptoms (Sheng et al., 2021). In an Australian study, Phillipou et al. (2020) recruited 180 participants who self-identified as having an eating disorder of any kind, as well as individuals from the general population. Results among individuals with an ED showed that 67% reported having restricted food intake more since the start of the pandemic, while 9% reported having restricted food intake less than prior to the pandemic. Furthermore, 21% reported binging more during COVID, while 10% reported less binging during these times. And 18% reported purging more during COVID, while 5% reported purging less than before the pandemic. In terms of physical activity, 49% of individuals with an eating disorder reported having exercised more during the pandemic, while 33% of individuals reported having exercised less. Among respondents in that study from the general population, increased restricting and binge eating were also reported; however, individuals without an eating disorder reported less exercise relative to before the pandemic (Phillipou et al., 2020). Other research has similarly shown that individuals with binge eating report a worsening of symptoms during COVID-19 (Fernández-Aranda et al., 2020; Schlegl et al., 2020; Termorshuizen et al., 2020).

## COVID-19 and Orthorexia Nervosa

While emerging research reveals the effects of the COVID-19 pandemic on individuals with traditional ED diagnoses (i.e., anorexia nervosa, bulimia nervosa, binge eating disorder), its effects on individuals reporting symptoms of orthorexia nervosa have yet to be examined. The term orthorexia nervosa (ON) was first coined over two decades ago by Steven Bratman, capturing people who are concerned about the "cleanliness" of their food and, as a result, restrict or completely eliminate entire categories of food (e.g., meat, dairy) or ingredients (e.g., sugar, preservatives) they perceive to be impure and/or unhealthy. They spend considerable time scrutinizing food sources for possible contamination or toxins, as well as avoiding specific nutrients, such as saturated fats, proteins, and carbohydrates (Bratman and Knight, 2000). Complex eating rituals and internalized beliefs about the dangers of combining certain foods may arise. Individuals with ON may have distorted beliefs around digestion and the need to eat in a highly prescribed way to avoid health problems. Although improved health is often the purported goal of ON, it was observed that such rigid and restrictive eating practices may lead to malnutrition, social isolation, and psychological distress (Fidan et al., 2010).

ON has come to be conceptualized as an ED (Janas-Kozik et al., 2012; Barthels et al., 2015). Bratman (2017) and others have since emphasized that healthy eating alone does not imply pathology and must be extreme to be clinically significant, and proposed criteria have been theorized (Moroze et al., 2015). Dunn and Bratman (2016) have proposed a revised set of diagnostic criteria based on a review of the literature that clarify that orthorexic tendencies are pathological when food theories intensify and escalate over time into an extreme fixation.

People with ON and anorexia nervosa share high trait perfectionism, high trait anxiety, and a high need to exert self-discipline and control (Fidan et al., 2010; Barnes and Caltabiano, 2017). In one study, the prevalence of ON symptoms was higher among individuals with ED symptoms, suggesting that ON might be either a precursor for or a residual of an eating disorder (Brytek-Matera et al., 2020). Given the associated risks for individuals reporting symptoms of ON, it is essential to understand the level of risk for this population during the current global pandemic.

## The Current Study

The current study's main objective was to examine reported changes to adults' eating habits, exercise, and social media use during the COVID-19 pandemic and a lockdown period in Canada during the summer of 2020. We examined only women since dieting, drive for thinness, and disordered eating are strongly influenced by gender and are disproportionately prevalent among women (Mills et al., 2018). We needed to collect an adequate sample size during the critical lockdown period of study and, thus, focused on recruiting female participants. Furthermore, this study compared changes between individuals with and without symptoms of ON. Given the overlap between ON and disordered eating, it was hypothesized that individuals high on ON symptoms would report increased disordered eating habits, worsened body image, and would be more negatively affected by social media during a COVID-19 lockdown as compared to those low on ON symptoms. Most of the research to-date on the effects of lockdowns were conducted during the hardest hit and earliest outbreaks of COVID-19. The current study took place a few months into the pandemic, after some habituation to the initial change in circumstances had presumably occurred.

# MATERIALS AND METHODS

## Participants

Participants ($N$ = 170) were recruited either through an undergraduate research participant pool at York University in Toronto, Canada ($n$ = 85) or through online community advertisements ($n$ = 58). Twenty-seven participants were excluded because of significant missing data, resulting in a final sample of 143 female participants. Participant ages ranged from 17 to 73 years ($M$ = 25.85, $SD$ = 8.12). The self-reported ethnic distribution of the sample was primarily Caucasian (51.7%), followed by South Asian (11.9%), Middle Eastern (9.1%), East Asian (6.3%), Asian (6.3%), Other (5.6%), Black (4.9%), and

Latino/Hispanic (3.5%). Participants' self-reported body mass index (BMI = kg/m$^2$) scores ranged from 15.20 to 52.40 ($M$ = 25.37, $SD$ = 7.45). The majority of the sample (35.0 %) had completed some university as their highest level of education, followed by an undergraduate degree (22.4%), high school diploma (19.6%), college diploma (12.6%), master's degree (7.0%), and doctorate degree (2.8%).

## Measures

### Orthorexia Nervosa

The Eating Habits Questionnaire (EHQ; Gleaves et al., 2013; Oberle et al., 2017) was used to assess ON symptomology. The EHQ is a 21-item self-report questionnaire that is composed of three distinct subscales. The first subscale is composed of eight items which measure knowledge of healthy eating behaviors (EHQ-Knowledge; e.g., "*I am more informed than others about healthy eating*"; $a$ = 0.75). The second subscale is composed of nine items, which measure problems due to healthy eating (EHQ-Problems; e.g., "*In the past year, friends or family members have told me I'm overly concerned with healthy eating*"; $a$ = 0.91). The third subscale is composed of four items, which measure feeling positively about healthy eating (EHQ-Feelings; e.g., "*I feel in control when I eat healthily*"; $a$ = 0.72). Higher scores reflect stronger endorsement of ON symptoms. Participants were asked to respond to each item on a four-point scale from *False, not at all true* to *Very true*. Internal consistency in the current study was excellent for the global score ($a$ = 0.93).

### Eating, Exercise, and Social Media Habits During Quarantine

Because of the uniqueness of the event in question, the authors created a self-report questionnaire designed to measure changes in eating, exercise, and social media habits during the pandemic. Participants were asked to indicate whether "*during the last few weeks since the COVID-19 (coronavirus) lockdown began*" they had experienced any increases or decreases in dieting and food consumption compared to usual, purging, and laxative use habits, as well as changes to exercise and social media habits compared to usual. Participants responded on a five-point scale (1–5): a lot less, somewhat less, about the same, somewhat more, and a lot more.

## Procedure

Participants were recruited during a pandemic lockdown period between May 29th to June 9th, 2020. Starting on March 17, 2020, the province of Ontario, where the study was conducted, was in a declared state of emergency due to COVID-19. Residents were advised to practice social distancing and stay home, group gatherings were limited to five people or fewer, and schools, universities, gyms, and all non-essential businesses were closed. Grocery stores and take-out food businesses were allowed to remain open. These restrictions were all still in place during data collection.

Ethics approval was granted by the York University Human Participants Review Committee. Eligible participants volunteered for the study through an online experiment management system or through advertisements on the internet. Upon signing up, participants provided informed consent online and then were asked to complete the measures listed above as well as demographic information. Participants either received partial course credit or the chance to win a gift card.

## Data Analysis

Because there are no established diagnostic criteria for ON, we categorized participants into high and low ON symptom groups based on a median split on the EHQ. This type of categorical approach to assessment allows for between-group comparisons and simpler language when describing different types of individuals, and is used in the assessment of other eating-related behaviors, such as the identification of dieters vs. non-dieters (see Polivy et al., 2020). A median split was similarly used to independently examine the EHQ subscales of knowledge about healthy eating behaviors, problems due to healthy eating, and feeling positively about healthy eating. A chi-square test of independence was conducted between the two groups on each potential change of interest. Items with at least 80% of expected frequencies greater than five were examined at all five levels of the Likert scale (Field, 2013). For items with expected frequencies less than $n$ = 5, groups were collapsed to either two or three levels. For two levels, the groups were collapsed to "about the same or less" (scale items 1, 2, and 3) or "more than usual" (scale items 4 and 5). For three levels, the groups were collapsed to "less than usual" (scale items 1 and 2), "about the same" (scale item 3), and "more than usual" (scale items 4 and 5). Significant chi-square analyses were followed up with *post hoc* $z$-tests to determine where the significant interaction occurred. One-way analysis of variance (ANOVA) was used to compare differences between the groups on engaging in a COVID-19 diet, hours spent viewing diet-related social media accounts per day, and viewing social media content about losing weight.

# RESULTS

## High vs. Low ON Symptom Groups

A one-way ANOVA demonstrated that there was no significant difference in age between those high and low on ON symptoms, $F$ (1,142) = 0.74, $p > 0.05$. There was a significant difference in self-reported BMI, $F$ (1,138) = 6.28, $p$ = 0.013, whereby those high on ON symptoms had a higher BMI ($M$ = 26.91, $SD$ = 8.08) compared to those low on ON symptoms ($M$ = 23.80, $SD$ = 6.43). BMI was not adjusted for statistically for ensuing analyses (i.e., used as a covariate), so as not to obscure meaningful group differences. There were no significant differences on age or BMI for the two groups when examined for each EHQ subscale.

## Eating Attitudes and Behaviors

Significant differences were found between participants high and low on ON symptoms in regard to thoughts about food during the COVID-19 lockdown, $\chi^2(4)$ = 16.79, $p$ = 0.002, Cramer's V = 0.35. Specifically, women high on ON symptoms reported thinking about food "a lot more" than usual compared to those low on ON symptoms ($z = -3.71$, $p < 0.001$). In other words, thinking about food "a lot more" than before lockdown

was disproportionately common among women high on ON symptoms. There were also significant differences in the amount of food participants reported eating during lockdown compared to usual, $\chi^2(4) = 15.89$, $p = 0.003$, Cramer's V = 0.33, such that those high on ON symptoms were more likely to report eating "a lot more" compared to those low on ON symptoms ($z = -2.05$, $p = 0.040$) and those low in ON tendencies were more likely to report eating "about the same" compared to those high in these tendencies ($z = 3.30$, $p < 0.001$). In other words, eating "a lot more food" than before lockdown was disproportionately common among women high on ON symptoms. Additionally, there were significant difference between the groups in regard to perceived weight change since the start of the COVID-19 lockdown, $\chi^2(2) = 11.25$, $p = 0.004$, Cramer's V = 0.28. Those high on ON symptoms were more likely to report "somewhat to much greater" increases in weight compared to the low ON symptoms group ($z = -2.46$, $p = 0.014$), while those low on ON symptoms were more likely to report having "about the same" weight since the start of the lockdown as compared to those high in these symptoms ($z = 3.24$, $p = 0.001$). In other words, perceiving having gained weight during lockdown was disproportionately common among women high on ON symptoms. See **Table 1** for statistical test results.

## Dieting Attitudes and Behaviors

Significant differences between the two ON symptom groups were found in regard to perceived pressure to lose weight during lockdown, $\chi^2(4) = 27.51$, $p < 0.001$, Cramer's V = 0.46. Those high on ON symptoms were more likely to report "a lot more" perceived pressure to lose weight compared to their low ON symptom counterparts ($z = -4.05$, $p < 0.001$), while those low on ON symptoms were more likely to report "about the same" ($z = 2.32$, $p = 0.020$) or "a lot less" ($z = 3.64$, $p < 0.001$) pressure to lose weight since the lockdown began as their high ON symptom counterparts. In other words, perceiving "a lot more" pressure to lose weight during lockdown was disproportionately common among women high on ON symptoms. This pattern was also seen when examining the EHQ subscales of knowledge about healthy eating, $\chi^2(4) = 16.31$, $p = 0.003$, Cramer's V = 0.35, and positive feelings about healthy eating, $\chi^2(4) = 10.12$, $p = 0.038$, Cramer's V = 0.28. More specifically, those who scored low on EHQ-Knowledge were more likely to report feeling "somewhat less" ($z = 2.93$, $p = 0.003$) or "a lot less" ($z = 2.39$, $p = 0.017$) pressure to lose weight since the start of the pandemic than the high EHQ-Knowledge group. Those low on EHQ-Feelings reported "a lot less" perceived pressure to lose weight than those high on EHQ-Feelings ($z = 2.52$, $p = 0.012$).

The two ON symptoms groups also significantly differed in their perceived pressure to diet, $\chi^2(4) = 34.02$, $p < 0.001$, Cramer's V = 0.52, such that those low on ON symptoms were more likely to report "about the same" ($z = 3.63$, $p < 0.001$) or "somewhat less" ($z = 2.42$, $p = 0.016$) pressure to diet than before lockdown began as compared to the high ON symptom group. In other words, women low on ON were disproportionately likely to say that they felt less pressure to diet during lockdown. This difference was found to be marginally significant when examining the EHQ subscale of feelings about healthy eating, $\chi^2(4) = 9.48$, $p = 0.050$, Cramer's V = 0.27. Individuals who scored low on EHQ-Feelings were more likely to report "somewhat less" perceived pressure to diet during the pandemic than those who scored high on EHQ-Feelings ($z = 1.94$, $p = 0.052$).

Beyond perceived pressure and attitudes about weight loss, there was also a significant difference between the two ON symptom groups in regard to whether they chose to start a diet during lockdown or not, $F(1,141) = 4.31$, $p = 0.040$. On average, those high on ON symptoms ($M = 1.61$, $SD = 0.49$) were more likely to endorse having started a diet during the lockdown period than those in the low ON symptom group ($M = 1.77$, $SD = 0.43$). When examining subscales of the ON measure there was a trend toward significant differences in laxative use on the EHQ-Feelings subscale, $\chi^2(1) = 4.24$, $p = 0.039$, Cramer's V = 0.28. More specifically, those who scored low on EHQ-Feelings were more likely to report "about the same to a lot less" laxative use during the lockdown ($z = 2.06$, $p = 0.039$) as compared to the high EHQ-Feelings group, while those who scored high on positive feelings toward healthy eating were more likely to report "somewhat to a lot more" laxative use ($z = -2.06$, $p = 0.039$) since the start of the pandemic. See **Table 2** for statistical test results.

**TABLE 1 |** Items related to eating attitudes and behaviors (chi-squared tests).

| Items | $\chi^2$ | *df* | *z* | *p* | Cramer's V |
|---|---|---|---|---|---|
| Thinking about food more than usual | 16.79 | 4 | – | 0.002 | 0.35 |
| A lot less | – | – | 1.93 | 0.054 | – |
| Somewhat less | – | – | −0.32 | 0.749 | – |
| About the same | – | – | 1.82 | 0.069 | – |
| Somewhat more | – | – | 0.05 | 0.960 | – |
| A lot more | – | – | −3.71 | <0.001 | – |
| Eating compared to usual | 15.89 | 4 | – | 0.003 | 0.33 |
| A lot less | – | – | −1.95 | 0.051 | – |
| Somewhat less | – | – | 0.29 | 0.662 | – |
| About the same | – | – | 3.30 | <0.001 | – |
| Somewhat more | – | – | −1.01 | 0.313 | – |
| A lot more | – | – | −2.05 | 0.040 | – |
| COVID weight change | 11.25 | 2 | – | 0.004 | 0.28 |
| A lot lower or somewhat lower | – | – | −1.19 | 0.230 | – |
| About the same | – | – | 3.24 | 0.001 | – |
| Somewhat higher to much higher | – | – | −2.46 | 0.014 | – |

## Social Media Use and Influence

There was a significant difference between the two ON symptom groups in regard to perceived pressure from social media to lose weight, $\chi^2(2) = 16.96$, $p < 0.001$, Cramer's V = 0.39, whereby the low ON symptom group was more likely to report "somewhat to a lot less" pressure ($z = 3.27$, $p < 0.001$) than the high ON symptoms group. On the other hand, the high ON symptom group was more disproportionately more likely to report "somewhat to a lot more" pressure to lose weight coming from social media ($z = -3.65$, $p < 0.001$)

**TABLE 2 |** Items related to dieting attitudes and behaviors (chi-squared tests).

| Items | | $\chi^2$ | *df* | *z* | *p* | Cramer's V |
|---|---|---|---|---|---|---|
| **Pressure to lose weight** | | | | | | |
| Total | | 27.51 | 4 | – | <0.001 | 0.46 |
| | A lot less | – | – | 3.64 | <0.001 | – |
| | Somewhat less | – | – | 0.31 | 0.757 | – |
| | About the same | – | – | 2.32 | 0.020 | – |
| | Somewhat more | – | – | −0.65 | 0.516 | – |
| | A lot more | – | – | −4.05 | <0.001 | – |
| EHQ-Knowledge | | 16.31 | 4 | – | 0.003 | 0.35 |
| | A lot less | – | – | 2.39 | 0.017 | – |
| | Somewhat less | – | – | 2.93 | 0.003 | – |
| | About the same | – | – | −0.46 | 0.646 | – |
| | Somewhat more | – | – | −1.83 | 0.067 | – |
| | A lot more | – | – | −0.85 | 0.395 | – |
| EHQ-Feelings | | 10.12 | 4 | – | 0.038 | 0.28 |
| | A lot less | – | – | 2.52 | 0.012 | – |
| | Somewhat less | – | – | 1.53 | 0.126 | – |
| | About the same | – | – | −1.49 | 0.136 | – |
| | Somewhat more | – | – | −0.81 | 0.418 | – |
| | A lot more | – | – | −0.23 | 0.818 | – |
| **Pressure to diet** | | | | | | |
| Total | | 34.02 | 4 | – | <0.001 | 0.52 |
| | A lot less | – | – | 1.56 | 0.119 | – |
| | Somewhat less | – | – | 2.42 | 0.016 | – |
| | About the same | – | – | 3.63 | <0.001 | – |
| | Somewhat more | – | – | −1.19 | 0.230 | – |
| | A lot more | – | – | −4.61 | <0.001 | – |
| EHQ-Feelings | | 9.48 | 4 | – | 0.050 | 0.27 |
| | A lot less | – | – | 1.61 | 0.107 | – |
| | Somewhat less | – | – | 1.94 | 0.052 | – |
| | About the same | – | – | −1.64 | 0.101 | – |
| | Somewhat more | – | – | −1.48 | 0.139 | – |
| | A lot more | – | – | 0.14 | 0.889 | – |
| **Laxative use** | | | | | | |
| EHQ-Feelings | | 4.24 | 1 | – | 0.039 | 0.28 |
| | A lot less, somewhat less, or about the same | – | – | 2.06 | 0.039 | – |
| | Somewhat more or a lot more | – | – | −2.06 | 0.039 | – |

than their low ON symptom counterparts. In addition, there was a significant difference on this item for the subscale of feelings toward healthy eating, $\chi^2(2) = 8.35$, $p = 0.015$, Cramer's V = 0.27. Those low on EHQ-Feelings reported "somewhat to a lot less" pressure ($z = 2.31$, $p = 0.021$) whereas those high on EHQ-Feelings reported experiencing "about the same" amount of pressure as before the lockdown began ($z = -2.29$, $p = 0.022$).

Both high and low ON symptom groups reported significant changes on perceived pressure from social media to exercise since the start of the pandemic, $\chi^2(2) = 15.33$, $p < 0.001$, Cramer's V = 0.36, but in opposite directions. The low ON symptom group were more likely than the high ON symptoms group to report "somewhat to a lot less" pressure from social media to exercise ($z = 2.59$, $p = 0.009$). On the other hand, the high ON symptom group were more likely to report either "about the same" ($z = 2.34$, $p = 0.019$) or "somewhat to a lot more" ($z = -3.80$, $p < 0.001$) pressure from social media to exercise since the start of the pandemic than the low ON symptoms group. This reveals that whereas women low on ON symptoms were disproportionately more likely to say that they felt less pressure to exercise, those high on ON symptoms were disproportionately more likely to say that they felt more pressure to exercise due to social media.

This pattern was also found when comparing low vs. high scorers on the EHQ-Feelings subscale, $\chi^2(2) = 6.29$, $p = 0.043$, Cramer's V = 0.23, such that individuals who scored low on that subscale were more likely to report "somewhat to a lot less" pressure to exercise from social media compared to those who score high on that subscale ($z = 2.50$, $p = 0.012$). See **Table 3** for statistical test results.

**TABLE 3 |** Items related to social media use (chi-squared tests).

| Items | $\chi^2$ | *df* | *z* | *p* | Cramer's V |
|---|---|---|---|---|---|
| **Perceived pressure from social media to lose weight** | | | | | |
| Total | 16.96 | 2 | – | <0.001 | 0.39 |
| A lot less or somewhat less | – | – | 3.27 | <0.001 | – |
| About the same | – | – | 1.52 | 0.129 | – |
| Somewhat more or a lot more | – | – | −3.65 | <0.001 | – |
| EHQ-Feelings | 8.35 | 2 | – | 0.015 | 0.27 |
| A lot less or somewhat less | – | – | 2.31 | 0.021 | – |
| About the same | – | – | −2.29 | 0.022 | – |
| Somewhat more or a lot more | – | – | 0.59 | 0.555 | – |
| **Perceived pressure from social media to exercise** | | | | | |
| Total | 15.33 | 2 | – | <0.001 | 0.36 |
| A lot less or somewhat less | – | – | 2.59 | 0.009 | – |
| About the same | – | – | 2.34 | 0.019 | – |
| Somewhat more or a lot more | – | – | −3.80 | <0.001 | – |
| EHQ-Feelings | 6.29 | 2 | – | 0.043 | 0.23 |
| A lot less or somewhat less | – | – | 2.50 | 0.012 | – |
| About the same | – | – | −0.70 | 0.484 | – |
| Somewhat more or a lot more | – | – | −0.98 | 0.327 | – |

Notably, there were marginally significant differences in the hours spent scrolling through diet accounts on social media (i.e., accounts whose posts promote clean eating or health-related diets) each day, $F$ (1,141) = 3.82, $p$ = 0.053. Those high on ON symptoms reported slightly more time on social media ($M$ = 52.2 min, $SD$ = 49.2 min) than those low on ON symptoms ($M$ = 36.6 min, $SD$ = 28.8 min). When examining the subscales, women who scored high on EHQ-Problems described seeing more content on social media about losing weight during the lockdown ($M$ = 1.73, $SD$ = 0.45) than those who scored low on that subscale ($M$ = 1.57, $SD$ = 0.50), $F$ (1,141) = 3.74, $p$ = 0.055. However, the high and low scoring groups on EHQ-Problems were equally likely to report more time spent on Facebook, $\chi^2(4) = 2.18$, $p$ = 0.703, Instagram, $\chi^2(2) = 2.44$, $p$ = 0.295, and TikTok, $\chi^2(1) = 0.60$, $p$ = 0.437.

## DISCUSSION

The COVID-19 pandemic has had adverse effects both on mental health and on eating and related constructs for many individuals across the globe. In addition to expanding the literature on the deleterious effects of pandemic lockdowns on well-being (see Novotný et al., 2020), the current study sought to expand our understanding of the psychology of the proposed eating disorder orthorexia nervosa (ON). Individuals with an eating disorder have been previously thought to be especially vulnerable to an exacerbation of symptoms during this pandemic. To our knowledge, this study is the first to examine the effects of a pandemic lockdown on individuals with symptoms of ON—a pathological preoccupation with clean or healthy eating. This study examined reported changes to adults' eating habits, exercise, and social media use during a COVID-19 lockdown period in Canada, and to compare women with and without symptoms of ON.

We recruited women across the adult lifespan; women in the high ON symptom group were generally the same age as those in the low ON symptom group, with the average age in both groups being 25 years old. Interestingly, we found that the high ON symptom group reported being heavier than the low ON symptom group; the high ON group average BMI fell in the "overweight" range and the low ON group's average fell in the "healthy" range according to World Health Organization BMI categories (WHO, 1995). There is scarce and mixed literature on the weight status of individuals with ON (McComb and Mills, 2019). The current findings suggest that despite ON sharing features with anorexia nervosa (Gramaglia, 2017), women with ON may, if anything, tend to be heavier relative to women without ON. More research is needed to verify whether this is a reliable finding. However, the current findings suggest that a pathological obsession with clean or healthy eating does not necessarily manifest as being underweight.

It was hypothesized that women high on ON symptoms would report increased disordered eating habits, worsened body image, and would report being more negatively affected by social media as compared to those low on ON symptoms and since the start of lockdown. The findings supported our hypotheses in the following inter-related areas of inquiry: (1) eating behavior and thoughts about food, (2) body image and weight, and (3) pressure from social media. The findings for each area of inquiry are discussed below.

### Eating and Thoughts About Food

When asked about changes they had experienced since the lockdown period began, women high on ON symptoms, but not women low on ON symptoms, were more likely to report undesirable changes to their eating behavior, including eating a

lot more food than usual and thinking about food more often than usual since lockdown began. These findings suggest that women who are extremely preoccupied with eating clean or healthy food were more negatively affected by the lockdown in terms of eating and thoughts about food. Furthermore, the findings suggest that their eating behavior during lockdown was in the *opposite* direction of what individuals with ON are motivated to do, which includes eliminating a great deal of foods from their diet so as to be healthier. Increased food consumption is not in line with the goals of ON. One of the more reliable findings from past studies of changes to eating behavior during the COVID-19 pandemic is the reporting of increased food consumption (i.e., snacking among the general population, binging among individuals with eating disorders). In the current study, that result was replicated; however, increased food consumption and thinking more about food was reported only by the women high on ON symptoms and not by women without symptoms of ON.

## Body Image and Dieting

Another consequence of the lockdown on women high on ON symptoms, but not those low on ON symptoms, was that they reported that they had gained a significant amount of weight during lockdown, felt increased pressure to lose weight, and were likely to have started a diet during lockdown. Together, these findings are evidence that the lockdown worsened various aspects of body image among women with ON tendencies. As is true among individuals with a traditional eating disorder, who have been shown to be vulnerable to worsened symptoms during the pandemic (Brown et al., 2021), the current study found that the lockdown triggered negative body image and increased dieting behavior in women high on ON symptoms. Women with low ON symptoms, on the other hand, were most likely to state that their weight had stayed the same during lockdown. Although we cannot test these associations causally with the available data, the findings suggest that the underlying psychology of ON is similar to other eating disorders and that body dissatisfaction is triggered when individuals feel as if they have eaten more than usual. When obsessive control over one's eating fails, negative body image and urges to diet tend to increase. In the case of ON, disruptions to one's ability to carefully monitor and control the "healthiness" of one's diet is clearly distressing to women with ON in terms of body image. This is consistent with other research suggesting individuals with ON experience value thinness and when they feel as if they have overeaten, they experience elevated levels of body dissatisfaction (see McComb and Mills, 2019).

What is interesting to consider, and unclear from the available data, is whether eating and/or weight changes were truly or objectively different between the two ON groups or whether the high ON symptom group was more *bothered* by disruptions to their eating due to lockdown. It could be that women who are not preoccupied with their diet are able to show more flexibility and to better tolerate the dietary and lifestyle changes they faced during lockdown. As such, those same women are less bothered by and/or less likely to report undesirable consequences of the lockdown. More research is needed, preferably with prospective designs and data that are not only self-report (e.g., behavioral, other-reports, collection of objective weight data).

## Pressure From Social Media

As reviewed earlier, there was a surge in social media use during the COVID-19 pandemic as people spent more time as home and were more socially isolated. This is the first study to our knowledge to examine perceived pressure from social media during the COVID-19 pandemic; this is a novel contribution of the current study to the literature on the effects of the COVID-19 pandemic on adult women. The current study found support for the hypothesis that social media pressure worsened during the lockdown, but only for women high on ON symptoms. Specifically, women high on ON symptoms felt more pressure from social media to lose weight during lockdown. Conversely, women low on ON symptoms actually felt *less* pressure from social media to lose weight during lockdown. This could be because they were paying more attention to COVID-19-related news during that time and paying less attention to appearance-related content. Women high on ON tendencies may have a hard time ignoring weight-based content on social media or even have sought it out more than usual during lockdown, as a result of the body dissatisfaction and perceived changes to their eating discussed above.

Taking a detailed look at the different facets of ON as measured by the EHQ, we examined associations between individual subscales and perceived pressure from social media. We had no formal hypotheses but were curious as to whether different subscales on the EHQ measure of ON might reveal different patterns of effects. Women who endorsed *problems* caused by their healthy eating reported seeing more weight loss content on their social media during the pandemic than those who reported few ON symptoms. Women who endorsed *knowledge* of healthy behaviors were more likely to report feeling either somewhat more or a lot more pressure to lose weight than those who reported fewer ON symptoms. And women who endorsed *feeling positive* about their healthy eating tended to report a lot more pressure to lose weight, both somewhat more or a lot more pressure to lose weight or to exercise from social media specifically, and trended toward more laxative use during the lockdown period of study, compared to those who scored lower on items endorsing positive feelings about healthy eating. These results need to be replicated with a larger sample. However, they suggest that feeling positive about extreme healthy eating may be an especially problematic symptom of ON. In the context of disordered eating, laxative use is a very problematic behavior aimed at weight loss and/or reducing body dissatisfaction due to stomach bloating. This observed trend of increased laxative use during lockdown among women who feel good about their ON symptoms is cause for concern. Taken together, the responses of this group of women who feel good about their ON symptoms and the sense of control those symptoms give them suggests a lack of insight into when healthy eating crosses the line and becomes pathological. For these individuals, extreme healthy eating could be an emotion regulation strategy that is ego syntonic. Emotion regulation is implicated in other forms of disordered eating (e.g., Shakory et al., 2015) and further research

into ON as an emotion regulation strategy is warranted. In turn, when attempts at healthy eating fail, they may turn to other compensatory behaviors, such as laxatives. Taken together, these findings provide evidence of the influence of social media on some women's perceived pressure to lose weight during the pandemic. Because social media use has increased during the pandemic, this form of media may be more important than ever as an influence on adult women's body image. Future research should investigate the link between social media and ON since this may be an especially powerful way by which disordered attitudes about so-called "healthy" eating are learned.

## Possible Explanations

Although beyond the scope of the current study, there are numerous reasons why lockdowns during the COVID-19 pandemic might worsen any type of disordered eating, including ON. Fitness centers and gym closures may increase concern that one will gain weight. Food restriction can result from contagion fears around grocery shopping. Social isolation and less control over time spent with family and roommates may cause significant stress that can manifest in many of the results we found here: overeating, dieting, body dissatisfaction, and perceived pressure to lose weight. Importantly, loneliness and sadness may increase engagement in harmful behaviors such as overeating and dieting as a way to cope, as has been documented with respect to substance use (Wardell et al., 2020). Other research has shown that loneliness in particular predicts surges in mental distress during lockdowns among the general population (Novotný et al., 2020) and should be a construct of interest in future research on disordered eating. We speculate that individuals with eating disorders, including ON, might struggle more with their eating during times of social isolation as they retreat more into their disordered eating as a way of coping with uncertainty and stress. Eating can become a major life focus when there is little else to do outside of the home. Stress-induced overeating or abandonment of previously restrictive eating may have deleterious effects on body image, which can fuel a vicious cycle of restriction and overeating. The current study design cannot tease apart the myriad factors mediating the changes that women reported, but can inform future research.

## Strengths and Limitations

The current findings contribute to the growing body of literature on the nature of ON. Much of the previous research has been marred by invalid measurement of ON and has been inconclusive regarding the motivation underlying ON tendencies (McComb and Mills, 2019). A strength of the current study is the use of a psychometrically sound measure of ON, the EHQ. Importantly, this study highlights the importance of body image, a drive for thinness, and a particular vulnerability to perceived social pressures to achieve a thin body that characterizes individuals with ON tendencies. While most of the existing research on ON treats weight loss as a *consequence* of restricting one's diet in the pursuit of clean or health eating, this study suggests that the stress of the current pandemic has provoked even more of a reoccupation with weight loss, dieting, and exercise among these individuals.

One limitation of this study is the use of self-report data for ON symptoms. Although we utilized a well-supported self-report measure of ON (McComb and Mills, 2019), there may be nuances and characteristics better assessed through a psychodiagnostic interview with a trained clinician. Moreover, because the ON measure was completed in after the start of the global pandemic, this study cannot isolate whether these symptoms are longstanding or emerged during the pandemic. However, given the unique circumstance of this social event and, thus, the inability to collect prospective data, this form of data collection allows for preliminary insight into the experiences of people with ON tendencies. Another limitation is the modest sample size. Although the findings were statistically significant, a larger sample and replication would increase confidence in these findings. We did not have a large enough sample (or enough statistical power) to perform a tertile split based on EHQ score, which would offer a more accurate picture of the differences between truly high and low ON tendencies than a median split. This should be considered in future studies. Finally, another limitation of the study is that it included only women. Dieting, drive for thinness, and disordered eating are highly gendered constructs and more common among women than men. Because of a finite amount of time available to collect data during the lockdown period, we narrowed recruitment to just female participants. The current findings cannot be generalized to men with and without ON tendencies, which is an area for future research.

## Clinical Implications

During the SARS epidemic in 2003, studies reported elevated levels of anxiety and depression that persisted 3 years later (Liu et al., 2012), with those under quarantine showing a dramatic increase in post-traumatic stress symptoms (Hawryluck et al., 2004; Liu et al., 2012). COVID-19 has been an even more significant disruptor. The current findings suggest that, like individuals with the traditional eating disorder diagnoses, women who are high on ON tendencies should be monitored carefully in the coming years and may need clinical intervention. EDs are an especially stubborn form of psychopathology, showing less evidence of natural recovery in young adults than anxiety or depression symptoms (Mills et al., 2012), and ON might show a similar trend. The current findings underscore the seriousness of ON and a need for evidence-based primary prevention programs, such as media literacy, and other evidence-based strategies for reducing the impact of an EDs (see Stice et al., 2013), and a non-dieting approach, which might discourage the development of ON (Varga et al., 2014). Educating at-risk youth and adults around "healthy" media messaging, especially on social media, is paramount. Health and thinness are often confounded across all forms of media. Much of "health-related" messaging is actually anti-fat messaging that stigmatizes people in larger bodies (e.g., Puhl and Heuer, 2010). Stress management, mindfulness practice, and emotion regulation skills training may all be useful in building resilience and can prevent worsening of disordered eating symptoms, including ON, in the face of unforeseen stressors. Individual with an eating disorder rated virtual social interactions with friends, moderate physical activity,

and pleasurable activities as the most helpful strategies to aid with their disorder during the pandemic (Schlegl et al., 2020).

## CONCLUSION

Women who endorsed high levels of ON symptoms experienced an exacerbation of disordered eating thoughts and behaviors during a period of lockdown 3 months into the COVID-19 pandemic. Women high on ON symptoms reported eating a lot more food and thinking about food more often, being more likely to have started a diet, feeling greater pressure to diet and to lose weight, experiencing greater weight gain, and perceiving more pressure from social media specifically to lose weight and to exercise, compared to women without ON. Social media may be a contributing factor to worsened body image during the pandemic.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by York University Human Participants Review Committee. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

KG, JM, and SM contributed to conception and design of the study. KG and SM organized the database. KG performed the statistical analysis. JM and KG wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

## FUNDING

This work was supported by the Social Sciences and Humanities Research Council.

## REFERENCES

Barnes, M. A., and Caltabiano, M. L. (2017). The interrelationship between orthorexia nervosa, perfectionism, body image and attachment style. *Eat. Weight Disord.* 22, 177–184. doi: 10.1007/s40519-016-0280-x

Barthels, F., Meyer, F., and Pietrowsky, R. (2015). Orthorexic eating behaviour: a new type of disordered Eating. *Ernährungs Umschau* 62, 156–161. doi: 10.4455/eu.2015.029

Bratman, S. (2017). Orthorexia vs. theories of healthy eating. *Eat. Weight Disord.* 22, 381–385. doi: 10.1007/s40519-017-0417-6

Bratman, S., and Knight, D. (2000). *Health Food Junkies: Overcoming the Obsession With Healthful Eating*. New York, NY: Broadway Books.

Brown, S., Opitz, M., Peebles, A., Sharpe, H., Duffy, F., and Newman, E. (2021). A qualitative exploration of the impact of Covid-19 on individuals with eating disorders in the UK. *Appetite* 156:104977. doi: 10.1016/j.appet.2020.104977

Brytek-Matera, A., Onieva-Zafra, M. D., Parra-Fernández, M. L., Staniszewska, A., Modrzejewska, J., and Fernández-Martínez, E. (2020). Evaluation of orthorexia nervosa and symptomatology associated with eating disorders among European university students: a multicentre cross-sectional study. *Nutrients* 12:3716. doi: 10.3390/nu12123716

Chopra, S., Ranjan, P., Singh, V., Kumar, S., Arora, M., Hasan, M., et al. (2020). Impact of COVID-19 on lifestyle-related behaviours-A cross-sectional audit of responses from nine hundred and ninety five participants from India. *Diabetes Metab. Syndr.* 14, 2021–2030. doi: 10.1016/j.dsx.2020.09.034

Conversano, C., Di Giuseppe, M., Miccoli, M., Ciacchini, R., Gemignani, A., and Orru, G. (2020). Mindfulness, age and gender as protective factors against psychological distress during COVID-19 pandemic. *Front. Psychol.* 11:1900. doi: 10.3389/fpsyg.2020.01900

Di Giuseppe, M., Zilcha-Mano, S., Prout, T. A., Perry, J. C., Orrù, G., and Conversano, C. (2020). Psychological impact of Coronavirus Disease 2019 among Italians during the first week of lockdown. *Front. Psychiatry* 11:576597. doi: 10.3389/fpsyt.2020.576597

Dunn, T. M., and Bratman, S. (2016). On orthorexia nervosa: a review of the literature and proposed diagnostic criteria. *Eating Behaviours* 21, 11–17. doi: 10.1016/j.eatbeh.2015.12.006

Fernández-Aranda, F., Casas, M., Claes, L., Bryan, D. C., Favaro, A., Granero, R., et al. (2020). COVID-19 and implications for eating disorders. *European Eating Disord. Rev.* 28, 239–245. doi: 10.1002/erv.2738

Fidan, T., Ertekin, V., Isikay, S., and Kirpinar, I. (2010). Prevalence of orthorexia among medical students in Erzurum. Turkey. *Compr. Psychiatry* 51, 49–54. doi: 10.1016/j.comppsych.2009.03.001

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*, 4th. Edn. Thousand Oaks, CA: Sage Publications Ltd.

Flanagan, E., Beyl, R., Fearnbach, N., Altazan, A., Martin, C., and Redman, L. (2020). The impact of COVID-19 stay-at-home orders on health behaviors in adults. *Obesity* 29, 438–445.

Gleaves, D. H., Graham, E. C., and Ambwani, S. (2013). Measuring "orthorexia": development of the eating habits questionnaire. *Int. J. Educ. Psychol. Assess.* 12, 1–18.

Gramaglia, B. (2017). Orthorexia and anorexia nervosa: two distinct phenomena? A cross-cultural comparison of orthorexic behaviours in clinical and non-clinical samples. *BMC Psychiatry* 17:75. doi: 10.1186/s12888-017-1241-2

Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., and Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emer. Infect. Disord.* 10, 1206–1212. doi: 10.3201/eid1007.030703

Hogue, J. V., and Mills, J. S. (2019). The effects of active social media engagement with peers on body image in young women. *Body Image* 28, 1–5. doi: 10.1016/j.bodyim.2018.11.002

Janas-Kozik, M., Zejda, J., Stochel, M., Brozek, G., Janas, A., and Jelonek, I. (2012). Orthorexia–A new diagnosis? *Psychiatria Polska* 46, 441–450. doi: 10.1207/s15327965pli0501_15

Kemp, S. (2020). *Report: Most Important Data on Digital Audiences During Coronavirus. Growth Quarters—The Next Web*. Available online at: https://thenextweb.com/growth-quarters/2020/04/24/report-most-important-data-on-digital-audiences-during-coronavirus/ (accessed April 24, 2020).

Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921

Liu, X., Kakade, M., Fuller, C. J., Fan, B., Fang, Y., Kong, J., et al. (2012). Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Compr. Psychiatry* 53, 15–23. doi: 10.1016/j.comppsych.2011.02.003

Mayasari, N., Ho, D., Lundy, D., Skalny, A., Tinkov, A., Teng, I., et al. (2020). Impacts of the covid-19 pandemic on food security and diet related lifestyle

behaviours: an analytical study of good trends-based query volumes. *Nutrients* 12:3103. doi: 10.3390/nu12103103

McComb, S. E., and Mills, J. S. (2019). Orthorexia nervosa: a review of psychosocial risk factors. *Appetite* 140, 50–75. doi: 10.1016/j.appet.2019.05.005

Mills, J. S., Polivy, J., McFarlane, T. L., and Crosby, R. (2012). The natural course of eating pathology in female university students. *Eat. Behav.* 13, 297–304. doi: 10.1016/j.eatbeh.2012.07.005

Mills, J. S., Weinheimer, L., Polivy, J., and Herman, C. P. (2018). ). Are there different types of dieters? A review of personality and dietary restraint. *Appetite* 125, 380–400. doi: 10.1016/j.appet.2018.02.014

Moroze, R. M., Dunn, T. M., Holland, J. C., Yager, J., and Weintraub, P. (2015). Microthinking about micronutrients: a case of transition from obsessions about healthy eating to near-fatal "orthorexia nervosa" and proposed diagnostic criteria. *Psychosomatics* 56, 397–403. doi: 10.1016/j.psym.2014.03.003

Novotný, J. S., Gonzalez-Rivas, J. P., Kunzová, Š, Skladaná, M., Pospíšilová, A., Polcrová, A., et al. (2020). Risk factors underlying COVID-19 lockdown-induced mental distress. *Front. Psychiatry* 11:603014. doi: 10.3389/fpsyt.2020.603014

Oberle, C. D., Samaghabadi, R. O., and Hughes, E. M. (2017). Orthorexia nervosa; Assessment and correlates with gender, BMI, and personality. *Appetite* 108, 303–310.

Pearl, R. L. (2020). Weight stigma and the "quarantine-15". *Obesity* 28, 1180–1181. doi: 10.1002/oby.22850

Phillipou, A., Meyer, D., Neill, E., Tan, E. J., Toh, W., Van Rheenen, T., et al. (2020). Eating and exercise behaviors in eating disorders and the general population during the COVID-19 pandemic in Australia: initial results from the COLLATE project. *Int. J. Eat. Disord.* 53, 1158–1165. doi: 10.1002/eat.23317

Poelman, M., Gillebaart, M., Schlinket, C., Dijkstra, S., Derksen, E., Mensink, F., et al. (2021). Eating behaviour and food purchases during the COVID-19 lockdown: a cross-sectional study among adults in the Netherlands. *Appetite* 157:105002. doi: 10.1016/j.appet.2020.105002

Polivy, J., Herman, C. P., and Mills, J. S. (2020). What is restrained eating and how do we identify it? *Appetite* 155:104820. doi: 10.1016/j.appet.2020.104820

Prout, T. A., Zilcha-Mano, S., Aafjes-van Doorn, K., Békés, V., Christman-Cohen, I., Whistler, K., et al. (2020). Identifying predictors of psychological distress during COVID-19: a machine learning approach. *Front. Psychol.* 11:586202. doi: 10.3389/fpsyg.2020.586202

Puhl, R. M., and Heuer, C. A. (2010). Obesity stigma: important considerations for public health. *Am. J. Public Health* 100, 1019–1028. doi: 10.2105/AJPH.2009.159491

Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatry* 33:100213.

Renzo, L., Gualtieri, P., Pivari, F., Soldati, L., Attina, A., Cinelli, G., et al. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J. Transl. Med.* 18:229. doi: 10.1186/s12967-020-02399-5

Reyes-Olavarría, D., Latorre-Román, P. Á, Guzmán-Guzmán, I. P., Jerez-Mayorga, D., Caamaño-Navarrete, F., and Delgado-Floody, P. (2020). Positive and negative changes in food habits, physical activity patterns, and weight status during COVID-19 confinement: associated factors in the Chilean population. *Int. J. Environ. Res. Public Health* 17:5431. doi: 10.3390/ijerph17155431

Rodgers, R., Lombardo, C., Cerolini, S., Franko, D., Omori, M., Fuller-Tyszkiewicz, M., et al. (2020). The impact of COVID-19 pandemic on eating disorder risks and symptoms. *Int. J. Eat. Disord.* 53, 1166–1170. doi: 10.1002/eat.23318

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., et al. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Global. Health* 16:57. doi: 10.1186/s12992-020-00589-w

Scarmozzino, F., and Visioli, F. (2020). COVID-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. *Foods* 9:675. doi: 10.3390/foods9050675

Schlegl, S., Maier, J., Meule, A., and Voderholzer, U. (2020). Eating disorders in times of the COVID-19 pandemic—Results from an online survey of patients with anorexia nervosa. *Int. J. Eat. Disord.* 53, 1791–1800. doi: 10.1002/eat.23374

Shakory, S., Van Exan, J., Mills, J. S., Taube-Schiff, M., and Sockalingam, S. (2015). Binge eating in bariatric surgery candidates: the role of insecure attachment and emotion regulation. *Appetite* 91, 69–75. doi: 10.1016/j.appet.2015.03.026

Sheng, R., Yang, X., Liu, X., and Xu, W. (2021). Covid-19 and eating problems in daily life: the mediating roles of stress, negative affect and posttraumatic stress symptoms. *Res. Sq.* 1–18. doi: 10.21203/rs.3.rs-145764/v1

Sidor, A., and Rzymski, P. (2020). Dietary choices and habits during COVID-19 lockdown: experience from Poland. *Nutrients* 12:1657. doi: 10.3390/nu12061657

Stice, E., Becker, C. B., and Yokum, S. (2013). Eating disorder prevention: current evidence-base and future directions. *Int. J. Eat. Disord.* 46, 478–485. doi: 10.1002/eat.22105

Tanguy, M., Pecollo, N., Esseddik, Y., Edelenyi, F., Alles, B., Andreeva, V., et al. (2021). Diet and physical activity during the Coronavirus Disease 2019 (COVID-19) lockdown (March-May 2020): results from the French nutrinet-sante cohort study. *Am. J. Clin. Nutr.* 113, 924–938. doi: 10.1093/ajcn/nqaa336

Termorshuizen, J. D., Watson, H. J., Thornton, L. M., Borg, S., Flatt, R. E., MacDermond, C. M., et al. (2020). Early impact of COVID −19 on individuals with self−reported eating disorders: a survey of ˜1,000 individuals in the United States and the Netherlands. *Int. J. Eat. Disord.* 53, 1780–1790. doi: 10.1002/eat.23353

Todisco, P., and Donini, L. M. (2020). Eating disorders and obesity (EDandO) in the COVID-19 storm. *Eat. Weight Disord.* 26, 747–750. doi: 10.1007/s40519-020-00938-z

Touyz, S., Lacey, H., and Hay, P. (2020). Eating disorders in the time of COVID-19. *Journal of Eat Disord.* 8:19.

Varga, M., Thege, B. K., Dukay-Szabó, S., Túry, F., and Van Furth, E. F. (2014). When eating healthy is not healthy: orthorexia nervosa and its measurement with the ORTO-15 in Hungary. *BMC Psychiatry* 14:59. doi: 10.1186/1471-244x-14-59

Wardell, J., Kempe, T., Rapinda, K. K., Single, A. N., Bilevicius, E., Frohlich, J. R., et al. (2020). *Drinking to Cope During the COVID-19 Pandemic: The Role of External and Internal Stress-Related Factors in Coping Motive Pathways to Alcohol use, Solitary Drinking, and Alcohol Problems*. Available online at: https://doi.org/10.31234/osf.io/8vfp9 (accesed June 15, 2020).

Waters, A., Hill, A., and Waller, G. (2001). Internal and external antecedents of binge eating episodes in a group of women with bulimia nervosa. *Int. J. Eat. Disord.* 29, 17–22. doi: 10.1002/1098-108x(200101)29:1<17::aid-eat3>3.0.co;2-r

WHO (1995). *Physical Status: The Use and Interpretation of Anthropometry: Report of a World Health Organization (WHO) Expert Committee*. Geneva: World Health Organization.

Zachary, Z., Brianna, F., Brianna, L., Garrett, P., Jade, W., Alyssa, D., et al. (2020). Self-quarantine and weight gain related risk factors during the COVID-19 pandemic. *Obes. Res. Clin. Pract.* 14, 210–216. doi: 10.1016/j.orcp.2020.05.004

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

MINI REVIEW
published: 27 January 2022
doi: 10.3389/fpsyg.2021.802567

# Parenting Styles and Disordered Eating Among Youths: A Rapid Scoping Review

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Youth is a critical period in the development of maladaptive eating behaviors. Previous systematic reviews suggest the etiological significance of parent-child relationships for the onset of disordered eating in youth, but less is known about the role of parenting styles. This rapid scoping review aimed to identify whether research supports the role of parenting styles in the development of disordered eating symptoms among youths. Sixteen studies, retrieved from three databases (PsycArticles, PsycInfo, and BASE), met the inclusion criteria: original studies, published in English, examined the effect of parenting styles (authoritative or neglectful) on cognitive (drives for thinness and body dissatisfaction) and behavioral (weight control behaviors) disordered eating outcomes, among young people up to 18 years of age. Studies supported an association between various youth disordered eating symptoms such as unhealthy weight control behaviors, and experiences of adverse parenting styles characterized by high levels of control and low levels of responsiveness. Associations between adverse parenting styles and youth disordered eating were frequently indirect and differed depending on the sex of the parent and offspring. Synthesis of findings was limited due to variation in the operationalization and measurement of parenting styles, family context and disordered eating across studies. Longitudinal and standardized research is required to better understand the dynamic associations between parenting styles and youth disordered eating. Implications for family-based care in clinical practice are discussed.

**Keywords: youth, adolescents, parenting styles, authoritative, neglectful, disordered eating, family context**

OPEN ACCESS

***Edited by:***
*Ana Rosa Sepúlveda, Autonomous University of Madrid, Spain*

***Reviewed by:***
*Andrea Sabrina Hartmann, University of Konstanz, Germany*
*Chiara Tosi, Autonomous University of Madrid, Spain*

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***Specialty section:***
*This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *26 October 2021*
***Accepted:*** *21 December 2021*
***Published:*** *27 January 2022*

***Citation:***
*Hampshire C, Mahoney B and Davis SK (2022) Parenting Styles and Disordered Eating Among Youths: A Rapid Scoping Review. Front. Psychol. 12:802567. doi: 10.3389/fpsyg.2021.802567*

## INTRODUCTION

Disordered eating (DE) refers to maladaptive attitudes, behaviors, and cognitions related to eating and weight (Stice et al., 2010), and has been broadly applied to both clinical (Deas et al., 2011) and subclinical (National Health Service, 2018) populations. In the present review, DE encapsulates a subthreshold presentation of eating disorder (ED) symptomology in terms of severity and frequency (e.g., National Health Service, 2018). EDs – including anorexia nervosa, bulimia nervosa, binge eating disorder, other specified feeding and/or eating disorder, and avoidant/restrictive food intake disorder – are clinically diagnosed and involve the maladaptive use of food as a coping mechanism (National Health Service, 2021). DE may predict an ED later in life (Stice and Van Ryzin, 2019), with longitudinal research tracking the progression of subclinical symptoms into severe symptomology (Herle et al., 2020). Given that DE is a frequent antecedent of an ED diagnosis (for overview, see McClelland et al., 2020), evaluating the onset of DE is important for

understanding the clinical course of EDs and, additionally, the improvement of health among subclinical populations. Further, youth (here defined as young people up to 18 years of age, e.g., Grogan et al., 2020) may be a critical period for DE onset. DE frequently manifests in teenage years (Elmasry and Khali, 2018), though children as young as eight have presented DE (Yilmaz Kafali et al., 2020). Engagement in weight control behaviours (WCB) is common in young people (estimated prevalence rate of 44.4%, Solmi et al., 2021) and occurs more frequently than a clinical diagnosis of an ED (Elmasry and Khali, 2018).

The influence of the parent-child relationship on offspring DE has been explored (Botta and Dumlao, 2009). One component of the parent-child relationship is parenting styles – the typical attitudes held, and behaviors exerted, by those occupying a parenting role (Baumrind, 1971, 1991). Whilst domain-specific behaviors are indicative of parenting practices (such as pressure to eat or weight criticism), parenting styles are characterized by the childrearing attitudes and behaviors presenting across a range of parenting contexts (Darling and Steinberg, 1993; Power, 2013). Parenting styles have been categorized into four typologies comprising of dimensional constructs of responsiveness and demandingness (Maccoby, 1994; Gorostiaga et al., 2019): authoritative, authoritarian, permissive, and neglectful (Baumrind, 1991). Putatively considered adverse parenting styles include authoritarian (exhibiting high demandingness and low responsiveness), permissive (exhibiting low demandingness and high responsiveness), and neglectful (exhibiting low demandingness and low responsiveness) typologies (Baumrind, 1991). Parenting styles demonstrating increased parental indifference (exhibiting low responsiveness to offspring needs) are associated with a range of ED diagnoses, including anorexia and bulimia nervosa (Grogan et al., 2020). Moreover, these "unfavorable" parenting styles have been etiologically implicated in later stages of illness (Stice and Van Ryzin, 2019). It is therefore critical to understand this association in earlier illness- and life-stages before subclinical symptoms develop into serious mental illness.

Parenting styles may be viewed as a process through which attachment with caregivers is established and maintained across development (Neppl et al., 2019). Parents' fostering of a nurturing bond with infants is critical; optimal internal working models (predictively guiding future psychosocial functioning) are established by an early secure bond and are necessary for adaptive development (Bowlby, 1977). To this end, there is evidence to suggest insecure attachment styles are both directly (Jewell et al., 2016) and also indirectly (Gugliandolo et al., 2020), associated with youth DE. Indirect associations suggests theories of attachment offer an important theoretical lens for understanding parental risk pathways to the onset of DE in youth.

Within such risk pathways, youths' experience of adverse parenting styles may be conceptualized as a non-abuse adverse life experience (ALE). Non-abuse ALEs refer to adverse experiences excluding abuse (e.g., sexual or physical) (Grogan et al., 2020), and are characterized by prolonged exposure wherein associated (frequently detrimental) impacts accumulate over time (Cavelzani et al., 2018). Youths' experience of adverse parenting styles may be conceptualized as a non-abuse ALE given that parenting styles remain relatively stable throughout offspring youth development (Zhang et al., 2017), and have been associated with a variety of offspring psychopathological outcomes, including an ED in youth (Erriu et al., 2020) and adulthood (Grogan et al., 2020).

Although some studies have examined the impact of adverse parenting styles on DE symptoms in youth, the results lack consistency. Though demanding (McEwen and Flouri, 2009) and unaccepting (Kerr et al., 2021) parenting styles have been associated with youth DE, non-significant associations have also been reported between paternal (Zubatsky et al., 2015) and maternal (Berge et al., 2014) parenting styles and adolescent DE. As the parent-child relationship is dynamic throughout youth development – with parental influence decreasing in salience relative to other social influences (e.g., Branje, 2018) – parenting styles may not be as influential on offspring outcomes as youths mature. Empirical inconsistencies may also arise from variation in the way that parenting styles and DE have been operationalized and measured. For instance, studies inconsistently capture collective parental contributions within co-parenting contexts (Kuppens and Ceulemans, 2019) with some studies converging maternal and paternal parenting styles in measurement (e.g., Rozenblat et al., 2017). Further, unvalidated tools have been implemented (e.g., Zubatsky et al., 2015). Therefore, as the literature on parenting styles is patterned by conceptual, methodological, and empirical inconsistency, it is necessary to conduct a review (Aromataris and Pearson, 2014).

Previous systematic reviews have evaluated the etiological significance of the parent-child relationship for the onset for both clinical and subclinical maladaptive eating behaviors in youth. Insecure attachment styles (Jewell et al., 2016) and dysfunctional family systems (Langdon-Daly and Serpell, 2017) have been associated with DE and ED symptom presentation among teenagers, respectively. However, to date, a focused systematic search has not been conducted for parenting styles and maladaptive eating behaviors among youth samples. For the present rapid scoping review, a symptom-based approach is undertaken due to (1) the relevance of DE to youth maladaptive eating behaviors (Elmasry and Khali, 2018; Yilmaz Kafali et al., 2020) and (2) the illness progression of DE into an ED (Stice and Van Ryzin, 2019). In sum, the current review aims to establish to what extent the evidence suggests that youths with experience of adverse parenting styles present with DE symptoms by systematically reviewing and methodologically evaluating all relevant literature in the field.

## METHODS

In this rapid scoping review, a systematic search of the literature was conducted (**Figure 1**). SD & CH decided on the scope and focus of the review and selection of search terms and inclusion criteria. Given that the present study is not a full systematic review, a single-reviewer coding and analysis of studies was deemed appropriate and was undertaken by CH in discussion with SD, as per Gartlehner et al. (2020).

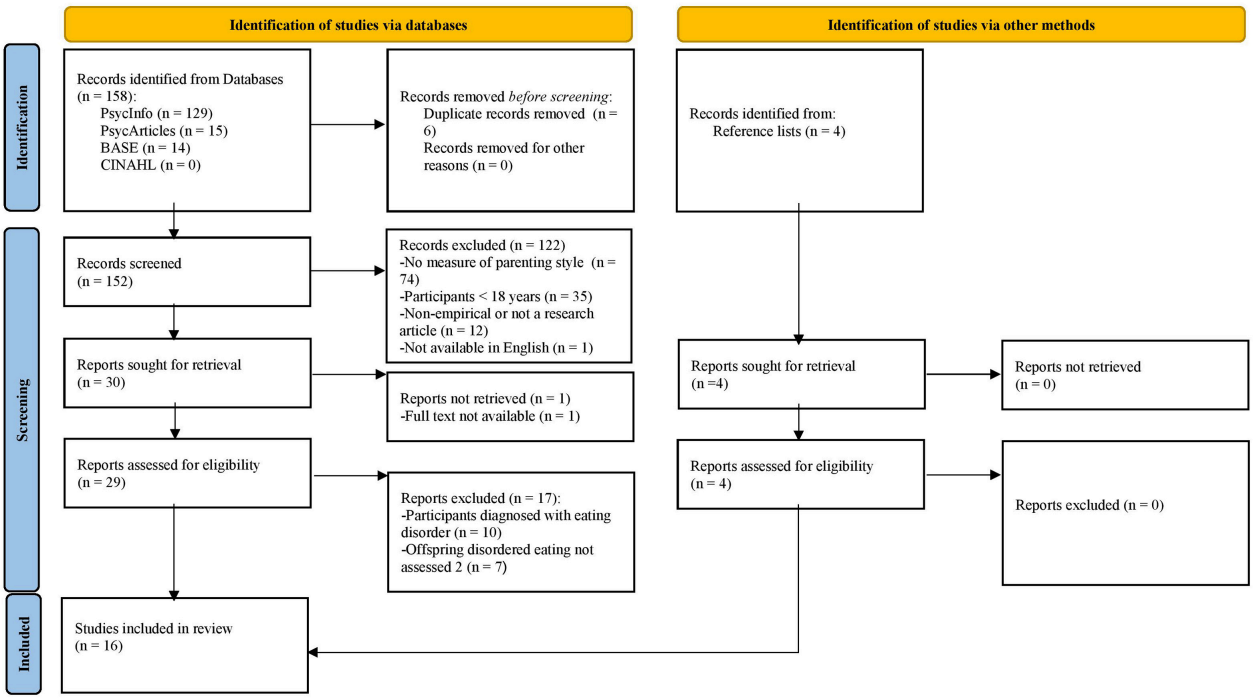


**FIGURE 1 |** PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and other sources (Page et al., 2021).

## Search Strategy

PsycArticles, PsycInfo, and CINAHL were searched in March 2021 to gather primary published studies. The BASE database was also searched for gray literature for additional relevant sources. *Parenting style* and *teenage* or *childhood* (with synonyms) were used as search terms, combined with the following (including their abbreviations, synonyms, and derivatives): *disordered eating* and *maladaptive eating*. Full search strings are included in the **Appendix**. Manual searches of reference lists of relevant articles were conducted to source potential studies not included in original database searches.

## Inclusion and Exclusion Criteria

Included studies met the following requirements: (1) included a youth sample (up to 18 years of age, e.g., Grogan et al., 2020); (2) incorporated a measure of parenting style; (3) participants had not been diagnosed with an ED; (4) were empirical and not a theoretical paper or meta-analysis; (5) quantitative; (6) published after 1980, corresponding with the publication of the DSM-III (e.g., Grogan et al., 2020); and (7) available in English.

Further to criteria (2); studies solely measuring parenting behaviors relating to food or exercise, such as food restriction (e.g., Loth et al., 2014), were excluded from the review as these are indicative of domain-specific parenting practices (e.g., Darling and Steinberg, 1993) and not of parenting styles presenting across a range of situations (e.g., Baumrind, 1971). Furthermore, (5); as a systematic search has not been conducted for parenting styles and youth populations in the ED field, there were no restrictions on the type of study design included in order to capture all relevant research.

## Data Extraction and Synthesis

One hundred and fifty eight studies were identified from initial database searches. Following the removal of duplicates and screening, 122 studies were excluded, primarily for not including a measure of parenting style or for using an adult sample. Full-texts of the remaining 34 studies were evaluated, yielding 16 eligible studies for inclusion. Studies were excluded for using participants with an ED diagnosis or not assessing offspring DE.

Data from selected studies were extracted by CH and included studies' author; year; country; design; sample characteristics; measure of parenting style and DE; parents assessed; risk of bias; and findings (**Table 1**). Given the heterogenous selection of DE outcomes and measures of parenting styles, a narrative synthesis was deemed the most appropriate form of analysis.

## Quality and Risk of Bias Assessment

A modified version of the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (Effective Public Health Practice and Project, 1998) was used to evaluate study quality and risk of bias. The following main domains were assessed: selection bias; study design; confounders; data collection methods; withdrawals and drop-outs; and appropriacy of analysis ("blinding" and "intervention integrity" were not relevant for the scope of this review). Included studies' final score following quality appraisal were graded as "weak," "moderate," or "strong" (see **Table 1**). Studies with domains with

**TABLE 1 |** Characteristics of cross-sectional and longitudinal studies analyzing the effect of parenting styles on youth presentation of disordered eating.

| References | Study design | Country of origin | Sample characteristics | Parenting style measure | Parents assessed | Disordered eating measure | Relevant findings | Quality appraisal |
|---|---|---|---|---|---|---|---|---|
| Berge et al., 2014 | Cross-sectional | United States | *N* = 2,793 (1,307 females) *M* = 14.4 years; S.D. = 2.0; range = 11–19 | Family assessment device | Mother and father | Eating and activity in teens (EAT-26) | Youths reporting greater parental psychological control were more likely to engage in dieting and DEB behaviors. Psychologically controlling mothers were most associated with more DEB in males (extreme WCB) and all DEB in females (dieting, binge eating, unhealthy, and extreme WCB). For females, those with experience of higher perceived paternal psychological control were more likely to engage in all DE behaviors. | Moderate |
| Blodgett Salafia et al., 2009 | Longitudinal attrition N/A | United States | *N* = 131 (73 females) *M* = 11.65 years; S.D. = 0.51; range = 11–13 years | Psychological control scale-youth self-report | Mother | Eating Disorder Inventory (EDI-1) | For both male and female participants, reported maternal psychological control predicted bulimic symptoms 2 years later. However, this association was indirect and mediated by adolescents' lowered self-competence. | Weak |
| Blodgett Salafia et al., 2007 | Longitudinal attrition N/A | United States | *N* = 73 (73 female) *M* = 11.59 years; S.D. = 0.52; range = 11–13 years | Psychological control scale youth report democracy scale parental knowledge scale | Mother | Eating Disorder Inventory (EDI-1) | The mother-youth relationship was important. Girls reporting their mothers' undemocratic parenting style, restriction of psychological autonomy, and less knowledge of daily activities and social interactions were more likely to engage in DEB (dieting) and attitudes (drive for thinness and body dissatisfaction) 2 years later. However, this relationship was indirect, and fully mediated by internalized psychological distress. | Moderate |
| Fonseca et al., 2002 | Cross-sectional | Portugal | *N* = 9,042 (4,625 female) Range = 12–18 years | Voice of Connecticut youth | Converged | Voice of Connecticut youth | Parenting style risk factors for engaging in DEB (extreme dieting) among males were reports of high parental supervision and monitoring. In contrast, there were no significant parenting risk factors associated with females. | Weak |
| Furnham and Adam-Saib, 2000 | Cross-sectional | United Kingdom | *N* = 168 (168 female) Range = 15–17 years | Parental bonding instrument | Mother and father | Eating attitudes test (EAT-26) | Many findings were non-significant. Parental overprotection scores were not significantly associated with EAT scores across any groups. However, both maternal and paternal responsiveness negatively correlated with body satisfaction. Further, socio-cultural factors influenced the development of DE symptoms, with the British-Asian sample reporting higher EAT scores and parental overprotectiveness compared to white participants. | Weak |
| Hautala et al., 2011 | Longitudinal T0 *N* = N/A T1 *N* = 1,891 T2 *N* = 935 | Finland | *N* = 722 (535 female) *M* = 14.9 years. Divided into reported eating disturbance (*n* = 208), and non-symptomatic controls (*n* = 514) | Parental Bonding Instrument | Mother and father | SCOFF (Finnish translation) | Due to attrition, analyses were conducted on females. Parenting styles were associated with both onset of and remission from DE. Paternal overprotection alone was significantly associated with onset of DE; maternal parenting style was not. However, only maternal care uniquely predicted the recurrence of DE in adolescents. Further, prolonged DE symptoms were associated less caring and more controlling parenting styles. In terms of remission, "good enough" parenting was sufficient to remit female participants from symptoms. | Moderate |
| Hochgraf et al., 2017 | Cross-sectional | United States | *N* = 699 (351 female) Range = 11–12 years | Parental Warmth report | Mother and father | Child's eating habits and body self-image scale | Both maternal and paternal hostility were independently associated with youth DE. Further, an additive effect was observed as associations between youth DE and parenting styles were amplified when both parents were high in hostility. However, differential implications of parenting styles were observed, as paternal hostility was associated with more severe DE. | Weak |
| Kerr et al., 2021 | Longitudinal T0 *N* = 4,950 T1 *N* = 4,950 | United States | T0 *N* = 4,950 (2,370 female) Range = 9–10 years | Children's report of parent behavior inventory | Mother and father | Kiddie schedule for affective disorders and Schizophrenia | Effects of parenting styles differed between parents and offspring gender. Offspring perceptions of a lack of maternal acceptance was associated with heightened risk of DE a year later in females, but not males. However, this was an interaction effect as maternal acceptance was a mediator for the relationship between gastric symptoms and DE. In contrast, there were no statistically significant effects for paternal acceptance. | Moderate |
| Korotana et al., 2018 | Longitudinal T0 *N* = 446 T1 *N* = 383 T2 *N* = 352 | Canada | T0 *N* = 446 (466 female) Range = 11–17 years | Parental environmental questionnaire | Mother and father | Minnesota eating behavior survey | Longitudinal associations between daughter DE and the parent-child relationship were limited. However, reciprocal associations were found between adverse parenting styles and daughter DE (body dissatisfaction, weight preoccupation, binge eating, compensatory behavior) as reporting of DE symptoms were associated with maladaptive changes to parenting styles. | Strong |
| Krug et al. (2014) | Longitudinal Attrition N/A | Australia | *N* = 1,391 (684 female) *M* = 11.59 years; S.D. = 0.52; range = 11–13 years) | N/A | N/A | Eating Disorder Inventory (unspecified) | For female participants, low parental monitoring was significantly associated with bulimia. Further, reports of low parental warmth and monitoring were associated with increased risk of reporting all DE symptoms (body dissatisfaction, drive for thinness, and bulimia) for adolescent females. However, for males, no significant associations were found between any parenting styles and reported DE symptoms. | Moderate |
| Krug et al., 2016 | Longitudinal Attrition N/A | Australia | *N* = 1,300 (667 female) Range = 15–16 years | ATP parenting practices questionnaire | 1 parent (95% mother) | Eating Disorder Inventory (EDI-1) body dissatisfaction scale | There was limited evidence for a direct parental effect on youths' DE attitudes and behaviors. For males, there were no significant associations between reported parenting styles and any indicator of DEB. For females, low parental warmth alone was associated with bulimic behaviors. Further, exposure to both low parental warmth and monitoring increased females' odds of reporting all DE outcomes (drive for thinness, bulimia, and body dissatisfaction). | Moderate |
| McEwen and Flouri, 2009 | Cross-sectional | United Kingdom | *N* = 203 (125 female) *M* = 14.04 years; S.D. = 1.91; range = 11–18 years | Parental bonding instrument parental control scales | Father | Eating attitudes test (EAT-26) | Paternal overprotection, warmth, psychological control contributed independently to youth DE symptoms. Further, paternal psychological control and overprotection were directly associated with adolescent DE. However, paternal behavioral control (monitoring, knowledge, discipline) was not related to DE symptoms. | Strong |
| Meesters et al., 2007 | Cross-sectional | Netherlands | *N* = 405 (224 female) *M* = 12.5; S.D. = 1.5; range = 10–16 years | Egna Minnen Beträffande Uppfrostran, (Swedish "My memories of upbringing") | Mother and father | Children's Eating Attitudes Test (ChEAT) | Reported maternal rejection was positively related to food preoccupation and dieting for both male and female participants. However, gender differences were observed as familial influences were more predictive of DE in boys than girls. High levels of both maternal and paternal control associated with dieting, food and muscle preoccupation in males. Further, maternal control significantly predicted muscle preoccupation in males. | Moderate |
| Pearson et al., 2009 | Cross-sectional | United Kingdom | *N* = 328 (142 female) Range = 12–16 years Divided into younger participants *M* = 13.3 years, and older participants *M* = 15.6 years | Parenting style measure made by Kremers et al. (2003) | Converged | Youth/adolescent food frequency questionnaire | No significant interactions between parental involvement or strictness and any dietary behaviors were found after controlling for gender and age. | Strong |
| Rozenblat et al., 2017 | Cross-sectional | Australia | Study 1. *N* = 650 (338 female) Range = 15–16 years Study 2. *N* = 304 (161 female) | Australian temperament project parenting practices scale Iowa family interaction rating scale | 1 parent (mainly mother, no statistic available) | Eating Disorder Inventory (EDI-2) | Study 1. Bulimic symptoms were significantly associated with self-reported parental warmth and use of harsh punishment, though drive for thinness was not. Study 2. However, observations of parental hostility did not directly predict either bulimia or drive for thinness. | Weak |
| Zubatsky et al., 2015 | Longitudinal attrition N/A | Switzerland | *N* = 2,516 (1,386 female) Divided into middle school, *M* = 12.8 years; S.D. = 0.8, at time 1, and *M* = 17.2 years; S.D = 0.6, at time 2 And high school, *M* = 15.8 years; S.D. = 0.8 at time 1; *M* = 20.4; S.D. = 0.8, at time 2 | Created for study (assessing authoritative, authoritarian, permissive, and neglectful parenting) | Mother and father | Created for study (binge eating, WCBs, extreme WCBs) | The mother-youth relationship was significant, as maternal parenting style longitudinally predicted DEB (WCB) for both males and females. Specifically, youths with authoritarian mothers were more likely to have unhealthy WCBs compared to alternative parenting styles. For females, maternal authoritarian parenting style predicted increased risk for binge-eating behaviors; for males, less extreme WCB. In contrast, there were no significant associations between paternal parenting style and included youth DE symptoms. | Moderate |

*DEB, disordered eating behaviors; DE, disordered eating; and WCB, weight control behaviors.*

≥2, 1, and 0 weak ratings were considered to demonstrate "weak," "moderate," and "strong" risk of bias, respectively.

# RESULTS

Eight studies were cross-sectional and eight were longitudinal (**Table 1**). All studies used community samples to assess DE, though one also included non-symptomatic controls (Hautala et al., 2011). Included studies were predominantly conducted in English-speaking countries, though studies also originated from Portugal (Fonseca et al., 2002), Netherlands (Meesters et al., 2007), Finland (Hautala et al., 2011) and Switzerland (Zubatsky et al., 2015). Overall, studies inconsistently reported the psychometric properties of tools used, with only 6 studies providing information on both parenting style and DE measures (Blodgett Salafia et al., 2009; Hautala et al., 2011; Berge et al., 2014; Hochgraf et al., 2017; Rozenblat et al., 2017; Korotana et al., 2018).

Parenting styles were assessed *via* offspring self-report and utilized a range of tools. Parental control scales were implemented in three studies, including the Psychological Control Scale Youth Report (Blodgett Salafia et al., 2007, 2009). The Parental Bonding Instrument (PBI) was implemented in a further three studies among samples including youths younger than the recommended 16 years of age (Furnham and Adam-Saib, 2000; McEwen and Flouri, 2009; Hautala et al., 2011).

DE outcomes were measured using self-report tools with the exception of one study, where parents reported on offspring DE using the Kiddie Schedule for Affective Disorders and Schizophrenia (Kerr et al., 2021). Of the rest, five studies used versions of the Eating Disorder Inventory (EDI-1 and -2) and two implemented the Eating Attitudes Test (EAT-26), with one study using a modified version for children (ChEAT, Meesters et al., 2007). The remaining six studies used various alternative tools.

Included studies used a range of statistical analysis techniques, though this information was missing in one study (Krug et al., 2014). Regression models were frequently used, with logistic, linear, and stepwise techniques used by four, two and one studies, respectively. Of the rest, four studies used structural equation modeling, of which one study utilized cross-lagged analyses (Korotana et al., 2018). Notably, structural equation modeling identified associations between parenting styles and youth DE were mediated by offspring emotional reactivity (Hochgraf et al., 2017), psychological distress (Blodgett Salafia et al., 2007) and lowered self-competence (Blodgett Salafia et al., 2009). The remaining four studies used various alternative analyses.

Overall, the divergence in the methodologies, measures and reporting in included studies limited the summarization and synthesis of findings within this scoping review.

## Cross-Sectional Studies

Both paternal (McEwen and Flouri, 2009) and maternal (Meesters et al., 2007) overprotection were correlated with DE food preoccupation. Further, youths who were exposed to controlling parenting styles presented with various DE symptoms, such as internalized muscle preoccupation (Meesters et al., 2007) and externalizing extreme WCBs (Berge et al., 2014). McEwen and Flouri (2009) assessed associations between paternal parenting styles and self-reported DE with additional predictor variables. Paternal psychological control and overprotection were directly associated with all selected indicators of DE behaviors for youths (McEwen and Flouri, 2009). However, conflicting evidence was found as no significant associations were found between any parenting styles and youth dietary behaviors after controlling for a number of potential confounders (Pearson et al., 2009).

## Longitudinal Studies

Similar to the cross-sectional results, adverse parenting presenting varying levels of responsiveness and demandingness was associated with a substantial range of operationalizations of DE. High levels of parental control predicted unhealthy WCBs (Zubatsky et al., 2015) and body dissatisfaction (Blodgett Salafia et al., 2007). Additionally, unresponsive parenting styles (exhibiting low behavioral monitoring) predicted various DE among daughters, such as body dissatisfaction (Blodgett Salafia et al., 2007) and bulimic behaviors (Krug et al., 2014). However, findings were inconsistent as many studies reported non-significant results for males which were not present for their female counterparts (Krug et al., 2014, 2016; Zubatsky et al., 2015; Kerr et al., 2021). Further, some studies compared longitudinal measurements of parental responsiveness and demandingness using logistic regression analyses (Hautala et al., 2011; Krug et al., 2016). Combined (Krug et al., 2016) and prolonged (Hautala et al., 2011) exposure to low parental warmth *and* high control predicted increased odds of, and more severe, DE. Two studies also aggregated findings at multiple time points throughout the study (Hautala et al., 2011; Korotana et al., 2018). Associations between parenting style and youths' DE were dynamic: cross-lagged analyses suggested they were reciprocal (Korotana et al., 2018) and differed with age as associations were stronger in early teens relative to later teenage years (Hautala et al., 2011). Finally, the quality of included studies was restricted by a failure to report attrition rates, with only three studies including this information (Hautala et al., 2011; Korotana et al., 2018; Kerr et al., 2021).

# DISCUSSION

The present review focused on associations between parenting styles and DE presentation in youth. Most studies provided preliminary support for an association between symptoms of DE and experience of various adverse parenting styles (e.g., McEwen and Flouri, 2009; Kerr et al., 2021), although some studies did not (e.g., Fonseca et al., 2002; Korotana et al., 2018). This resonates with previous work that has identified an association between DE beyond youth and other forms of non-abusive ALE present in family contexts, such as family dynamics (Mousoulidou et al., 2019). However, overall, review findings lacked consistency and stability, and associations were often indirect.

A number of characteristics of adverse parenting styles were associated with youth DE. Parenting styles that were perceived as controlling were associated with a range of youth DE outcomes (Meesters et al., 2007; McEwen and Flouri, 2009; Berge et al., 2014). Specifically, paternal overprotection correlated with (McEwen and Flouri, 2009) and increased

risk of Hautala et al. (2011) DE symptoms. In addition, parental warmth was salient to youth DE, with exposure to low levels associated with a range of DE symptoms (Krug et al., 2014), including bulimia outcomes (Krug et al., 2016).

However, many studies found indirect effects of adverse parenting styles on DE; only one study established a direct association between high paternal demandingness, low responsiveness and DE (McEwen and Flouri, 2009). Associations between adverse parenting styles were mediated by offspring psychological distress (Blodgett Salafia et al., 2007), lowered self-competence (Blodgett Salafia et al., 2009) and emotional reactivity (Hochgraf et al., 2017), thus indicating the affective functioning of young people is an important facilitatory mechanism of DE onset. Attachment theory may thus be useful as a model to explain indirect effects identified in this scoping review, with parenting styles distally influencing youth eating pathology through correlates of the attachment system, such as offspring emotional competency (Laible, 2007) and self-competence (de Minzi, 2010).

Furthermore, longitudinal studies found interactions between parenting styles and DE varied throughout youth (Hautala et al., 2011; Korotana et al., 2018). The teenage years are a transitionary period for the parent-child relationship as parental influence decreases in salience relative to other social influences, including peers (Branje, 2018). It is likely the significance of mediating factors increases as offspring age due to changes in the parent-child relationship (Albarello et al., 2018), and contradictory findings within the review may be attributed to differences in sample age ranges. In sum, longitudinal studies implementing transactional models of parental styles better capture the development of DE across youth life-stages.

## Methodological Divergence

Although many studies assessed and aggregated maternal and paternal parenting styles, some studies converged parental contributions into a unitary construct of parenting in measurement (Pearson et al., 2009) and analysis (Rozenblat et al., 2017). However, the concept of parenting styles has been clarified to acknowledge the coexistence of discrete styles within joint parenting contexts, such as co-parent households (Kuppens and Ceulemans, 2019). Notably, some studies used the marital status of youths' biological parents as inclusion criteria (e.g., Blodgett Salafia et al., 2007). Aggregated evidence from the present review indicate maternal and paternal parenting styles from the same household can differ (Zubatsky et al., 2015) and additively interact (Krug et al., 2014, 2016). Therefore, parents' discrete styles are not consistently captured in convergent concepts of parenting, meaning the utility of current findings is restricted.

A significant differentiator of study quality was researchers' consideration of the confounding effects of co-variates of parenting style. Higher quality studies situated parenting styles in the broader family context, for example collecting self-reported parental marital status (Krug et al., 2016) and number of siblings (Pearson et al., 2009), which has been implicated in modifying parenting style (Fan and Chen, 2020). However, research inconsistently assessed covariates and thus current data were insufficient to interpret meaningful patterns of findings within the review. Additionally, assessments of DE frequently measured drives for thinness and bulimia and body dissatisfaction, though researchers selected various tools to do so. Higher quality studies generally implemented well validated measures, such as the EDI-1 and EAT-26. However, some studies compiled (Berge et al., 2014) or created new measures by selecting operationalizations of DE from existing tools, without providing sufficient justification for selection (e.g., Fonseca et al., 2002). Collectively, the included studies introduced heterogeneity into the outcome of interest, thereby reducing the ability to synthesize findings and draw symptom-specific conclusions from youth experiences of parenting styles. Standardization of methods (specifically the measurement of covariates of parenting style, DE outcome and parenting style) is required to strengthen comparative conclusions drawn from the evidence base.

## Limitations

Only one study implemented a multi-modal procedure to assess parenting style (Rozenblat et al., 2017), thereby most studies in this review relied on an assumed convergence between knowledge and functioning (Baumrind, 2005; Herbers et al., 2017). Critically, observations of parenting style demonstrated low convergence with parental self-report (Rozenblat et al., 2017), suggesting conclusions relating to parenting style and youth DE outcomes may be dependent on the mode of assessment. Future research should implement standardized procedures incorporating multi-modal, aggregated assessments of maternal and paternal parenting styles.

Additionally, directional influences of parenting styles cannot be inferred from reported DE symptoms in cross-sectional studies. Though Baumrind (1991) conceptualizes parental influence on offspring outcomes as unidirectional, parenting style has been reconceptualized as bidirectional (Estlein, 2021) and reciprocal (Pinquart and Gerke, 2019), acknowledging the contribution of the offspring in parent-child interactions. Longitudinal evidence from the review indicates that DE acts a risk factor for adverse parenting, suggesting that youths' DE symptoms subsequently modify parenting styles (Korotana et al., 2018). Establishing the directionality of associations is critical for the accurate interpretation of findings, and future research must continue to implement this design in order to capture the bidirectional and temporally dynamic nature of associations between parenting styles and youth DE throughout offspring development.

Finally, selection bias may be present as review results were limited to the English language. However, as the majority studies were conducted by English speaking countries, the risk of excluding additional relevant findings is anticipated to be low.

## Implications

Findings from the present review have implications for clinical practice. The prevalence of reported DE symptoms in youth across studies demonstrates the clinical necessity of intervention into maladaptive parenting styles. Clinicians must implement a patient-centered recovery model (e.g., Wetzler et al., 2020) and consider parental influences in the treatment of DE; family level interventions must be offered if appropriate to the young person's experiences of DE (see Lock and Le Grange, 2019

for overview). From the findings of the present review, interventions into parenting styles characterized by controlling (e.g., Berge et al., 2014), overprotective (e.g., McEwen and Flouri, 2009) and unresponsive (e.g., Krug et al., 2016) parental behaviors are recommended. Such interventions may thus prevent the maintenance of youth DE symptoms. In addition, interventive promotion of "good enough" parenting styles exhibiting age appropriate control and responsiveness are recommended to remit youth from DE (Hautala et al., 2011, p.961). Subsequently, consistent with the conceptualization of maladaptive eating behaviors as a continuum from DE to an ED (Dinkler et al., 2021), targeted interventions into parental pathways of risk for the onset of DE can work to reduce family based risk of development and circumvent the development of subclinical symptoms into an ED (Stice and Van Ryzin, 2019).

## CONCLUSION

This rapid scoping review evaluated 16 studies to assess whether parenting style could be a risk factor for youth DE. Exposure to demanding, unresponsive, or a combination of these, parenting styles both predicted and correlated with reports of various symptoms of DE. However, included results were often conflicted, and comparative conclusions concerning the influence of adverse parenting styles on youth DE are limited due to the heterogenous operationalization and measurement of parenting styles, family context, and DE outcomes. Therefore, the present review does not establish a definitive account of the etiological influence of parental style to the onset of DE in youth. Further research implementing longitudinal and standardized procedures is essential for good quality research into parenting styles.

## AUTHOR CONTRIBUTIONS

CH: conceptualization, methodology, investigation, and writing – original draft. BM: writing – review and editing. SD: conceptualization and writing – review and editing. All authors contributed to the article and approved the submitted version.

## REFERENCES


Albarello, F., Crocetti, E., and Rubini, M. (2018). I and us: a longitudinal study on the interplay of personal and social identity in adolescence. *J. Youth Adolesc.* 47, 689–702. doi: 10.1007/s10964-017-0791-4

Aromataris, E., and Pearson, A. (2014). The systematic review: an overview. *Am. J. Nurs.* 114, 53–58. doi: 10.1097/01.NAJ.0000444496.24228.2C

Baumrind, D. (1971). Current patterns of parental authority. *Dev. Psychol. Monogr.* 4(1 Pt. 2), 1–103.

Baumrind, D. (1991). "Effective parenting during the early adolescent transition," in *Family Transitions. Advances in Family Research Series*, eds P. A. Cowan and E. M. Hetherington (Hillsdale: Lawrence Erlbaum Associates, Inc). doi: 10.1017/s0954579420002096

Baumrind, D. (2005). Patterns of parental authority and adolescent autonomy. *New Direct. Child Adolesc. Dev.* 20, 61–69. doi: 10.1002/cd.128

Berge, J. M., Wall, M., Larson, N., Eisenberg, M. E., and Loth, K. A. (2014). The unique and additive associations of family functioning and parenting practices with disordered eating behaviors in diverse adolescents. *J. Behav. Med.* 37, 205–217. doi: 10.1007/s10865-012-9478-1

Blodgett Salafia, E. H. B., Gondoli, D. M., Corning, A. F., Bucchianeri, M. M., and Godinez, N. M. (2009). Longitudinal examination of maternal psychological control and adolescents' self-competence as predictors of bulimic symptoms among boys and girls. *Int. J. Eat. Dis.* 42, 422–428. doi: 10.1002/eat.20626

Blodgett Salafia, E. H., Gondoli, D. M., Corning, A. F., Mcenery, A. M., and Grundy, A. M. (2007). Psychological distress as a mediator of the relation between perceived maternal parenting and normative maladaptive eating among adolescent girls. *J. Counsell. Psychol.* 54, 434–446. doi: 10.1037/0022-0167.54.4.434

Botta, R. A., and Dumlao, R. (2009). How do conflict and communication patterns between fathers and daughters contribute to or offset eating disorders? *Health Commun.* 14, 199–219. doi: 10.1207/S15327027HC1402_3

Bowlby, J. (1977). The making and breaking of affectional bonds: II. Some principles of psycho-therapy. *Br. J. Psychiatry* 130, 421–431. doi: 10.1192/bjp.130.5.421

Branje, S. (2018). Development of parent-adolescent relationships: conflict interactions as a mechanism of change. *Child Dev. Perspect.* 12, 171–176. doi: 10.1111/cdep.12278

Cavelzani, A. S., Trinchieri, M., Gorio, M. C. F., and Romeo, L. (2018). Micro-traumatic experiences and psychotherapeutic treatment. *J. Integr. Med.* 7, 1–6. doi: 10.18282/jim.v7i1.518

Darling, N., and Steinberg, L. (1993). Parenting style as context: an integrative model. *Psychol. Bull.* 113, 56–78.

de Minzi, M. C. R. (2010). Gender and cultural patterns of mothers' and fathers' attachment and links with children's self-competence, depression and loneliness in middle and late childhood. *Early Child Dev. Care* 180, 193–209. doi: 10.1080/03004430903415056

Deas, S., Power, K., Collin, P., Yellowlees, A., and Grierson, D. (2011). The relationship between disordered eating, perceived parenting, and perfectionistic schemas. *Cogn. Ther. Res.* 5, 414–424. doi: 10.1007/S10608-010-9319-X

Dinkler, L., Taylor, M. J., Råstam, M., Hadjikhani, N., Bulik, C. M., Lichtenstein, P., et al. (2021). Association of etiological factors across the extreme end and continuous variation in disordered eating in female Swedish twins. *Psychol. Med.* 51, 750–760. doi: 10.1017/S0033291719003672

Effective Public Health Practice and Project (1998). *Quality Assessment Tool For Quantitative Studies*. Hamilton, ON: Effective Public Health Practice.

Elmasry, N., and Khali, D. (2018). Subclinical eating disorders in a sample of secondary school girls and comorbidity with depression in Sharkia Governorate, Egypt. *Egypt J. Psychiatry* 39:129. doi: 10.4103/1110-1105.243024

Erriu, M., Cimino, S., and Cerniglia, L. (2020). The role of family relationships in eating disorders in adolescents: a narrative review. *Behav. Sci.* 10:88. doi: 10.3390/BS10040071

Estlein, R. (2021). Parenting as a communication process: integrating interpersonal communication theory and parenting styles conceptualization. *J. Family Theory Rev.* 13, 21–33. doi: 10.1111/jftr.12407

Fan, J., and Chen, B. (2020). Parenting styles and coparenting in China: the role of parents and children's sibling status. *Curr. Psychol.* 39, 1505–1512. doi: 10.1007/s12144-019-00379-7

Fonseca, H., Ireland, M., and Resnick, M. D. (2002). Familial correlates of extreme weight control behaviors among adolescents. *Int. J. Eat. Dis.* 32, 441–448. doi: 10.1002/eat.10078

Furnham, A., and Adam-Saib, S. (2000). Abnormal eating attitudes and behaviours and perceived parental control: a study of white British and British-Asian school girls. *Soc. Psychiatry Epidemiol.* 36, 462–470. doi: 10.1007/s001270170025

Gartlehner, G., Affengruber, L., Titscher, V., Noel-Storr, A., Dooley, G., Ballarini, N., et al. (2020). Single-reviewer abstract screening missed 13 percent of relevant studies: a crowd-based, randomized controlled trial. *J. Clin. Epidemiol.* 121, 20–28. doi: 10.1016/J.JCLINEPI.2020.01.005

Gorostiaga, A., Aliri, J., Balluerka, N., and Lameirinhas, J. (2019). Parenting styles and internalizing symptoms in adolescence: a systematic literature review. *Int. J. Environ. Res. Public Health* 16, 1–19. doi: 10.3390/ijerph16173192

Grogan, K., MacGarry, D., Bramham, J., Scriven, M., Maher, C., and Fitzgerald, A. (2020). Family-related non-abuse adverse life experiences occurring for adults diagnosed with eating disorders: a systematic review. *J. Eat. Dis.* 8:36. doi: 10.1186/s40337-020-00311-6

Gugliandolo, M. C., Costa, S., Cuzzocrea, F., Larcan, R., and Martino, G. (2020). Adolescents and body uneasiness: the contribution of supportive parenting and trait emotional intelligence. *J. Child Fam. Stud.* 29, 2453–2462. doi: 10.1007/S10826-020-01779-1/FIGURES/1

Hautala, L., Helenius, H., Karukivi, M., Maunula, A.-M., Nieminen, J., Aromaa, M., et al. (2011). The role of gender, affectivity and parenting in the course of disordered eating: a 4-year prospective case-control study among adolescents. *Int. J. Nurs. Stud.* 48, 959–972. doi: 10.1016/j.ijnurstu.2011.01.014

Herbers, J. E., Garcia, E. B., and Obradović, J. (2017). Parenting assessed by observation versus parent-report: moderation by parent distress and family socioeconomic status. *J. Child Fam. Stud.* 26, 3339–3350.

Herle, M., Stavola, B. De, Hübel, C., Abdulkadir, M., Ferreira, D. S., Loos, R. J. F., et al. (2020). A longitudinal study of eating behaviours in childhood and later eating disorder behaviours and diagnoses. *Br. J. Psychiatry* 216, 113–119.

Hochgraf, A. K., Kahn, R. E., and Kim-Spoon, J. (2017). The moderating role of emotional reactivity in the link between parental hostility and eating disorder symptoms in early adolescence. *Eat. Dis.* 25, 420–435.

Jewell, T., Collyer, H., Gardner, T., Tchanturia, K., Simic, M., Fonagy, P., et al. (2016). Attachment and mentalization and their association with child and adolescent eating pathology: a systematic review. *Int. J. Eat. Dis.* 49, 354–373. doi: 10.1002/eat.22473

Kerr, K. L., Ralph-Nearman, C., Colaizzi, J. M., DeVille, D. C., Breslin, F. J., Aupperle, R. L., et al. (2021). Gastric symptoms and low perceived maternal warmth are associated with eating disorder symptoms in young adolescent girls. *Int. J. Eat. Dis.* 54, 1009–1018. doi: 10.1002/eat.23516

Korotana, L. M., von Ranson, K. M., Wilson, S., and Iacono, W. G. (2018). Reciprocal associations between eating pathology and parent-daughter relationships across adolescence: a monozygotic twin differences study. *Front. Psychol.* 9:914. doi: 10.3389/fpsyg.2018.00914

Kremers, S. P. J., Brug, J., De Vries, H., and Engels, R. C. M. E. (2003). Parenting style and adolescent fruit consumption. *Appetite* 41, 43–50. doi: 10.1016/S0195-6663(03)00038-2

Krug, I., King, R. M., Youssef, G. J., Sorabji, A., Wertheim, E. H., Le Grange, D., et al. (2016). The effect of low parental warmth and low monitoring on disordered eating in mid-adolescence: findings from the Australian temperament project. *Appetite* 105, 232–241. doi: 10.1016/j.appet.2016.05.015

Krug, I., Sorabji, A., King, R., Letcher, P., and Olsson, C. (2014). Does low parental warmth and monitoring predict disordered eating in Australian female and male adolescents? *J. Eat. Dis.* 2:O29. doi: 10.1186/2050-2974-2-S1-O29

Kuppens, S., and Ceulemans, E. (2019). Parenting styles: a closer look at a well-Known concept. *J. Child Fam. Stud.* 28, 168–181. doi: 10.1007/s10826-018-1242-x

Laible, D. (2007). Attachment with parents and peers in late adolescence: links with emotional competence and social behavior. *Pers. Individ. Diff.* 43, 1185–1197. doi: 10.1016/J.PAID.2007.03.010

Langdon-Daly, J., and Serpell, L. (2017). Protective factors against disordered eating in family systems: a systematic review of research. *J. Eat. Dis.* 5:22. doi: 10.1186/s40337-017-0141-7

Lock, J., and Le Grange, D. (2019). Family-based treatment: where are we and where should we be going to improve recovery in child and adolescent eating disorders. *Int. J. Eat. Dis.* 52, 481–487. doi: 10.1002/eat.22980

Loth, K. A., Maclehose, R., Bucchianeri, M., Crow, S., and Neumark-Sztainer, D. (2014). Predictors of dieting and disordered eating behaviors from adolescence to young adulthood. *J. Adolesc. Health* 55, 705–712. doi: 10.1016/j.jadohealth.2014.04.016

Maccoby, E. E. (1994). The role of parents in the socialization of children: an historical overview. *Century Dev. Psychol.* 68, 589–615.

McClelland, J., Robinson, L., Potterton, R., Mountford, V., and Schmidt, U. (2020). Symptom trajectories into eating disorders: a systematic review of longitudinal, nonclinical studies in children/adolescents. *Eur. Psychiatry* 63, 1–11. doi: 10.1192/J.EURPSY.2020.55

McEwen, C., and Flouri, E. (2009). Fathers' parenting, adverse life events, and adolescents' emotional and eating disorder symptoms: the role of emotion regulation. *Eur. Child Adolesc. Psychiatry* 18, 206–216. doi: 10.1007/s00787-0080719-3

Meesters, C., Muris, P., Hoefnagels, C., and van Gemert, M. (2007). Social and family correlates of eating problems and muscle preoccupation in young adolescents. *Eat. Behav.* 8, 83–90. doi: 10.1016/j.eatbeh.2006.02.002

Mousoulidou, M., Argyrides, M., and Ioannou, M. (2019). Effects of family dynamics on disordered eating patterns and behaviors: evidence from cyprus. *Eur. J. Counsell. Psychol.* 8, 64–77. doi: 10.5964/ejcop.v8i1.181

National Health Service (2018). *Disordered Eating: Guidelines for Schools and Staff*. London: National Health Service.

National Health Service (2021). *Overview – Eating Disorders*. London: National Health Service.

Neppl, T. K., Wedmore, H., Senia, J. M., Jeon, S., and Diggs, O. (2019). Couple interaction and child social competence: the role of parenting and attachment. *Soc. Dev.* 28:363. doi: 10.1111/SODE.12339

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372:71. doi: 10.1136/bmj.n71

Pearson, N., Atkin, A. J., Jh Biddle, S., Gorely, T., and Edwardson, C. (2009). Parenting styles, family structure and adolescent dietary behaviour. *Public Health Nutr.* 13, 1245–1253. doi: 10.1017/S1368980009992217

Pinquart, M., and Gerke, D. C. (2019). Associations of parenting styles with self-esteem in children and adolescents: a meta-analysis. *J. Child Fam. Stud.* 28, 2017–2035. doi: 10.1007/s10826-019-01417-5

Power, T. G. (2013). Parenting dimensions and styles: a brief history and recommendations for future research. *Child. Obes.* 9, S14–S21. doi: 10.1089/CHI.2013.0034

Rozenblat, V., Ryan, J., Wertheim, E., King, R., Olsson, C. A., and Krug, I. (2017). Relationships between self-reported and observed parenting behaviour, adolescent disordered eating attitudes and behaviours, and the 5-HTTLPR polymorphism: data from the Australian temperament project. *Eur. Eat. Dis. Rev.* 25, 381–388. doi: 10.1002/erv.2530

Solmi, F., Helen Sharpe, P., Gage, S. H., Maddock, J., Lewis, G., and Patalay, P. (2021). Changes in the prevalence and correlates of weight-control behaviors and weight perception in adolescents in the UK, 1986-2015. *JAMA Pediatr.* 175, 267–275. doi: 10.1001/JAMAPEDIATRICS.2020.4746

Stice, E., and Van Ryzin, M. J. (2019). A Prospective test of the temporal sequencing of risk factor emergence in the dual pathway model of eating disorders. *J. Abnorm. Psychol.* 128, 119–128. doi: 10.1037/abn0000400

Stice, E., Ng, J., and Shaw, H. (2010). Risk factors and prodromal eating pathology. *J. Child Psychol. Psychiatry* 51, 518–525. doi: 10.1111/J.1469-7610.2010.02212.X

Wetzler, S., Hackmann, C., Peryer, G., Clayman, K., Friedman, D., Saffran, K., et al. (2020). A framework to conceptualize personal recovery from eating disorders: a systematic review and qualitative meta-synthesis of perspectives from individuals with lived experience. *Int. J. Eat. Dis.* 53, 1188–1203. doi: 10.1002/eat.23260

Yilmaz Kafali, H., Atik Altinok, Y., Ozbaran, B., Ozen, S., Kose, S., Tahillioglu, A., et al. (2020). Exploring emotional dysregulation characteristics and comorbid psychiatric disorders in type 1 diabetic children with disordered eating behavior risk. *J. Psychosom. Res.* 131:109960. doi: 10.1016/j.jpsychores.2020.109960

Zhang, W., Wei, X., Ji, L., Chen, L., and Deater-Deckard, K. (2017). Reconsidering parenting in Chinese culture: subtypes, stability, and change of maternal parenting style during early adolescence. *J. Youth Adolesc.* 46, 1117–1136. doi: 10.1007/S10964-017-0664-X

Zubatsky, M., Berge, J., and Neumark-Sztainer, D. (2015). Longitudinal associations between parenting style and adolescent disordered eating behaviors. *Eat. Weight Dis.* 20, 187–194. doi: 10.1007/s40519-014-0154-z

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## APPENDIX

Search strings:

***PsycArticles***

Parenting styles or parenting or parental practices.
Disordered eating or eating pathology or maladaptive eating.
Adolescents or teenagers or children or kids or youth.

***PsycInfo***

Parenting styles or parenting or parental practices.
Disordered eating or maladaptive eating or eating pathology.
Adolescents or teenagers or children or teen or youth.

***BASE***

Parenting styles or parenting.
Disordered eating or eating pathology or maladaptive eating.
Teenagers or adolescents or children.

***CINAHL***

Parenting styles or parenting.
Disordered eating or maladaptive eating or eating pathology.

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BRIEF RESEARCH REPORT
published: 18 February 2022
doi: 10.3389/fpsyg.2022.806460

# Physical Appearance Perfectionism: Psychometric Properties and Factor Structure of an Assessment Instrument in a Representative Sample of Males

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Perfectionism is a multidimensional construct with both positive and negative aspects. Recently, the concept of appearance-oriented perfectionism has been introduced, which is associated with body image dissatisfaction and weight and shape control behaviors. The Physical Appearance Perfectionism Scale (PAPS) is a 12-item two-factor instrument developed to assess this new dimension of perfectionism. The aim of the study is to validate the Spanish version of PAPS among a representative sample of 850 male university students in Spain ($M$ = 20 years old; $SD$ = 2.7). Exploratory and confirmatory factorial structure, internal consistency, convergent and concurrent validity, and associated predictor variables analyses have been carried out. Results showed that the Spanish version of the PAPS maintains the original factor structure with all items and proves to be a reliable instrument. Physical appearance-oriented perfectionism is associated with general perfectionism, higher body dissatisfaction, Eating Disorders and Muscle Dysmorphia symptomatology, and compulsive exercise, particularly in the Worry about Imperfection subscale. These variables also act as predictors of physical appearance perfectionism. The use of the PAPS-S and the analysis of its subscales is recommended in the context of body image-related pathologies such as Eating Disorders and Muscle Dysmorphia.

**Keywords: PAPS-Spanish version, body image, male body image, body dissatisfaction measure, male students**

OPEN ACCESS

***Edited by:***
*Fuschia M. Sirois, The University of Sheffield, United Kingdom*

***Reviewed by:***
*Lisa Di Blas, University of Trieste, Italy*
*Cristina Senín-Calderón, University of Cádiz, Spain*

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***Specialty section:***
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *31 October 2021*
***Accepted:*** *20 January 2022*
***Published:*** *18 February 2022*

***Citation:***
*Rica R, Solar M, Moreno-Encinas A, Foguet S, Compte EJ and Sepúlveda AR (2022) Physical Appearance Perfectionism: Psychometric Properties and Factor Structure of an Assessment Instrument in a Representative Sample of Males. Front. Psychol. 13:806460. doi: 10.3389/fpsyg.2022.806460*

## INTRODUCTION

Perfectionism is a multidimensional and multifaceted personality disposition characterized by striving for flawlessness and setting exceedingly high standards of performance accompanied by overly critical evaluations of one's behavior (Frost et al., 1990; Hewitt and Flett, 1991; Stoeber et al., 2015). Given the great importance they attach to external evaluation, perfectionists feel pressure to perform at their best to avoid disapproval or disappointment from others (Frost et al., 1990; Hewitt and Flett, 1991).

Frost et al. (1993) found that perfectionism was distributed into two dimensions that captured both negative and positive aspects: maladaptive evaluative concerns and positive achievement

striving. This distinction is important, as only the components of the first dimension are related to psychopathology, such as negative affect, depression, anxiety, rumination and avoidance coping, emotional dysregulation, body image dissatisfaction (i.e., both muscularity and thinness oriented), compulsive exercise, obsessive-compulsive disorders, eating disorders (ED) or muscle dysmorphia (MD) (Frost et al., 1993; Grammas and Schwartz, 2009; Murray et al., 2012; Donahue et al., 2018; Bergunde and Dritschel, 2020; Çakin et al., 2021).

Recently, Yang and Stoeber (2012) introduced the concept of physical appearance perfectionism, which is composed of two components: Hope for Perfection (HFP) and Worry about Imperfection (WAI). The first one relates to approach-oriented perfectionistic strivings, associated with the positive reinforcement that comes from achieving attractiveness or admiration. The second component is related to aspects or avoidance-oriented perfectionistic concerns, linked to attempts to avoid imperfection, disapproval and criticism (Stoeber and Yang, 2015). Appearance-oriented perfectionism, as a specific domain, is also positively associated, without sex differences, with social anxiety related to appearance, appearance disturbance, body shape disturbance, body image concerns, body weight control behaviors; and is negatively associated with body appearance self-esteem (Yang and Stoeber, 2012; Simon et al., 2022).

To evaluate the desire for a perfect physical appearance, the Physical Appearance Perfectionism Scale (PAPS; Yang and Stoeber, 2012) was developed. The PAPS is a 12-item instrument with five alternative Likert-type responses from 1 (i.e., totally disagree) to 5 (i.e., totally agree) that presents a two-factor structure, differentiating between maladaptive concerns (i.e., WAI, seven items) and positive strivings (i.e., HFP, five items), which are all aspects of physical appearance perfectionism. "*I am never happy with my appearance no matter how I dress*" is an example from the WAI subscale, while "*I hope my body shape is perfect*" is an item from de HFP subscale. The original study validated the scale in a mixed sample of students in both China (47.4% male) and United Kingdom (20.5% male), with high reliability rates for both the Chinese and the English samples. The PAPS has also been used in another Chinese adolescent sample showing good indices of internal consistency and fit to the original factor structure (Yang et al., 2017). A recent study using the PAPS on a sample of female university students in the United Kingdom, slightly modifying the Hope for Perfection subscale (i.e., "*hope*" was replaced with "*strive*"), also found good reliability indices and replicated the two-factor structure (Bergunde and Dritschel, 2020). The PAPS has recently been adapted and validated to Brazilian Portuguese in a mixed sample of adults (i.e., 49.4% males) providing satisfactory indices of internal consistency and maintaining the two-factor structure by removing items 1 and 2 (Ferreira et al., 2018; Neves et al., 2019).

English, Chinese and Brazilian Portuguese adaptations make the PAPS a widely applicable instrument. However, so far, no adaptation and validation has been made to Spanish. On the other hand, none of the studies using the PAPS found sex differences in its factor structure (Yang and Stoeber, 2012; Yang et al., 2017; Neves et al., 2019; Bergunde and Dritschel, 2020), which is consistent with previous studies on general aspects of perfectionism (Frost et al., 1993). However, although the relationship of PAPS with ED symptomatology has been studied, it has not been explored in the context of male body dissatisfaction related to muscularity-oriented and MD symptomatology, which is more prevalent in males (Pope et al., 2000).

The main objective of this study was to fill this research gap and explore the factorial structure of the Spanish translation of the PAPS in a representative sample of Spanish university men. The aims were: (a) to assess the factor structure of the instrument, (b) its reliability, (c) its convergent validity with general perfectionism, (d) its concurrent validity with body dissatisfaction, ED and MD symptomatology, and compulsive exercise, and (e) and to explore the associated predictor variables. We hypothesized that: (1) the original two-factor structure would be supported, (2) the test would show good reliability, (3) students with greater levels of physical appearance perfectionism would be associated positively with general perfectionism and a greater body dissatisfaction, ED and MD symptomatology. Specifically, we expect higher levels of Worry about imperfection to be more strongly associated with psychopathological variables than scores on the Hope for Perfection subscale. For the latter, we expect stronger associations with the apparently positive aspects of perfectionism (i.e., achievement expectations and organization). Finally (4), the study variables are expected to act as predictor variables associated with physical appearance perfectionism.

# MATERIALS AND METHODS

## Participants

Among the 21 schools on the university campus, the five schools with the highest number of male students enrolled (i.e., over 70%) were selected. In this manner, a total of 1634 students were targeted. To achieve a representative sample of the university campus by school, the sample design was proportionally stratified according to this variable, assuming a 95% confidence interval and 0.05 of sampling error. A total of 1088 students were identified as the desired sample size.

The final sample comprised 850 male university students from different degrees: (1) Physical Activity and Sports Sciences from Polytechnic ($n$ = 297; 91.1% response rate), (2) Physics ($n$ = 92; 96.8 response rate), (3) Economics ($n$ = 171; 77.7% response rate), (4) Computer Science Engineering ($n$ = 114; 49.6% response rate), and (5) Business Administration and Management ($n$ = 176; 81.1% response rate). The mean age of the sample was 20 years old ($SD$ = 2.7). The mean Body Mass Index (BMI) was 22.4 ($SD$ = 2.8).

## Measures

In addition to the PAPS, students answered a set of questions regarding their age, and nationality. Participants also reported their height and their weight, allowing us to calculate an estimate of their BMI (kg/m$^2$). The participants also completed the following measures:

**Multidimensional Perfectionism Scale** (MPS; Frost et al., 1990; Carrasco et al., 2009): 35-items questionnaire with 5 Likert answer options from 1 (*strongly disagree*) to 5 (*strongly agree*). In its original version, the MPS provides a total score and 6 subscales (i.e., Concern over Mistakes, Personal Standards, Parental Expectations, Parental Criticism, Doubt about Actions and Organization). The Spanish adaptation showed a four-factor structure. The Fear of Mistakes subscale refers to the more negative aspects of perfectionism related to the concern about mistakes and doubts about one's own actions, the Parental Influences subscale relates to the influence of family expectations and criticism in the genesis of perfectionism, the Achievement Expectations subscale refers to competitiveness and comparison with the performance of others when evaluating one's own performance, and finally, the Organization subscale refers to the importance of order and organization. The Spanish version has excellent levels of internal consistency (range: $\alpha$ = 0.87 to 0.93). In the current sample, the scale showed an omega score of 0.94.

**Eating Disorder Examination Questionnaire** (EDE-Q; Fairburn and Beglin, 1994; Peláez-Fernández et al., 2012; Rica et al., 2021): The questionnaire has 28 items, that asks directly about attitudes related to key features of ED psychopathology in a 28-day time frame. The same four subscales (i.e., Restraint, Eating concern, Weight concern and Shape concern), of the EDE interview are calculated through 22 attitudinal items, and responses are given on a 7-point Likert-type scale from 0 (*never*) to 6 (*every day*). The EDE-Q global score is obtained by averaging subscales' scores. The initial Spanish version shows adequate levels of internal consistency (range: $\alpha$ = 0.74 to 0.91) as well a recent validation study in a representative sample of Spanish males (range: omega = 0.72 to 0.93). In the present study, we used the most recent Spanish male sample validation of the EDE-Q, which yields a two-factor structure (i.e., Restraint and Eating, Weight and Shape concern). The first subscale refers to altered eating behaviors to lose or avoid weight gain (e.g., decreasing amounts of food), while the second subscale refers to the presence of ruminations about calorie content, body shape or weight number. In the current sample, the EDE-Q also showed good reliability indices (range: omega = 0.74 to 0.92).

**Male Body Attitudes Scale** (MBAS; Tylka et al., 2005; Sepúlveda et al., 2016): The MBAS measures body dissatisfaction in men and consists of 24 items on a Likert-type scale, with scores between 1 (*never*) and 6 (*always*). In the Spanish version the only two items of the Height subscale were excluded. The internal consistency levels for the total score of the MBAS-S were good, as well as for the subscales of Muscularity and Low Body Fat (range: $\alpha$ = 0.85 to 0.88). The Muscularity subscale relates to the presence of concern about muscle bulk and the pursuit of greater muscle development, while the Low Body Fat subscale refers to concern derived from the rejection of body fat that hinders muscle visibility and the feeling of being fat. In the current sample, MBAS showed good reliability indices (range: omega = 0.84 to 0.94).

**Muscle Dysmorphic Disorder Inventory** (MDDI; Hildebrandt et al., 2004; Sepúlveda et al., 2019): Questionnaire of 13 items with a response range from 1 (*never*) to 5 (*always*) that evaluates body dissatisfaction from a male perspective related to muscle development. The MDDI is divided into three subscales and a total score. The Drive for Size subscale refers to the perception of not being sufficiently, the Appearance Intolerance subscale evaluates the presence of avoidance behaviors of displaying one's own body (e.g., wearing loose clothing) and, finally, the Functional Impairment subscale contains items related to maintaining a routine of excessive exercise, the discomfort of altering this behavior, and the avoidance of social situations. muscular, looking small and the desire to increase body size. The Spanish version showed adequate reliability indices (range: $\alpha$ = 0.73 to 0.85). In the current sample, MDDI showed adequate levels of internal consistency (range: omega = 0.84 to 0.90).

**Compulsive Exercise Test** (CET; Taranis et al., 2011; Author et al., 2022). This is a 24-item self-report questionnaire that uses a 6-point Likert scale, ranging from 0 (*never true*) to 5 (*always true*), with higher scores indicating greater levels of compulsive exercise. In the original validation five factors were identified (i.e., Avoidance and rule-driven behavior, Weight control exercise, Mood improvement, Lack of exercise enjoyment, Exercise rigidity) and total score. The Spanish version shows a brief three-factor structure and 15-items with good reliability indices (range: omega = 0.82 to 0.91). The Avoidance of negative affect factor is related to the avoidance of negative feelings that are experienced when exercise is missed, the Weight control exercise factor refers to exercising to improve appearance or for weight and shape reasons and, the Mood improvement factor is related to the positive mood improvements associated with exercise. In the current sample, the scale showed an Omega score of 0.93.

## Procedure

Permission was requested from the original authors of the PAPS for the cultural adaptation of the instrument into Spanish (**Annex 1**). A back-translation procedure was then conducted (Brislin, 1970). First, two psychologists translated the English 12-item instrument into Spanish. Second, Spanish items were independently back translated into English by another bilingual psychologist. A small proportion of students ($n$ = 10) read the items to ensure that clarity and relevance was expressed for all the items. Finally, the original version was compared with the translation, keeping the items identical, and discussing possible discrepancies.

The tests were administered collectively in the classroom and completed individually in electronic or paper forms after obtaining informed consent, highlighting voluntary participation, confidentiality and anonymity of the responses. The battery could be completed in 30 min. Permission to conduct the study was granted by the university's deans and the participants' teachers. Approval was obtained by the Ethics Committee of the University ("MASKED FOR REVIEW," CEI-75-1368). All procedures performed in this study involving human participants were in accordance with the ethical standards and with de Helsinki Declaration and its later amendments or comparable ethical standards.

## Statistical Analysis

Statistical analyses were carried out using SPSS 25.0, Mplus 7.11, and RStudio, employing the MNV package (Korkmaz et al., 2014) and the psych package (Revelle, 2020). Descriptive statistics (mean ± standard deviation) were calculated for all scale scores. In order to assess the internal structure of the PAPS, a cross-validation was carried out, dividing the total sample into two equivalent random subsamples (Swami and Barron, 2019). There were no significant differences between both subsamples in terms of mean age ($t_{848}$ = –1.04; $p$ = 0.30) or mean IMC ($t_{848}$ = 0.71; $p$ = 0.48), as well as degree ($\chi^2_4$ = 3.17; $p$ = 0.53) or year ($\chi^2_2$ = 2.48; $p$ = 0.29). One subsample ($n$ = 435) was used to test the factor structure proposed by Yang and Stoeber (2012) through a confirmatory factor analysis (CFA) and an Exploratory Structural Equation Modeling (ESEM) approach (Asparouhov and Muthén, 2009) with target rotation. The other subsample ($n$ = 415) was used to carry out an Exploratory Factor Analysis (EFA) with oblimin rotation; the number of factors was determined through parallel analysis (Horn, 1965) with an Unweighted Least Squares (ULS) estimator. Mardia's test revealed that the PAPS did not follow a multivariate normal distribution (skewness = 2426.90, $p < 0.001$; kurtosis = 26.73, $p < 0.001$). Since data were ordinal and non-normal, both analyses were carried out using Robust Weighted Least Squares (WLSMV). Several fit indices were considered in CFA and ESEM analyses: The Root Mean Square Error of Approximation (RMSEA) and its 90% confidence interval, the Tucker Lewis index (TLI), the Comparative Fit Index (CFI), and the Weighted Root Mean Square Residual (WRMR). A model is considered to present a good fit when RMSEA $\leq$ 0.08 (Browne and Cudeck, 1993; Swami and Barron, 2019), WRMR $\leq$ 1.0 (DiStefano et al., 2018), and CFI and TLI $\geq$ 0.95 (Hu and Bentler, 1999; Swami and Barron, 2019). Given the Likert-type nature of the PAPS, internal consistency was assessed using an omega coefficient (McDonald, 1999; Swami and Barron, 2019); values $\geq$ 0.80 were considered adequate (Nunnally, 1976). In addition, its convergent and concurrent validity was assessed through Spearman correlations with the MPS, EDE-Q, MBAS-S, MDDI and CET-S. Finally, the capacity for the variables measured by the aforementioned tests and for the BMI to predict physical appearance perfectionism was analyzed using multiple hierarchical regression, after checking the assumptions of this kind of analysis.

# RESULTS

## Internal Structure

First, a CFA was carried out in one of the subsamples ($n$ = 435). Fit statistics for this analysis are presented in **Table 1**. The model proposed by Yang and Stoeber (2012) showed a poor fit to our data since fit indices were far from the recommended cut-off points. An examination of modification indices suggested a cross-loading for item 5 ("I worry that my appearance is not good enough") onto the Hope for Perfection factor (MI = 195.66). Thus, even after excluding item 5 from the analysis, this model continued to show a poor fit. Next, we tested the same model using the ESEM approach. This model showed a good fit, except for RMSEA, with a value above the recommended cut-off point (see **Table 1**). As expected, item 5 had a significant loading onto the Worry About Imperfection factor (loading = 0.596), but it also had a significant cross-loading onto the Hope for Perfection factor (loading = 0.395). Although there were more significant zero-target cross-loadings, their values were below 0.30 (i.e., between 0 and 0.20).

We then carried out an EFA analysis using the other subsample ($n$ = 415). Parallel analysis results suggested the extraction of two factors. EFA results supported ESEM results, and all items loaded onto both factors in accordance with theoretical expectations (Yang and Stoeber, 2012), although item 5 showed a significant large cross-loading. Factor loadings are presented in **Table 2**.

## Descriptive Statistics, Internal Consistency, Convergent and Concurrent Validity

Means, standard deviations, and internal consistency for all measures, as well as correlations among all scale scores, are presented in **Table 3**. The PAPS and its subscales showed excellent internal consistency, with omega coefficient values above 0.90.

**TABLE 2 |** Pattern matrix of PAPS items.

| | Factor 1 | Factor 2 |
|---|---|---|
| Item 1 | **0.753** | – 0.044 |
| Item 3 | **0.827** | – 0.086 |
| Item 5 | **0.518** | **0.424** |
| Item 8 | **0.895** | – 0.057 |
| Item 9 | **0.859** | – 0.076 |
| Item 10 | **0.617** | 0.252 |
| Item 11 | **0.763** | 0.183 |
| Item 2 | 0.114 | **0.625** |
| Item 4 | – 0.024 | **0.883** |
| Item 6 | 0.019 | **0.811** |
| Item 7 | – 0.045 | **0.891** |
| Item 12 | 0.001 | **0.889** |

*This analysis was carried out using one half of the total sample (n = 415). Loadings with values ≥ 0.30 are bolded.*

**TABLE 1 |** Fit index values for the tested models.

| Models | $\chi^2$ (d.f.) | RMSEA [C.I.; 90%] | CFI | TLI | WRMR |
|---|---|---|---|---|---|
| CFA two-factor model | 565.40 (53) | 0.150 [0.139 –0.162] | 0.909 | 0.887 | 1.978 |
| CFA two-factor excluding item 5 | 333.10 (43) | 0.126 [0.113 –0.138] | 0.945 | 0.929 | 1.607 |
| ESEM two-factor model | 239.04 (43) | 0.103 [0.091 –0.116] | 0.965 | 0.947 | 0.858 |

*All models were tested using one half of the total sample (n = 435).*

**TABLE 3 |** Means (standard deviations), internal consistency in the Spanish male sample, and correlations among variables with the PAPS-S.

| | Mean (*SD*) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. PAPS-S-WAI | 13.92 (5.74) | **0.94** | 0.40** | 0.87** | 0.52** | 0.32** | 0.28** | 0.07* | 0.43** | 0.25** | 0.67** | 0.64** | 0.47** | 0.62** | 0.72** | 0.45** | 0.71** | 0.17** | 0.60** | 0.34** |
| 2. PAPS-S-HFP | 15.81 (4.84) | | **0.94** | 0.80** | 0.28** | 0.19** | 0.35** | 0.17** | 0.34** | 0.21** | 0.30** | 0.32** | 0.30** | 0.20** | 0.31** | 0.35** | 0.21** | 0.31** | 0.42** | 0.39** |
| 3. PAPS-S total | 29.73 (8.86) | | | **0.94** | 0.49** | 0.31** | 0.37** | 0.14** | 0.47** | 0.28** | 0.60** | 0.58** | 0.47** | 0.51** | 0.64** | 0.49** | 0.58** | 0.28** | 0.62** | 0.43** |
| 4. MPS-FM | 24.40 (7.50) | | | | **0.85** | 0.58** | 0.53** | 0.19** | 0.83** | 0.14** | 0.38** | 0.35** | 0.28** | 0.32** | 0.39** | 0.32** | 0.38** | 0.26** | 0.44** | 0.31** |
| 5. MPS-PI | 18.09 (6.84) | | | | | **0.86** | 0.38** | 0.10** | 0.74** | 0.08* | 0.27** | 0.25** | 0.14** | 0.22** | 0.24** | 0.20** | 0.25** | 0.17** | 0.29** | 0.26** |
| 6. MPS-AE | 26.55 (7.27) | | | | | | **0.86** | 0.41** | 0.81** | 0.22** | 0.21** | 0.24** | 0.21** | 0.15** | 0.23** | 0.24** | 0.19** | 0.29** | 0.34** | 0.32** |
| 7. MPS-O | 20.36 (4.91) | | | | | | | **0.89** | 0.51** | 0.15** | 0.10** | 0.13** | 0.05 | 0.06 | 0.05 | 0.08* | 0.07 | 0.13** | 0.13** | 0.16** |
| 8. MPS total | 89.39 (19.65) | | | | | | | | **0.94** | 0.20** | 0.34** | 0.34** | 0.25** | 0.27** | 0.33** | 0.30** | 0.32** | 0.30** | 0.43** | 0.37** |
| 9. EDE-Q: R | 0.89 (1.1) | | | | | | | | | **0.74** | 0.51** | 0.71** | 0.16** | 0.50** | 0.38** | 0.12** | 0.34** | 0.32** | 0.34** | 0.45** |
| 10. EDE-Q: EWSC | 0.79 (0.88) | | | | | | | | | | **0.91** | 0.97** | 0.32** | 0.79** | 0.69** | 0.29** | 0.77** | 0.21** | 0.55** | 0.42** |
| 11. EDE-Q total | 0.81 (0.84) | | | | | | | | | | | **0.92** | 0.30** | 0.80** | 0.68** | 0.28** | 0.73** | 0.27** | 0.55** | 0.48** |
| 12. MBAS-S-M | 2.59 (0.97) | | | | | | | | | | | | **0.88** | 0.24** | 0.82** | 0.79** | 0.27** | 0.20** | 0.65** | 0.24** |
| 13. MBAS-S-LBF | 2.07 (0.87) | | | | | | | | | | | | | **0.84** | 0.73** | 0.17** | 0.74** | 0.14** | 0.43** | 0.41** |
| 14. MBAS-S total | 2.32 (0.73) | | | | | | | | | | | | | | **0.94** | 0.65** | 0.65** | 0.20** | 0.70** | 0.39** |
| 15. MDDI-DFS | 9.77 (4.12) | | | | | | | | | | | | | | | **0.88** | 0.28** | 0.29** | 0.81** | 0.27** |
| 16. MDDI-AI | 5.74 (2.63) | | | | | | | | | | | | | | | | **0.84** | 0.12** | 0.58** | 0.27** |
| 17. MDDI-FI | 6.58 (3.47) | | | | | | | | | | | | | | | | | **0.86** | 0.69** | 0.59** |
| 18. MDDI total | 4.25 (5.24) | | | | | | | | | | | | | | | | | | **0.90** | 0.53** |
| 19. CET-S total | 2.25 (0.96) | | | | | | | | | | | | | | | | | | | **0.93** |

*Omega coefficients are presented along the diagonal in bold. PAPS-S, Physical Appearance Perfectionism Scale, Spanish version; WAI, Worry About Imperfection; HFP, Hope for Perfection; MPS, Multidimensional Perfectionism Scale; FM, Fear of Mistakes; PI, Parental Influence; AE, Achievement Expectations; O, Organization; EDE-Q, Eating Disorders Examination-Questionnaire; R, Restraint; EWSC, Eating, Weight, and Shape Concern; MBAS-S, Male Body Attitudes Scale, Spanish version; M, Muscularity; LBF, Low Body Fat; MDDI, Muscle Dysmorphia Disorder Inventory; DFS, Drive for Size; AI, Appearance Intolerance; FI, Functional Impairment; CET-S, Compulsive Exercise Test, Spanish version. *p < 0.05, **p < 0.01.*

Regarding the convergent validity, most correlations between the PAPS-S and the MPS total scores were positive, significant, with mild to high correlations. It is worth mentioning that the correlation between the two total scores, as well as the correlation of Worry About Imperfection and the PAPS-S total score with Fear of Mistakes, which were the highest correlations between both questionnaires.

On the other hand, regarding the concurrent validity, the PAPS-S scores showed moderate to high significant correlations with the EDE-Q total scores and the Eating, Weight and Shape Concern factor. The Worry About Imperfection factor showed the highest correlations with both EDE-Q scores, while the Hope for Perfection factor showed the lowest correlations. However, the correlations between the PAPS-S scores and the Restraint factor were rather low.

The PAPS-S also showed positive moderate to high significant correlations with the MBAS-S scores. As was the case for the EDE-Q, the Worry About Imperfection factor showed the highest correlations with the MBAS-S, while the Hope for Perfection factor showed the lowest correlations. It is worth mentioning that the Muscularity subscale correlations with the PAPS-S were lower than Low Body Fat and MBAS-S total score correlations.

We found a similar pattern of correlations with the MDDI. There were positive moderate to high significant correlations between both questionnaires, with the Worry About Imperfection showing the highest correlations with the MDDI, and the Hope for Perfection factor showing the lowest correlations. As can be seen in **Table 3**, the Appearance Intolerance and the MDDI total score showed the highest correlations with the PAPS-S. Lastly, there was a positive moderate significant correlation between all PAPS-S scores and CET-S total score.

Finally, **Tables 4**, **5** show the results of multiple hierarchical analyses. The final regression models for each dependent variable accounted for 24–67% of the variance of PAPS scores. Regarding the general physical appearance perfectionism (PAPS-S total), the independent variables that made a significant contribution were general perfectionism (MPS total); general male body dissatisfaction (MBAS-S total); compulsive exercise (CET-S total); eating, weight, and shape concerns (EDE-Q: EWSC); restraint behaviors (EDE-Q: R); muscle body dissatisfaction (MDDI); and functional impairment (MDDI FI).

However, as seen in **Table 5**, there were differences between both PAPS factors (i.e., WAI and HFP) in terms of significant predictive variables, although general perfectionism (MPS) accounted for both factors. On one hand, general male body dissatisfaction; restraint behaviors; general ED attitudes (EDE-Q); and appearance intolerance (MDDI AI) made a

**TABLE 4 |** Multiple hierarchical regression: overall model effect.

| Dependent variable | Final model | *F* | $R^2$ |
|---|---|---|---|
| PAPS total score | Model 7 | 139.09*** | 0.55 |
| PAPS WAI score | Model 5 | 311.22*** | 0.67 |
| PAPS HFP score | Model 7 | 50.38*** | 0.24 |

****p < 0.001.*

**TABLE 5 |** Multiple hierarchical regression: final regression coefficients for each dependent variable.

| Dependent variable | Independent variable | Final unstandardized coefficients | Final β (standardized coefficients) | *t* |
|---|---|---|---|---|
| PAPS total score | Intercept | 7.25 | – | 6.11*** |
| | MBAS total score | 1.90 | 0.16 | 3.44** |
| | MPS total score | 0.08 | 0.19 | 6.91*** |
| | EDE-Q EWSC score | 2.77 | 0.28 | 7.63*** |
| | MDDI total score | 0.42 | 0.35 | 6.24*** |
| | EDE-Q R score | – 0.75 | – 0.09 | – 3.15** |
| | CET total score | 1.02 | 0.11 | 3.43** |
| | MDDI FI score | – 0.35 | – 0.14 | – 3.11** |
| PAPS WAI score | Intercept | – 1.37 | – | 12.63*** |
| | MBAS total score | 3.04 | 0.38 | 8.43*** |
| | MDDI AI score | 0.62 | 0.29 | 7.46*** |
| | MPS total score | 0.05 | 0.17 | – 6.84*** |
| | EDE-Q R score | – 1.14 | – 0.22 | 5.48*** |
| | EDE-Q total score | 1.76 | 0.26 | 12.63*** |
| PAPS HFP score | Intercept | 1.14 | – | 9.57*** |
| | CET total score | 0.04 | 0.23 | 6.36*** |
| | MPS total score | 0.25 | 0.16 | 4.56*** |
| | MDDI DFS score | 1.07 | 0.21 | 6.19*** |
| | EDE-Q EWSC score | – 0.72 | 0.20 | 3.70*** |
| | MBAS LBF score | 1.14 | – 0.13 | – 2.52** |

*$^{**}p < 0.01$; $^{***}p < 0.001$.*

significant contribution to WAI factor. On the other hand, compulsive exercise; eating, weight, and shape concerns; drive for size (MDDI-DFS); and low body fat (MBAS LBF) made a significant contribution to HFP factor. It is worth mentioning that the BMI did not make a significant contribution to any of the dependent variables.

## DISCUSSION

Scientific research on perfectionism agrees that the best way to understand this complex construct is through the use of measures that incorporate both its positive and negative aspects (Antony et al., 2004). In this line, the PAPS is a multidimensional assessment instrument, with the novelty of measuring a domain in which many people act with perfectionist tendencies: physical appearance (Yang and Stoeber, 2012).

The aim of the present study was to evaluate the psychometric properties of the PAPS-S in a representative sample of male university students in Spain. The factor structure of the scale, its reliability its convergent and concurrent validity, and the associated predictor variables were examined.

The Spanish version of the PAPS showed a two-factor structure in both the EFA and CFA and in the parallel analysis, confirming the model of the original questionnaire. In our study, item 5 showed cross-loading on both factors, which influences the fit of the RMSEA index. However, removing the item did not significantly improve the model fit, so we opted for a conservative solution, keeping all the original items, and retaining appropriate values of the CFI and TLI fit indices of the factor model. Item 5 also showed fit problems in the Brazilian validation study of PAPS (Neves et al., 2019). However, to not further impoverish the short version of the Brazilian PAPS (i.e., without items 1 and 2) the authors also opted to retain it along with item 8, since its removal did not improve the explained variance of the questionnaire (Neves et al., 2019). Even with the slight modifications of the Brazilian version, the PAPS shows in all translations to date an unambiguous two-factor structure. Moreover, these studies have been conducted in mixed samples in which no differences in questionnaire functioning have been found between males and females, unlike other instruments related to body dissatisfaction that have been used interchangeably among males and females even though the content of the items is clearly biased toward a female body perspective (e.g., Body Shape Questionnaire). Thus, the PAPS has been shown to be a robust instrument in its factor structure and the content of its items has been shown to be apparently neutral in terms of gender differences.

Regarding reliability, the PAPS-S showed high reliability indices in its different translations, with Cronbach's alpha values above 0.80 in the Chinese, English, and Brazilian version (Yang and Stoeber, 2012; Neves et al., 2019). Although they did not conduct a factor analysis, also a recent study in a mixed sample of adults in the Philippines showed reliability scores above 0.88 on the PAPS (Simon et al., 2022), supporting the reliability of the test. For the Spanish version, the questionnaire showed Omega values of 0.94 for the total scale and the two factors. Although comparisons are limited by the difference in the reliability index calculated in the different studies, the PAPS is confirmed as a highly reliable instrument in all its translations.

In terms of convergent validity, the results of the PAPS-S are related to those of the MPS without being the same construct, confirming the multidimensionality of perfectionism. Our results confirm that the negative dimension of physical appearance-oriented perfectionism (i.e., WAI subscale) is more closely associated with the negative aspects of general perfectionism (i.e., Fear of Mistakes, Parental Influence), in line with previous research (Stoeber and Yang, 2015; Bergunde and Dritschel, 2020). In addition, the positive dimension of the PAPS-S (i.e., HFP subscale) was more associated with the Achievement Expectations and Organization subscales of the MPS. However, in line with previous research (Yang and Stoeber, 2012; Stoeber and Yang, 2015; Bergunde and Dritschel, 2020), the difference between the association of the two subscales of the PAPS with the negative aspects of perfectionism is more pronounced than that of both subscales with the positive aspects of perfectionism. Perfectionism is a complex dimension, and its exploration requires a broad view that allows for a deeper exploration also of its positive dimension (Stoeber, 2018). Although perfectionism may have less harmful aspects, it is dangerously close to psychopathological risk factors, so the study of protective factors that block a possible drift toward pathological hyper self-demand is a key element in the development of a new approach.

Concerning concurrent validity, the results confirm the study hypotheses regarding the association of PAPS-S with body dissatisfaction, ED and DM symptomatology, and compulsive exercise. To our knowledge, this is the first study that has explored the relationship between appearance-oriented perfectionism and

body dissatisfaction from a male perspective that included muscle-related aspects. The total PAPS-S, and particularly the WAI subscale, was associated strong and positively with MBAS-S total scores, which measures body dissatisfaction in men. The results regarding the association of the PAPS-S with the MDDI are similar, with higher associations of the WAI subscale of the PAPS-S with the body dissatisfaction subscales of the MDDI. Only the Functional Impairment subscale of the MDDI shows a stronger association with the HFP subscale. This subscale of the MDDI is primarily related to prioritizing the training routine over other activities and the associated impact of not training. Thus, the pursuit of physical perfection may lead people to have a more rigid relationship with their physical activity to the point of impacting on other spheres (e.g., social). On the other hand, although the PAPS-S was associated with ED symptomatology, the low relationship with the Restraint subscale as opposed to the Concern subscales of the EDE-Q, particularly with the HFP subscale of the PAPS-S, was remarkable. The fact that the PAPS-S score is not related to explicit eating disordered behaviors suggests that the PAPS is a measure more oriented to body image concerns in a negative sense beyond the relationship with weight and shape and that, although it may include it, it has not yet translated into clear risk behaviors and associated impairment. Another possible explanation may have to do with the male sample being less prone to restraint behaviors as explored by the EDE-Q (i.e., anorexia nervosa) and more oriented to muscularity-oriented EDs (Murray et al., 2012). In any case, the correlations of the ED and DM questionnaires are higher for the PAPS-S and its subscales than for the general perfectionism measure, supporting data from previous research that suggests that the use of domain-specific measures of appearance-oriented perfectionism explains higher percentages of variance in eating symptomatology and is a better predictor of psychopathology than a generic measure (Stoeber and Yang, 2015; Bergunde and Dritschel, 2020; Czepiel and Koopman, 2021; McComb and Mills, 2021). Finally, the relationship between PAPS-S and CET-S shows fewer differences between the positive and negative dimension of the questionnaire with relation to compulsive exercise. This result is not surprising given that the motives that lead young people to exercise may be varied and related to both health and psychopathological components derived from body dissatisfaction and difficulties in emotional regulation characteristic of EDs and DM (Sicilia et al., 2021). Even so, the findings associated with functional impairment resulting from a rigid training routine place appearance-oriented perfectionism as a relevant study factor in the field of exercise-related pathology.

Regarding the study of predictor variables associated with the PAPS-S, the final model explains 55% of the variance of the total scale, 67% of the WAI subscale and 24% of the HFP subscale. In the literature on perfectionism, perfectionistic concerns are considered more maladaptive and associated with psychopathological variables (Yang et al., 2017; Simon et al., 2022). Since the variables in our study are of this nature, it is not surprising that the variance explained for the WAI subscale across the applied questionnaires is higher than in the case of HFP, which may have adaptive aspects. In all retained regression models, total MPS plays a significant role as a predictor of appearance-oriented perfectionism in general, and of the WAI and HFP subscales. Previous research has used PAPS as a predictor of eating symptomatology (Stoeber and Yang, 2015) and body dissatisfaction (Yang et al., 2017), finding that BMI plays a significant role as a predictor variable. However, to date this is the first study to perform a predictive model of appearance-oriented perfectionism as a dependent variable, with BMI not being a significant predictor. In contrast, for the PAPS total scale, male body dissatisfaction, dissatisfaction with muscularity, weight and shape concerns, restrictive eating behaviors, compulsive exercise and associated functional impairment are relevant predictors. Regarding the WAI subscale, body dissatisfaction, appearance intolerance, food restriction and ED symptomatology act as predictors. On the other hand, compulsive exercise, drive for size, weight and shape concerns, and rejection of body fat and the feeling of fatness influence as predictors in the HFP subscale. This result is interesting, as HFP is apparently associated with perfectionistic strivings that are not necessarily pathological. However, the presence of compulsive exercise and functional impairment derived from a high emphasis on routine exercise is of considerable concern, particularly in the male population who tend to be more physically active and at higher risk of exercise-related pathology (Author et al., 2022).

## Limitations and Future Research

Despites its contributions, this study has several limitations. The present study examined perfectionism as a multidimensional construct based on the Frost et al. (1990) model. Although this model is one of the most widely used in the field of the study of perfectionism, further studies from the perspective of Hewitt and Flett's (1991) model, or other more recent models (e.g., Hill et al., 2004) may help to extend the research results. In addition, the study was conducted in a sample of university students, which affects the generalizability of the results in other populations (e.g., men with ED or MD) or age groups (e.g., middle aged men, adolescents). Although the validation studies in English and Brazilian Portuguese found no differences between men and women, the results of the present study do not guarantee the reliability of the scale in Spanish women, so it would be desirable to include them in future research. Finally, the study design was cross-sectional and therefore causal relationships between variables cannot be established. Longitudinal studies in this regard are required in the future.

# CONCLUSION

In conclusion, the PAPS is a valid and reliable instrument for use in a Spanish-speaking male population. Given the multidimensional nature of perfectionism, its use is also recommended using its two subscales. Appearance-oriented perfectionism is associated in males with the presence of body dissatisfaction, risk of ED and MD, and compulsive exercise. These variables are more strongly associated with the WAI subscale. However, risk behaviors such as compulsive exercise act as significant predictors for the HFP subscale. It is hoped

that this validation will contribute to improve knowledge about perfectionism oriented to physical appearance, one of its less studied manifestations.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the Autonomous University of Madrid (CEI-75-1368). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

RR: investigation, visualization, project administration, writing – original draft. AM-E: recruitment, formal analysis, results writing. MS: recruitment, formal analysis, results revision original draft. SF: recruitment, writing – review draft. EC: supervision, writing – review and editing. AS: conceptualization, methodology, recruitment, supervision, writing – review and editing. All authors contributed to the article and approved the submitted version.

## REFERENCES


Antony, M. M., Bieling, P. J., and Israeli, A. L. (2004). Is perfectionism good, bad, or both? Examining models of the perfectionism construct. *Personal. Indiv. Diff.* 36, 1373–1385. doi: 10.1016/S0191-8869(03)00235-6

Asparouhov, T., and Muthén, B. (2009). Exploratory structural equation modeling. *Struct. Equ. Model.* 16, 397–438. doi: 10.1080/10705510903008204

Author, et al. (2022). Validation of the Spanish Compulsive Exercise Test Version in Male University Students: confirmatory Factor Analysis and invariance study. *Cuadernos de Psicología del Deporte* 2–22.

Bergunde, L., and Dritschel, B. (2020). The shield of self-compassion: A buffer against disordered eating risk from physical appearance perfectionism. *PLoS One* 15:e0227564. doi: 10.1371/journal.pone.0227564

Brislin, R. W. (1970). Back-translation for cross-cultural research. *J. Cross-Cult. Psychol.* 1, 185–216. doi: 10.1177/135910457000100301

Browne, M. W., and Cudeck, R. (1993). "Alternative ways of assessing model fit," in *Testing structural equation models*, eds K. A. Bollen and J. S. Long (Newbury Park, CA: Sage), 136–162.

Çakin, G., Juwono, I. D., Potenza, M. N., and Szabo, A. (2021). Exercise Addiction and Perfectionism: a Systematic Review of the Literature. *Curr. Addict. Rep.* 8, 144–155. doi: 10.1007/s40429-021-00358-8

Carrasco, A., Belloch, A., and Perpiñá, C. (2009). La evaluación del perfeccionismo: utilidad de la Escala Multidimensional de Perfeccionismo en población española. *Análisis y Modificación de Conducta* 35, 49–65. doi: 10.33776/amc.v35i152.1225

Czepiel, D., and Koopman, H. M. (2021). Does physical appearance perfectionism predict disordered dieting? *Curr. Psychol.* 2021, 1–11. doi: 10.1007/s12144-020-01308-9

DiStefano, C., Liu, J., Jiang, N., and Shi, D. (2018). Examination of the weighted root mean square residual: Evidence for trustworthiness? *Struct. Equat. Mod.* 25, 453–466. doi: 10.1080/10705511.2017.1390394

Donahue, J. M., Reilly, E. E., Anderson, L. M., Scharmer, C., and Anderson, D. A. (2018). Evaluating Associations Between Perfectionism, Emotion Regulation, and Eating Disorder Symptoms in a Mixed-Gender Sample. *J. Nerv. Ment. Dis.* 206, 900–904. doi: 10.1097/NMD.0000000000000895

Fairburn, C. G., and Beglin, S. J. (1994). Assessment of eating disorders: interview or self-report questionnaire. *Internat. J. Eat. Dis.* 16, 363–370. doi: 10.1002/1098-108X(199412)16:4<363::AID-EAT2260160405<3.0.CO;2-\#

Ferreira, L., Corazza, J. F., Francisco, J. N., and Neves, A. N. (2018). Tradução e adaptação cultural da Escala de Perfeccionismo para Aparência Física (PAPS) para a língua portuguesa no Brasil. *Revista Brasileira de Ciências do Esporte* 40, 266–272. doi: 10.1016/j.rbce.2018.03.002

Frost, R. O., Heimberg, R. G., Holt, C. S., Mattia, J. I., and Neubauer, A. L. (1993). A comparison of two measures of perfectionism. *Personal. Indiv. Diff.* 14, 119–126. doi: 10.1016/0191-8869(93)90181-2

Frost, R. O., Marten, P., Lahart, C., and Rosenblate, R. (1990). The dimensions of perfectionism. *Cogn. Ther. Res.* 14, 449–468. doi: 10.1007/bf01172967

Grammas, D. L., and Schwartz, J. P. (2009). Internalization of messages from society and perfectionism as predictors of male body image. *Body Image* 6, 31–36. doi: 10.1016/j.bodyim.2008.10.002

Hewitt, P. L., and Flett, G. L. (1991). Perfectionism in the self and social contexts: conceptualization, assessment, and association with psychopathology. *J. Person. Soc. Psychol.* 60:456. doi: 10.1037/0022-3514.60.3.456

Hildebrandt, T., Langenbucher, J., and Schlundt, D. G. (2004). Muscularity concerns among men: development of attitudinal and perceptual measures. *Body Image* 1, 169–181. doi: 10.1016/j.bodyim.2004.01.001

Hill, R. W., Huelsman, T. J., Furr, R. M., Kibler, J., Vicente, B. B., and Kennedy, C. (2004). A new measure of perfectionism: the perfectionism inventory. *J. Person. Assess.* 82, 80–91. doi: 10.1207/s15327752jpa8201_13

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika* 30, 179–185. doi: 10.1007/BF02289447

Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidiscipl. J.* 6, 1–55. doi: 10.1080/10705519909540118

Korkmaz, S., Goksuluk, D., and Zararsiz, G. M. V. N. (2014). An R Package for Assessing Multivariate Normality. *R J.* 6, 151–162.

McComb, S. E., and Mills, J. S. (2021). Young women's body image following upwards comparison to Instagram models: The role of physical appearance perfectionism and cognitive emotion regulation. *Body Image* 38, 49–62. doi: 10.1016/j.bodyim.2021.03.012

McDonald, R. P. (1999). *Test theory: A unified treatment*. L. Mahwah: Erlbaum Associates.

Murray, S. B., Rieger, E., Hildebrandt, T., Karlov, L., Russell, J., Boon, E., et al. (2012). A comparison of eating, exercise, shape, and weight related symptomatology in males with muscle dysmorphia and anorexia nervosa. *Body Image* 9, 193–200. doi: 10.1016/j.bodyim.2012.01.008

Neves, A. N., Francisco, J. N., Corazza, J. F., Carvalho, R. L. P., and Ferreira, L. (2019). Psychometric properties of Brazilian Portuguese version of the Physical Appearance Perfectionism Scale. *Cuadernos de Psicología del Deporte* 19, 302–314.

Nunnally, J. C. (1976). *Psychometric Theory*, 2nd Edn. New York, NY: McGraw-Hill.

Peláez-Fernández, M. A., Labrador, F. J., and Raich, R. M. (2012). Validation of eating disorder examination questionnaire (EDE-Q)–Spanish version–for screening eating disorders. *Span. J. Psychol.* 15, 817–824. doi: 10.5209/rev_SJOP.2012.v15.n2.38893

Pope, H., Phillips, K. A., and Olivardia, R. (2000). *The Adonis Complex: The Secret Crisis of Male Body Obsession*. New York, NY: Simon and Schuster.

Revelle, W. (2020). *Psych: Procedures for Psychological, Psychometric, and Personality Research* R package version 2.0.8. Evanston, IL: Northwestern University.

Rica, R., Solar, M., Compte, E. J., and Sepúlveda, A. R. (2021). Establishing the optimal male cut-off point: Confirmatory Factor Analysis of the Eating Disorder Examination-Questionnaire (EDE-Q) in a representative sample of

spanish university students. *Eat. Weight Dis.* 2021, 1–9. doi: 10.1007/s40519-021-01234-0

Sepúlveda, A. R., Anastasiadou, D., Pellegrin, Y., Parks, M., Blanco, M., Garcia, P, et al. (2016). Confirmatory factor analysis of the Male Body Attitudes Scale (MBAS) among Spanish adolescent males. *Men Masc.* 20, 345–363. doi: 10.1177/1097184X16634798

Sepúlveda, A. R., Rica, R., Moreno, A., Román, F. J., and Compte, E. J. (2019). Asessing the male body image: Spanish validation of two instruments. *Psychiatry Res.* 272, 483–490. doi: 10.1016/j.psychres.2018.12.125

Sicilia, A., Paterna, A., Alcaraz-Ibáñez, M., and Griffiths, M. D. (2021). Theoretical conceptualizations of problematic exercise in psychometric assessment instruments: a systematic review. *J. Behav. Addict.* 10, 4–20. doi: 10.1556/2006.2021.00019

Simon, P. D., Cu, S. M. O., De Jesus, K. E. M., Go, N. T. S., Lim, K. T. F., and Say, C. K. C. (2022). Worried about being imperfect? The mediating effect of physical appearance perfectionism between Instagram addiction and body esteem. *Personal. Indiv. Diff.* 186, 111346. doi: 10.1016/j.paid.2021.111346

Stoeber, J. (2018). "The psychology of perfectionism: Critical issues, open questions, and future directions," in *The psychology of perfectionism: Theory, research, applications*, ed. J. Stoeber (Milton Park: Routledge), 333–352.

Stoeber, J., Haskew, A. E., and Scott, C. (2015). Perfectionism and exam performance: The mediating effect of task-approach goals. *Personal. Indiv. Diff.* 74, 171–176. doi: 10.1016/j.paid.2014.10.016

Stoeber, J., and Yang, H. (2015). Physical appearance perfectionism explains variance in eating disorder symptoms above general perfectionism. *Person. Indiv. Diff.* 86, 303–307. doi: 10.1016/j.paid.2015.06.032

Swami, V., and Barron, D. (2019). Translation and validation of body image instruments: Challenges, good practice guidelines, and reporting recommendations for test adaptation. *Body Image* 31, 204–220. doi: 10.1016/J.BODYIM.2018.08.014

Taranis, L., Touyz, S., and Meyer, C. (2011). Disordered eating and exercise: development and preliminary validation of the compulsive exercise test (CET). *Eur. Eat. Dis. Rev.* 19, 256–268. doi: 10.1002/erv.1108

Tylka, T. L., Bergeron, D., and Schwartz, J. P. (2005). Development and psychometric evaluation of the Male Body Attitudes Scale (MBAS). *Body Image* 2, 161–175. doi: 10.1016/j.bodyim.2005.03.001

Yang, H., and Stoeber, J. (2012). The physical appearance perfectionism scale: Development and preliminary validation. *J. Psychopathol. Behav. Assess.* 34, 69–83. doi: 10.1007/s10862-011-9260-7

Yang, H., Yang, Y., Xu, L., Wu, Q., Xu, J., Weng, E., et al. (2017). The relation of physical appearance perfectionism with body dissatisfaction among school students 9–18 years of age. *Personal. Indiv. Diff.* 116, 399–404. doi: 10.1016/j.paid.2017.05.005

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

# ANNEX 1

## Physical Appearance Perfectionism Scale – Spanish version

**ANNEX 1 |** Lea cada oración y decida en qué medida está de acuerdo o en desacuerdo. Si está muy de acuerdo debe rodear el 5. Si está muy en desacuerdo, debe rodear el 1. Para una respuesta intermedia debe rodear del 2 al 4. Si se siente neutral al respecto o no está seguro debe rodear el 3, el número central.

| | Muy en desacuerdo | | | | Muy de acuerdo |
|---|---|---|---|---|---|
| (1) No estoy satisfecho/a con mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (2) Espero que la forma de mi cuerpo sea perfecta. | 1 | 2 | 3 | 4 | 5 |
| (3) No importa cómo me vista, nunca estoy contento/a con mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (4) Espero ser atractivo/a. | 1 | 2 | 3 | 4 | 5 |
| (5) Me preocupa que mi apariencia física no sea lo suficientemente buena. | 1 | 2 | 3 | 4 | 5 |
| (6) Espero que otras personas admiren mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (7) Espero que otras personas me encuentren atractivo/a. | 1 | 2 | 3 | 4 | 5 |
| (8) Desearía poder cambiar por completo mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (9) Mi apariencia física está lejos de mis expectativas. | 1 | 2 | 3 | 4 | 5 |
| (10) Me preocupa que otras personas critiquen mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (11) A menudo pienso sobre los defectos de mi apariencia física. | 1 | 2 | 3 | 4 | 5 |
| (12) Espero ser guapo/a. | 1 | 2 | 3 | 4 | 5 |

frontiers in Psychology

ORIGINAL RESEARCH
published: 01 March 2022
doi: 10.3389/fpsyg.2022.806563

# Psychometric Properties of the Eating Disorder Inventory-3 (EDI-3) in Chilean Youth

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The aim of this study was to analyze the psychometric properties of the Eating Disorder Inventory (EDI)-3 test to evaluate eating disorders in young Chilean population. Methods: The sample consisted of 1,091 Chilean adolescents and young people (i.e., 476 men and 615 women) between 15 and 28 years old, from the metropolitan region, and four regions from the coast and south-central zone of the country. The reliability and factorial structure of the instrument were analyzed, replicating the confirmatory factor analyses of Brookings et al. (2020), evaluating four additional models that included bifactor exploratory structural equation modeling (ESEM), bifactor, and two-bifactor. Results: A majority of the subscales presented alphas and omegas equal to or greater than 0.70, with the exception of asceticism ($\alpha$ = 0.543, $\omega$ = 0.552) and interpersonal alienation ($\alpha$ = 0.684, $\omega$ = 0.695) scales, which are consistent with the values of the Spanish and Mexican non-clinical samples. The best fit indices were obtained by the ESEM two-bifactor model, with twelve specific factors corresponding to the EDI-3 subscales and two general orthogonal factors (i.e., risk subscales and psychological subscales), consistently with the theoretical basis.

**Keywords: Eating Disorder Inventory-3 (EDI-3), bifactor exploratory structural equation modeling (ESEM), eating disorders (ED), psychometric procedures, eating disorders–diagnosis, therapy**

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***Edited by:***
*Jena Shaw Tronieri, University of Pennsylvania, United States*

***Reviewed by:***
*Haleh Dadgostar, Iran University of Medical Sciences, Iran*
*Brenda María Murawski, Universidad de Buenos Aires, Argentina*

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***Specialty section:***
*This article was submitted to Eating Behavior, a section of the journal Frontiers in Psychology*

***Received:*** *01 November 2021*
***Accepted:*** *18 January 2022*
***Published:*** *01 March 2022*

***Citation:***
*Lizana-Calderón P, Cruzat-Mandich C, Díaz-Castrillón F, Alvarado JM and Compte EJ (2022) Psychometric Properties of the Eating Disorder Inventory-3 (EDI-3) in Chilean Youth. Front. Psychol. 13:806563. doi: 10.3389/fpsyg.2022.806563*

## INTRODUCTION

Eating disorders (EDs) are serious psychological problems, with high mortality and poor prognosis, strongly associated with thinness typical ideal of contemporary western societies (American Psychiatric Association, 2014). A recent systematic review (Galmiche et al., 2019), which includes 94 studies published in English or French, between 2000 and 2018, shows that the mean lifetime prevalence of EDs and their ranges in women was 8.4% [3.3–18.6%] and in men 2.2% [0.8–6.5%]. The mean prevalence in the last year and its range corresponded to 2.2% [0.8–13.1%] for women and 0.7% [0.3–0.9%] for men. The weighted means of the point prevalence and their ranges were 5.7% [0.9–13.5%] for women and 2.2% [0.2–7.3%] for men. When analyzing by continent, it stands out that America has the highest point prevalence mean, with 4.6% [2.0–13.5%]. The authors also

incorporated 27 other studies that revealed that the mean point prevalence of any ED is 19.4% [6.5–36.0%] in women and 13.8% [3.6–27.1%] in men. The increase in point prevalence in the period studied was 3.5% between 2000 and 2006 and 7.8% between 2013 and 2018. An important study carried out with a sample of 36,309 people in the United States (Udo and Grilo, 2018) indicates that the ED would be linked to a significant deterioration in psychosocial functioning and that there were relevant associations between binge ED and extreme obesity, which, together with the high prevalence, would constitute a major public health problem.

The age of onset of EDs is earlier in anorexia nervosa (AN), on average before the age of 22 years. In bulimia nervosa (BN), it would appear before the age of 24 years. Due to the changes in the DSM-5 diagnostic criteria, there has been an increase in AN and BN and a decrease in diagnoses not specified (EDNOS) or other diagnoses (OSFED) (Lindvall Dahlgren et al., 2017).

In Chile, Correa et al. (2006) described that EDs have become chronic and, in recent years, have spread to men and different socioeconomic levels. Urzúa et al. (2011) observed significant differences between adolescents who attended public schools, showing a greater drive for thinness DT than those who attended private schools. In turn, a high-risk factor is the initiation of unsupervised diets at an early age, especially in overweight or obese young people, who have shown greater DT and body dissatisfaction (BD) (Contreras et al., 2015).

It was identified that the age of greatest risk of developing ED would be 16 years in women and 17 years in men (Zapata et al., 2018). Men may have a later onset of ED because pubertal changes are later than those observed in women (Salas et al., 2011).

For all the above, it is important to have standardized instruments that allow an early detection of EDs and is necessary to take a test that provides information on the risks in normal populations, especially adolescents, and also, in young adult populations, in whom high rates of maintenance of EDs are observed (Treasure et al., 2011). In addition, the instruments must be sensitive in the populations where they are used especially because EDs are strongly related to a social factor, such as DT, and the internalization of this ideal of beauty, especially in female adolescents (Mellor et al., 2008; Caqueo-Urízar et al., 2011; Cash and Smolak, 2011), and because Chilean families seem to exert a greater influence than another families on BD compared with that in peers influence (Mellor et al., 2008).

Although there are numerous instruments that allow the evaluation and diagnosis of EDs (Losada and Marmo, 2013), it is probably the Eating Disorders Inventory (EDI) that has been the most widely used to standardize the self-reports that measure the psychological symptoms associated with AN, BN, and other EDs (Nevonen et al., 2003; Clausen et al., 2009). The original EDI (Garner et al., 1983) that was revised in Garner (1991) covered a total of 64 items that were organized into eight subscales. The next version, EDI-2, was made up of 11 subscales derived from 91 items, against which it is possible to choose six response alternatives ranging from always to never agree.

From EDI-2, a new version called EDI-3 was created (Garner, 2004). New statistical analyses were carried out, generating new groupings of the items in the scales (item 71 was left out of the computations), and a new scoring system was incorporated which includes greater variability of the evaluated elements (i.e., 6-point Likert scale, which is scored between 0 and 4 points, and it was 0–3 points earlier). Thus, the EDI-3 scales seek to measure more reduced and discriminative constructs than the previous version.

The EDI-3 consists of 12 main scales and 6 indices. Three of the main scales are called risk scales, namely, DT, bulimia (B), and BD. The remaining nine scales, namely, low self-esteem (LSE), personal alienation (PA), interpersonal insecurity (II), interpersonal alienation (IA), interoceptive deficits (ID), emotional dysregulation (ED), perfectionism (P), asceticism (A), and maturity fears (MF) assess psychological aspects especially associated with the development and maintenance of ED. The EDI-3 also allows grouping some scales into six indices called risk of ED (DT + B + BD) and ineffectiveness index (LSE + PA), which account for a low personal assessment and a feeling of emotional emptiness related to a deficit in the constitution of identity. A third index is interpersonal problems (II + IA). It evaluates the possibility of the individual to trust interpersonal relationships, and the belief that these are tense and disappointing, so it has a predictive value for poor response to treatment. Another index is affective problems (ID + ED). It refers to difficulties in discriminating emotional problems and in expressing emotions appropriately. This element appears as a relevant factor in the maintenance of ED and therefore is one of the main goals of the therapy. Another index refers to excess control (P + A), which measures the desire for perfection through self-sacrifice, pillars of the ED generally resistant to change.

Another index is the general psychological maladjustment (i.e., sum all the psychological scales), which would allow predicting the results of the treatment, measuring the pattern of responses of the subject and indicating high levels of psychopathology. In addition, the EDI-3 has three scales, namely, validity, inconsistency, and infrequency (it refers to the responses that maximize the pathology, which is infrequent in the subjects of the clinical sample), and negative impression (it refers to the responses in which the subject chooses the most extreme options with the greatest symptoms), allowing the analysis of response patterns that suggest a bias in the results.

The EDI-3 has been validated with large samples in multiple languages and countries (Garner et al., 2010; Clausen et al., 2011; Nyman-Carlsson et al., 2015; Dadgostar et al., 2017), which has made it possible to develop scales for use in clinical and non-clinical populations and not only at risk, as was the EDI-2.

Only the EDI-2 psychometric properties have been analyzed in the Chilean population (Urzúa et al., 2009).

The EDI-3 Spanish version validations (Garner et al., 2010) have been carried out in various countries. In Mexico, it was carried out with a clinical sample in more than 500 women with a diagnosis of EDs (Unikel et al., 2006), who, through the principal component analysis (i.e., varimax rotation), conclude that the factorial structure corresponds to six factors, including 36 items, which explain 56% of the total variance. In Peru, the Spanish version was adapted using a sample of more than 600

people (Infantes, 2015). Another validation was carried out in Argentina with a sample of more than 700 female adolescents from the general population, who, based on an exploratory factor analysis of the risk and psychological scales separately, conclude that only the structure of the risk scales would be equivalent to the original version (Rutsztein et al., 2013). However, none of these validations checks the fit of the items to their respective factors (i.e., subscales), by means of the confirmatory factor analysis. Clausen et al. (2011) carried out the first evaluation of the first- and second-order factorial structure of the EDI-3 in its Danish language version, with a sample of 561 adult patients and a control group of 878 adult women, obtaining a good fit to a model of two second-order factors, one of risk and the other made up of psychological disorders, which supports the original structure proposed by Garner (2004). From these analyses, Brookings et al. (2020) replicated the evaluation of the second-order two-factor model, this time for the English version, in a clinical sample of 1,206 female patients aged between 11.4 and 74.3 years (mean 22.6 and SD 8.9 years) and test alternative models. The authors divided the sample into two subsamples. With the first, they evaluated the fit of the models proposed *a priori* and models proposed *a posteriori*. With the models tested in sample 1, a cross-validation was performed using sample 2. Finally, the models with the best fit were analyzed using the full sample. The model that presented the best fit was a model of 12 correlated factors and a second general factor orthogonal to the content factors, which covers the 90 items, considering five pairs of correlated errors, which correspond to items that refer to the same content, and either directly or inverse.

Based on the antecedents raised about the EDI-3 factorial structure, non-existent for the Spanish version, the aim of this study was to analyze the psychometric properties of the Eating Behavior Inventory (EDI-3) in a non-clinical population of young Chileans, replicating the analyses carried out by Brookings et al. (2020) and evaluating alternatives using Exploratory Structural Equation Modeling (ESEM).

# MATERIALS AND METHODS

## Participants

The initial sample consisted of 1,346 students. 255 cases were discarded because they presented systematic missing values in the sociodemographic variables and in the items of the instrument. The eliminated cases were compared with the definitive cases and did not present a difference in the proportion of men and women ($\chi^2 = 0.007$; gl = 1; $p = 0.933$), nor in the mean body mass index (BMI, $t = -1.411$; gl = 1,301; $p = 0.158$). Only a difference in the mean age of 0.492 years (5.9 months) was observed in favor of the final sample ($t = 2.782$; gl = 1,344; $p = 0.005$), which would not be substantively relevant. Thus, the sample was made up of 1,091 Chilean adolescents and young people, of which 476 were men (43.6%) and 615 women (56.4%). The ages fluctuated between 15 and 28 years, with an average of 19.1 years (*SD* = 2.52) and 46.1% were between 15 and 18 years and the rest 19 years or more. The young people came from the Metropolitan Region and four regions from the coast and south-central zone of the country. Participants were selected by non-probability sampling by quotas. The minimum size of the sample was determined according to Soper (2015), considering $\alpha = 0.05$; $1-\beta = 0.8$; 14 latent variables, 90 observed variables, and anticipated effect size of 0.14, yielding a minimum sample size for the model structure of 274 and a minimum size for detecting the effect size of 1,110 subjects.

The BMI (weight kg/height $m^2$) showed an average of 22.5 (*SD* = 3.1). According to this parameter, 2% were obese, 6.4% underweight, 16% overweight, and 82.2% had a normal nutritional state.

Regarding family history, 52.9% had a history of overweight, 45.4% of diabetes mellitus, and 41.6% of hypertension.

The students participated voluntarily in this study, without receiving compensation in return. A total of 338 participants (31%) were in secondary education, while 735 (67.4%) were in university studies (18 cases with missing values: 1.65%), including 25 different undergraduate programs, addressing all knowledge areas.

## Procedures

The participants were contacted through secondary and university educational institutions. In each of them, an institutional authorization was obtained, and the students were then evaluated in their educational entities. Consent was requested from adults, and in case of minors, consent was requested from parents and assent from students, explaining the aims of the study, the type of collaboration that was requested, and the guarantees of confidentiality, anonymity, and voluntariness This consent was approved by the Bioethics Committee of the National Commission for Scientific and Technological Research of Chile, CONICYT, and the students kept a copy of it. All questionnaires were anonymous.

The students answered the Eating Disorder Inventory 3 (EDI-3) and, in addition, a sociodemographic questionnaire that was used to characterize the sample and that included variables such as sex, age, weight, height, occupation and educational level, and health history of the parents and relatives of the participant.

## Data Analysis

For the evaluation of the psychometric properties of the EDI-3, the internal consistency of its scores for each subscale was first analyzed using the reliability coefficient Cronbach's alpha and McDonald's omega because it is not possible to assume that the items are tau-equivalent (Trizano-Hermosilla and Alvarado, 2016).

The adjustment was evaluated using the confirmatory factor analysis (CFA, Weighted Least Square Mean and Variance Adjusted Estimators, WLSMV, for ordinal data) using the models proposed by Brookings et al. (2020): Model 1: 12 correlated factors; Model 1A: 12 correlated factors and select correlated errors, corresponding to five pairs of items: 2 and 12 from BDI; 13 and 43 of P; 19 and 20 of BDI and PA, respectively; 69 and 73 of II; and 72 and 83 of ED (J. Brookings, personal communication, January 11, 2021); Model 2: 12 correlated factors with 10 correlated errors for inconsistency scale items; Model 3: two second-order factors (risk scales and psychological scales);

**TABLE 1 |** Descriptive statistics for the EDI-3 scales and composites (*N* = 1,091).

| Scale/composite | M | SD | Skew | α total[1] | α low | α high | α 15–18 years old[2] | α 19 and older[3] | ω total | ω low | ω high |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Drive for thinness | 8.27 | 7.67 | 0.89 | 0.893 | 0.884 | 0.902 | 0.894 | 0.893 | 0.905 | 0.896 | 0.914 |
| Bulimia | 4.98 | 4.88 | 1.40 | 0.746 | 0.724 | 0.766 | 0.730 | 0.759 | 0.763 | 0.742 | 0.785 |
| Body dissatisfaction | 12.37 | 8.24 | 0.69 | 0.816 | 0.799 | 0.832 | 0.813 | 0.820 | 0.822 | 0.807 | 0.838 |
| Low self-esteem | 3.60 | 3.84 | 1.19 | 0.777 | 0.756 | 0.796 | 0.784 | 0.765 | 0.788 | 0.768 | 0.807 |
| Personal alienation | 4.65 | 4.27 | 1.39 | 0.745 | 0.721 | 0.767 | 0.754 | 0.729 | 0.740 | 0.717 | 0.764 |
| Interpersonal insecurity | 7.14 | 5.40 | 0.67 | 0.796 | 0.777 | 0.814 | 0.786 | 0.805 | 0.804 | 0.787 | 0.822 |
| Interpersonal alienation | 6.06 | 4.23 | 0.88 | 0.684 | 0.655 | 0.711 | 0.655 | 0.710 | 0.695 | 0.668 | 0.723 |
| Interoceptive deficits | 7.03 | 6.05 | 1.20 | 0.800 | 0.781 | 0.817 | 0.813 | 0.782 | 0.806 | 0.789 | 0.823 |
| Emotional dysregulation | 5.25 | 5.10 | 1.49 | 0.728 | 0.703 | 0.751 | 0.718 | 0.737 | 0.719 | 0.695 | 0.744 |
| Perfectionism | 8.97 | 5.12 | 0.39 | 0.710 | 0.682 | 0.736 | 0.676 | 0.739 | 0.713 | 0.687 | 0.739 |
| Asceticism | 4.81 | 3.79 | 1.09 | 0.543 | 0.502 | 0.582 | 0.518 | 0.567 | 0.552 | 0.511 | 0.593 |
| Maturity fears | 12.43 | 6.04 | 0.69 | 0.759 | 0.737 | 0.780 | 0.744 | 0.758 | 0.766 | 0.745 | 0.787 |

*Scale statistics are based on item sums. For all scales, higher scores reflect greater distress.*
*[1]Total sample (N = 1,091).*
*[2]15–18 years old (N = 503).*
*[3]19 years and older (N = 588).*

**TABLE 2 |** Models fit indices.

| Model | $X^2$ | df | CFI | TLI | RMSEA | RMSEA LOW | RMSEA HIGH | SRMR |
|---|---|---|---|---|---|---|---|---|
| M0: Null | 54329.31** | 4,005 | | | | | | |
| M1: 12 corr factors | 12828.50** | 3,849 | 0.822 | 0.814 | 0.046 | 0.045 | 0.047 | 0.081 |
| M1A: 12 corr factors, select corr errors (5) | 12650.91** | 3,844 | 0.825 | 0.818 | 0.046 | 0.045 | 0.047 | 0.081 |
| M2: 12 corr factors, Inconsistency Scale corr errors (10) | 12699.25** | 3,839 | 0.824 | 0.816 | 0.046 | 0.045 | 0.047 | 0.078 |
| M3: Two 2nd order factors | 14251.87** | 3,902 | 0.794 | 0.789 | 0.049 | 0.048 | 0.050 | 0.087 |
| M3A: Two 2nd order factors, select corr errors (5) | 14096.32** | 3,897 | 0.797 | 0.792 | 0.049 | 0.048 | 0.050 | 0.086 |
| M4: Bifactor, corr content factors | 9360.91** | 3,759 | 0.893 | 0.886 | 0.036 | 0.035 | 0.037 | 0.060 |
| M4A: Bifactor, corr content factors, select corr errors (5) | 8915.31** | 3,754 | 0.897 | 0.890 | 0.036 | 0.035 | 0.036 | 0.059 |
| M4b: Bifactor, corr content factors, Inconsistency Scale corr errors (10) | 8922.83** | 3,749 | 0.897 | 0.890 | 0.036 | 0.035 | 0.037 | 0.059 |
| M5 (ESEM): 12 factors. Target oblique rotation | 4503.91** | 2,991 | 0.970 | 0.960 | 0.022 | 0.020 | 0.023 | 0.028 |
| M5A (ESEM): bifactor: 12 specific factors + general factor. Target orthogonal rotation | 4158.66** | 2,913 | 0.975 | 0.966 | 0.020 | 0.018 | 0.021 | 0.026 |
| M6: two bifactor corr, 12 corr cont factors | 8711.766** | 3,758 | 0.902 | 0.895 | 0.035 | 0.034 | 0.036 | 0.059 |
| M7: (ESEM) two bifactor, 12 especific factors, target orthogonal rotation | 3932.102** | 2,836 | 0.978 | 0.969 | 0.019 | 0.017 | 0.020 | 0.025 |

***p < 0.01.*
*Estimator = Weighted least square mean and variance adjusted estimators (WLSMV).*
*corr, correlated; cont, content.*

Model 3A: two second-order factors plus five select correlated errors; Model 4: correlated content 12 factors plus an orthogonal bifactor; and Model 4A: correlated content 12 factors plus an orthogonal bifactor plus five select correlated errors.

Finally, according to the recommendations of Brookings et al. (2020), two exploratory structural equation models are analyzed, using the method proposed by Asparouhov and Muthén (2009): Model 5 (ESEM): correlated content 12 factors (target oblique rotation) and Model 5A (ESEM): correlated content 12 factors plus a bifactor (i.e., target orthogonal rotation). The comparison of the fit of the models was based on $\chi^2$, comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR), using the criteria that indicate that values greater than 0.95 for CFI and TLI would account for an optimal fit and >0.90 would be acceptable; for RMSEA, values under 0.06 would be considered optimal and under 0.8 considered acceptable. For SRMR, the criterion is <0.06 (Hu and Bentler, 1999).

The analyses were carried out using the software Mplus 8.6 (Muthén and Muthén, 1998/2017).

## RESULTS

**Table 1** presents the means, standard deviation, asymmetry coefficients, and internal consistency values (i.e., Cronbach's alpha and omega) for all scales. Cronbach's alpha was calculated separately for minors and adults as recommended by Gleaves et al. (2014) and evaluated by Brookings et al. (2020). Lower α coefficients were obtained in adolescents in P, IA, and A. In the other subscales, the values would be equivalent.

The scales that present positive asymmetry are ED (1.49), B (1.40), PA (1.39), ID (1.20), LSE (1.19), and A (1.09), which are

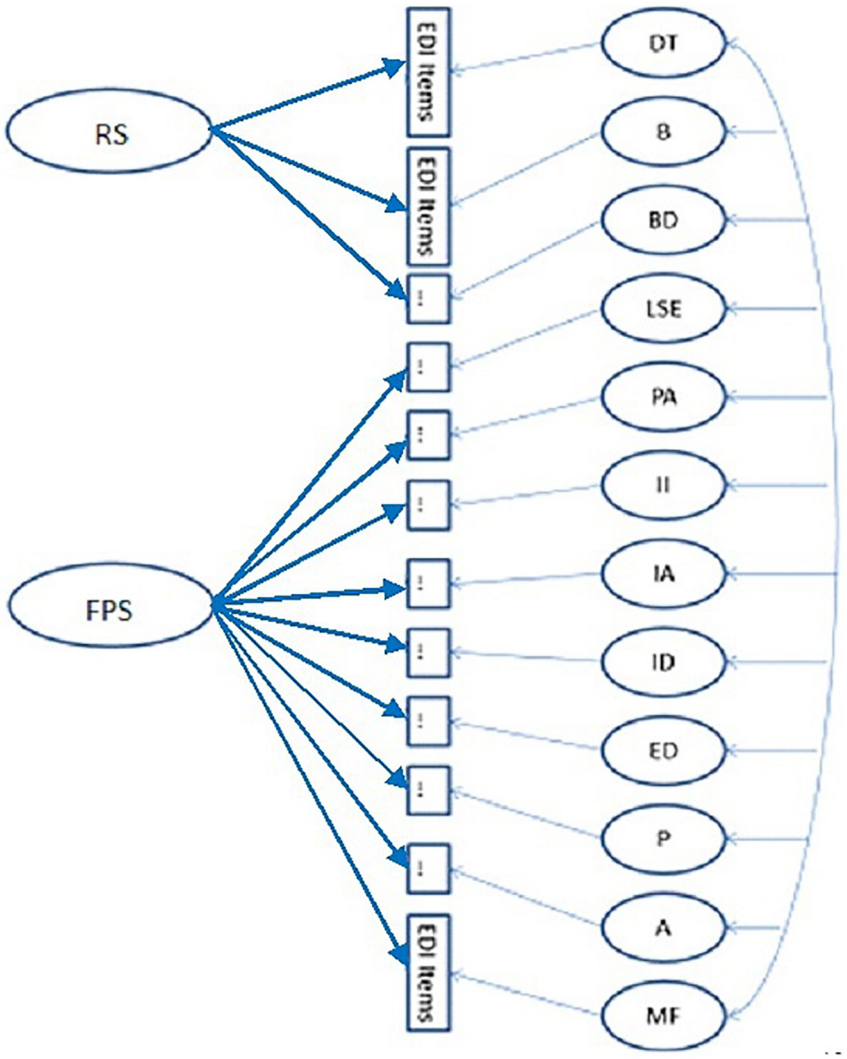


**FIGURE 1 |** Model 7: two bifactor, 12 specific factors, target orthogonal rotation (ESEM). DT, Drive for thinness; B, Bulimia, BD, Body dissatisfaction; LSE, Low self-esteem; PA; personal alienation; II, Interpersonal insecurity; IA; Interpersonal alienation; ID, Interoceptive deficits; ED, Emotional dysregulation; P, Perfectionism; A, Asceticism; MF, Maturity fears.

expected in most of the subscales when the instrument is applied to a non-clinical sample (Garner, 2004).

Regarding the analysis of the structure of the instrument, the first-order models (1, 1A, and 2) present weak fit to the data, which even worsens when testing the second-order two-factor models. The introduction of a general factor (i.e., bifactor) orthogonal to the 12 factors corresponding to the subscales improves the fit in a relevant way, especially when considering the five pairs of items whose errors would be correlated (**Table 2**).

However, when evaluating the ESEM models, which do not require that the factorial loads of the items load in a single factor, it is observed how the fit improves substantially, highlighting the 5A model, which considers a bifactor, 12 content factors and target orthogonal rotation.

Considering the theoretical foundations of EDI-3 (Garner, 2004), which organizes the general structure into two groups of constructs, namely, risk scales and psychological scales, it made more sense to evaluate, rather than a bifactor model with only one general factor, a two-bifactor model, grouping the subscales according to what was proposed by the authors of the original instrument. Model 6 (i.e., two-bifactor model and 12 correlated factors) and model 7, which corresponds to an ESEM two-bifactor model, target orthogonal rotation, were then evaluated, obtaining a noticeable improvement in the adjustment indicators (refer to **Table 2** and **Figure 1**).

When analyzing in detail the outputs of model 7, it is observed (refer to **Supplementary Table 1**) that almost all the items present significant loads in the general factor ($\alpha = 0.05$), except for items 72 ED, 81 ED, and 43 P, which, at the same time, present a high association with its specific factor: $0.71^{**}$, $0.76^{**}$, and $0.76^{**}$, respectively.

Regarding the factorial loads of the items by subscales, ten of them do not present a significant load in the expected factor but in their corresponding general factor; these are item 53 of the B subscale (0.54**) and item 47 belonging to BD, load in general factor risk scales (0.41**); in the PA subscale, items 18, 24, 56, 80, and 84 load significantly in general factor psychological scales (FPS) (0.69**, 0.56**, 0.77**, 0.43**, and 0.72**, respectively) *; items 54 and 74 of IA load significantly in FPS (0.53** and 0.60**); and finally, from subscale A, item 86 presents a higher load of 0.40** in FPS.

There are four items that do not present significant loads > | 0.3| in any subscale and present significant loads in general factor risk scales (RS). These are items 53 of the B subscale (0.54**), item 12 BD (0.69**), 19 BD (0.61**), and 47 BD (0.41**).

The same occurs with 20 items that present significant loads in general FPSs and > | 0.3| on no subscale. They are item 41 of LSE (0.64**); of the PA subscale, items 18 (0.69**), 20 (0.45**), 24 (0.56**), 56 (0.77**), and 84* (0.72**). In the II subscale, items 69 (0.57**) and 87 (0.49**) present this situation; In IA, items 17 (0.49**), 30 (0.40**), 54 (0.53**) 65 (0.51**), 74 (0.60**), and 76 (0.47**). In the ID subscale, items 40 (0.32**) and 77 (0.61**); in ED, item 67 (0.62**) and in A, items 66 (0.63**), 78 (0.33**), and 86 (0.40**).

The reverse situation occurs in a group of three items, that is, they show loads ≤ | 0.3| in the general factor risk scales and significant loads > | 0.3|, in its specific subscale, with values between 0.32 and 0.69. These are items 1 of DT, 5 and 38 of B, and 31 of BD. For the general FPSs, this occurs in ten items with loads between 0.32** and 0.68**: items 13, 29, 52, and 63 of P and items 14, 22, 35, 39, 48, and 58 of the subscale MF.

In contrast, items 75 and 88 of A do not present significant loads > | 0.3| in any specific factor, nor in its general factor (GPF). Item 68, also of the A subscale, only loads significantly in the general factor risk scales (0.37**).

Finally, item 26 of ID ("I can clearly identify what emotion I am feeling") presents its highest factor load (0.40**) in the II subscale.

## DISCUSSION

In the first place, it should be noted that the analysis carried out revealed a structure congruent with the theoretical postulates of the instrument, in its Spanish version, in a young Chilean non-clinical population.

Regarding the structure of the subscales, it was observed that A and IA have shown the lowest internal consistency, which is consistent with the findings of the Iranian investigation (Dadgostar et al., 2017), with the Spanish and Mexican non-clinical samples (Garner et al., 2010), and with the Swedish and Danish version, in this case, specifically for the A subscale in general population (Clausen et al., 2011; Nyman-Carlsson et al., 2015). None of the items that make up the A subscale presented a load in said factor > | 0.3|.

Also, six items of IA and five of PA presented significant loads only in general FPSs, and six items of MF and 4 of P, only in their specific factor. This is consistent with the analysis of the Spanish version (Garner et al., 2010), wherein IA and PA showed the highest correlations with general FPSs, and MF and P the lowest.

When analyzing the content of the items of the A subscale, it can be observed that some of them explicitly refer to aspects related to a moral dimension (i.e., "moral weakness," "self-denial," "suffering to be a better person," and "human weaknesses"), rather than associated with the initial descriptions of cases of AN and as a specific risk factor for EDs, that are probably not so clearly presented in general population youth (Izydorczyk et al., 2020; Obeid et al., 2021). Something similar happens in IA, where the items are directed toward trusting others, having close friends, and feeling appreciated, which gives the impression of not being perceived in the same dimension by non-clinical youth. This has also been seen in PA, where the content of the items does not appear to be homogeneous, since they include feelings of loneliness and emptiness with elements seemingly related to identity.

In contrast, the P and MF subscales propose apparently much more specific content, which would have a more independent behavior from the rest of the subscales.

This systematic behavior of the items makes it necessary to review these subscales both in relation to the instrument and considering the theoretical postulates.

When comparing the adjustment of the models obtained by Brookings et al. (2020), the adjustment for the Chilean sample is equivalent or slightly lower in those that include 12 correlated factors and among those that consider second-order factors. In contrast, it highlights that when evaluating bifactor models 4 and 4A, the adjustment obtained in the Chilean sample is better than that of the United States sample.

Further, when comparing with the Danish results, the adjustment indices of the Chilean sample are lower for the model of 12 correlated factors for patients and normal controls. This could be attributed to the fact that in this study, a sample of only women was used (Clausen et al., 2011).

As ESEM models are incorporated, it is observed how the adjustment of the models improves, until reaching very good indicators in model 7 (i.e., two–bifactor model, 12 specific factors, and target orthogonal rotation).

Finally, it is interesting to reflect, based on the empirical results, on the cross-loading of the different items and factors and how to consider it, as it would be expected in real-life situations. Therefore, the analyses carried out would allow us to realize that, since latent psychological constructs necessarily interact with each other, the structure of the instruments that evaluate them should adjust to this condition (i.e., ESEM).

### Limitations

A limitation of this study is that the instrument was designed for a clinical population, which limits the variability of responses in a non-clinical sample, with the consequent difficulties for analysis. Therefore, it is necessary to evaluate the fit of the model in a clinical sample.

Furthermore, due to the complexity of the model, it has not been possible to carry out an invariance analysis between men and women, which would have been very interesting to evaluate.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Universidad Adolfo Ibáñez. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

PL-C, CC-M, and FD-C created and organized the study, collected the data, and wrote the first draft of the manuscript. PL-C and JA analyzed and interpreted the data. JA and EC critically reviewed the manuscript and provided the constructive comments. All authors contributed to the article and approved the submitted version.

## FUNDING

This work was supported by Project: FONDECYT REGULAR 2014-2016, N°: 1140085 (Fondo Nacional de Desarrollo Científico y Tecnológico), financed by CONICYT (Comisión Nacional de Investigación Científica y Tecnológica), Chile.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.806563/full#supplementary-material

## REFERENCES

Asparouhov, T., and Muthén, B. (2009). Exploratory structural equation modeling. *Struct. Equ. Model. Multidiscipl. J.* 16, 397–438. doi: 10.1080/10705510903008204

American Psychiatric Association (2014). *Manual Diagnóstico y Estadístico de las Enfermedades Mentales, DSM-5*, 5th Edn, Washington, DC: American Psychiatric Publishing.

Brookings, J. B., Jackson, D. L., and Garner, D. M. (2020). A bifactor and item response theory analysis of the eating disorder inventory-3. *J. Psychopathol. Behav. Assess.* 43:1. doi: 10.1007/s10862-020-09827-2

Caqueo-Urízar, A., Ferrer-García, M., Toro, J., Gutiérrez-Maldonado, J., Peñaloza, C., Cuadros-Sosa, Y., et al. (2011). Associations between sociocultural pressures to be thin, body distress, and eating disorder symptomatology among Chilean adolescent girls. *Body Image* 8, 78–81. doi: 10.1016/j.bodyim.2010.11.004

Cash, T. F., and Smolak, L. (2011). "Understanding body images: historical and contemporary perspectives," in *Body Image: A Handbook of Science, Practice, and Prevention*, eds T. F. Cash and L. Smolak (New York, NY: The Guilford Press), 3–11. doi: 10.1093/shm/15.1.17

Clausen, L., Rosenvinge, J. H., Friborg, O., and Rokkedal, K. (2011). Validating the eating disorder inventory-3 (EDI-3): a comparison between 561 female eating disorders patients and 878 females from the general population. *J. Psychopathol. Behav. Assess.* 33, 101–110. doi: 10.1007/s10862-010-9207-4

Clausen, L., Rokkedal, K., and Rosenvinge, J. H. (2009). Validating the Eating Disorder Inventory (EDI-2) in two Danish samples: a comparison between female eating disorder patients and females from the general population. *Eur. Eat. Disord. Rev.* 17, 462–467. doi: 10.1002/erv.945

Contreras, M. L., Morán, J., Frez, S., Lagos, C., Marín, M. P., de los Ángeles Pinto, M., et al. (2015). Conductas de control de peso en mujeres adolescentes dietantes y su relación con insatisfacción corporal y obsesión por la delgadez. *Rev. Chil. Pediatr.* 86, 97–102. doi: 10.1016/j.rchipe.2015.04.020

Correa, M. L., Zubarew, T., Silva, P., and Romero, M. I. (2006). Prevalencia de riesgo de trastornos alimentarios en adolescentes mujeres escolares de la Región Metropolitana. *Rev. Chilena Pediatr.* 77, 153–160. doi: 10.4067/s0370-41062006000200005

Dadgostar, H., Nedjat, S., Dadgostar, E., and Soleimany, G. (2017). Translation and evaluation of the reliability and validity of eating disorder inventory -3 questionnaire among Iranian university students. *Asian J. Sports Med.* 8:e13950. doi: 10.5812/asjsm.13950

Galmiche, M., Déchelotte, P., Lambert, G., and Tavolacci, M. P. (2019). Prevalence of eating disorders over the 2000-2018 period: a systematic literature review. *Am. J. Clin. Nutr.* 109, 1402–1413. doi: 10.1093/ajcn/nqy342

Garner, D., Elosua, P., López-Jáuregui, A., and Sánchez-Sánchez, F. (2010). *EDI 3. Inventario de Trastornos de la Conducta Alimentaria-3. Manual*. Madrid: TEA Ediciones.

Garner, D., Olmstead, M., and Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *Intern. J. Eat. Disord.* 2, 15–34. doi: 10.1016/j.brat.2006.10.004

Garner, D. M. (1991). *Eating Disorder Inventory-2 Professional Manual*. Odessa, FL: Psychological Assessment Resources Inc.

Garner, D. M. (2004). *EDI-3 Eating Disorders Inventory-3: Professional Manual*. Odessa, FL: Psychological Assessment Resources, Inc.

Gleaves, D. H., Pearson, C. A., Ambwani, S., and Morey, L. C. (2014). Measuring eating disorder attitudes and behaviors: a reliability generalization study. *J. Eat. Disord.* 2, 1–12. doi: 10.1186/2050-2974-2-6

Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55. doi: 10.1080/10705519909540118

Infantes, M. (2015). *Propiedades Psicométricas del Inventario de Trastornos de la Conducta Alimentaria en Adolescentes Escolarizados*. Tesis de licenciatura. Trujillo: Universidad César Vallejo.

Izydorczyk, B., Khanh, H., Lizinczyk, S., Sitnik-Warchulska, K., Lipowska, M., and Gulbicka, A. (2020). Body dissatisfaction, restrictive, and bulimic behaviours among young women: a polish–japanese comparison. *Nutrients* 12:666. doi: 10.3390/nu12030666

Lindvall Dahlgren, C., Wisting, L., and Rø, Ø (2017). Feeding and eating disorders in the DSM-5 era: a systematic review of prevalence rates in non-clinical male and female samples. *J. Eat. Disord.* 5, 1–10. doi: 10.1186/s40337-017-0186-7

Losada, A., and Marmo, J. (2013). *Herramientas de Evaluacion En Trastornos de La Conducta Alimentaria*. Madrid: Editorial Académica Española.

Mellor, D., McCabe, M., Ricciardelli, L., and Merino, M. E. (2008). Body dissatisfaction and body change behaviors in Chile: the role of sociocultural factors. *Body Image* 5, 205–215. doi: 10.1016/j.bodyim.2008.01.004

Muthén, L. K., and Muthén, B. O. (1998/2017). *Mplus User's Guide*, 8th Edn. Los Angeles, CA: Muthén & Muthén.

Nevonen, L., Broberg, A. G., Clinton, D., and Norring, C. (2003). A measure for the assessment of eating disorders: reliability and validity studies of the rating of anorexia and bulimia interview – revised version (RAB-R). *Scand. J. Psychol.* 44, 303–310. doi: 10.1111/1467-9450.00349

Nyman-Carlsson, E., Engström, I., Norring, C., and Nevonen, L. (2015). Eating disorder inventory-3, validation in Swedish patients with eating disorders, psychiatric outpatients and a normal control sample. *Nordic J. Psychiatry* 69, 142–151. doi: 10.3109/08039488.2014.949305

Obeid, N., Valois, D. D., Bedford, S., Norris, M. L., Hammond, N. G., and Spettigue, W. (2021). Asceticism, perfectionism and overcontrol in youth with eating disorders. *Eat. Weight Disord.* 26, 219–225. doi: 10.1007/s40519-019-00837-y

Rutsztein, G., Leonardelli, E., Scappatura, M. L., Murawski, B., Elizathe, L., and Maglio, A. (2013). Psychometric properties of the Eating Disorders Inventory-3 (EDI-3) among female adolescents from Argentina. *Rev. Mex. Trastor. Alimentarios* 4, 1–14. doi: 10.1016/s2007-1523(13)71987-6

Salas, F., Hodgson, M. I., Figueroa, D., and Urrejola, P. (2011). Características clínicas de adolescentes de sexo masculino con trastornos de la conducta alimentaria. Estudio de casos clínicos. *Rev. Med. Chile* 139, 182–188. doi: 10.4067/s0034-98872011000200007

Soper, D. S. (2015). *A-Priori Sample Size Calculator for Structural Equation Models [Software]*. Available online at: https://www.danielsoper.com/statcalc/calculator.aspx?id=89

Treasure, J., Smith, G., and Crane, A. (2011). *Los Trastornos de la Alimentación. Guía Práctica para Cuidar de un ser Querido*. Paris: Desclée de Brouwer.

Trizano-Hermosilla, I., and Alvarado, J. M. (2016). Best alternatives to Cronbach's alpha reliability in realistic conditions: congeneric and asymmetrical measurements. *Front. Psychol.* 7:769. doi: 10.3389/fpsyg.2016.00769

Udo, T., and Grilo, C. M. (2018). Prevalence and correlates of DSM-5 eating disorders in nationally representative sample of United States adults. *Biol. Psychiatry* 84, 345–354. doi: 10.1016/j.biopsych.2018.03.014

Unikel, C., Bojorquez, I., Carreño, S., and Caballero, A. (2006). Validación del eating disorder inventory en una muestra de mujeres mexicanas con trastorno de la conducta alimentaria. *Salud Ment.* 29, 44–51.

Urzúa, A., Castro, S., Lillo, A., and Leal, C. (2009). Evaluation of eating disorders: psychometric properties of EDI-2 in students 13 to 18 years old. *Rev. Chilena Nutr.* 36, 1063–1073. doi: 10.4067/S0717-75182009000400002

Urzúa, A., Castro, S., Lillo, A., and Leal, C. (2011). Prevalencia de riesgo de trastornos alimentarios en adolescentes escolarizados del norte de Chile. *Rev. Chil. Nutr.* 38, 128–135. doi: 10.4067/s0717-75182011000200003

Zapata, D., Granfeldt, G., Muñoz, S., Celis, M., Vicente, B., Saez, K., et al. (2018). Riesgo de trastorno de la conducta alimentaria en adolescentes chilenos de diferentes tipos de establecimientos educacionales. *Archiv. Latinoam. Nutr.* 68, 217–222.

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 24 March 2022
doi: 10.3389/fpsyg.2022.856933

# The Relationship Between Women's Negative Body Image and Disordered Eating Behaviors During the COVID-19 Pandemic: A Cross-Sectional Study

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**Edited by:**
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**Specialty section:**
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

**Received:** *17 January 2022*
**Accepted:** *04 March 2022*
**Published:** *24 March 2022*

**Citation:**
*Corno G, Paquette A, Monthuy-Blanc J, Ouellet M and Bouchard S (2022) The Relationship Between Women's Negative Body Image and Disordered Eating Behaviors During the COVID-19 Pandemic: A Cross-Sectional Study. Front. Psychol. 13:856933. doi: 10.3389/fpsyg.2022.856933*

Recent studies have shed light on how the COVID-19 pandemic changed our lives, and most of them have documented its detrimental effect on eating habits. Until now, the effects of this global crisis on negative body image and its association with disordered eating behaviors remain largely understudied. This study aimed to investigate changes in frequency of disordered eating behaviors (i.e., restrictive eating, emotional eating, and overeating) and negative body image (i.e., shape and weight concern, and body dissatisfaction) among a community sample of women during the COVID-19 pandemic (October 2020–May 2021). Furthermore, we explored the possible relation between body image-related variables and changes in the frequency of disordered eating behaviors in the context of the pandemic. A total of 161 self-identified female participants enrolled in an online-based survey. Descriptive statistics showed that women did not report clinically significant levels of weight and body shape concerns, but participants reported being dissatisfied with their body. One sample Wilcoxon Signed Rank tests revealed a tendency toward an increasing of the frequency of all disordered eating behaviors during the COVID-19 pandemic. Multinomial logistic regressions showed that weight concerns predicted an overall increase in the frequency of restrictive eating behaviors, whereas higher body dissatisfaction was associated with a moderate self-perceived increase in the frequency of emotional eating. These results shed light on a risk pattern of phenomena in a non-clinical sample of women, as they represent the key risk factors for the development of eating disorders. Findings could have implications for designing and implementing prevention programs.

**Keywords: body dissatisfaction, weight concerns, shape concerns, negative body image, disordered eating, COVID-19, women's health**

## INTRODUCTION

In December 2019, the world became aware of the development of a novel coronavirus, the coronavirus disease 2019 (COVID-19, World Health Organization, 2020a, 2020b). To limit the spread of COVID-19, a high proportion of countries implemented severe restrictions on social life, travels, and lockdown periods. While these measures were essential to limit the disease spread, there is increasing evidence of negative impact of this pandemic and lockdown responses on mental health of the general population, with increased levels of anxiety, stress, depression, emotional exhaustion, negative social emotions (e.g., shame and guilt), sleeping issues, feelings of loneliness, and cases of post-traumatic stress and suicide (Brooks et al., 2020; Cavalera, 2020; de Medeiros Carvalho et al., 2020; Galea et al., 2020; McCombie et al., 2020; Torales et al., 2020; Ramalho et al., 2021).

Pandemic-related restrictions and lockdown periods significantly changed daily routines. Home confinement and food insecurity could have an impact on food consumption and eating habits. On one hand, they could increase restrictive eating (e.g., restrictive calories intake and skipping meals), but on the other hand, they may also foster overeating and binge eating episodes as consequences of the increased availability of food at home brought and stored up in response to general food insecurity and increased time spent at home (Scarmozzino and Visioli, 2020; Schlegl et al., 2020; Touyz et al., 2020; Weissman et al., 2020). Furthermore, boredom from being forced to stay at home could have promoted overeating as a way to escape the monotony, whereas negative experiences could give rise to restrictive eating patterns due to a stress reaction that emulate the interoceptive sensations associated to satiety (Crockett et al., 2015; Sanlier et al., 2021). By the same token, the pandemic-related stress could have led to emotional eating as a mechanism to cope with mood changes and negative emotions (e.g., shame and guilt; Cavalera et al., 2018; Ferrell et al., 2020; Madali et al., 2021; Sanlier et al., 2021).

Research conducted so far points to a marked increase of irregular eating patterns since the beginning of the pandemic (Flaudias et al., 2020, 2021; Ismail et al., 2020). In line with these studies, an international online survey demonstrates the negative effects of the pandemic on dietary habits, such as increasing unhealthy food consumption, overeating, meal skipping, snacking, and loss of control (Ammar et al., 2020). A large-scale survey including an Australian community and clinical sample (Phillipou et al., 2020) reports that, since the beginning of the pandemic, 27.6% of their community sample reported to have increased the frequency of restrictive eating behaviors as a way to control their shape and weight and 34.6% reported increased binge eating behaviors, despite any antecedent of eating disorders. Ramalho et al. (2021) denounce a variousness of disordered eating behaviors as skipping meals (52.8%), overeating (81%), binge eating episodes (39.2%), grazing eating behavior (80.9%), and loss of control over eating (47.2%) among a Portuguese community population 1 week after the end of the first lockdown period (i.e., May 11th, 2020). Results from an Italian large-scale survey show that most of the participants reported a change in their hunger and satiety perception as well as in their dietary habits (Di Renzo et al., 2020). Notably, women were more likely to report increasing struggles with regulating eating and preoccupation with food (Robertson et al., 2021).

There is also preliminary evidence of increased concerns about appearance and heightened weight and shape concerns in people from the United Kingdom's general population during the COVID-19 pandemic (Robertson et al., 2021). Several studies suggest strong links between exposure to media and social network harmful appearance-related content and disordered eating attitudes/behaviors (e.g., Groesz et al., 2002; Agliata and Tantleff-Dunn, 2004; Glauert et al., 2009; Hawkins et al., 2010; Marques et al., 2022). In the context of the COVID-19 pandemic, evidence shows that the lack of access to in person social interactions due to confinement has led to an increase in media consumption and social networking, exposing confined individuals to a more thin/athletic ideal (Cooper et al., 2020). Increased consumption of social media and daily screen-time during the lockdown, collective concerns about weight gain, and messages conveyed by social media about the dangers of being overweight might significantly influence one's body image concerns (Flaudias et al., 2020; Vall-Roqué et al., 2021). COVID-19-related stress and anxiety are also found to be associated with more negative body image (Swami et al., 2021). Indeed, Swami et al. (2021) propose a pathway linking COVID-19 stress/anxiety to a worsening of negative body image: COVID-19-related stress and anxiety could undermine one's coping resources to face increasing threats to body image, such as an increased exposure to thin/athletic bodies (e.g., due to the increased usage of social media since the pandemic onset; see Cooper et al., 2020; Koeze and Popper, 2020; Pietrobelli et al., 2020), greater worries about body weight and shape (e.g., due to exercise limitations especially during lockdown, see Cooper et al., 2020; Mattioli et al., 2020), and increased frequency of negative body rumination.

Negative body image has been found to be related to disordered eating behaviors (e.g., Stice et al., 1996, 1998; Cash and Deagle, 1997; Burrows and Cooper, 2002; Neumark-Sztainer et al., 2003; Levine and Piran, 2004; Andersen and Swami, 2021) and to be a well-established risk factor for the development and maintenance of eating disorders (e.g., Stice, 2001, 2002; Fairburn et al., 2003; Glashouwer et al., 2019). Nevertheless, the impact of COVID-19 crisis on body image issues and their association with disordered eating behaviors remains largely understudied. Understanding how the COVID-19 pandemic affected body image and problematic eating habits is of critical importance as the adverse consequences related to the pandemic could result in greater risk of development of eating disorders and the aggravation of symptoms in individuals already suffering from an eating disorder. Indeed, Rodgers et al. (2020) identify three different pathways that could promote the development or enhancement of eating disorder symptomatology during the COVID-19 pandemic. The first pathway suggests that restrictions placed on people's movements, daily routine, and outdoor activities might increase weight and shape concerns as well as eating, exercising, and sleeping patterns. The second pathway proposes that media consumption related to the COVID-19 pandemic (i.e., exposure to harmful eating and appearance-related media,

increased consumption of global social media, and use of video-conferencing) may increase eating disorders risk and symptoms. The third pathway suggests that the fear of contagion from COVID-19 might augment stress and avoidance of food believed to be impure or to be a vehicle of contagion. These orthorexia-based cognitions could subsequently increase restrictive eating patterns (Rodgers et al., 2020).

In consideration of the aforementioned findings and their possible preventive and therapeutic implications, we investigated self-reported changes in frequency of disordered eating behaviors (i.e., restrictive eating, emotional eating, and overeating) and negative body image (i.e., shape and weight concern and body dissatisfaction) among a community sample of women during the COVID-19 pandemic. Furthermore, we explored the possible relationship between body image-related variables and perceived changes in the frequency of disordered eating behaviors in the context of the COVID-19 pandemic. In light of the literature on problematic eating behaviors during the COVID-19 pandemic, we expected an increase in disordered eating patterns since the beginning of the COVID-19 crisis. Regarding negative body image, since we were interested in a community sample of women, we did not expect clinical levels of body image-related issues. Nevertheless, since negative body image is considered as normative (i.e., "normative discontent," see Rodin et al., 1984; Tantleff-Dunn et al., 2011; Tiggemann, 2011; Siegel et al., 2020) among women in Western cultures, we expected to find non-clinical levels of shape and weight concerns as well as body dissatisfaction. Given the aforementioned relation between negative body image issues and problematic eating behaviors, we hypothesized a positive relationship between these two phenomena. However, previous data regarding the COVID-19 pandemic period do not exist to guide predictions as to the relative strength of these relationships.

# MATERIALS AND METHODS

## Participants

The sample consisted of 197 female self-identified participants, who accepted participating in an online-based survey exploring the impact of the COVID-19 pandemic on the self. Inclusion criteria were as: over 18 years old, self-identifying as female, never having been diagnosed with EDs, having access to the Internet, being Canadian residents, and being able to read and understand French. Almost all participants (98.2%) self-reported to be Canadian residents. Participants ($n = 3$) who self-reported to be resident in a country other than Canada were excluded. To provide context for the situation during the recruitment period, Canada had reached a critical level of COVID-19 cases in the population. Between October 2020 and December 2020, most regions went into maximum alert, which involved closing non-essential businesses, restricting inter-regional travel, and banning gatherings, a curfew in effect from 8 p.m. to 5 a.m., mandatory teleworking and online school. Canada experienced several tightening of regulations until May 2021, with a slight loosening in March 2021 due to the start of vaccination (e.g., Gouvernement du Québec, 2021). Data collection was ended when most of the pandemic-related restrictions started to be removed in order to preserve data from potential bias. Finally, individuals ($n = 33$) with a self-reported current or past diagnosed eating disorder were excluded from this study, yielding a sample size of $n = 161$.

## Procedure

Recruitment took place over seven (7) months, from October 2020 to May 2021. The study was advertised on social media and participants were recruited using opportunistic and snowball sampling. Participants completed an anonymous online-based survey on LimeSurvey containing sociodemographic questions and questions around their eating habits and body image during the pandemic. Informed consent was obtained prior to completing the survey. The present study was carried out in compliance with current legislation regarding the protection of personal data (Helsinki Declaration of 1975, as revised in 2018, and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans—TCPS 2 of 2018) and obtained the approval from the ethical committee of Université du Québec en Outaouais (Quebec, Canada) and of Université du Québec à Trois-Rivières (Quebec, Canada).

## Measures

### Demographic Information

Participants were asked information about self-reported age, gender, country of residency, relationship status, level of education, skin color, and self-reported current height and weight (to calculate Body Mass Index, BMI). In addition, participants were asked if they ever received (in their past or present) an eating disorder diagnosis. In the present study, participants were considered to have never received a diagnosis of an eating disorder if they answered no to either question.

### Self-Rated Changes in the Frequency of Disordered Eating Behaviors

Participants were asked, "Since the COVID-19 pandemic, please rate each of the following using this scale:," ranging from "1 = Much less than before," "2 = Less than before," "3 = Somewhat less than before," "4 = No change than before," "5 = Somewhat more than before," "6 = More than before," and "7 = Much more than before." Items included "Emotional eating (overeating in response to negative emotions such as anxiety or irritability)" (Van Strien et al., 2007), "Restrictive eating (deliberately trying to limit the amount of food you eat or exclude any food from your diet to influence your shape or weight)," and "Overeating (eating an unusually large amount of food given the circumstances)" (Fairburn and Cooper, 1993; Fairburn and Beglin, 1994).

### Shape Concerns and Weight Concerns

Participants were asked to answer the body shape and weight concerns subscales of the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn and Cooper, 1993; Fairburn and Beglin, 1994). The EDE-Q is a 28-items questionnaire derived from the Eating Disorder Examination (EDE; Cooper and Fairburn, 1987; Fairburn and Cooper, 1993) interview. It is a well-established self-report questionnaire measuring eating disorder-related attitudes

and behaviors and is used for research among community and clinical samples. Items of the EDE-Q are scored on a 7-point scale. Subscale and global scores indicate the severity of eating disorder psychopathology. Scores of 4 or higher indicate a clinical range (Carter et al., 2001). In the present study, the EDE-Q showed good internal consistency for both the subscales (Shape concern: Cronbach's $\alpha = 0.905$, McDonald's $\omega = 0.906$; Weight concern: Cronbach's $\alpha = 0.808$; and McDonald's $\omega = 0.825$).

### Body Dissatisfaction

Body dissatisfaction was calculated using the *e*LoriCorps Immersive Body Rating Scale (*e*LoriCorps-IBRS 1.0; Monthuy-Blanc et al., 2020). This scale is composed of seven virtual bodies of increasing BMIs, from 15 to 33 kg/m$^2$ (**Figure 1**). Since the scale was available only with light skin color virtual bodies, in the present study, virtual bodies were presented in shadows of grey in order to be more inclusive. However, the virtual bodies did not represent the morphological characteristics of women with dark or very dark skin. To control the potential lack of representativeness, we asked participants to self-report their skin color as mentioned above. This scale was used in order to perform visual depictive body size estimation tasks (Moelbert et al., 2017). Participants were asked to choose between a line-up of seven 3D bodies (presented in a third person-allocentric perspective), the one that better represents their perceived body, and the one that better represents their ideal body. Body dissatisfaction corresponds to the perceived body size minus the ideal body size. A positive score indicates that a participant's ideal body is thinner than their perceived body, whereas a negative score indicates that a participant's ideal size is bigger than their perceived size. A score of 0 indicates that there is no difference between ideal and perceived body size (i.e., participants are not dissatisfied with their body). Body dissatisfaction scores can range from −6 to +6.

## Data Analysis Plan

Descriptive statistics were used to paint a portrait about body image-related variables and self-perceived changes in the frequency of disordered eating habits (i.e., restrictive eating, overeating, and emotional eating) since the COVID-19 outbreak. One sample Wilcoxon Signed Rank tests were used to compare whether sample means for each eating habit differed from a null hypothesis of "No change than before" (corresponding to a rating of 4 in the questionnaire developed for this study aims). One sample *t*-tests were run to further probe these findings. Non-parametric correlation analysis was used to explore the relationship between the three disordered eating habits and body image-related measures. Because ratings on these items represented an ordinal versus continuous variable, we conducted a second set of parametric correlation analysis. Finally, we conducted multinomial (polychotomous) logistic regressions in order to predict several categorical outcomes (changes in the frequency of each disordered eating habit) from continuous predictors (body image-related variables). Cohen's *d* effect sizes and Nagelkerkes's $R^2$ coefficients of determination are reported (Cohen, 1988; Field, 2018). The z-scores of Kurtosis and Skewness of the continuous variables were analyzed to verify their normal distribution (at $p < 0.05$; Field, 2018). Pairwise deletion was used to handle missing data and statistics were performed using IBM SPSS, version 27.

# RESULTS

Mean participants age was 35.72 (SD = 13.87). Self-reported mean height was 162.91 cm (SD = 5.85), and weight was 72.89 kg (SD = 19.62), resulting in an average BMI of 27.41 kg/m$^2$ (SD = 6.97). Three (3) participants reported that their level of education was less than high school (1.9%), 101 participants obtained a high school diploma (62.7%), 8 participants obtained a university certificate (5%), and 25 a bachelor's degree (15.5%), whereas 24 reported a postgraduate level of education (14.9%). Regarding self-reported relationship status, 87 participants reported being married or in a common-law relationship (54.1%), 11 participants reported being divorced or separated (6.8%), 29 to be in a relationship (18%), 33 did not have a partner (20.5%), and 1 person preferred not to answer (0.6%). Concerning self-reported skin color, 38 participants self-identified their skin

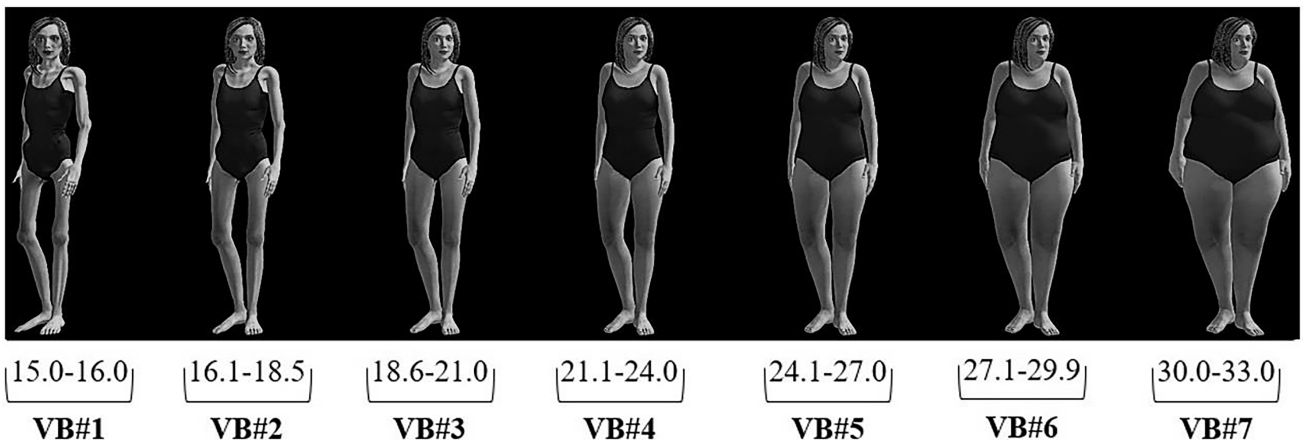


**FIGURE 1** | The *e*LoriCorps-IBRS 1.0.

color as very light (38.8%), 43 as light (43.9%), 14 as intermediate (14.3%), and 3 as tan (3.1%). No participant reported having dark or very dark skin. The skin color scale used in this study is available in **Supplementary Material**.

## Negative Body Image-Related Variables

Women did not report clinically significant levels of weight (M = 2.18, SD = 1.49, range: 0.00–5.60) and body shape (M = 2.28, SD = 1.54, range: 0.00–5.75) concerns. On average participants reported being dissatisfied with their body (M = 1.01, SD = 0.90, range: −1.00-3.00), desiring a thinner body (M = 3.48, SD = 0.82, range: 2.00–6.00) than their perceived one (M = 4.49, SD = 1.08, range: 3.00–7.00). Since no participant self-reported to have dark or very dark skin, we did not conduct any analyses in order to explore the possible effect of the lack of representativeness of the virtual bodies.

## Self-Perceived Changes in the Frequency of Eating Habits

**Table 1** presents participants' self-reported changes since the COVID-19 outbreak in frequency of emotional eating, overeating, and restrictive eating. Women's mean scores were significantly different from a rating of "4" (i.e., no change than before) on all variables (restrictive eating: $p = 0.012$; overeating: $p = 0.002$; and emotional eating: $p < 0.001$). Effect sizes were small for restrictive eating and overeating, and moderate for emotional eating. Differences indicate a tendency to have increased the frequency of restrictive eating, overeating, and emotional eating. Results from parametric analyses paralleled the ones obtained with the non-parametric analyses, indicating that the median value for each eating habit was significantly different than "4" (i.e., no change than before; see **Supplementary Material**).

## Self-Reported Changes in the Frequency of Restrictive Eating and Their Relationship With Body Image

Non-parametric correlation analysis between eating habits and body image-related variables are reported in **Table 2**. Pearson's correlations are available in **Supplementary Material**. Self-perceived changes in the frequency of restrictive eating were significantly positively correlated to both body shape ($p = 0.001$) and weight ($p < 0.001$) concerns. A multinomial logistic regression was performed to create a model of the relationship between the predictor variables (i.e., shape and weight concerns) and six outcome categories (i.e., self-rated changes in the frequency of restrictive eating behaviors: "1 = Much less than before," "2 = Less than before," "3 = Somewhat less than before," "5 = Somewhat more than before," "6 = More than before," and "7 = Much more than before") when compared to a baseline outcome category (i.e., "4 = No change than before"). Analysis of collinearity statistics shows the assumption of no multicollinearity had been met since tolerance values were above 0.1 and Variance Inflated Factor (VIF) values were less than 10 (VIF = 4.67, tolerance score = 0.214; Bowerman and O'Connell, 1990; Myers, 1990; Field, 2018, p. 402). **Table 3** presents the results of this multinomial logistic regression. The fit between the model containing only the intercept and data significantly improved with the addition of the predictor variables, $\chi^2(12) = 52.07$, $p < 0.001$, Nagelkerkes's $R^2 = 0.351$. Pearson Chi-Square test indicated that the model was a good fit to the data ($p = 0.975$). Weight concerns had a significant main effect on self-perceived changes in the frequency of restrictive eating, $\chi^2(6) = 17.28$, $p = 0.008$, whereas shape concerns did not have a significant main effect, $\chi^2(6) = 4.30$, $p = 0.637$. Once the overall effects were broken down, results showed that higher weight concerns significantly predicted a slight ("A little more than before") $b = 1.36$, Wald $\chi^2(1) = 12.11$, $p = 0.001$, and moderate ("More than before") $b = 1.35$, Wald $\chi^2(1) = 6.44$, $p = 0.011$ increase in the frequency of restrictive eating behavior. In other words, women were more likely to self-perceive an increase in the frequency of restrictive eating behavior—than not change the frequency—if they experienced higher weight concerns during the COVID-19 pandemic.

**TABLE 1** | Self-rated changes in frequency of disordered eating behaviors based on retrospective self-report ($n = 152$).

| | Restrictive eating | Overeating | Emotional eating |
|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) |
| 1 = Much less than before | 5 (3.3) | 5 (3.3) | 2 (1.3) |
| 2 = Less than before | 6 (3.9) | 3 (2.0) | 1 (0.7) |
| 3 = A little less than before | 10 (6.6) | 4 (2.6) | 10 (6.6) |
| 4 = No change from before | 80 (52.6) | 92 (60.5) | 66 (43.4) |
| 5 = A little more than before | 33 (21.7) | 37 (24.3) | 53 (34.9) |
| 6 = More than before | 14 (9.2) | 7 (4.6) | 11 (7.2) |
| 7 = Much more than before | 4 (2.6) | 4 (2.6) | 9 (5.9) |
| *z* | 2.50 | 3.16 | 5.98 |
| *r* | 0.20 | 0.26 | 0.49 |
| Value of p | 0.012 | 0.002 | < 0.001 |

## Self-Perceived Changes in the Frequency of Overeating and Their Relationship With Body Image

None of the body image-related variables (i.e., weight and shape concerns and body dissatisfaction) were significantly related to overeating (see **Table 2**).

## Self-Reported Changes in the Frequency of Emotional Eating and Their Relationship With Body Image

Weight and shape concerns were not significantly correlated to self-rated changes in the frequency of emotional eating, whereas body dissatisfaction was significantly positively correlated to changes in the frequency of emotional eating ($p = 0.032$; see **Table 2**). A multinomial logistic regression was performed to create a model of the relationship between the predictor variable (i.e., body dissatisfaction) and six outcome categories (i.e., self-perceived changes in the frequency of emotional eating: "1 = Much less than before," "2 = Less than before," "3 = Somewhat less than before," "5 = Somewhat more than before," "6 = More than before," and "7 = Much more than before") when compared to a baseline outcome category (i.e., "4 = No change than before"). The model fit improved with the addition of the predictor variable, $\chi^2(6) = 18.21$, $p = 0.006$, Nagelkerkes's $R^2 = 0.184$. Pearson

**TABLE 2 |** Spearman's correlation analyses between disordered eating behaviors and negative body image ($n = 152$).

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Restrictive eating | – | –0.02 | 0.06 | 0.33*** | 0.28** | 0.15 |
| 2. Overeating | –0.02 | – | 0.41*** | 0.05 | 0.07 | 0.19 |
| 3. Emotional eating | 0.06 | 0.41*** | – | 0.00 | 0.00 | 0.22* |
| 4. Weight concerns [a] | 0.33*** | 0.05 | 0.00 | – | 0.88*** | 0.51*** |
| 5. Shape concerns [b] | 0.28** | 0.07 | 0.00 | 0.88*** | – | 0.49*** |
| 6. Body dissatisfaction [c] | 0.15 | 0.19 | 0.22* | 0.51*** | 0.49*** | – |

*$p < 0.05$; **$p < 0.01$; and ***$p < 0.001$. $N = 152$, except for [a]$n = 130$, [b]$n = 131$, and [c]$n = 97$.

**TABLE 3 |** Multinomial logistic regression: weight and shape concerns and their relations with self-rated changes on restrictive eating ($n = 130$).

| | *b* (*SE*) | 95% CI for Odds Ratio | | |
|---|---|---|---|---|
| | | Lower | Odds Ratio | Upper |
| Much less than before vs. No change than before | | | | |
| Intercept | –4.39 (1.11)*** | | | |
| Weight concerns | 0.71 (0.71) | 0.51 | 2.04 | 8.21 |
| Shape concerns | 0.11 (0.65) | 0.31 | 1.11 | 3.98 |
| Less than before vs. No change than before | | | | |
| Intercept | –3.74 (0.97)*** | | | |
| Weight concerns | 0.15 (0.74) | 0.27 | 1.16 | 4.92 |
| Shape concerns | 0.39 (0.67) | 0.40 | 1.47 | 5.49 |
| Somewhat less than before vs. No change than before | | | | |
| Intercept | –3.14 (0.75)*** | | | |
| Weight concerns | 0.96 (0.53) | 0.93 | 2.62 | 7.44 |
| Shape concerns | –0.39 (0.50) | 0.26 | 0.68 | 1.80 |
| Somewhat more than before vs. No change than before | | | | |
| Intercept | –3.00 (0.60)*** | | | |
| Weight concerns | 1.36 (0.39)** | 1.81 | 3.88 | 8.33 |
| Shape concerns | –0.44 (0.35) | 0.32 | 0.64 | 1.28 |
| More than before vs. No change than before | | | | |
| Intercept | –5.13 (1.03)*** | | | |
| Weight concerns | 1.35 (0.53)* | 1.36 | 3.86 | 10.96 |
| Shape concerns | –0.02 (0.47) | 0.39 | 0.98 | 2.44 |
| Much more than before vs. No change than before | | | | |
| Intercept | –7.86 (2.37)** | | | |
| Weight concerns | 0.75 (1.04) | 0.27 | 2.11 | 16.22 |
| Shape concerns | 0.87 (1.01) | 0.33 | 2.40 | 17.31 |

*$p < 0.05$; **$p < 0.01$; and ***$p < 0.001$.

Chi-Square test indicated that the model was a good fit for the data ($p = 0.604$). Once the overall effect of body dissatisfaction was broken down, results showed that higher body dissatisfaction significantly predicted a moderate ("More than before") increase in the frequency of emotional eating, $b = 2.25$, Wald $\chi^2(1) = 9.91$, $p = 0.002$. Therefore, women were more likely to self-perceive an increase in the frequency of emotional eating—than no change in the frequency—if they experienced higher body dissatisfaction during the COVID-19 pandemic. **Table 4** presents the results of this multinomial logistic regression.

## DISCUSSION

To our knowledge, this is the first study which describes self-reported changes in disordered eating behaviors, as well as negative body image among a community population of women during the COVID-19 pandemic. Consistent with our hypotheses, we found a tendency toward a self-rated increase of the frequency of all problematic eating behaviors. We did not find clinical levels of negative body image, but women reported, on average, a certain discontent about their bodies. These results are consistent with the concept of "normative discontent," which proposes that a negative feeling about one's physical appearance is thought to be the "norm" in a woman's life, instead of to be an exception (Rodin et al., 1984; Tantleff-Dunn et al., 2011; Tiggemann, 2011).

Our results showed a significant relation between weight concerns and self-perceived changes in the frequency of restrictive eating during the COVID-19 pandemic. In particular, we found that weight concerns predicted an overall increase in the frequency of restrictive eating behavior. The COVID-19 has brought limitations on physical activities and an increase in time spent indoors (Constandt et al., 2020; Hu et al., 2020). The increase in the rate of depression since the start of COVID-19 (Ettman et al., 2020; Huang and Zhao, 2020; Mazza et al., 2020) may contribute to partly explain the decrease in the level of physical activity and the development of an inactive lifestyle, as these phenomena have been previously associated with each other (Stavrakakis et al., 2012). The aforementioned limitations may as well heighten shape and weight concerns and lead to increased restrictive eating, as theorized by Rodgers and colleagues (Rodgers et al., 2020). Researchers suggest that individuals who follow a restrictive diet composed of multiple requesting rigid food rules to help achieve their ideal body are mainly motivated by high weight and shape concerns (Stice et al., 1996). Stice (2001) proposes a risk factor model in which weight and shape concerns result from an internalization of appearance ideals that leads to eating disorders behaviors *via* dietary restraint and affect regulation mechanisms. In conclusion, the limitations imposed by COVID-19 could have increased concerns about body image and reinforced ideas about ideal appearance, which could possibly have led to increased frequency of restrictive eating.

We found that higher body dissatisfaction was associated with a moderate self-perceived increase in the frequency of emotional eating in our sample during the pandemic. This relation is in line with findings from before the pandemic outbreak (Van Strien et al., 2005; Anschutz et al., 2008). Data from Van Strien et al. (1995) indicate that emotional eating is associated with emotional problems, such as depression, suicidal ideas, anxiety, problems with relationship, and sex, which might indicate that emotional eaters have a general susceptibility for negative affect. Body dissatisfaction, which has previously been associated with negative affect, might impede emotional eaters to cope with the negative

**TABLE 4** | Multinomial logistic regression: body dissatisfaction and its relationship with self-rated changes on emotional eating ($n = 97$).

| | *b* (*SE*) | 95% CI for odds ratio | | |
|---|---|---|---|---|
| | | Lower | Odds ratio | Upper |
| Much less than before vs. No change from before | | | | |
| Intercept | −3.30 (1.03)** | | | |
| Body dissatisfaction | −1.18 (1.30) | 0.02 | 0.31 | 3.92 |
| Less than before vs. No change from before | | | | |
| Intercept | −3.30 (1.03)** | | | |
| Body dissatisfaction | −1.18 (1.30) | 0.02 | 0.31 | 3.92 |
| Somewhat less than before vs. No change from before | | | | |
| Intercept | −2.38 (0.69)** | | | |
| Body dissatisfaction | 0.69 (0.49) | 0.77 | 1.99 | 5.15 |
| Somewhat more than before vs. No change from before | | | | |
| Intercept | −0.60 (0.36) | | | |
| Body dissatisfaction | 0.40 (0.29) | 0.85 | 1.49 | 2.60 |
| More than before vs. No change from before | | | | |
| Intercept | −5.37 (1.47)*** | | | |
| Body dissatisfaction | 2.25 (0.72)** | 2.34 | 9.48 | 38.48 |
| Much more than before vs. No change from before | | | | |
| Intercept | −3.08 (0.95)** | | | |
| Body dissatisfaction | 0.69 (0.66) | 0.55 | 1.99 | 7.17 |

**$p < 0.01$; and ***$p < 0.001$.

feelings (e.g., negative self-conscious emotions predisposition such as shame and guilt-proneness) and, consequently, increase the frequency of emotional eating (Van Strien et al., 2005; Cavalera et al., 2016). In the context of the COVID-19 pandemic, the relation found between body dissatisfaction and emotional eating might be explained by the increase in negative affects brought by COVID-19-related stress, anxiety, and depression. Indeed, stress, anxiety, and depression have exacerbated in populations mainly by its new and unexplored characteristics and by the uncertainty about the future that accompanies it (Gallagher et al., 2020; Kujawa et al., 2020; Salari et al., 2020). Time spent on social media also increased significantly during the COVID-19 pandemic, probably because of physical distancing (Cellini et al., 2020). Researchers report a significant increase in the frequency of use of appearance-centered social network sites, especially in women (Vall-Roqué et al., 2021), which have previously been associated with coping difficulties, low self-esteem, and body dissatisfaction (Kostanski and Gullone, 1998; Anderson et al., 2011; Holland and Tiggemann, 2016; Cohen et al., 2017). Thus, stress, anxiety, and time spent on social networks may have diminished coping skills to manage threats against messages conveyed by social media on body image and, consequently, might increase body dissatisfaction, which is known to lead individuals to eat as a way to calm or to reward themselves (Geller et al., 2019; Al-Musharaf, 2020).

Body dissatisfaction as well as weight and shape concerns were not significantly related to self-rated changes in the frequency of overeating among women of our sample. These results go against what was expected. Indeed, the relationship between overeating and negative body image has been shown to be significant in the literature (e.g., Ahrberg et al., 2011; Holmes et al., 2015; Linardon et al., 2019). Our results suggest that the relationship between negative body image and overeating episodes should be further explored. We could hypothesize that in our sample, overeating episodes would not be predicted by negative body image, but by emotional distress caused by the COVID-19 pandemic, as suggested by the dual-pathway model proposed by Stice (1994, 2001) to explain bulimic behavior. Specifically, Stice proposed that body dissatisfaction and bulimic behavior could be linked though the pathway of negative emotions. Overeating could represent an escape from experiencing negative emotions (Heatherton and Baumeister, 1991; Van Strien et al., 2005; Goldfield et al., 2008). Van Strien et al. (2005) found support for the pathway of negative affect but they also propose an extended pathway model. The relationship between negative affect and overeating could be explained by emotional eating and a lack of interoceptive awareness. More precisely, the authors found a strong relation between emotional eating and overeating/binge eating in a clinical sample, and both interoceptive awareness and emotional eating as intermediating variables between negative affect and overeating/binge eating. Van Strien et al. (2005) did not find the same pathway in their community sample of female students. Specifically, the authors found a weaker, although still significant, relation between emotional eating and overeating/binge eating. The lack of interoceptive awareness was strongly associated with negative affect but did not totally explain the relation between negative affect and emotional eating. Future studies should include instruments to measure negative affect (e.g., shame and guilt) and interoceptive awareness to shed light on the possible predictors of overeating episodes.

The findings of this study should be interpreted in light of some limitations. First, this study included self-reported measures in which participants were asked to indicate perceived changes in frequency of eating habits. It is possible that women may not be reporting their eating behaviors accurately. Second, since the study relies on a convenience sample, results may not be generalizable to younger and/or older women and to women from different countries. Furthermore, our findings cannot

be generalized to men and individuals with a current or history of eating disorders as they were excluded from this study. Third, body dissatisfaction was only measured only with visual depictive body size estimation tasks using the *e*LoriCorps-IBRS v 1.0 (Monthuy-Blanc et al., 2020). It could be interesting to measure body dissatisfaction with another type of instrument, such as a questionnaire. Indeed, it has been suggested that different instruments could assess different dimensions of body image-related construct (Moelbert et al., 2017). Finally, this is a cross-sectional study that does not allow us to interpret associations between variables as reflecting causal relations. Longitudinal studies could allow examining the long-term contribution of body image-related variables on women's problematic eating behaviors.

The results of this study can have important preventive and therapeutic implications. As we are entering the third year of the pandemic, it is critical to understand how people have been affected so far, and how to prepare to mitigate the impact of a prolonged pandemic crisis. A possible strategy could be the implementation of cognitive and behavioral body image interventions combined with intuitive eating education programs. Cognitive and behavioral body image interventions could help ameliorate negative body image by implementing and adopting daily life techniques that can alter the dysfunctional affective and cognitive dimensions of body image and promoting a more positive body image (e.g., Butters and Cash, 1987; Jarry and Berardi, 2004; Jarry and Ip, 2005; Cash, 2008). Cognitive-behavioral models consider negative body image (e.g., shape and weight concerns and body dissatisfaction) as the core of disordered eating symptomatology (Fairburn et al., 2003). However, before directly targeting negative body image (during, for instance, cognitive-behavior interventions), it is suggested to indirectly reduce its influence by targeting other disordered eating symptoms, such as restrictive eating, overeating episodes, and emotional eating (Fairburn, 2008; Linardon and Mitchell, 2017). Intuitive eating can be defined as having a strong connection with one's own internal signals of hunger and satiety cues, and consequently eating in response to these signals (Tylka, 2006; Messer et al., 2021). Increasing scientific evidence is pointing to the potential positive role of intuitive eating as a protective factor against several eating disorder symptoms such as disordered eating, binge eating, restrictive eating, and unhealthy weight control behaviors (Dockendorff et al., 2012; Hazzard et al., 2020; Christoph et al., 2021; Linardon et al., 2021; Messer et al., 2021; Sanlier et al., 2021). Intuitive eating appears to be associated also to lower body image concerns, higher positive body image, body appreciation, self-esteem, self-compassion, self-determination, body empowerment, and wellbeing (Dockendorff et al., 2012; Tylka and Wood-Barcalow, 2015; Bruce and Ricciardelli, 2016; Messer et al., 2021; Sanlier et al., 2021).

## CONCLUSION

The effect of the pandemic on body image and eating behaviors remains largely understudied. This paper highlights the existence of a positive relation between negative body image and increased frequency of disordered eating behaviors in a community sample of women during the COVID-19 crisis. These results should be taken into consideration, as they shed light on a dangerous pattern of phenomena in a non-clinical sample of women. They seem of critical importance as they represent the key risk factors for the development of eating disorders. Our hope is that future studies would follow and that we would be able to reach a better understanding about how people were affected by this global crisis to promptly react with the development and implementation of prevention programs.

## DATA AVAILABILITY STATEMENT

The data for this study is available upon request addressed directly to the Research Ethics Boards (comite.ethique@uqo.ca). The dataset is not publicly available due to privacy and ethical restrictions.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by ethical committee of Université du Québec en Outaouais (Quebec, Canada) and of Université du Québec à Trois-Rivières (Quebec, Canada). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

GC, AP, JM-B, and SB created and conceptualized the study. GC, AP, and MO collected the data. GC, AP, and SB analyzed and interpreted the data. GC and AP wrote the first draft. GC, AP, JM-B, MO, and SB critically revised the manuscript and provided constructive comments. All authors contributed to the article and approved the submitted version.

## FUNDING

This work was supported by a postdoctoral grant awarded to the first author (GC) by the Fond de Recherche du Québec—Santé (FRQS; 289006); the Canada research Chair in clinical cyberpsychology (950-210762)awarded to SB; and the RBC Royal Bank, the Lemaire family, Fond. UQTR-RBC Banque Royale-PI-Loricorps, 2017–2021, by the Fonds de Recherche du Québec- Société et culture, FRQSC-2014-NP-17646, 2013–2020, by the Social Sciences and Humanities Research Council of Canada, 2018–2023 (CRSH-SAVOIR-430-2018-00970–PIE-IC), and the settlement fund of the Centre de Recherche de l'Institut Universitaire en Santé Mentale de Montréal, awarded to JM-B.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.856933/full#supplementary-material

## REFERENCES


Agliata, D., and Tantleff-Dunn, S. (2004). The impact of media exposure on males' body image. *J. Soc. Clin. Psychol.* 23, 7–22. doi: 10.1521/jscp.23.1.7.26988

Ahrberg, M., Trojca, D., Nasrawi, N., and Vocks, S. (2011). Body image disturbance in binge eating disorder: a review. *Eur. Eat. Disord. Rev.* 19, 375–381. doi: 10.1002/erv.1100

Al-Musharaf, S. (2020). Prevalence and predictors of emotional eating among healthy young Saudi women during the COVID-19 pandemic. *Nutrients* 12:2923. doi: 10.3390/nu12102923

Ammar, A., Brach, M., Trabelsi, K., Chtourou, H., Boukhris, O., Masmoudi, L., et al. (2020). Effects of COVID-19 home confinement on eating behaviour and physical activity: results of the ECLB-COVID19 international online survey. *Nutrients* 12:1583. doi: 10.3390/nu12061583

Andersen, N., and Swami, V. (2021). Science mapping research on body image: a bibliometric review of publications in body image, 2004–2020. *Body Image* 38, 106–119. doi: 10.1016/j.bodyim.2021.03.015

Anderson, K. G., Ramo, D. E., and Brown, S. A. (2011). Life stress, coping and comorbid youth: an examination of the stress-vulnerability model for substance relapse. *J. Psychoactive Drugs* 38, 255–262. doi: 10.1080/02791072.2006.10399851

Anschutz, D. J., Engels, R., and Van Strien, T. (2008). Susceptibility for thin ideal media and eating styles. *Body Image* 5, 70–79. doi: 10.1016/j.bodyim.2007.06.008

Bowerman, B. L., and O'Connell, R. R. (1990). *Linear Statistical Models: An Applied Approach. 2nd Edn.* Duxbury, MA: Duxbury Press.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8

Bruce, L. J., and Ricciardelli, L. A. (2016). A systematic review of the psychosocial correlates of intuitive eating among adult women. *Appetite* 96, 454–472. doi: 10.1016/j.appet.2015.10.012

Burrows, A., and Cooper, M. (2002). Possible risk factors in the development of eating disorders in overweight pre-adolescent girls. *Int. J. Obes.* 26, 1268–1273. doi: 10.1038/sj.ijo.0802033

Butters, J. W., and Cash, T. F. (1987). Cognitive-behavioral treatment of women's body-image dissatisfaction. *J. Consult. Clin. Psychol.* 55, 889–897. doi: 10.1037/0022-006X.55.6.889

Carter, J. C., Stewart, D. A., and Fairburn, C. G. (2001). Eating disorder examination questionnaire: norms for young adolescent girls. *Behav. Res. Ther.* 39, 625–632. doi: 10.1016/s0005-7967(00)00033-4

Cash, T. F. (2008). *The Body Image Workbook: An Eight-Step Program for Learning to Like Your Looks. 2nd Edn*. Oakland, CA: New Harbinger Publications.

Cash, T. F., and Deagle, E. A. III. (1997). The nature and extent of body-image disturbances in anorexia nervosa and bulimia nervosa: a meta-analysis. *Int. J. Eat. Disord.* 22, 107–126. doi: 10.1002/(SICI)1098-108X(199709)22:2<107::AID-EAT1>3.0.CO;2-J

Cavalera, C. (2020). Covid-19 psychological implications: the role of shame and guilt. *Front. Psychol.* 11:571828. doi: 10.3389/fpsyg.2020.571828

Cavalera, C., Francesco, P., Zurloni, V., Diana, B., Realdon, O., Castelnuovo, G., et al. (2016). Shame proneness and eating disorders: a comparison between clinical and non-clinical samples. *Eat. Weight Disord.* 21, 701–707. doi: 10.1007/s40519-016-0328-y

Cavalera, C., Pepe, A., Zurloni, V., Diana, B., Realdon, O., Todisco, P., et al. (2018). Negative social emotions and cognition: shame, guilt and working memory impairments. *Act. Psychol.* 188, 9–15. doi: 10.1016/j.actpsy.2018.05.005

Cellini, N., Canale, N., Mioni, G., and Costa, S. (2020). Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. *J. Sleep Res.* 29:e13074. doi: 10.1111/jsr.13074

Christoph, M., Järvelä-Reijonen, E., Hooper, L., Larson, N., Mason, S. M., and Neumark-Sztainer, D. (2021). Longitudinal associations between intuitive eating and weight-related behaviors in a population-based sample of young adults. *Appetite* 160:105093. doi: 10.1016/j.appet.2021.105093

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences. 2nd Edn.* Hillsdale, NJ: Lawrence Erlbaum.

Cohen, R., Newton-John, T., and Slater, A. (2017). The relationship between Facebook and Instagram appearance-focused activities and body image concerns in young women. *Body Image* 23, 183–187. doi: 10.1016/j.bodyim.2017.10.002

Constandt, B., Thibaut, E., De Bosscher, V., Scheerder, J., Ricour, M., and Willem, A. (2020). Exercising in times of lockdown: an analysis of the impact of COVID-19 on levels and patterns of exercise among adults in Belgium. *Int. J. Environ. Res. Public Health* 17:4144. doi: 10.3390/ijerph17114144

Cooper, Z., and Fairburn, C. G. (1987). The eating disorder examination: a semi-structured interview for the assessment of the specific psychopathology of eating disorders. *Int. J. Eat. Disord.* 6, 1–8. doi: 10.1002/1098-108X(198701)6:1<1::AID-EAT2260060102>3.0.CO;2-9

Cooper, M., Reilly, E. E., Siegel, J. A., Coniglio, K., Sadeh-Sharvit, S., Pisetsky, E. M., et al. (2020). Eating disorders during the COVID-19 pandemic and quarantine: an overview of risks and recommendations for treatment and early intervention. *Eat. Disord.* 9, 1–23. doi: 10.1080/10640266.2020.1790271

Crockett, A. C., Myhre, S. K., and Rokke, P. D. (2015). Boredom proneness and emotion regulation predict emotional eating. *J. Health Psychol.* 20, 670–680. doi: 10.1177/1359105315573439

de Medeiros Carvalho, P. M., Moreira, M. M., de Oliveira, M. N. A., Landim, J. M. M., and Neto, M. L. R. (2020). The psychiatric impact of the novel coronavirus outbreak. *Psychiatry Res.* 286:112902. doi: 10.1016/j.psychres.2020.112902

Di Renzo, L., Pivari, F., Soldati, L., Attinà, A., Cinelli, G., Leggeri, C., et al. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J. Transl. Med.* 18:229. doi: 10.1186/s12967-020-02399-5

Dockendorff, S. A., Petrie, T. A., Greenleaf, C. A., and Martin, S. (2012). Intuitive eating scale: an examination among early adolescents. *J. Couns. Psychol.* 59, 604–611. doi: 10.1037/a0029962

Ettman, C. K., Abdalla, S. M., Cohen, G. H., Sampson, L., Vivier, P. M., and Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw. Open* 3:e2019686. doi: 10.1001/jamanetworkopen.2020.19686

Fairburn, C. G. (2008). *Cognitive Behavior Therapy and Eating Disorders*. New York, NY: Guilford Press.

Fairburn, C. G., and Beglin, S. J. (1994). Assessment of eating disorders: interview or self-report questionnaire? *Int. J. Eat. Disord.* 16, 363–370. doi: 10.1002/1098-108X(199412)16:4<363::AID-EAT2260160405>3.0.CO;2-%23

Fairburn, C. G., and Cooper, Z. (1993). "The eating disorder examination (12th edition)," in *Binge Eating: Nature, Assessment, and Treatment*. eds. C. G. Fairburn and G. T. Wilson (New York: Guilford Press), 317–360.

Fairburn, C. G., Cooper, Z., and Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: a "transdiagnostic" theory and treatment. *Behav. Res. Ther.* 41, 509–528. doi: 10.1016/S0005-7967(02)00088-8

Ferrell, E. L., Watford, T. S., and Braden, A. (2020). Emotion regulation difficulties and impaired working memory interact to predict boredom emotional eating. *Appetite* 144:104450. doi: 10.1016/j.appet.2019.104450

Field, A. (2018). *Discovering Statistics Using SPSS. 5th Edn.* Thousand Oaks, CA: Sage Publications Ltd.

Flaudias, V., Iceta, S., Zerhouni, O., Rodgers, R. F., Billieux, J., Llorca, P., et al. (2020). COVID-19 pandemic lockdown and problematic eating behaviors in a student population. *J. Behav. Addict.* 9, 826–835. doi: 10.1556/2006.2020.00053

Flaudias, V., Zerhouni, O., Pereira, B., Cherpitel, C. J., Boudesseul, J., de Chazeron, I., et al. (2021). The early impact of the COVID-19 lockdown on stress and addictive behaviors in an alcohol-consuming student population in France. *Front. Psych.* 12:628631. doi: 10.3389/fpsyt.2021.628631

Galea, S., Merchant, R. M., and Lurie, M. (2020). The mental health consequences of COVID-19 and physical distancing: the need for prevention and early intervention. *JAMA Intern. Med.* 180, 817–818. doi: 10.1001/jamainternmed.2020.1562

Gallagher, M. W., Zvolensky, M. J., Long, L. J., Rodgers, A. H., and Garey, L. (2020). The impact of Covid-19 experiences and associated stress on anxiety, depression, and functional impairment in American adults. *Cognit. Ther. Res.* 44, 1043–1051. doi: 10.1007/s10608-020-10143-y

Geller, S., Levy, S., Goldzweig, G., Hamdan, S., Manor, A., Dahan, S., et al. (2019). Psychological distress among bariatric surgery candidates: the roles of body image and emotional eating. *Clin. Obes.* 9:e12298. doi: 10.1111/cob.12298

Glashouwer, K. A., van der Veer, R. M., Adipatria, F., de Jong, P. J., and Vocks, S. (2019). The role of body image disturbance in the onset, maintenance, and relapse of anorexia nervosa: a systematic review. *Clin. Psychol. Rev.* 74:101771. doi: 10.1016/j.cpr.2019.101771

Glauert, R., Rhodes, G., Byrne, S., Fink, B., and Grammer, K. (2009). Body dissatisfaction and the effects of perceptual exposure on body norms and ideals. *Int. J. Eat. Disord.* 42, 443–452. doi: 10.1002/eat.20640

Goldfield, G. S., Adamo, K. B., Rutherford, J., and Legg, C. (2008). Stress and the relative reinforcing value of food in female binge eaters. *Physiol. Behav.* 93, 579–587. doi: 10.1016/j.physbeh.2007.10.022

Gouvernement du Québec (2021). *Ligne du temps COVID-19 au Québec*. Institut national de santé publique du Québec. Available at: https://inspq.qc.ca/covid-19/donnees/ligne-du-temps (Accessed December 28, 2021).

Groesz, L. M., Levine, M. P., and Murnen, S. K. (2002). The effect of experimental presentation of thin media images on body satisfaction: a meta-analytic review. *Int. J. Eat. Disord.* 31, 1–16. doi: 10.1002/eat.10005

Hawkins, N., Richards, P. S., Granley, H. M., and Stein, D. M. (2010). The impact of exposure to the thin-ideal media message on women. *Eat. Disord.* 12, 35–50. doi: 10.1080/10640260490267751

Hazzard, V. M., Telke, S. E., Simone, M., Anderson, L. M., Larson, N. I., and Neumark-Sztainer, D. (2020). Intuitive eating longitudinally predicts better psychological health and lower use of disordered eating behaviors: findings from EAT 2010–2018. *Eat. Weight Disord.* 26, 287–294. doi: 10.1007/s40519-020-00852-4

Heatherton, T. F., and Baumeister, R. F. (1991). Binge eating as escape from self-awareness. *Psychol. Bull.* 110, 86–108. doi: 10.1037/0033-2909.110.1.86

Holland, G., and Tiggemann, M. (2016). A systematic review of the impact of the use of social networking sites on body image and disordered eating outcomes. *Body Image* 17, 100–110. doi: 10.1016/j.bodyim.2016.02.008

Holmes, M., Fuller-Tyszkiewicz, M., Skouteris, H., and Broadbent, J. (2015). Understanding the link between body image and binge eating: a model comparison approach. *Eat. Weight Disord.* 20, 81–89. doi: 10.1007/s40519-014-0141-4

Hu, Z., Lin, X., Chiwanda Kaminga, A., and Xu, H. (2020). Impact of the COVID-19 epidemic on lifestyle behaviors and their association with subjective well-being among the general population in mainland China: cross-sectional study. *J. Med. Internet Res.* 22:e21176. doi: 10.2196/21176

Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954

Ismail, L. C., Osaili, T. M., Mohamad, M. N., Al Marzouqi, A., Jarrar, A. H., Abu Jamous, D. O., et al. (2020). Eating habits and lifestyle during COVID-19 lockdown in the United Arab Emirates: a cross-sectional study. *Nutrients* 12:3314. doi: 10.3390/nu12113314

Jarry, J. L., and Berardi, K. (2004). Characteristics and effectiveness of stand-alone body image treatments: a review of the empirical literature. *Body Image* 1, 319–333. doi: 10.1016/j.bodyim.2004.10.005

Jarry, J. L., and Ip, K. (2005). The effectiveness of stand-alone cognitive-behavioural therapy for body image: a meta-analysis. *Body Image* 2, 317–331. doi: 10.1016/j.bodyim.2005.10.001

Koeze, E., and Popper, N. (2020). The virus changed the way we Internet. *The New York Times*. Available at: https://www.nytimes.com/interactive/2020/04/07/technology/coronavirus-internet-use.html (Accessed October 27, 2021).

Kostanski, M., and Gullone, E. (1998). Adolescent body image dissatisfaction: relationships with self-esteem, anxiety, and depression controlling for body mass. *J. Child Psychol. Psychiatry Allied Discip.* 39, 255–262. doi: 10.1017/S0021963097001807

Kujawa, A., Green, H., Compas, B. E., Dicker, L., and Pegg, S. (2020). Exposure to COVID-19 pandemic stress: associations with depression and anxiety in emerging adults in the United States. *Depress. Anxiety* 37, 1280–1288. doi: 10.1002/da.23109

Levine, M. P., and Piran, N. (2004). The role of body image in the prevention of eating disorders. *Body Image* 1, 57–70. doi: 10.1016/S1740-1445(03)00006-8

Linardon, J., Fuller-Tyszkiewicz, M., de la Piedad Garcia, X., Messer, M., and Brennan, L. (2019). Do body checking and avoidance behaviours explain variance in disordered eating beyond attitudinal measures of body image? *Eat. Behav.* 32, 7–11. doi: 10.1016/j.eatbeh.2018.11.001

Linardon, J., and Mitchell, S. (2017). Rigid dietary control, flexible dietary control, and intuitive eating: evidence for their differential relationship to disordered eating and body image concerns. *Eat. Behav.* 26, 16–22. doi: 10.1016/j.eatbeh.2017.01.008

Linardon, J., Tylka, T. L., and Fuller-Tyszkiewicz, M. (2021). Intuitive eating and its psychological correlates: a meta-analysis. *Int. J. Eat. Disord.* 54, 1073–1098. doi: 10.1002/eat.23509

Madali, B., Alkan, Ş. B., Örs, E. D., Ayrancı, M., Taşkın, H., and Kara, H. H. (2021). Emotional eating behaviors during the COVID-19 pandemic: a cross-sectional study. *Clin. Nutr. ESPEN* 46, 264–270. doi: 10.1016/j.clnesp.2021.09.745

Marques, M. D., Paxton, S. J., McLean, S. A., Jarman, H. K., and Sibley, C. G. (2022). A prospective examination of relationships between social media use and body dissatisfaction in a representative sample of adults. *Body Image* 40, 1–11. doi: 10.1016/j.bodyim.2021.10.008

Mattioli, A. V., Sciomer, S., Cocchi, C., Maffei, S., and Gallina, S. (2020). Quarantine during COVID-19 outbreak: changes in diet and physical activity increase the risk of cardiovascular disease. *Nutr. Metab. Cardiovasc. Dis.* 30, 1409–1417. doi: 10.1016/j.numecd.2020.05.020

Mazza, M. G., De Lorenzo, R., Conte, C., Poletti, S., Vai, B., Bollettini, I., et al. (2020). Anxiety and depression in COVID-19 survivors: role of inflammatory and clinical predictors. *Brain Behav. Immun.* 89, 594–600. doi: 10.1016/j.bbi.2020.07.037

McCombie, C., Austin, A., Dalton, B., Lawrence, V., and Schmidt, U. (2020). "Now It's just old habits and misery"–understanding the impact of the Covid-19 pandemic on people with current or life-time eating disorders: a qualitative study. *Front. Psych.* 11:589225. doi: 10.3389/fpsyt.2020.589225

Messer, M., McClure, Z., Lee, S., and Linardon, J. (2021). Bidirectional relationships between intuitive eating and shape and weight overvaluation, dissatisfaction, preoccupation, and fear of weight gain: a prospective study. *Body Image* 39, 227–231. doi: 10.1016/j.bodyim.2021.09.001

Moelbert, S. C., Klein, L., Thaler, A., Mohler, B. J., Brozzo, C., Martus, P., et al. (2017). Depictive and metric body size estimation in anorexia nervosa and bulimia nervosa: a systematic review and meta-analysis. *Clin. Psychol. Rev.* 57, 21–31. doi: 10.1016/j.cpr.2017.08.005

Monthuy-Blanc, J., Bouchard, S., Ouellet, M., Corno, G., Iceta, S., and Rousseau, M. (2020). "eLoriCorps immersive body rating scale": exploring the assessment of body image disturbances from allocentric and egocentric perspectives. *J. Clin. Med.* 9:2926. doi: 10.3390/jcm9092926

Myers, R. H. (1990). *Classical and Modern Regression With Applications. 2nd Edn.* Duxbury, MA: Duxbury.

Neumark-Sztainer, D., Wall, M. M., Story, M., and Perry, C. L. (2003). Correlates of unhealthy weight-control behaviors among adolescents: implications for prevention programs. *Health Psychol.* 22, 88–98. doi: 10.1037/0278-6133.22.1.88

Phillipou, A., Meyer, D., Neil, E., Tan, J. E., Toh, W. L., Van Reenhen, T. E., et al. (2020). Eating and exercise behaviors in eating disorders and the general population during the COVID-19 pandemic in Australia: initial results from the COLLATE project. *Int. J. Eat. Disord.* 53, 1158–1165. doi: 10.1002/eat.23317

Pietrobelli, A., Pecoraro, L., Ferruzzi, A., Heo, M., Faith, M., Zoller, T., et al. (2020). Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study. *Obesity* 28, 1382–1385. doi: 10.1002/oby.22861

Ramalho, S. M., Trovisqueira, A., de Lourdes, M., Gonçalves, S., Ribeiro, I., Vaz, A. R., et al. (2021). The impact of covid-19 lockdown on disordered eating behaviors: the mediation role of psychological distress. *Eat. Weight Disord.* 27, 179–188. doi: 10.1007/s40519-021-01128-1

Robertson, M., Duffy, F., Newmann, E., Bravo, C. P., Ates, H. H., and Sharpe, H. (2021). Exploring changes in body image, eating and exercise during the COVID-19 lockdown: a UK survey. *Appetite* 159:105062. doi: 10.1016/j.appet.2020.105062

Rodgers, R. F., Lombardo, C., Cerolini, S., Franko, D. L., Omori, M., Fuller-Tyszkiewicz, M., et al. (2020). The impact of the COVID-19 pandemic on eating disorder risk and symptoms. *Int. J. Eat. Disord.* 53, 1166–1170. doi: 10.1002/eat.23318

Rodin, J., Silberstein, L., and Striegel-Moore, R. (1984). Women and weight: a normative discontent. *Neb. Symp. Motiv.* 32, 267–307.

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., et al. (2020). Prevalence of stress, anxiety, depression

among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Glob. Health* 16:57. doi: 10.1186/s12992-020-00589-w

Sanlier, N., Kocabas, Ş., Ulusoy, H. G., and Celik, B. (2021). The relationship between adults' perceptions, attitudes of COVID-19, intuitive eating, and mindful eating behaviors. *Ecol. Food Nutr.* 61, 90–109. doi: 10.1080/03670244.2021.1968849

Scarmozzino, F., and Visioli, F. (2020). Covid-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. *Foods* 9:675. doi: 10.3390/foods9050675

Schlegl, S., Maier, J., Meule, A., and Voderholzer, U. (2020). Eating disorders in times of the COVID-19 pandemic—results from an online survey of patients with anorexia nervosa. *Int. J. Eat. Disord.* 53, 1791–1800. doi: 10.1002/eat.23374

Siegel, J. A., Huellemann, K. L., Hillier, C. C., and Campbell, L. (2020). The protective role of self-compassion for women's positive body image: an open replication and extension. *Body Image* 32, 136–144. doi: 10.1016/j.bodyim.2019.12.003

Stavrakakis, N., de Jonge, P., Ormel, J., and Oldehinkel, A. J. (2012). Bidirectional prospective associations between physical activity and depressive symptoms. The TRAILS study. *J. Adolesc. Health* 50, 503–508. doi: 10.1016/j.jadohealth.2011.09.004

Stice, E. (1994). A review of the evidence for a sociocultural model of bulimia nervosa and an exploration of the mechanisms of action. *Clin. Psychol. Rev.* 14, 633–661. doi: 10.1016/0272-7358(94)90002-7

Stice, E. (2001). A prospective test of the dual-pathway model of bulimic pathology: mediating effects of dieting and negative affect. *J. Abnorm. Psychol.* 110, 124–135. doi: 10.1037/0021-843X.110.1.124

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol. Bull.* 128, 825–848. doi: 10.1037/0033-2909.128.5.825

Stice, E., Mazotti, L., Krebs, M., and Martin, S. (1998). Predictors of adolescent dieting behaviors: a longitudinal study. *Psychol. Addict. Behav.* 12, 195–205. doi: 10.1037/0893-164X.12.3.195

Stice, E., Nemeroff, C., and Shaw, H. E. (1996). Test of the dual pathway model of bulimia nervosa: evidence for dietary restraint and affect regulation mechanisms. *J. Soc. Clin. Psychol.* 15, 340–363. doi: 10.1521/jscp.1996.15.3.340

Swami, V., Horne, G., and Furnham, A. (2021). COVID-19-related stress and anxiety are associated with negative body image in adults from the United Kingdom. *Pers. Individ. Differ.* 170:110426. doi: 10.1016/j.paid.2020.110426

Tantleff-Dunn, S., Barnes, R. D., and Larose, J. G. (2011). It's not just a "woman thing:" the current state of normative discontent. *Eat. Disord.* 19, 392–402. doi: 10.1080/10640266.2011.609088

Tiggemann, M. (2011). "Sociocultural perspectives on human appearance and body image," in *Body Image: A Handbook of Science, Practice, and Prevention*. eds. T. F. Cash and L. Smolak (New York: The Guilford Press), 12–19.

Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., and Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int. J. Soc. Psychiatry* 66, 317–320. doi: 10.1177/0020764020915212

Touyz, S., Lacey, H., and Hay, P. (2020). Eating disorders in the time of COVID-19. *J. Eat. Disord.* 8:19. doi: 10.1186/s40337-020-00295-3

Tylka, T. L. (2006). Development and psychometric evaluation of a measure of intuitive eating. *J. Couns. Psychol.* 53, 226–240. doi: 10.1037/0022-0167.53.2.226

Tylka, T. L., and Wood-Barcalow, N. L. (2015). The body appreciation scale-2: item refinement and psychometric evaluation. *Body Image* 12, 53–67. doi: 10.1016/j.bodyim.2014.09.006

Vall-Roqué, H., Andrés, A., and Saldana, C. (2021). The impact of COVID-19 lockdown on social network sites use, body image disturbances and self-esteem among adolescent and young women. *Prog. Neuro-Psychopharmacol. Biol. Psychiatry* 110:110293. doi: 10.1016/j.pnpbp.2021.110293

Van Strien, T., Engels, R., Leeuwe, J. V., and Snoek, H. M. (2005). The Stice model of overeating: tests in clinical and non-clinical sample. *Appetite* 45, 205–213. doi: 10.1016/j.appet.2005.08.004

Van Strien, T., Schippers, G. M., and Cox, W. M. (1995). On the relationship between emotional and external eating behavior. *Addict. Behav.* 20, 585–594. doi: 10.1016/0306-4603(95)00018-8

Van Strien, T., van de Laar, F. A., van Leeuwe, J. F., Lucassen, P. L., van den Hoogen, H. J., Rutten, G. E., et al. (2007). The dieting dilemma in patients with newly diagnosed type 2 diabetes: does dietary restraint predict weight gain 4 years after diagnosis? *Health Psychol.* 26, 105–112. doi: 10.1037/0278-6133.26.1.105

Weissman, R. S., Bauer, S., and Thomas, J. J. (2020). Access to evidence-based care for eating disorders during the COVID-19 crisis. *Int. J. Eat. Disord.* 53, 369–376. doi: 10.1002/eat.23279

World Health Organization (2020a). Origin of SARS-CoV-2, 26 March 2020. World Health Organization, 1-2. doi: 10.1016/S1473-3099(20)30641-1 (Accessed October 27, 2021).

World Health Organization (2020b). WHO Director-General's Opening Remarks at the Media Briefing on COVID-19-11 March 2020. WHO Director-General's speeches. Available at: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (Accessed October 27, 2021).

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 31 March 2022
doi: 10.3389/fpsyg.2022.805596

# Examining Shared Pathways for Eating Disorders and Obesity in a Community Sample of Adolescents: The REAL Study

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**Edited by:**
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**Specialty section:**
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

**Received:** *30 October 2021*
**Accepted:** *16 February 2022*
**Published:** *31 March 2022*

**Citation:**
*Obeid N, Flament MF, Buchholz A, Henderson KA, Schubert N, Tasca G, Thai H and Goldfield G (2022) Examining Shared Pathways for Eating Disorders and Obesity in a Community Sample of Adolescents: The REAL Study. Front. Psychol. 13:805596. doi: 10.3389/fpsyg.2022.805596*

Several psychosocial models have been proposed to explain the etiology of eating disorders (EDs) and obesity separately despite research suggesting they should be conceptualized within a shared theoretical framework. The objective of the current study was to test an integrated comprehensive model consisting of a host of common risk and protective factors (socio-environmental, psychological, and behavioral) expected to explain both eating and weight disorders simultaneously in a large school-based sample of adolescents. Data were collected from 3,043 youth (60% female, 14.00 ± 1.61) from 41 schools in the Ottawa region, Canada. Working with interested school staff, validated self-report scales in the form of a questionnaire booklet were administered to participating students to assess several understood risk and protective factors common to both eating disorders and obesity. Anthropometric measurements of weight and height were taken at the end of the questionnaire administration period by trained research staff. Structural equation modeling with cross-validation was used to test the hypothesized model. Findings demonstrated that dysregulated eating was associated with both eating disorder and weight status with diet culture and emotion dysregulation directly associated with some of these disordered eating patterns. It equally pointed to how lifestyle made up of high sedentary behaviors, low vigorous exercise and varied eating patterns contributed to both emotion dysregulation and poor body image which subsequently affected eating issues and weight status simultaneously, signaling the complex interplay of psychosocial factors that underlie these concerns. This study provides evidence for an integrated psychosocial model consisting of socio-environmental, psychological, and behavioral factors may best explain the complex interplay of risk and protective factors influencing eating disorders and obesity. It equally highlights understanding the direct and indirect effects of some of the most salient risk

factors involved in eating and weight-related concerns, including the strong effects of diet culture and stressors such as weight-based teasing, providing interventionalists evidence of important risk factors to consider targeting in eating disorder and weight-based prevention efforts.

**Keywords: eating disorder (ED), obesity, adolescent and youth, risk and protective factors, structural equation model – SEM**

## INTRODUCTION

Adolescence is a developmental period in which individuals experience enormous change in eating behaviors and body weight. These rapid changes are often accompanied by weight and shape preoccupations and some degree of body dissatisfaction, with prevalence in Western countries ranging between 34.1 and 61.8% for adolescent girls and 14.1 and 19.9% for adolescent boys (Bornioli et al., 2021). Body dissatisfaction that derives from changes in eating and weight places adolescents at risk for various health compromising behaviors including inadequate dietary intake, excessive weight gain, and usage of extreme weight control strategies (Jankauskiene et al., 2019). These concerns also place young people at higher risk for added mental health struggles including low mood, anxiety and substance use (Perryman et al., 2018; Vannucci and Ohannessian, 2018; Bornioli et al., 2021). Given the multiple physical, psychological, and social changes that occur during puberty, adolescence represents a time of peak incidence for eating disorders (EDs) (Javaras et al., 2015) and other mental health issues (Boak et al., 2020), and a critical time for the development of lifelong weight concerns (Wang et al., 2008). Investigating shared risk and protective factors for EDs and obesity that could potentially stave off some of these concerns during this vulnerable developmental period could have benefits for these prevalent public health issues facing high numbers of youth.

However, until recently, the etiological and treatment models for EDs and obesity have had different theoretical foundations, leading to polarized clinical and research agendas and conflicting messages for the scientific community and public. Accordingly, prevention efforts for youth in the field of EDs and obesity have sometimes had contraindicated consequences as the ED prevention programs typically targeted dieting, body dissatisfaction and weight talk, whereas interventions aimed at obesity prevention addressed low levels of physical activity and high intakes of food (Neumark-Sztainer, 2012). Attempts to consolidate these efforts across these two public health domains could yield a number of wider scale benefits and impacts across these fields.

In 2003, the Research on Eating and Adolescent Lifestyle study (REAL study; Flament et al., 2019) was initiated to tackle this gap in understanding of the shared risk and protective factors for eating and weight disorders in Canadian youth. This large school-based study endeavored to survey students in grades 7–12, asking about a wide range of factors relevant to eating and weight related issues, in order to validate a complex model of direct and indirect etiological risk and protective pathways for both eating and weight disorders. A comprehensive review of the ED and obesity risk factor literature (conducted in 2003) revealed more than 30 variables from diverse theoretical perspectives emerging as shared risk factors for both EDs (Stice, 2002; Jacobi et al., 2004; Treasure et al., 2010) and obesity (Maffeis, 2000; Berkowitz and Stunkard, 2002; Adair, 2008; McAllister et al., 2009; Sørensen, 2009) all meriting contribution to a model. Potential factors were categorized into four broad domains of risk: biological (including weight status, pubertal status, history of ED or obesity in family member), environmental (including family context, stressors, and societal influences), individual (including self-perception, interpersonal functioning, lifestyle, and emotional regulation/coping), and eating and weight specific behaviors (including restrained eating, dysregulated eating and body image), and were conceptualized to influence each other in direct and indirect ways. Despite this evidence-base, the empirical evidence for contributing factors varied from very strong to very weak; few of the proposed risk factors had been identified as significant in multiple samples; many studies focused on a small number of potential risk factors; and the relative role of different biological, familial, and psychosocial factors in predicting ED onset or obesity was still unclear (Jacobi et al., 2004; McAllister et al., 2009; Sørensen, 2009).

In addition to the risk factor literature that helped to advance knowledge on the underpinnings of eating and weight related disorders, several etiopathological models of EDs that emphasized dual- or multi-factor risk pathways also contributed to the REAL model design. Models, including Garner et al.'s (1983) dual pathway model, Halmi's (1997) bulimia nervosa (BN) model that stressed the role of dieting and its multiple contributors, Fairburn et al.'s (1999) personal, environmental and dieting vulnerability model, and Thompson et al.'s (2004) tripartite influence model including peers, parents and the media. Further mediation models by Stice et al. linking internalization of the thin ideal to body dissatisfaction and unhealthy dieting behaviors, negative affect and bulimic symptoms (Stice, 2001) and Steiger's (2004) that placed special emphasis on the exacerbation of genetic vulnerabilities by developmental experiences and current stressors including caloric deprivation and excessive dieting, also contributed to the design of the model. It did so by highlighting the multiple and sometimes mediational pathways that may exist from various risk factors, and the often complex relationships that could emerge amongst a number of risk factors.

With the evidence-base in 2003 limited to etiological theories and studies conducted in EDs or obesity samples separately, two American-based prospective longitudinal studies paved some of the early understanding of the interconnectedness of these factors and their outcomes. Specifically, the Project Eating Among Teens study (Project EAT; Haines et al., 2006), and the Growing Up

Today study (GUTS; Field et al., 1999) were both conducted in large community-based samples of United States adolescents. These pivotal studies confirmed a number of shared risk and protective factors for overweight and disordered eating practices among adolescents, although they focused their main outcomes on weight and selected ED behaviors (Project EAT: overweight, binge eating, and extreme weight control; GUTS: overweight, use of laxatives or purging, and binge eating) with much focus during this time being devoted to the "obesity crisis" (Miller et al., 2004). The results of these large-scale longitudinal studies (Project EAT: $n$ = 2,516 adolescents followed across 5 years; GUTS: $n$ = 16,539 youth followed over 10 years) supported the utility of a joint model to predict overweight and disordered eating outcomes, emphasizing the important role of body image and weight/shape concerns as pivotal factors.

Together, these literatures and models helped conceptualize an integrated biopsychosocial theoretical framework, the REAL model (see **Figure 1**). The model incorporated recognized shared risk and protective factors from the literature, direction from existing ED etiological models and learnings from Project EAT and GUTS. This lent to the model being built on the premise that (a) the influence of socio-environmental variables (namely, family context, stressors, cultural influences) on body image in youth would be mediated by general psychological and behavioral factors (i.e., unhealthy lifestyle, poor interpersonal functioning, emotional dysregulation); (b) poor body image would act as a central mediator between the socio-environmental, psychological and behavioral variables and restrained and dysregulated eating; (c) restrained eating and dysregulated eating would share an indirect and direct relationship with ED and weight status, respectively; and (d) socio-environmental factors are understood as some of the propagating factors in these complex relationships.

The objective of the present study was to test this theoretically informed cross-sectional model (outlined in **Figure 1**), expected to predict eating and weight disorders simultaneously in a large diverse community-based sample of male and female Canadian adolescents. It was anticipated that a unified model including an array of socio-environmental, psychological, and behavioral factors, and specific eating and weight related factors drawn from multiple theories would support pathway prediction for both EDs and obesity in youth in a shared model and that good model fit including direct and indirect pathways would emerge across boys and girls.

# MATERIALS AND METHODS

## Participants

The study sample consisted of 3,043 male and female students in grades 7 through 12. This age group was selected as it included the two major transition periods of early and late adolescence, times at which youth are at greater risk for emerging eating and/or weight-related issues and accompanying mental health difficulties (Schulenberg et al., 2004). Data were collected from 41 public and three private schools between 2004 and 2010, after all major public-school boards (urban, suburban, and rural), two alternative schools, and three private schools from the capital region of Canada (Ottawa, Ontario, and surrounding area) were approached for participation in a Research study on Eating and Adolescent Lifestyles (*REAL* study; Flament et al., 2019). Within each school that consented to participate, the number of classrooms and students approached were based on school interest and feasibility, generating a convenience sample for the study. Small incentives were provided for student participation. Across schools, the rate of students who provided parental and personal consent and completed the survey was about 45% of those approached. The study was approved by two institutional research ethic boards and the school boards where required.

## Measures

### Outcome Variables

Weight status was obtained based on measurements taken directly during survey administration while ED status was determined based on self-report.

#### *Weight Status*

Weight was measured using a UC-321 Digital Weighing Scale (Quick Medical Equipment and Supplies, United States), and recorded in kilograms to the nearest 0.1 kg. Height was measured using a HM200P Portable Stadiometer (Quick Medical Equipment and Supplies, United States), and recorded in centimeters to the nearest 0.1 cm. Students wore indoor clothing and were asked to remove their shoes and anything in their pockets before measurements were taken. Body mass index (BMI; $kg/m^2$) was calculated with weight status defined using the International Obesity Task Force (IOTF) criteria based on age and sex-based BMI centile curves (Cole et al., 2000): *(1) thinness grade 2* (BMI < 3rd percentile), *(2) thinness grade 1* (BMI $\geq$ 3rd- < 16th percentile), *(3) normal weight* (BMI $\geq$ 16th- < 85th percentile), *(4) overweight* (BMI $\geq$ 85th- < 95th percentile), and *(5) obesity* (BMI $\geq$ 95th percentile).

#### *Eating Disorders Diagnostic Scale (Stice et al., 2000)*

This self-report scale was designed to assess DSM-IV criteria for current diagnoses of EDs and includes 22 items adapted from validated clinical interviews. The scoring allows for the indication of ED diagnostic categories in addition to the capture of individuals ED behaviors. The EDDS has been validated in adolescent and adult females and males, and has shown excellent test-retest reliability (kappa = 0.75–0.95), internal consistency (alpha = 0.86–0.91), criterion validity, and convergent validity (Stice et al., 2000, 2004). For this study, the original scoring algorithms were revised to ascertain DSM-5 criteria for AN, BN, BED and Purging Disorder (PD) (Flament et al., 2015a) and the participants were classified into five ED categories: (1) *No disordered eating:* participants who did not endorse any ED related cognitions or behaviors, (2) *ED cognitions*: youth who endorsed ED related cognitions although they denied engaging in any ED behaviors, (3) *ED cognitions and behaviors:* participants who endorsed both ED related cognitions and some behaviors, but did not qualify for a diagnosis of full- or subthreshold ED. This group could be considered a "disordered eating" group,

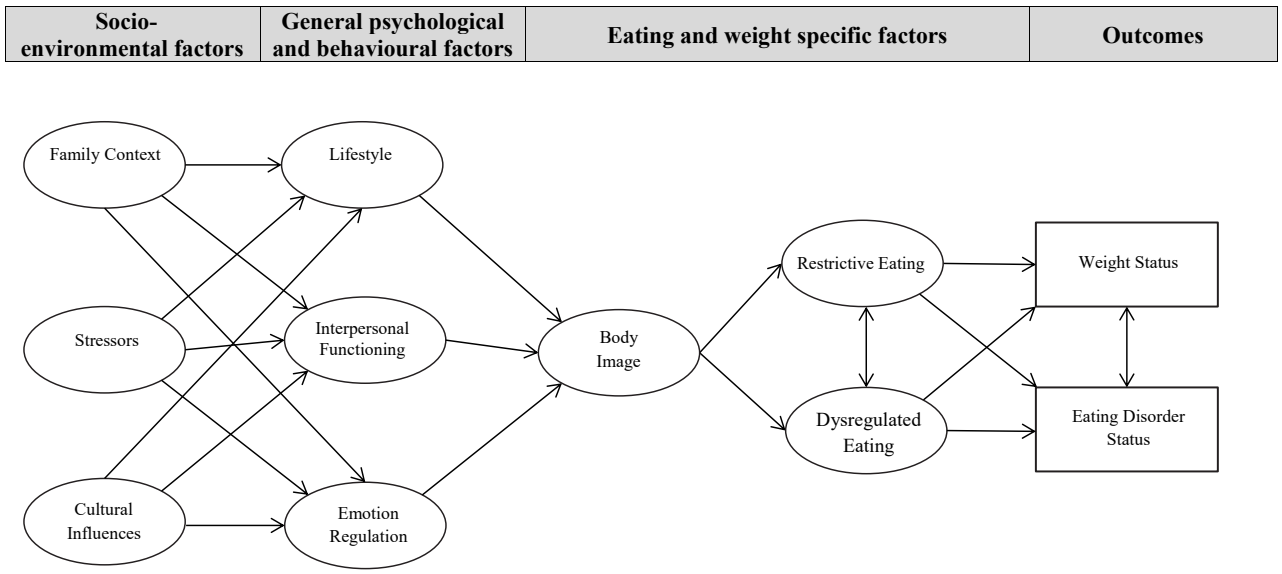


**FIGURE 1 |** Hypothesized model representing shared pathways to weight and eating disorder status. Family Context: family cohesion, family adaptability, family eating patterns, parents concern with thinness, weight-based teasing from parents; Stressors: negative life events, weight-based teasing from peers, perceived stress; Cultural Influences: internalization of beauty ideals, awareness of beauty ideals, peer concern with thinness; Lifestyle; exercise, sedentary behaviors; Interpersonal Functioning: attachment, non-assertiveness, connection(s) with a supportive person; Emotion Regulation: low mood, anxiety, emotion-oriented coping, inward expression of anger, outward expression of anger; Body Image: appearance esteem, weight esteem, beliefs about appearances; Restrictive Eating: restrained eating; and Dysregulated Eating: emotional eating and external eating.

(4) *Subthreshold ED:* participants with subthreshold AN, BN, BED or PD, based on the EDDS algorithms (Stice et al., 2004), and (5) *Full-threshold ED:* Participants with DSM-5 diagnoses of AN, BN, BED, or PD.

### *Predictor Variables*

A large number of predictor variables derived from various well-validated self-report measures were included in the conceptual model as guided by previous work. The specific scales or subscales used in the current study as indicator variables are listed in **Table 1** according to the latent variables for which they were included. All latent variables were constructed so that higher scores on the indicator variable indicated greater disturbance or psychopathology. **Table 1** provides psychometric information of the variables and shows the internal consistency of all measures in the current study sample. For a more detailed description of the measures including psychometric properties, please refer to Flament et al. (2019).

## Analytic Plan

Structural equation modeling (SEM) was used to test the hypothesized model. Missing data were assessed before analyses were completed and deemed to be missing at random; they were therefore imputed using the expectation-maximization algorithm (Moon, 1996). All analyses were performed using the Analysis of Moment Structures (AMOS) program version 21 (Arbuckle, 2012). The criteria used to assess model fit were a comparative fit index (CFI) of 0.90 or greater and a root mean square error of approximation estimates (RMSEA) lower than 0.07 (Steiger, 2007). In order to test the pathways found in the model, a bias-corrected bootstrap methodology with 5,000 samples was performed (Mackinnon et al., 2004).

# RESULTS

## Characteristics of the Sample

Participants were 1,789 (58.8%) females and 1,254 (41.2%) males, ranging in age from 11 to 20 years (14.19 $\pm$ 1.61). The majority of youth (69%) were of normal weight while 7.7% met criteria for a subthreshold or full-threshold ED based on self-report (see **Table 2**). Additional clinical characteristics of the sample have been reported elsewhere (Flament et al., 2015a,b).

## Measurement Model

The hypothesized measurement model that was tested is depicted in **Figure 1**. The model consisted of two observed variables (weight status and ED status), and nine latent variables, for a total of 27 indicator variables included in the hypothesized model. A confirmatory factor analysis was conducted in order to test whether the indicator variables could be mapped into their respective latent variables. Results from the initial measurement model revealed a few modifications that needed to be performed in order to achieve an adequate model fit. Seven of the 27 indicator variables were eliminated (Family Cohesion, Family Adaptability, Perceived Stress, Peer Concern with Thinness, Attachment, Silencing the Self, and Supportive Persons), and

**TABLE 1 |** Summary of predictor variables, measures, and their psychometric properties in the study sample.

| **Latent variables** assessment measures | **# of items** | **Response scale** | **α** |
|---|---|---|---|
| **Stressors** | | | |
| McKnight Risk Factor Survey IV (MRFS-IV) (Shisslak et al., 1999) | | | |
| *Negative life events* | 9 | yes/no | 0.52 |
| *Weight-based teasing from peers* | 8 | Five-point Likert | 0.89 |
| *Weight-based teasing from parents* | 2 | Five-point Likert | n/a |
| *Weight-based teasing from other adults* | 1 | Five-point Likert | n/a |
| **Diet culture** | | | |
| Sociocultural Attitudes Toward Appearance (SATAQ) (Heinberg et al., 1995) | | | |
| *Internalization* Items for males | 7 | Five-point Likert | 0.89 |
| Items for females | 7 | Five-point Likert | 0.93 |
| *Awareness* Items for males | 4 | Five-point Likert | 0.81 |
| Items for females | 7 | Five-point Likert | 0.87 |
| Dutch Eating Behavior Questionnaire (DEBQ) (Wardle, 1987) | | | |
| *Restrained eating* | 10 | Five-point Likert | 0.92 |
| **Emotional dysregulation** | | | |
| Children's Depression Inventory (CDI) (Kovacs, 1985, 1992) | 27 | Three-point Likert | 0.88 |
| Multidimensional Anxiety Scale for Children (MASC-10) (March et al., 1997) | 10 | Four-point Likert | 0.76 |
| State-Trait Anger Expression Inventory (STAXI) (Spielberger et al., 1985) | | | |
| *Anger-in* | 8 | Four-point Likert | 0.77 |
| *Anger-out* | 8 | Four-point Likert | 0.76 |
| Coping Inventory for Stressful Situations (CISS) (Endler and Parker, 1990) | | | |
| *Emotion-oriented coping* | 7 | Five-point Likert | 0.84 |
| **Unhealthy lifestyle** | | | |
| Godin Leisure-Time Exercise Questionnaire (Godin and Shephard, 1985) | 2 | frequencies | n/a |
| Leisure-Time Sedentary Activities Questionnaire (Maras et al., 2015) | | | 0.73 |
| *Week days* | 3 | Six-point Likert | |
| *Weekend days* | 3 | Six-point Likert | |
| Attitudes and Patterns of Eating (APE) (Quirk-Baillot et al., 2012) | | | |
| *Healthy family eating behaviors* | 7 | Five-point Likert | 0.54 |
| **Poor body image** | | | |
| Body-Esteem Scale for Adolescents and Adults (BESAA) (Mendelson et al., 2001) | | | 0.92 |
| *Appearance esteem* | 10 | Five-point Likert | 0.88 |
| *Attribution* | 5 | Five-point Likert | 0.80 |
| Beliefs About Appearance Scale (BAAS) (Spangler and Stice, 2001) | 6 | Five-point Likert | 0.93 |
| **Dysregulated eating** | | | |
| Dutch Eating Behavior Questionnaire (DEBQ) (Wardle, 1987) | | | |
| *External eating* | 10 | Five-point Likert | 0.87 |
| *Emotional eating* | 13 | Five-point Likert | 0.94 |

the final measurement model revealed a good model fit, with a CFI value of 0.901 and a RMSEA value of 0.069 (90% CI:0.067, 0.072).

## Structural Model

A structural model between latent variables was tested for model fit. In order to ensure adequate model fit, the sample was randomly divided in half in order to have two independent study samples available for cross-validation purposes. The tested model consisted of the hypothesized pathways between variables with many indirect and direct pathways indicated. The initial analysis of the structural model revealed a poor model fit to the data. Changes based on non-significant pathways, modification indices and conceptual relevance were conducted until an adequate model fit was found. Through this process, two latent variables were removed (family context and interpersonal functioning) and two latent variables were modified and then combined into one (restrained eating and cultural context became *diet culture*). Using the initial sample, several iterations resulted in a good model fit with a CFI value of 0.903 and a RMSEA value of 0.064 (90% CI:0.061, 0.067). Cross-validation of this model with the second half of the sample revealed a good model fit [CFI value of 0.910 and a RMSEA value of 0.063 (90% CI:0.060, 0.066)].

**TABLE 2 |** Demographic and clinical characteristics of sample.

| Characteristic | Full sample (*N* = 3,043) |
|---|---|
| **Age, years** | |
| Mean ± SD | 14.19 ± 1.61 |
| Range | 11.08–20.75 |
| **School setting, n (%)** | |
| Urban | 13 (31.0) |
| Suburban | 20 (44.9) |
| Rural | 11 (24.2) |
| **Parental education, n (%)** | |
| Both parents have college/higher degree | 1528 (50.7) |
| **Ethnic origin, n (%)** | |
| North American/European | 2208 (74.1) |
| Asian | 266 (8.9) |
| Middle Eastern | 140 (4.7) |
| Central/South American | 96 (3.2) |
| African | 89 (3.0) |
| Aboriginal | 58 (1.9) |
| Other | 100 (3.4) |
| Bi-ethnic | 22 (0.7) |
| **Body mass index (BMI) categories, n (%)** | |
| Thinness grade 2 | 22 (0.7) |
| Thinness grade 1 | 155 (5.1) |
| Normal weight | 2096 (69.0) |
| Overweight | 587 (19.3) |
| Obese | 177 (5.8) |
| **Eating disorder (ED) diagnostic status, n (%)** | |
| No ED symptoms | 1427 (46.9) |
| ED cognitions only | 852 (28.0) |
| ED cognitions and behaviors | 380 (12.5) |
| Subthreshold ED | 259 (8.5) |
| Full-threshold ED | 122 (4.1) |

## Direct Effects

Review of the final structural model (see **Figure 2**) revealed five direct effects in total; two direct effects for ED status and three direct effects for weight status with disordered eating having a direct effect to both ED and weight status. Stressors ($B = 0.51$, $p < 0.001$), dysregulated eating ($B = 0.22$, $p < 0.001$) and poor body image ($B = 0.49$, $p < 0.001$) all had significant direct effects on weight status, with higher levels of these resulting in higher BMI status. Higher diet culture engagement also significantly contributed to higher ED status ($B = 0.48$, $p < 0.001$), whereas dysregulated eating ($B = -0.12$, $p < 0.01$) shared a significant inverse direct relationship with ED status, indicating that higher level of these behaviors would predict lower ED category. This unexpected finding is most likely due to a suppression effect that existed between dysregulated eating and ED status given the positive correlation between the variables (0.272, $p < 0.001$). Lastly, a significant reciprocal relationship or feedback loop (Kline, 2011) also existed between weight and ED status.

## Indirect Effects

Several indirect effects were also detected within the structural model. There were four significant indirect effects related to predicting BMI status. Poor body image acted as a mediator between stressors and BMI status ($p = 0.007$), and between diet culture and BMI status ($p = 0.015$), while emotional dysregulation shared an indirect effect with BMI status through dysregulated eating ($p = 0.008$). As stated above, dysregulated eating was inversely related to ED status, which was inversely related to BMI status ($p = 0.003$).

There were four additional indirect effects predicting ED status. Stressors was indirectly related to ED status through diet culture ($p = 0.012$); emotional dysregulation was indirectly related to ED status via dysregulated eating ($p = 0.004$); and both dysregulated eating ($p = 0.009$) and poor body image ($p = 0.007$) were indirectly related to ED status through BMI status. In addition, nine serial mediator pathways to BMI or ED status were found, as illustrated in **Figure 2**.

# DISCUSSION

To our knowledge, this is the first study to examine a complex model of shared pathways integrating various theoretical facets for EDs and obesity in a large community-based sample of male and female adolescents using structural equation modeling. The hypothesized model was conceptually derived, based on existing theoretical models and previous research findings in both the ED and the obesity field, and was empirically refined and finalized. The model was supported by cross-validation across two randomly split samples from the study population, adding to its generalizability. It provides further understanding of the shared pathways for EDs and obesity during the critical developmental stage of adolescence for both males and females, and brings together the many constructs that have been tested in smaller, more parsimonious models.

Results from the final model (see **Figure 2**) demonstrated that stressors, diet culture, lifestyle, emotion regulation, body image, and dysregulated eating all have important and interrelated contributions to the risk pathways of eating and weight-related disorders, and remain salient when taking into account all other risk factors in the model simultaneously. The model confirms that at minimum there are 20 respective factors that span across societal, familial, peer, cultural, and individual domains that are all influencing eating and weight related thoughts and behaviors at any given time, providing further evidence of these complex relationships and need for comprehensive interventions designed to tackle many of the risk factors together. The wide-reaching benefits of possible prevention efforts focused on these shared factors could have significant impact for young people at high risk for EDs and weight-based issues.

The confirmed model found that higher levels of stressors (weight-based teasing, negative life events), dysregulated eating and poor body image all directly influenced higher weight status, providing further strength to these known relationships (e.g., Torres and Nowson, 2007; Sominsky and Spencer, 2014; Tomiyama, 2019). The model also revealed that higher diet culture engagement and dysregulated eating related directly to higher ED status, also building on an existing large body of evidence (e.g., Hesse-Biber et al., 2006). Novel are the

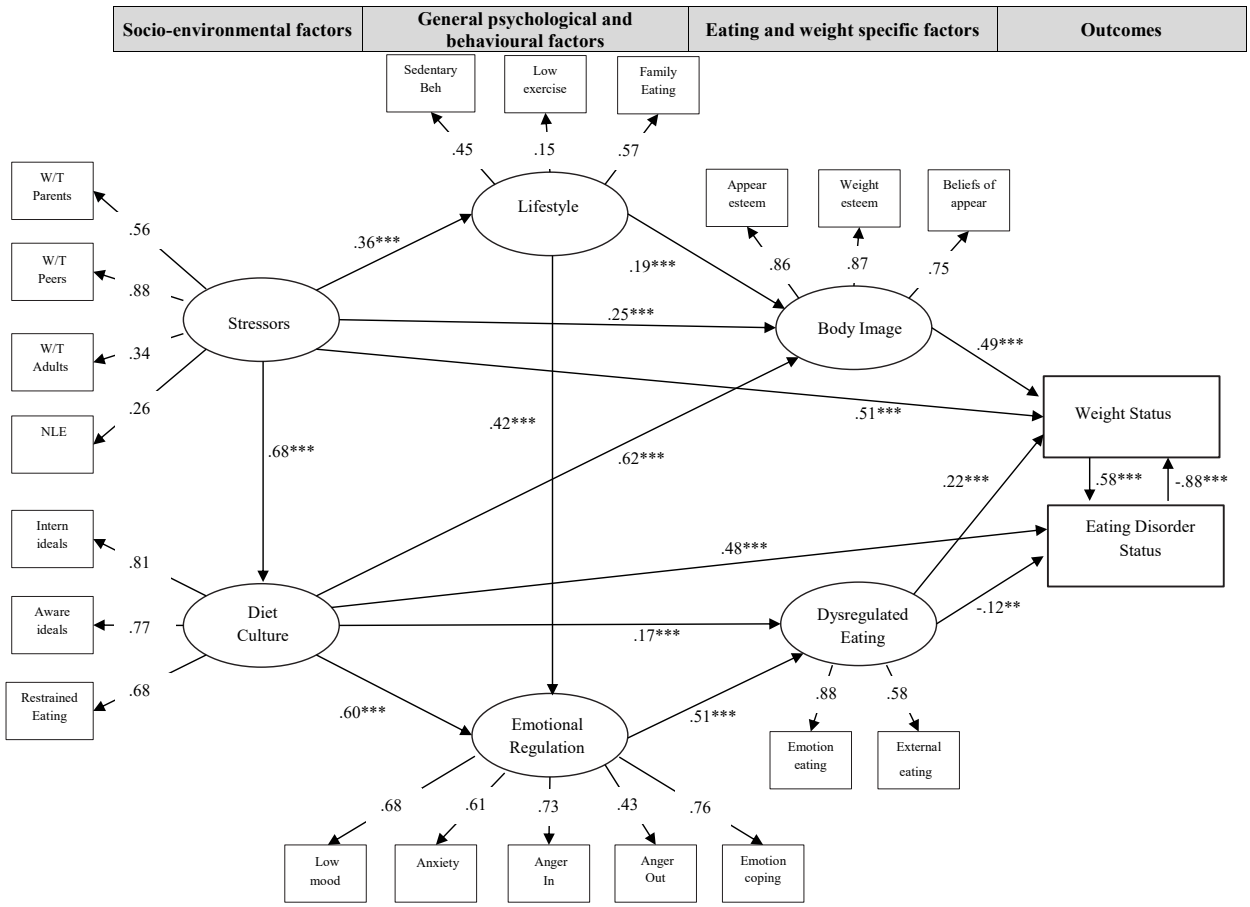


**FIGURE 2 |** Final structural model of standardized path coefficients. $^{**}p < 0.01$, $^{***}p < 0.001$; W/T Parents: McKnight Risk Factor Survey (MRFS) – Weight-based teasing from parents subscale; W/T Peers: McKnight Risk Factor Survey (MRFS) – Weight-based teasing from peers subscale; W/T Adults: McKnight Risk Factor Survey (MRFS) – Weight-based teasing from other adults subscale; NLE: McKnight Risk Factor Survey (MRFS) – Negative Life Events Subscale; Intern of Ideals: Sociocultural Attitudes Toward Appearance Scale (SATAQ) – Internalization of beauty ideals subscale; Aware of Ideals: Sociocultural Attitudes Toward Appearance Scale (SATAQ) – Awareness of beauty ideals subscale; Restrained Eating: Dutch Eating Behaviour Questionnaire (DEBQ) – Restrained Eating subscale; Sedentary Beh: Sedentary Behaviors Scale; Low exercise: GODIN Exercise Scale; Family Meals: Attitudes and Patterns of Eating (APE) – Family Eating Patterns; Low Mood: Child Depression Inventory (CDI) – Total score; Anxiety: Multidimensional Anxiety Scale for Children (MASC) – Total score; Anger In: State-Trait Anger Expression Inventory (S-TAXI) – Internal Expression of Anger subscale; Anger Out: State-Trait Anger Expression Inventory (S-TAXI) – External Expression of Anger subscale; Emotion Coping: Coping Inventory for Stressful Situations (CISS) – Emotion-focused coping subscale; Appear esteem: Body Esteem Scale for Adolescents and Adults (BESAA) – Appearance esteem subscale; Weight esteem: Body Esteem Scale for Adolescents and Adults (BESAA) – Weight esteem subscale; Beliefs of appear: Beliefs About Appearance Scale (BASS) – Total score; Emotion eating: Dutch Eating Behaviour Questionnaire (DEBQ) – Emotional eating subscale; External eating: Dutch Eating Behaviour Questionnaire (DEBQ) – External Eating subscale.

multiple significant direct associations found that co-exist alongside many other risk factors and their direct effect on ED symptoms and measured weight status. Additionally, diet culture was also indirectly associated with ED and weight status through three addition pathways (i.e., through Emotion Regulation, Dysregulated Eating, Body Image), as was Stressors (i.e., Lifestyle, Body Image, Diet Culture), demonstrating their far-reaching effects on many other related factors, which in turn further contribute to these thoughts and symptoms. These findings are in line with one of the original hypothesis that socio-environmental factors, such as being a recipient of weight-based teasing/body shaming comments and high endorsement of diet culture contribute directly and indirectly to eating and/or weight related issues, seen in some cases to propagate the issues, yet can be seen as modifiable risk factors that can be easy targets of prevention efforts. As such, our final model may be an important finding for prevention and health promotion efforts, wherein media literacy and deconstruction of the billion-dollar dieting industry could be powerful agents of change against disordered eating and weight-related problems.

Building from Project EAT (Haines et al., 2006) and the GUTS' learnings (Field et al., 1999), findings from this study provide further evidence, in a Canadian youth sample, of shared risk factors for all types of eating disorder symptoms and severity and across youth of all weights and sizes, building on some of

this early work. It additionally showed findings consistent with the first hypothesis that socio-environmental factors would be associated with body image and dysregulated eating, although mediated by psychological and behavioral factors.

For example, the pathway from diet culture to emotion dysregulation, to dysregulated eating, to BMI status, and to ED status, in combination with the direct pathway from diet culture to ED status, is both clinically and conceptually relevant. It demonstrates that these socio-environmental factors have significant impacts not only directly, but also indirectly through emotions and other psychological factors, demonstrating their complex etiopathological effects. This finding compliments previous studies that indicate the unique role that emotional dysregulation plays in ED-specific factors that initiate BED and BN (Lavender et al., 2014; Smith et al., 2018). Studying these factors simultaneously within a model allowed for the examination of varied ED risk pathways, wherein different patterns of disordered eating emerged when triggered by sociocultural factors depending on whether they affected an individual either directly or indirectly through emotions. The ability to depict these varying pathways within a shared model in a large sample of youth provides novel findings to the existing literature. Similarly, stressors were indirectly related to ED status through diet culture in one pathway and through BMI status in another pathway. This result emphasizes that stressors alone do not directly relate to ED status, but stressors become an important contributor to ED status in female and male youth through the lens of diet culture and/or through increased BMI status. This could be seen as potentially contributing to a transdiagnostic view of ED status, acknowledging how stress can manifest differently in various individuals (e.g., under or over-eating).

In addition to both body image and dyregulated eating emerging as central mediators in the model, another significant pathway of interest that emerged from this study's final model was related to the mediated pathway between poor body image and ED status via BMI status. Poor body image was not directly related to ED status when both eating and weight-related disorders are being considered simultaneously, however, poor body image is related to higher BMI status, which in turn is related to higher ED status, suggesting that the onset of EDs is potentially triggered by anticipated weight fluctuations expected during puberty and adolescence. This is an especially critical finding given that weight fluctuations are to be expected during adolescence, puberty and this period of growth. While we know that youth who are overweight report higher levels of body dissatisfaction, chronic dieting, binge eating with loss of control, drive for thinness, and weight control behaviors compared to their normal/healthy weight peers (Goldfield et al., 2010; Russo et al., 2011; Loth et al., 2015; Jebeile et al., 2021), this results suggest that increases in BMI, expected throughout adolescence for all youth, can translate to ED struggles when poor body image is already present, placing a large majority of young people at risk. Taken together, these findings suggest that it may be important to provide high-school age youth accurate information about expected weight fluctuations during adolescence to help normalize these changes and potentially avert eating or weight-related preoccupations driven by these anticipated weight increases.

Lastly, emotional dysregulation also emerged as a key construct within the model. It mediated the effect of diet culture and unhealthy lifestyle, and also impacted directly dysregulated eating. There has been a growing awareness of the importance of emotions (Harrison et al., 2009), mood disorders and emotional avoidance (Dolhanty and Greenberg, 2007) in the obesity (e.g., Korczak et al., 2014) and ED literature (e.g., Fragkos and Frangos, 2013), especially as it relates to etiological patterns for BN and BED (Stice et al., 2017). Having a greater focus on promoting emotional regulation skills in schools and families as it relates to food and bodies (e.g., mindful awareness or mindful eating skills) may enhance prevention of EDs and obesity in youth while promoting practice of these skills in everyday life, which have been shown to have beneficial effects for a host of other mental health areas (e.g., Cloitre et al., 2019).

The confirmation of this complex risk factor model for EDs and obesity across a large sample of youth yields several practical implications. Namely, the findings could be used to inform universal prevention programs for weight-related issues and EDs simultaneously, and should aim to target the multiple yet interconnected constructs of stressors, diet culture, unhealthy lifestyle, emotion dysregulation, dysregulated eating, and poor body image to optimize the prevention of EDs and weight-based concerns among adolescents. The findings also provide further evidence of the complex nature of eating, weight and body image, and provides concrete modeling of the intersectional nature of eating and mental health concerns. This study is also unique in its inclusion of males and females together, an important Contribution To The Fields of obesity and EDs, which have in many instances targeted prevention efforts to gender specific audiences. This allows for some more universal prevention strategies aimed at whole schools or youth populations. Lastly, given the resounding psychosocial effects of weight-based teasing, stressors, internalization of beauty ideals and pervasiveness of restrictive eating practices in today's society, prevention efforts should gear focus to these highly impactful risk factors.

Despite the study's strengths, the study also had noted limitations. Namely, the cross-sectional design does not allow for interpretations of causality or temporal sequencing of relationships. Examination of the pathways identified in this study will need to be confirmed using longitudinal designs. Additionally, this study relied on self-report measures to determine ED status rather than clinical interview and utilized a convenience sample. While the large study population was representative of the youth in the region where it was conducted based on Census data (Flament et al., 2015a), results may not generalize to all adolescents. Finally, the model does not include biological, genetic, and potentially important social determinants (e.g., poverty and family burden) of the disorders under study, nor did it include the role of social media given the time of model construction. Future studies should consider inclusion of these factors in the study of integrated models.

The results of this study offer a first attempt at understanding the interconnectedness of these multiple risk factors and their effects on eating and weight status in a shared model, raising

awareness around the complexity and multi-factorial nature of contributors to these issues. They also emphasize the importance of continuing to develop integrated models aimed to inform health promotion, policy, prevention, and treatment efforts tackling eating and weight related issues concurrently.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because informed consent from the participants and their legal guardians to share the raw data publicly was never explicitly collected. Requests to access the datasets should be directed to NO, nobeid@cheo.on.ca.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Royal Ottawa Mental Health Centre and Children's Hospital of Eastern Ontario Research Ethics Board and the Ottawa-Carleton District School Board Research Advisory Committee. Written informed consent to participate in this study was provided by both the participant and their parent/legal guardian.

## AUTHOR CONTRIBUTIONS

NO, MF, AB, KH, and GG conceived and designed the work that led to the submission and acquired data. NO and GT played an important role in analyzing and interpreting the results. NO, MF, NS, and HT drafted and revised the manuscript. All authors revised and approved the final version and agreed to be accountable for all aspects of the work.

## FUNDING

This study has been funded by the Ontario Centre of Excellence for Child and Youth Mental Health (# RG627), the University of Ottawa Medical Research Fund (# 03-2009), and the Youth Research Unit at the Institute of Mental Health Research (# 11-19).

## ACKNOWLEDGMENTS

We would like to thank all real participants, volunteers, and students for their important contribution and help with this study.

## REFERENCES

Adair, C. (2008). Child and adolescent obesity: epidemiology and developmental perspectives. *Physiol. Behav.* 94, 8–16.

Arbuckle, J. L. (2012). *IBM SPSS Amos 21 Users Guide*. Chicago, IL: IBM Software Group.

Berkowitz, R. I., and Stunkard, A. J. (2002). "Development of childhood obesity," in *Handbook Of Obesity Treatment*, eds T. A. Wadden and A. J. Stunkard (New York, NY: Guilford Press), 515–531.

Boak, A., Elton-Marshall, T., Mann, R. E., and Hamilton, H. A. (2020). *Detailed Findings From The Ontario Student Drug Use and Health Survey Among Ontario Students [Internet]*. Toronto. Available online at: www.camh.ca (accessed Dec 13, 2021).

Bornioli, A., Lewis-Smith, H., Slater, A., and Bray, I. (2021). Body dissatisfaction predicts the onset of depression among adolescent females and males: a prospective study. *J. Epidemiol. Commun. Health* 75:jech-2019-213033. doi: 10.1136/jech-2019-213033

Cloitre, M., Khan, C., Mackintosh, M. A., Garvert, D. W., Henn-Haase, C. M., Falvey, E. C., et al. (2019). Emotion regulation mediates the relationship between ACEs and physical and mental health. *Psychol. Trauma* 11, 82–89. doi: 10.1037/tra0000374

Cole, T. J., Bellizzi, M. C., Flegal, K. M., and Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320, 1240–1243.

Dolhanty, J., and Greenberg, L. (2007). Emotion-focused therapy in the treatment of eating disorders. *Eur. Psychother.* 7, 95–115.

Endler, N. S., and Parker, J. D. (1990). Multidimensional assessment of coping: a critical evaluation. *J. Pers. Soc. Psychol.* 58, 844-854. doi: 10.1037//0022-3514.58.5.844

Fairburn, C. G., Cowen, P. J., and Harrison, P. J. (1999). Twin studies and the etiology of eating disorders. *Int. J. Eat. Disord.* 26, 349–358. doi: 10.1002/(SICI)1098-108X(199912)26:4<349::AID-EAT1<3.0.CO;2-B

Field, A. E., Camargo, C. A., Taylor, C. B., Berkey, C. S., Frazier, A. L., Gillman, M. W., et al. (1999). Overweight, weight concerns, and bulimic behaviors among girls and boys. *J. Am. Acad. Child Adolesc. Psychiatry* 38, 754–760.

Flament, M. F., Henderson, K., Buchholz, A., Obeid, N., Maras, D., Schubert, N., et al. (2015a). Comparative distribution and validity of DSM-IV and DSM-5 diagnoses of eating disorders in adolescents from the community. *Eur. Eat. Disord. Rev.* 23, 100–110.

Flament, M. F., Henderson, K., Buchholz, A., Obeid, N., Nguyen, H. N. T., Birmingham, M., et al. (2015b). Weight status and DSM-5 diagnoses of eating disorders in adolescents from the community. *J. Am. Acad. Child Adolesc.Psychiatry* 54, 403–411. doi: 10.1016/j.jaac.2015.01.020

Flament, M., Buchholz, A., Henderson, K. A., Obeid, N., and Goldfield, G. S. (2019). The research on eating and adolescent lifestyle (real) study protocol: a shared biopsychosocial model for predicting eating disorders and obesity in adolescents. *OSF Preprints* doi: 10.31219/osf.io/x6wyt

Fragkos, K. C., and Frangos, C. C. (2013). Assessing eating disorder risk: the pivotal role of achievement anxiety, depression and female gender in non-clinical samples. *Nutrients* 5, 811–828. doi: 10.3390/nu5030811

Garner, D. M., Olmstead, M. P., and Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *Int. J. Eat. Disord.* 2, 15–34. doi: 10.1002/1098-108X(198321)2:2<15::AID-EAT2260020203<3.0.CO;2-6

Godin, G., and Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Can. J. Appl. Sport Sci.* 10, 141–146.

Goldfield, G., Moore, C., Henderson, K., Buchholz, A., Obeid, N., and Flament, M. (2010). The relation between weight-based teasing and psychological adjustment in adolescents. *Paediatr. Child Health* 15, 283–288. doi: 10.1093/pch/15.5.283

Haines, J., Neumark-Sztainer, D., Eisenberg, M. E., and Hannan, P. J. (2006). Weight teasing and disordered eating behaviors in adolescents: longitudinal findings from Project EAT (Eating Among Teens). *Pediatrics* 117, e209–e215.

Halmi, K. A. (1997). Models to conceptualize risk factors for bulimia nervosa. *Arch. Gen. Psychiatry* 54, 507–508. doi: 10.1001/ARCHPSYC.1997.01830180013002

Harrison, A., Sullivan, S., Tchanturia, K., and Treasure, J. (2009). Emotion recognition and regulation in anorexia nervosa. *Clin. Psychol. Psychother.* 16, 248–256. doi: 10.1002/cpp.628

Heinberg, L. J., Thompson, J. K., and Stormer, S. (1995). Development and validation of the sociocultural attitudes towards appearance questionnaire.

*Int. J. Eat. Disord.* 17, 81–89. doi: 10.1002/1098-108x(199501)17:1<81::aid-eat2260170111>3.0.co;2-y

Hesse-Biber, S., Leavy, P., Quinn, C. E., and Zoino, J. (2006). The mass marketing of disordered eating and eating disorders: the social psychology of women, thinness and culture. *Womens Stud. Int. Forum* 29, 208–224. doi: 10.1016/J.WSIF.2006.03.007

Jacobi, C., Hayward, C., de Zwaan, M., Kraemer, H. C., and Agras, W. S. (2004). Coming to terms with risk factors for eating disorders: application of risk terminology and suggestions for a general taxonomy. *Psychol. Bull.* 130, 19–65. doi: 10.1037/0033-2909.130.1.19

Jankauskiene, R., Baceviciene, M., Pajaujiene, S., and Badau, D. (2019). Are adolescent body image concerns associated with health-compromising physical activity behaviours? *Int. J. Environ. Res. Public Health* 16:1225. doi: 10.3390/ijerph16071225

Javaras, K. N., Runfola, C. D., Thornton, L. M., Agerbo, E., Birgegard, A., Norring, C., et al. (2015). Sex-and Age-Specific Incidence of Healthcare-Register-Recorded Eating Disorders in the Complete Swedish 1979–2001 Birth Cohort. *Int. J. Eat. Disord.* 48, 1070–1081.

Jebeile, H., Lister, N. B., Baur, L. A., Garnett, S. P., and Paxton, S. J. (2021). Eating disorder risk in adolescents with obesity. *Obes. Rev.* 22:e13173. doi: 10.1111/obr.13173

Kline, R. B. (2011). *Principles And Practice Of Structural Equation Modeling*. New York, NY: Guilford Press Google Scholar, 156.

Korczak, D. J., Lipman, E., Morrison, K., Duku, E., and Szatmari, P. (2014). Child and adolescent psychopathology predicts increased adult body mass index: results from a prospective community sample. *J. Dev. Behav. Pediatr.* 35, 108–117. doi: 10.1097/DBP.0000000000000015

Kovacs, M. (1985). The Children's depression, inventory (CDI). *Psychopharmacol. Bull.* 21, 995–998.

Kovacs, M. (1992). *Children's Depression Inventory (CDI) Manual*. New York, NY: Multi-Health Systems.

Lavender, J. M., Wonderlich, S. A., Peterson, C. B., Crosby, R. D., Engel, S. G., Mitchell, J. E., et al. (2014). Dimensions of emotion dysregulation in bulimia Nervosa. *Eur. Eat. Disord. Rev.* 22, 212–216.doi: 10.1002/erv.2288

Loth, K., Wall, M., Larson, N., and Neumark-Sztainer, D. (2015). Disordered eating and psychological well-being in overweight and nonoverweight adolescents: secular trends from 1999 to 2010. *Int. J. Eat. Disord.* 48, 323–327.doi: 10.1002/eat.22382

Mackinnon, D. P., Lockwood, C. M., and Williams, J. (2004). Confidence limits for the indirect effect: distribtuion of the product and resampling methods. *Multivariate Behav. Res.* 39, 99–128. doi: 10.3758/BF03193007

Maffeis, C. (2000). Aetiology of overweight and obesity in children and adolescents. *Eur. J. Pediatr.* 159, S35–S44. doi: 10.1007/pl00014361

Maras, D., Flament, M. F., Murray, M., Buchholz, A., Henderson, K. A., Obeid, N., et al. (2015). Screen time is associated with depression and anxiety in Canadian youth. *Prev. Med.* 73, 133–138. doi: 10.1016/j.ypmed.2015.01.029

March, J. S., Parker, J. D., Sullivan, K., Stallings, P., and Conners, C. K. (1997). The multidimensional anxiety scale for children (MASC): factor structure, reliability, and validity. *J. Am. Acad. Child Adolesc. Psychiatry.* 36, 554–565. doi: 10.1097/00004583-199704000-00019

Mendelson, B. K., Mendelson, M. J., and White, D. R. (2001). Body-esteem scale for adolescents and adults. *J. Pers. Assess.* 76, 90–106. doi: 10.1207/S15327752JPA7601_6

McAllister, E. J., Dhurandhar, N., Keith, S. W., Aronne, L. J., Barger, J., Baskin, M., et al. (2009). Ten putative contributors to the obesity epidemic. *Crit. Rev. Food Sci. Nutr.* 49, 868–913. doi: 10.1080/10408390903372599

Miller, J., Rosenbloom, A., and Silverstein, J. (2004). Childhood Obesity. *J. Clin. Endocrinol. Metab.* 89, 4211–4218. doi: 10.1210/jc.2004-0284

Moon, T. K. (1996). The expectation-maximization algorithm. *IEEE Signal Process. Mag.* 13, 47–60. doi: 10.1109/79.543975

Neumark-Sztainer, D. R. (2012). Integrating messages from the eating disorders field into obesity prevention. *Adolesc. Med.* 23, 529–543.

Perryman, M., Barnard, M., and Reysen, R. (2018). College students' disordered eating, substance use, and body satisfaction. *Coll. Stud. J.* 52, 516–522.

Quirk-Baillot, D., Flament, M. F., Allen, A., Obeid, N., Van Laberghe, C., and Remy, B. (2012). The attitudes and patterns of eating (APE) questionnaire: development and validation in a US adolescent community population. *Eat. Weight Disord.* 17, 147–156. doi: 10.1007/BF03325341

Russo, J. V., Brennan, L., Walkley, J., Fraser, S. F., and Greenway, K. (2011). Psychosocial predictors of eating disorder risk in overweight and obese treatment-seeking adolescents. *Behav. Change* 28, 111–127.doi: 10.1375/bech.28.3.111

Schulenberg, J. E., Sameroff, A. J., and Cicchetti, D. (2004). The transition to adulthood as a critical juncture in the course of psychopathology and mental health. *Dev. Psychopathol.* 16, 799–806.

Shisslak, C. M., Renger, R., Sharpe, T., Crago, M., McKnight, K. M., Gray, N. et al. (1999). Development and evaluation of the McKnight Risk Factor Survey for assessing potential risk and protective factors for disordered eating in preadolescent and adolescent girls. *Int. J. Eat. Disord.* 25, 195–214. doi: 10.1002/(sici)1098-108x(199903)25:2<195::aid-eat9>3.0.co;2-b

Smith, K. E., Mason, T. B., Peterson, C. B., and Pearson, C. M. (2018). Relationships between eating disorder-specific and transdiagnostic risk factors for binge eating: an integrative moderated mediation model of emotion regulation, anticipatory reward, and expectancy. *Eat. Behav.* 31, 131–136.doi: 10.1016/j.eatbeh.2018.10.001

Sominsky, L., and Spencer, S. J. (2014). Eating behavior and stress: a pathway to obesity. *Front. Psychol.* 5:434. doi: 10.3389/FPSYG.2014.00434/BIBTEX

Sørensen, T. I. A. (2009). Conference on "Multidisciplinary approaches to nutritional problems". Symposium on "Diabetes and health". Challenges in the study of causation of obesity. *Proc. Nutr. Soc.* 68, 43–54. doi: 10.1017/S0029665108008847

Spangler, D., and Stice, E. (2001). Validation of the beliefs about appearance scale. Cogn. Ther. Res. 25, 813–827. doi: 10.1023/A:1012931709434

Spielberger, C. G., Johnson, E. H., Russell, S. F., Crane, R. J., Jacobs, G. A., and Worden T. J. (1985). "The experience and expression of anger: Construction and validation of an anger expression scale," in *Anger and Hostility in Cardiovascular and Behavioral Disorders*, eds M. A. Chesney and R. H. Rosenman (Washington, DC: Hemisphere Publishers), 5–30.

Steiger, H. (2004). Eating disorders and the serotonin connection: state, trait and developmental effects. *J. Psychiatry Neurosci.* 29:20.

Steiger, J. H. (2007). Understanding the limitations of global fit assessment in structural equation modeling. *Pers Individ. Differ.* 42, 893–898. doi: 10.1016/j.paid.2006.09.017

Stice, E. (2001). A prospective test of the dual-pathway model of bulimic pathology: mediating effects of dieting and negative affect. *J. Abnorm. Psychol.* 110, 124–135. doi: 10.1037//0021-843X.110.1.124

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol. Bull.* 128, 825–848.doi: 10.1037/0033-2909.128.5.825

Stice, E., Fisher, M., and Martinez, E. (2004). Eating disorder diagnostic scale: additional evidence of reliability and validity. *Psychol. Assess.* 16, 60–71. doi: 10.1037/1040-3590.16.1.60

Stice, E., Gau, J. M., Rohde, P., and Shaw, H. (2017). Risk factors that predict future onset of each DSM-5 eating disorder: predictive specificity in high-risk adolescent females. *J. Abnorm. Psychol.* 126, 38–51. doi: 10.1037/abn0000219

Stice, E., Telch, C. F., and Rizvi, S. L. (2000). Development and validation of the eating disorder diagnostic scale: a self-report measure of anorexia, bulimia, and binge eating disorder. *Psychol. Assess.* 12, 123–131.

Thompson, J. K., Heinberg, L. J., Altabe, M., and Tantleff-Dunn, S. (2004). Exacting beauty: theory, assessment, and treatment of body image disturbance. *Exacting Beauty* 2004:396. doi: 10.1037/10312-000

Tomiyama, A. J. (2019). Stress and Obesity, *Annu. Rev. Psychol.* 70, 703–718. doi: 10.1146/ANNUREV-PSYCH-010418-102936

Torres, S. J., and Nowson, C. A. (2007). Relationship between stress, eating behavior, and obesity. *Nutrition* 23, 887–894. doi: 10.1016/J.NUT.2007.08.008

Treasure, J., Claudino, A. M., and Zucker, N. (2010). Eating disorders. *Lancet* 375, 583–593. doi: 10.1016/S0140-6736(09)61748-7

Vannucci, A., and Ohannessian, C. M. C. (2018). Body image dissatisfaction and anxiety trajectories during adolescence. *J. Clin. Child Adolesc. Psychol.* 47, 785–795. doi: 10.1080/15374416.2017.1390755

Wang, L. Y., Chyen, D., Lee, S., and Lowry, R. (2008). The association between body mass index in adolescence and obesity in adulthood. *J. Adolesc.Health* 42, 512–518.

Wardle, J. (1987). Eating style: a validation study of the dutch eating behaviour questionnaire in normal subjects and women with eating disorders. *J. Psychosom. Res.* 31, 161–169. doi: 10.1016/0022-3999(87)90072-9

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