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The importance of the body-mind relationship in mental functioning and development of body-focused disorders in adolescence

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The importance of the body-mind relationship in mental functioning and development of body-focused disorders in adolescence

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Editorial: The importance of the body-mind relationship in mental functioning and development of body-focused disorders in adolescence

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Editorial on the Research Topic
The importance of the body-mind relationship in mental functioning and development of body-focused disorders in adolescence

The interest in the body as a theater representing the psychic scene had changed. Bodies emaciated, obese, cut, burned, mutilated; hyper-tattooed bodies, pierced everywhere, naked or in disguise; Marvel superhero bodies, giants of muscles trained daily, surgically modified bodies, unrecognizable faces that end up resembling each other because they are children of the same plastic surgeon; physically young older people and the huge anti-aging cosmetics industry. The body that in the last 50 years has become the bearer of the symptom appears as a concrete body, no longer an expression of psychological symbolism, now seems to represent the subjectivity of those who inhabit it concretely. It seems that the body must be modified in symptoms and fashion trends to adapt to the needs of subjectification of individuals. The papers on body-focused disorders that you will find in this special issue probably refer to a further change in body-mind relation. After all, these are "problems" of the body which are nevertheless determined by people's conscious choices, especially adolescents. The voluntary malnutrition that we observe in anorexia, the binge eating and self-induced vomiting in bulimia, the self-cutting in non-suicidal self-injuries (NSSI), the choice of hyper-tattooing the body, together with the addiction to cosmetic surgery or body-building, seem to be the new ways to express a psychological discomfort through a sort of omnipotent control over one's body. The body turns out to be disciplined, it must submit to the will of a psychism and an idea of itself that finds self-expression in manipulating the body and its image. The problem of the appearance of our body seems to have become of extreme importance at different levels, it affects all of us.

This Research Topic focuses on the mind-body relationship, comprising a prospective study and seven empirical papers.

Wei et al. recruited 643 Chinese adolescents and found that depression mediates the relationship between stressful life events and non-suicidal self-injury (NSSI). Moreover, resilience was found to moderate such a pathway: the adverse impact of stressful life events on NSSI through depression was weaker in adolescents with higher levels of resilience. These findings echo the importance of the emotion regulation processes, suggesting new directions for intervention and prevention.

Kuo et al. utilized a longitudinal cohort of adolescents [i.e., Taiwan Youth Project (1)] to investigate the relationship between weight status and self-image. The cross-sectional analysis demonstrated that those with a higher BMI were more likely to report a lower level of self-image. Moreover, pubertal timing and athletic performance significantly mediate the pathway from weight status and self-image among females, whilst only athletic competence mediated such association within males. The longitudinal association showed that males' BMI and athletic competence at baseline significantly predicted self-image at 9-years follow-up, while only BMI at baseline was predictive of long-term self-image among females. Such a pattern of results suggests the crucial role of pubertal development in the mind-body linkage, highlighting the role of masculine and feminine sex-role ideals in constructing self-image.

Using a mixed-method design, Ojeda et al. collected data from 278 tattooed Mexican adults attending a free healthcare clinic in Tijuana's Zona Norte to assess tattoo removal motives among economically disadvantaged individuals. Overall, 69% of participants were interested in undergoing free tattoo removal services due to their appearance consequences, such as employment barriers, stigmatization, and discrimination. Also, having tattoos negatively impacted participants' mental health, contributing to feelings of discomfort and shame. Findings shed light on the body perception within a sample of structurally vulnerable adults and its impact on wellbeing, and social and work functioning.

Also, concerns about physical appearance have a negative impact on quality of life (QoL) among women with polycystic ovary syndrome (PCOS; $n = 435$). Barberis et al. showed the mediating role of dysmorphic concerns and eating disorder symptoms in the relationship between BMI and QoL. Therefore, such results highlight the potential importance of harmful relationships with one's own body and food, explaining why weight issues may be linked to different levels of QoL in PCOS individuals.

In their cross-sectional study, Ishikawa et al. used a large sample of adolescents ($n = 9.998$) to investigate the association between the subjective degree of influence (DOI) and thinness. Results showed that DOI was associated with the risk of being thin during adolescence, which is one of the main risk factors for eating disorders.

Using a network analysis approach, Jin et al. investigated the association between social anxiety disorder (SAD), appearance anxiety, and eating disorders (ED) in a sample of Chinese university students. Results demonstrated that appearance anxiety was associated with both ED and SAD, although showing different patterns of associations across genders. These findings provide preliminary evidence to guide the formation of body-positive interventions for young people.

Tang et al. carried out an in-depth study of adolescents' QoL. Findings demonstrated that negative life events were negatively related to QoL. However, resilience and social support weakened and reduced the adverse effects of negative life events on adolescents, mediating the pathway. Therefore, health intervention should address these factors during adolescence, as a period characterized by the tendency for increased exposure to adverse life events and a gradual decline in QoL satisfaction.

In the perspective study by D'Agostino et al., the authors emphasize the body's function for the adolescent as a primary means for the regulation of the self-other relationship and the development of a greater sense of self-agency. Although scientific studies have highlighted an increase in body disorders (e.g., non-suicidal self-injury and eating disorders) among adolescents during the pandemic, results should be interpreted with caution. Overestimating the associaTion between bodily disorders and the pandemic risks obscuring the complex network of factors involved in such relationships. Consequently, they concluded that there is a need to conceptualize such disturbances from a developmental psychopathological perspective.

We hope that the reader will find in this Research Topic a useful reference to a better and broader understanding of the importance of the body in mental functioning and body-focused disorders (i.e., eating disorders, non-suicidal self-injury).

Author contributions

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

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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ORIGINAL RESEARCH
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Relationship Between Weight Status and Self-Image Mediated by Pubertal Timing and Athletic Competence: A Cohort Study With Taiwanese Adolescents

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Background: Self-image reflects overall self-acceptance in developing adolescents. Using a representative cohort of Taiwanese youth, this study aims to explore the relationship between weight status, pubertal timing, athletic competence, and adolescent self-image.

Methods: Data come from the Taiwan Youth Project that comprised a longitudinal cohort of adolescents (N = 2690, 51% males, M*age* = 13.3 ± 0.5 years) surveyed annually from seventh grade. Self-image was measured by perceived satisfaction with appearance and physique. Weight status was proxied by self-reported body mass index (BMI; kg/m^2). Pubertal timing was defined using the Pubertal Developmental Scale, which mainly measured physical changes in puberty. Athletic competence was assessed by experiences with participation in competitive sports and self-perceived talent for sports. Linear regression analysis was applied to test for an association between BMI and self-image. In order to test for mediating roles of pubertal timing and athletic competence, Hayes' PROCESS macro on SPSS was conducted applying 5,000 bootstrap resamples with 95% confidence intervals of the indirect effect.

Results: BMI was inversely associated with self-image in both males (β = −0.074, [−0.095, −0.053]) and females (β = −0.095, [−0.122, −0.069]). The boot-strapped 95% confidence intervals indicated statistically significant mediating effects of pubertal timing (β = −0.008, [−0.015, −0.001]) and athletic competence (β = −0.006, [−0.011, −0.002]) in the link between BMI and self–image in females, whilst only athletic

competence mediated this association (β = −0.006, [−0.009, −0.002]) in males. Moreover, BMI at baseline were also associated with long-term self-image in males (β = −0.037, [−0.057, −0.017]) and females (β = 0.132, [0.073, 0.190]).

Conclusions: Understanding the mediating factors may help enhance adolescents' self-image by providing guidance on healthy weight and physical activity behaviors according to different stages of pubertal progression.

Keywords: self-image, body image, weight status, pubertal timing, athletic performance

INTRODUCTION

Self-image lies on a continuum from a favorable and positive subjective perception to an unfavorable and negative subjective perception of oneself, which comes from a phenomenological organization of individual experiences and ideas in all aspects of self-influence (1). Self-image is practically determined by one's perceived appearance, physique, and the importance of the appearance and physique associated with one's performance within social groups (2). Particularly during adolescence, physical appearance is crucial to the perceptual self-image (3), and adolescents experience the process of transformation of old self-images with new ones, which involves the adaptability of the individual reorganization (4). Therefore, a positive self-image is correlated with more adaptive adolescents who are easier to internalize the new personal construct, while a negative self-image is in connection with less adaptive adolescents who face the difficulties of restructuring, resulting in the risk of personal dissonance and intrapersonal conflicts (5). More specifically, self-image is considered a vital driver of prosocial behavior and an essential indicator of health status (6), because of its relevance to depressive symptoms (7), suicidal ideation (8), eating disorders (9), and substance use disorders (10).

Puberty is usually marked by sexual maturation and physical growth that may have relevance to psychosocial adaptations during adolescence. Previous studies have shown early puberty to be associated with negative impacts on self-image in both males and females (11–13). Especially in female adolescents, poor self-image is potentially related to external manifestations resulting from early sexual maturation (14). They may be concerned about their physical selves due to cultural expectations for physical attractiveness at the age of initiating dating (15). Besides the cultural perspective on perceptual body image, pubertal hormones interact with the neurocognitive changes related to the social emotion region of the brain (16). Therefore, once the biological changes initiated by pubertal hormones are perceived, adolescents may adjust their body shape to keep up with social standards of high muscle mass and slenderness for boys and girls, respectively (17). That being said from a biobehavioral perspective, the pursuance of an ideal body shape may diverge because of different hormonal actions in females and males, as boys might work out for an ideal muscle and girls might chase or keep up with a slender body shape under social pressures (18). In addition, weight status proxied by the body mass index (BMI) has also been proven to be associated with self-image (19). An increase in BMI typically predicts dissatisfaction with one's body, and this correlation may become more manifested as children become adolescents during pubertal growth (20). Although the impacts of pubertal timing and weight status on adolescent self-image are usually discussed independently, these two predictors are physiologically intertwined potentially due to the interaction between the adipokines (e.g., leptin) and the kisspeptin systems (21). Particular pubescent transformations, including early pubertal timing and high BMI, have been found to be correlated in growing adolescents and result in worse self-reported health (22). Given a well-established link between obesity and early pubertal timing, whether this link suggests the mediating role of pubertal timing in the association between weight status and self-image may require more research to prove.

Moreover, athletic competence is another salient factor when adolescent self-image is concerned. Pubertal development and weight status at the same time have strong implications on athletic competence during adolescence (23). It has been observed that variations in maturity influence athletic competence (24). Youths who are experts in sports tend to have more rapid and advanced sexual maturation as compared with the general population (25). Gender differences have also been noted in this relationship in that early-maturing boys tend to have higher muscular strength than late-maturing boys at all ages between 11 and 17 years, while early-maturing girls may perform only slightly better than late maturing girls in early adolescence (26). Along with weight status, athletic activity also plays a critical role in adolescents' physical and psychological health (27). Regardless of sex or age, some studies suggest that those who participate in sports acquire positive benefits in self-image (28). Sports participation, which may be beneficial for neurogenesis and neurotrophin in brain plasticity correlated with self-efficacy (29), can lead to more positive attitudes about one's own body and self-image (30). After searching for previous similar studies, it was noted that there is no prior research investigating the association between weight status, pubertal timing, athletic competence, and adolescent self-image, and therefore more research is needed to fill this gap in the literature.

The Present Study

In Taiwan, only a few cross-sectional studies have indicated negative effects of overweight status on self-image (31, 32). However, these studies failed to describe the potential mediation mechanism linking weight status and self-image, except for one study that mainly focused on the mediating role of social class background (33). Therefore, this study is aimed toward examining whether there is a significant association between

weight status and adolescent self-image and if so, whether pubertal timing and athletic competence may play mediating roles in this relationship. Further, we tested the longitudinal effects of these salient factors on later self-image using a longitudinal representative youth cohort.

MATERIALS AND METHODS

Study Population

The data used in this study were retrieved from the Taiwan Youth Project (TYP), which was launched by the Institute of Sociology, Academia Sinica, Taiwan (34). In brief, two cohorts of 7th- and 9th-grade students were recruited in 2000 and followed up annually. The participants were recruited from northern Taiwan, including Taipei City, New Taipei City (called Taipei County before 2010), and Yilan County, using a multistage-stratified and class-clustered selection procedure with randomly selected schools and classes. Finally, 40 schools (Taipei City: 16 schools; New Taipei City: 15 schools; Yilan County: 9 schools) and 81 classes in each grade were chosen. All participants consented to participate in the TYP. We only included a subset of data (N = 2,690) on the same cohort of seventh graders that collected items related to self-image from wave 1 ($Mage = 13.3 \pm 0.5$ years in 2000) and wave 9 ($Mage = 22.3 \pm 0.5$ years in 2009) and thus were deemed valid for the analysis. The study was approved by the Institutional Review Board of the National Cheng Kung University Hospital.

Measures

Weight Status

The body mass index (BMI) was calculated based on self-reported body heights and weights. BMI is a value of a person's leanness or corpulence derived from their height and weight, and it has been proven to have high specificity in diagnosing obesity and related comorbidities in children and teenagers over other indicators (35). The formula is BMI = kg/$m^{2,}$ where kg is a person's weight in kilograms, and m^2 is their height in meters squared.

Pubertal Timing

Pubertal timing was assessed based on the items in the Pubertal Developmental Scale (PDS), which measures self-perceived physical changes, including height spurts, body hair development, skin changes, breast growth/deepening of the voice, and menarche/facial hair development (36, 37). This score was chosen because of its benefit in terms of assessing neuroendocrine changes in this phase of life. This scale does not have illustrations of pubertal stages; it does not mention genitalia, nor does it involve being seen naked or palpated. Thus, this scale is extensively used in the literature because it is less embarrassing for youngsters and is cheaper and easier to administer than Tanner ratings (38). Except for menarche, which was a dichotomous item ("yes" or "no"), all other items were rated using a 4-point Likert scale. Aligned with prior research, we added the PDS scores and standardized them within same-sex and same-age cohorts (in years) to represent pubertal timing among the participants (39) where a higher score represented earlier pubertal timing.

Athletic Competence

As for athletic competence, the participants were asked to report on their experiences with participation in competitive sports on behalf of their school before and after entry to junior high school and their self-perceived talent for sports. Perceived talent for sports and athletic competence has been shown to be correlated with actual physical fitness and physical activity participation (40, 41), and thus it was used to represent the level of physical fitness that was not measured in the dataset. Every response to these three questions was a dichotomous item ("yes" or "no"), which in the data analysis is presented as 1 = yes and no = 0, and then added to create a single scale that indicates the degree of athletic competence (range 0–3), where a higher score represents a higher level of athletic competence (Cronbach's alpha = 0.661).

Self-Image

Given the rapid biological and cognitive changes occurring during puberty, physical appearance is essential to consider when studying self-image during adolescence (3, 42). Self-image was measured using two items that assessed perceived satisfaction with appearance and physique. Each item was rated on a 4-point Likert scale, ranging from 1 (strongly unsatisfied) to 4 (strongly satisfied), and then added to create a single scale that indicated the degree of self-image, where a higher score represents a higher level of self-image (Spearman-Brown coefficient = 0.796).

Covariates

Socioeconomic covariates included parental education and family incomes. The parent with the most education of the two parents was used as the reference for parental education. Monthly family income was subdivided into three groups: "New Taiwanese dollar (NTD) 30,000 or less," "NTD 30,001–60,000," and "NTD 60,001" or more.

Statistical Analysis

Using the cross-section data at wave 1, we examined the sequential relationship among BMI, pubertal timing, athletic competence, and self-image. Firstly, linear regression analyses were applied to test for an association between BMI and self-image. Further, to test for an indirect effect of BMI on self-image via potential mediators (i.e., pubertal timing and athletic competence), these variables were included in a series of regression analyses with self-image as the outcome variable. The significance of the mediation effect of BMI and athletic competence on the association between pubertal timing and self-image was examined using the bootstrap method with 5,000 repeated random samples. In total 95% confidence intervals of the indirect effect were calculated, which provides evidence of a statistically significant indirect effect when the interval does not contain zero (43). Specifically, we tested three indirect paths linking pubertal timing to self-image: (1) BMI → pubertal timing → self-image, (2) BMI → athletic competence → self-image, and (3) BMI → pubertal timing → athletic competence → self-image (**Figure 1**). Given that pubertal timing and BMI were assessed at the same wave, we conducted another mediation analysis on the path from pubertal timing via BMI and athletic performance to self-image, in order to examine the reverse causality between

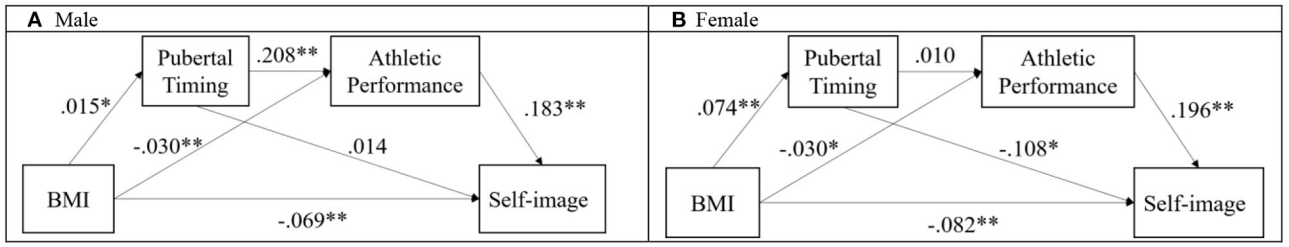

FIGURE 1 | Mediation analysis on pubertal timing and athletic competence in the association between BMI and self-image stratified into male **(A)** and female **(B)** samples. *$p < 0.05$; **$p < 0.01$; BMI indicates body mass index.

pubertal timing and BMI (see the **Supplementary Materials**). As to examining the long-term effects of BMI on self-image at wave 9, a full linear regression model included BMI, pubertal timing, athletic competence, and self-image at wave 1 as the independent variables. All the regression and mediation models were analyzed using gender-stratified subsamples and adjusted for parents' education and household income. We conducted statistical analyses using SPSS V.25.0 (SPSS, Chicago, Illinois, USA). The mediation analysis was performed using PROCESS macro 3.5 for SPSS developed by Preacher and Hayes (44).

RESULTS

Demographic Characteristics

Of the 2,690 participants, 51.2% were males, and 48.8% were females, with an average age of 13.3 (± 0.5) years at wave 1 (**Table 1**). The PDS score in females was 11.36 (± 2.10), and in males, it was 9.50 (± 2.27). At wave 1, a slightly higher level of self-image was observed in the males (score = 5.02 ± 1.46) as compared to the females (4.45 ± 1.48), but this difference was not statistically significant ($p = 0.06$). In addition, the majority ($N =$ 1,055, 39.2%) of monthly family income ranged between 30,001 and 60,000 NTD, and most of the ($N = 1{,}066$, 39.6%) parents had attained a senior high school education. Generally, males had higher levels of athletic performance and self-image than their female peers.

TABLE 1 | Demographic information of participants ($N = 2{,}690$).

	Male ($N = 1{,}378$)	Female ($N = 1{,}312$)	*p*-value
Variables of interest, mean (S.D.)			
Pubertal timing (range 5–20)	9.50 (2.27)	11.36 (2.10)	0.06
Body mass index	20.43 (4.07)	19.58 (3.22)	0.10
Athletic competence (range 0–3)	1.05 (1.08)	0.89 (1.02)	0.03
Self-image, wave 1 (range 1–7)	5.02 (1.46)	4.45 (1.48)	0.04
Self-image, wave 9 (range 1–7)	4.65 (1.14)	4.24 (1.18)	0.03
Covariates, *N* (%)			
Monthly family income (NTD)			0.68
≦30,000	230 (16.7)	213 (16.2)	
30,001–60,000	532 (38.6)	523 (39.9)	
≧60,001	487 (35.3)	453 (34.5)	
Missing	129 (9.4)	123 (9.4)	
Parents' education			0.68
Junior high or lower	443 (32.1)	407 (31.0)	
Senior high	512 (37.2)	554 (42.2)	
College or higher	323 (23.4)	294 (22.4)	
Missing	100 (7.3)	57 (4.3)	

The Cross-Sectional Effect of BMI on Self-Image and Sequential Mediation Analysis of Pubertal Timing and Athletic Competence at Wave 1

Using a linear regression model (**Table 2**), we found that BMI was inversely associated with self-image in both males (β = −0.074, [−0.095, −0.053]) and females (β = −0.095, [−0.122, −0.069]). That is, those who had a higher BMI were more likely to report a lower level of self-image. Meanwhile, there was also a positive association between BMI and pubertal timing in both males (β = 0.015, [0.001, 0.030]) and females (β = 0.074, [0.056, 0.092]) and a negative association between BMI and athletic competence in both males (β = −0.030, [−0.045, −0.014]) and females (β = −0.030, [−0.049, −0.011]) (**Figure 1**). Analyzing the indirect effects with the bootstrapped 95% confidence intervals (**Table 2**), results revealed that pubertal timing (β = −0.008, [−0.015, −0.001]) and athletic performance (β = −0.006, [−0.011, −0.002]) significantly mediated the relationship between BMI and self-images in females. That is, individuals with a higher BMI value were likely to have earlier pubertal timing and poorer athletic competence which were both associated with poor self-image (**Figure 1**). Among the males, we only found athletic competence to mediate the association between BMI and self-image (β = −0.005, [−0.009, −0.002]). Nevertheless, the results also suggested that after accounting for the mediating roles, BMI still had a negative impact on self-image (male: β = −0.069, [−0.090, −0.048]; female: β = −0.082, [−0.109, −0.054]).

Alternatively, we conducted a mediation analysis on the path from pubertal timing via BMI and athletic performance to self-image, given a potential reverse causality between pubertal timing and BMI (**Supplementary Figure S1**). We found that pubertal timing was inversely associated with self-image in females (β = 0.173 [−0.261, −0.085]) but not in males (**Supplementary Table S1**). Meanwhile, the association between pubertal timing and BMI (β = 0.256, [0.009, 0.503]) and athletic competence (β = 0.208, [0.143, 0.273]) was statistically significant in the males, but the association remained significant only between pubertal timing and BMI (β = 0.767, [0.577, 0.957]) in

TABLE 2 | Bootstrap test on the effect of pubertal timing and athletic competence on the association between BMI and self-image stratified by gender.

	Males B (95% CI)	Females B (95% CI)
Total effect	−0.074** (−0.095, −0.053)	−0.095** (−0.122, −0.069)
Direct effect	−0.069** (−0.090, −0.048)	−0.082** (−0.109, −0.054)
Indirect 1	0.000 (−0.001, 0.002)	−0.008* (−0.015, −0.001)
Indirect 2	−0.005* (−0.009, −0.002)	−0.006* (−0.011, −0.002)
Indirect 3	0.001* (0.000, 0.001)	−0.000 (−0.001, 0.001)

*$p < 0.05$; **$P < 0.01$.
Indirect 1, BMI → Pubertal timing → Self-image.
Indirect 2, BMI → Athletic competence → Self-image.
Indirect 3, BMI → Pubertal timing → Athletic competence → Self-image.
BMI, body mass index.

TABLE 3 | Regression analysis on the predictors of self-image at wave 9.

	Males B (95% CI)	Females B (95% CI)
Pubertal timing	−0.050 (−0.131, 0.032)	0.014 (−0.072, 0.100)
BMI	−0.037** (−0.057, −0.017)	−0.079** (−0.106, −0.052)
Athletic competence	0.110** (0.037, 0.182)	0.033 (−0.049, 0.116)
Self-image at wave 1	0.145** (0.090, 0.201)	0.132** (0.073, 0.190)

**$P \leqq 0.01$. *BMI, Body Mass Index; CI, confidence interval.*

the females. Further, the mediation analysis indicated significant total and indirect (via BMI) effects of pubertal timing on self-image among the female subjects.

The Longitudinal Association Between Pubertal Timing/ BMI/ Athletic Competence at Wave 1 and Self-Image at Wave 9

Adjusting for self-image at wave 1, we found that pubertal timing was not related to self-image at wave 9 in either males or females (**Table 3**). In the males, the self-image at wave 9 was related to both BMI ($\beta = -0.037$, [−0.057, −0.017]) and athletic competence ($\beta = 0.110$, [0.037, 0.182]) at wave 1. In the females, the self-image at wave 9 was only related to BMI at wave 1 ($\beta = 0.132$, [0.073, 0.190]). the *p*-value in the males was 0.05 and was 0.001 in the females, supporting the hypothesis tested in this study.

DISCUSSION

To the best of our knowledge, our study is the first to characterize the mediating role of pubertal timing and athletic competence in the relationship between weight status and self-image using a representative cohort of Taiwanese youth. Overall, we found that a high BMI was linked to negative self-image in both genders. Moreover, athletic competence mediated the abovementioned association in both genders since a linkage between increased BMI levels and decreased athletic performance was found to further lead to low self-image. Meanwhile, pubertal timing was only found to be a significant mediator among the females, which was reflected by earlier pubertal timing that was associated with a high BMI level leading to low self-image. Furthermore, the effect of weight status at baseline on self-image remained significant even in young adults.

Overall, our findings were consistent with prior research in that weight status is considered an important predictor of self-image, whereas our study further found the mediation pathway (45). Diving into the role of pubertal timing in this relationship, the results of this analysis indicated that earlier pubertal timing was associated with increased BMI and poor self-image, where the mediation effect was significant, particularly among the female participants. Correspondingly, prior research has shown that self-image declines in females during early adolescence because of the external manifestations of puberty, such as breast development and menarche (14). In addition, girls may feel devalued when they experience earlier pubertal development and increases in weight (46). This sense of self-devaluation may be aggravated in adolescent girls since they are primarily targeted with stereotypes about their ideal body shape and figure from various sources such as television or the Internet. Neuropsychological research may explain this body-mind linkage because girls with early puberty tend to have higher emotional reactivity, higher heart rate variability, and poorer physical competence, thus leading to poorer self-perception (47, 48). However, a comparative pattern appeared to be insignificant among male adolescents. In a previous study, it was found that males at all age levels tend to relate their body shape, such as the size of their shoulders, to masculinity, and thus they are generally satisfied with body changes inherent in pubertal development (49). In addition, the previous research on this topic reinforces the belief that the social standard of being muscular and slender exists among Taiwanese teenagers and may influence the incidence of body dissatisfaction in this age group (50).

A different covariant that was linked in this study is the mediating role of athletic competence. We found that a higher BMI was associated with poor athletic performance that was further linked to a poor self-image in both genders. Our findings corresponded to the findings of a prior study that showed BMI and leisure-time physical activity were two salient predictive factors of body satisfaction (51). Extending from this common observation, our results indicated that when adolescents develop earlier, they may acquire sports advantages that can be translated into negative or positive assets contributing to the construction of a positive self-image, which may mitigate the negative impacts brought about by BMI scores suggesting they are overweight or obese. However, this relationship was noted only in boys, but not in girls. Physiologically speaking, boys after entering puberty usually gain strength because of higher levels of testosterone, which results in better neuromuscular adaptation (52). The advantage of this change during puberty can be also seen in body changes that enable subjects to enroll in different physical activities. This was supported by a study indicating that early-maturing players have advantageous anthropometrical and physiological development that facilitates domination in sports (53). Another study also showed that biological maturation can be used to predict athletic competence during adolescence because of increased muscular power and high energy that can be applied in sports (54). In terms of biological mechanisms,

physical fitness would have blunt effects on hormonal stress-responsive systems, such as the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system, which contribute to reduced emotional and metabolic reactivity as well as increased positive mood and wellbeing. Also, the anti-inflammatory effects of exercise can promote behavioral and metabolic resilience, which exert a positive effect on mental health (55). Further, participation in sports programs may have a positive immediate effect on self-image, notably if the chosen activity is some form of team sport that can give the adolescents some peer support in terms of good opinions about their self-image (56). Therefore, we tentatively conclude that there is a critical mediating role of athletic competence in the relationship between weight status, pubertal timing, and self-image.

In the alternative mediation analysis investigating the path from pubertal timing via BMI and athletic performance to self-image, we only found significant total effects of pubertal timing on self-image in adolescent girls. Meanwhile, a large portion of the impacts were contributed by the indirect link via weight status, highlighting its importance as a determinant of adolescent self-image. Further, in the regression analyses examining the long-term effects on self-image, we found that an earlier level of self-image during adolescence may predict later evaluations of self-image in young adulthood. BMI in both genders and athletic competence in boys were found to be the other significant predictors of the level of a positive self-image in young adulthood, whereas pubertal timing was shown as no longer relevant after a multivariate adjustment. This finding also suggests a persistent effect of weight status on self-image as adolescents grow up. It is worth noting that low self-image may persist if it occurs earlier in adolescence. It is therefore necessary to identify the risks and strengths, such as encouraging participation in sports and a positive attitude toward the weight gain inherent in pubertal development among early-maturing adolescents, in order to build a healthier self-image.

Implications

Our study identified a potential linkage between weight status and self-image via pubertal timing and athletic competence, where gender differences were clearly noted. The implications of the findings can be 3-fold: Firstly, at the onset of puberty, children should be educated about the potential physical changes they will undergo related to hormonal surges. As the age at pubertal onset has skewed toward being earlier in recent years, and obese children are more likely to be affected (57), such information may need to be provided earlier. Secondly, providing dietary and physical activity guidance or designing age-appropriate nutritional menus and physical education classes may help mitigate the negative impacts brought by being overweight and obese and thus help these individuals build a positive self-image. The school, as the major developmental milieu in which adolescents spend long hours studying and interacting with their peers (58), may also play an active role in reducing the sale of unhealthy food and sugared drinks and promoting physical activities on campus (59). Third, information about physiological body changes should be addressed in the school settings or the media, in order to raise awareness about the importance of accepting oneself and providing ways to increase self-esteem. Last but not least, attention should be given to the influence of exposure to media overemphasizing slimness and fitness. Because body dissatisfaction can be developed in this kind of media environment, adolescents should be provided with education related to media literacy (60). The results highlight the need for parents, teachers, and healthcare providers to assess adolescents' self-image and provide guidance on pubertal progression and physical activity based on different weight statuses.

Limitations

Our sample has its strength in being a longitudinal cohort study design with a large number of participants and a cluster-based sampling strategy. However, our study had some limitations. First, the study was restricted to a limited choice of questions relevant to self-image. Using two items to evaluate such a complex construct of self-image might be simplistic. Although satisfaction with appearance and physique largely account for self-image during adolescence (61), more questions may be needed to measure the different dimensions of self-image. Secondly, athletic competence was constructed using only three self-reported items rather than standardized fitness tests, such as dashes for speed, vertical and standing long jumps, and distance throwing used to measure coordination and explosive strength (24). These objective measurements may improve or complement the representativeness of physical performance and may require further clarification. Third, the data collected were dated and might not represent the current situation. Readers should be cautious of this time gap between data collection and the proposed secondary data analysis. Despite this, the strength of our study is its longitudinal cohort study design due to collecting prospective observational data over the entire course of the subjects' adolescent period. Analyzing old archived data has arguably been an alternative approach to refining existing literature and inspiring new ideas (62). The analysis should be able to provide some mechanistic explanations regarding the link between weight status and adolescent self-image.

CONCLUSION

The results found that adolescents with a higher BMI were more likely to have a lower self-image, and this association could persist into young adulthood. Dissecting sequential mediation mechanisms, we further found that a higher BMI was associated with lower perceived athletic competence and thus further linked to pooer self-image. The finding on the role of pubertal timing was mixed, though. While a higher BMI was linked to an earlier pubertal timing that further led to lower self-image in females, an earlier pubertal timing might contribute to better perceived athletic competence and higher self-image in males. Obtaining knowledge of the mediating factors linking adolescent body and mind may help guide healthy weight and physical activity behaviors according to different stages of pubertal progression.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: The TYP dataset is archived in the Survey Research Data Archive, managed by the Institute of

Sociology, Academia Sinica, Taiwan. It requires registration, although it is free and open to the public, when accessing the dataset. All the waves can be found by following this link: https://srda.sinica.edu.tw/browsingbydatatype_result.php?category=surveymethodtype=2csid=1.

AUTHOR CONTRIBUTIONS

J-HK and M-CT conceived the study and drafted the manuscript. J-HK, JUH, and C-YL conducted the analysis, while CS, M-CT, and C-YL supervised the analysis. T-HL, Y-CL, Y-HC, and Y-PH contributed the development of study and critically reviewed the manuscript. All authors read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.890751/full#supplementary-material

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Stressful life events and non-suicidal self-injury among Chinese adolescents: A moderated mediation model of depression and resilience

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Stressful life events are associated with an increased risk of non-suicidal self-injury (NSSI) in adolescence, but the mechanisms explaining this association are unclear. Based on the experiential avoidance model of NSSI, and the protective factor model of resilience, the current study tested depression as a mediator and resilience as a moderator of this association. Chinese adolescents ($N = 643$; $M_{age} = 15.91$; 52.10 % female), anonymously completed self-report measures in classrooms. Results showed that stressful life events was linked to adolescent NSSI in part because of adolescent depression, and resilience was a protective factor that buffered this effect. These findings can inspire practitioners to pay attention to the interaction of risk factors and protective factors when providing prevention and intervention for adolescent NSSI.

KEYWORDS

adolescents, stressful life events, resilience, depression, non-suicidal self-injury

Introduction

Non-suicidal self-injury (NSSI) is a perplexing behavior problem. It involves deliberately and directly destroying one's body tissue without suicidal intention, most commonly by cutting or carving oneself (1). Much of the research on NSSI has focused on adolescents, who show a higher rate of NSSI than other age groups (2). The prevalence of adolescent NSSI in China is estimated to be from 15.0 to 41.5% in community samples (3–6). The largest of these studies, with a sample of 18,900 Chinese junior and senior high school students, found that the prevalence of NSSI was 28.5% (5).

NSSI is known to be associated with adolescents' mental health problems (7, 8). In addition, although people do not engage in NSSI with suicidal intent, the behavior is closely related to suicidal behavior (9). Longitudinal results have shown that NSSI is a predictor of adolescents' suicidal behavior, not only a simple correlate (10). The high prevalence and the clinical significance of NSSI in adolescents motivate us to identify risk and protective factors that can inform effective prevention and intervention.

Stressful life events and adolescent NSSI

Stressful life events refer to all kinds of negative events in individual life, which can have a negative impact on individuals' physical and mental health (such as family conflicts, classmate disputes, economic distress, death of relatives, and failure in examination) (11, 12). Previous research showed that stressful life events are strongly correlated with adolescents' risky behaviors (13, 14), consistent with general strain theory (15). In line with this theory, stressful life events have been shown to be associated with adolescent NSSI in correlational studies (16–18) and longitudinal studies (19–21). For example, in a longitudinal study, Baetens et al. (19) found that adolescents' stressful life events were significantly positively associated with NSSI 18 months later.

These studies document a direct link between stressful life events and adolescent NSSI. However, the underlying mechanism of this association, and the factors that may mitigate the risk, remain largely unexplored. Based on the experiential avoidance model of NSSI (22) and the protective factor model of resilience (23), the current research tested depression as a mediator, and resilience as a moderator, of the relationship between stressful life events and adolescent NSSI.

Depression as a potential mediator

Depression is an emotional disorder that causes a persistent feeling of sadness and loss of interest, which is thought be caused in part by an inability to cope with stressful events (24). The first part of the mediation pathway in our model is the association between stressful life events and depression. The experiential avoidance model of NSSI (22) maintains that adolescents who experience stressful life events are more likely to have negative emotions such as depression, which in turn lead to NSSI. There is empirical evidence that stressful life events could increase the risk of adolescent depression (17, 52). In one longitudinal study of 1,094 Chinese adolescents, Chen et al. (52) found that peer victimization (a stressful life event) positively predicted depression six months later.

The second part of the mediation pathway that we tested was the association between adolescent depression and NSSI. It is generally assumed that NSSI serves the function of distracting the individual from emotional pain, an idea expressed by the experiential avoidance model of NSSI (22). Two longitudinal studies have shown a link between depression and later NSSI among adolescents (25, 53). For example, Wu et al. (25) found that depressive symptoms were correlated with NSSI one year later in a sample of 813 Chinese adolescents. Previous research also demonstrated that negative emotions could mediate the association between stressful life events and NSSI. For example, in a longitudinal study, Zhu et al. (6) found that anxiety symptoms mediated the relationship between cybervictimization and NSSI in a sample of 1987 adolescents in Chinese. Similarly, in a sample of 2464 Italian adolescents, Cipriano et al. (16) found that anger expression mediated the relationship between parental rejection and direct and indirect forms of NSSI.

Thus, based on theory and empirical research, we assert that depression is an important intermediary factor in the process by which stressful life events increase the risk of adolescent NSSI.

Resilience as a moderator

Not all adolescents who experience stressful life events, and not all adolescents who experience depression, engage in NSSI. This suggests that there may be factors that lower the risk of NSSI even under these adverse conditions. One of these factors could be the adolescent's resilience. Resilience refers to an individual's ability to positively adapt to the environment even through adversity, including two critical conditions: exposure to significant adversity (such as exposure to community violence, parent mental illness, and poverty) and positive adaptation (good academic performance, positive relationships with teachers or classmate) (26, 27). According to the protective factor model of resilience (23), resilience can reduce the effects of environmental risk on negative outcomes. In our study, these ideas correspond to the environmental risk due to stressful life events and the negative outcomes of depression and NSSI.

There is also evidence that resilience could be an important influence on the mediation process of interest in the current study. There are several studies that can inform our hypotheses. Wang and Liu (28) found that resilience weakened the impact of stressful life events on delinquency in a sample of 306 Chinese adolescents whose parents had moved away in search of work. Ye et al. (29) found that resilience weakened the impact of peer victimization on depression in a sample of 721 Chinese children. Wu et al. (30) found that resilience buffered the association between depression and NSSI in a sample of 813 adolescents. In the current research, we examined whether

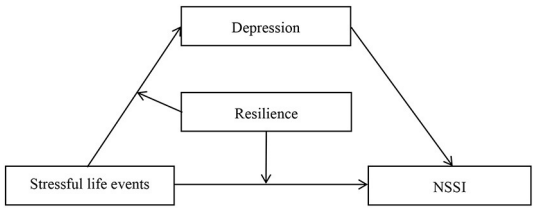

FIGURE 1
The proposed mediated moderation model. NSSI, non-suicidal self-injury.

resilience buffered the risk effects of stressful life events on adolescent NSSI.

The present study

On the basis of the experiential avoidance model of NSSI (22) and the protective factor model of resilience (23), this study tested a moderated mediation model in which stressful life events are a risk factor for adolescent NSSI *via* depression, and resilience is a protective factor against NSSI. The proposed model can be seen in Figure 1.

It should be noted that the current study was conducted during the COVID-19 pandemic. During this period several studies showed a negative impact of COVID-19 on adolescents' psychology (48, 49) and behavior (31–33). Thus, the stressful life events reported by the adolescents were occurring in the context of overarching, long term stress. In this respect their scores on the measure of stressful life events may be an underestimate of their true stress. Scores on the other study variables might also be affected by life during the pandemic; depression and NSSI might be higher, and resilience might be lower. This is an unfortunate but unique opportunity to study this group of adolescents, who can be considered high-risk because of their experiences related to COVID-19. Thus, this study exaned the prevalence rate of NSSI among adolescents during the COVID-19 epidemic.

We proposed the following hypotheses: (1) The prevalence rate of NSSI among adolescents will be higher during the COVID-19 epidemic than it was before the pandemic; (2) stressful life events will be positively associated with adolescent NSSI; (3) depression will mediate the association between stressful life events and NSSI; (4) resilience will weaken the direct and indirect relations between stressful life events and adolescent NSSI. Specifically, resilience will buffer the direct effect of stressful life events on NSSI, and will buffer the association between stressful life events and depression.

Methods

Participants

A random cluster sampling method was used to recruit students from a middle school in Hubei Province, in central China. A total of 643 students participated in our study. No adolescents had obvious mental or physical illness. The average age was 15.91 years old (SD = 0.74; age range: 14–17 years). There were 335 girls (52.1%) and 308 boys (47.9%), and 78.5 % had one or more sibling.

Procedure

This research was approved by the Ethics Committee of Hubei University of Science and Technology. The data were collected from March to April 2022. Parents provided written informed consent and adolescents provided assent. The adolescents were told that they could withdraw from the study at any time without penalty. They were also told that their responses would be kept confidential. All the data collected were anonymous. The questionnaires were administered by the researchers of this study and trained graduate students under their supervision. All participants completed the self-report measures in their classrooms.

Measures

Stressful life events

The number of stressful life events was measured with the Chinese Language Adolescent Life Events Scale (12). Participants were asked to report the seriousness of each listed event in the past year (such as "family conflicts," and "classmate disputes"). There are 27 items on the scale, and each item is scored on a 6-point scale (0 = none to 5 = very serious). Mean scores were used for analysis, with higher scores indicating higher severity of stressful life events. Cronbach's alpha in this study was 0.93.

Depression

Depression was measured with the Chinese version (34) of the Center for Epidemiological Studies-Depression Scale (35). Participants were asked to assess how often they experienced depressive symptoms in the past week (such as "I feel depressed," "I feel lonely," and "It's hard for me to concentrate"). There are 20 items on the scale, and each item is rated on a 4-point scale (0 = <1 to 3 = 5–7 days). Mean scores were used for analysis, with a higher score indicating a higher level of depression. Cronbach's alpha in this study was 0.85.

Resilience

Resilience was measured with the Resilience Scale for Chinese Adolescents (36). This questionnaire includes 27 items (such as "After experiencing setbacks, I generally become more mature and experienced") covering five dimensions: goal focus, interpersonal assistance, family support, emotional control, and positive cognition. Each item is rated on a 5-point scale (1 = almost always untrue to 5 = almost always true). Mean scores were used for analysis, with higher scores indicating a higher level of resilience. Cronbach's alpha in this study was 0.76.

NSSI

We assessed twelve NSSI behaviors (37) selected from the Deliberate Self-Harm Inventory (38), such as cutting, carving, burning, and severely scratching oneself. These 12 items were chosen because they are common forms of NSSI among adolescents (1), and have been shown to have good psychometric properties in previous studies of Chinese adolescents (25, 30, 37, 39). Participants were asked to report how often they had engaged in NSSI in the past year. Each item is rated on a 6-point scale (0 = never to 5 = 5 or more times). The 12 item scores were added, with higher scores indicating a higher frequency of NSSI. Cronbach's alpha in this study was 0.91.

Control variables

There are significant gender differences in NSSI among adolescents, with girls being more at risk than boys (40, 41). NSSI is also associated with age (1, 2). The students all came from neighborhoods near the school, and so they had a similar socioeconomic status. Therefore, the analyses controlled for age and gender (0 = female; 1 = male).

Statistical analyses

We used SPSS 21.0 to generate descriptive statistics and correlations. Mediation and moderation effects were calculated in Mplus 8.3. Missing data were handled *via* the full information maximum-likelihood (FIML) estimation method. We used bootstrapping with 2000 iterations to test the significance of each direct and indirect path. By convention, the model fit is considered good when $\chi^2/df < 5$, CFI >0.90, TLI >0.90, RMSEA < 0.08, and SRMR < 0.08 (42).

Results

Preliminary analyses

The results showed that 237 of the 643 adolescents endorsed one or more NSSI behaviors in the past 12 months, an estimated 12 month prevalence of 36.9%. The means, standard deviations, and correlation coefficients for all research variables are displayed in Table 1. Stressful life event scores were positively correlated with depression ($r = 0.43$, $p < 0.001$) and NSSI ($r = 0.22$, $p < 0.001$); depression was also positively correlated with NSSI ($r = 0.31$, $p < 0.001$). Resilience was negatively correlated with stressful life events ($r = -0.25$ $p < 0.001$), depression ($r = -0.39$, $p < 0.001$) and NSSI ($r = -0.15$, $p < 0.001$).

TABLE 1 Descriptive statistics and correlations for all variables.

Variable	1	2	3	4	5	6
1. Gender	1.00					
2. Age	0.07	1.00				
3. SLE	0.03	0.05	1.00			
4. Resilience	−0.02	0.05	−0.25***	1.00		
5. Depression	−0.08*	0.04	0.43***	−0.39***	1.00	
6. NSSI	0.04	0.05	0.22***	−0.15***	0.31***	1.00
Mean	0.48	15.91	1.27	3.23	0.73	1.33
SD	0.50	0.74	0.75	0.39	0.43	3.54

*$p < 0.05$, ***$p < 0.001$. Gender was dummy coded as 1 = male, 0 = female. SLE, stressful life events; NSSI, non-suicidal self-injury.

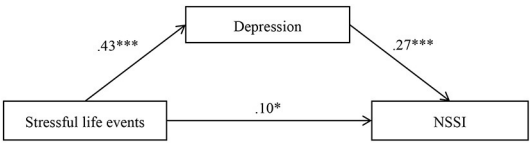

FIGURE 2
Model of the mediating role of depression between stressful life events and NSSI. NSSI, non-suicidal self-injury. The numbers are standardized regression coefficients. Path coefficients between control variables (age and gender) and each of the variables in the model are not displayed. Of the paths involving control variables, gender (dummy coded as 1 = male, 0 = female) was significantly related to depression ($b = -0.10$, $SE = 0.04$, $p < 0.01$). *$p < 0.05$. ***$p < 0.001$.

Mediation effect of depression

The hypothesized mediation model showed a good fit to the data, $\chi^2/df = 2.23$, CFI = 0.99, TLI = 0.96, RMSEA = 0.04, and SRMR = 0.02. Figure 2 displays the results for each path in the proposed model. Stressful life events positively predicted depression ($b = 0.43$, $SE = 0.03$, $p < 0.001$) and NSSI ($b = 0.10$, $SE = 0.04$, $p < 0.05$), and depression positively predicted NSSI ($b = 0.27$, $SE = 0.05$, $p < 0.001$). Bootstrapping analyses showed that depression partially mediated the pathway from stressful life events to NSSI (indirect effect = 0.12, $SE = 0.03$, 95% CI = [0.07, 0.17]).

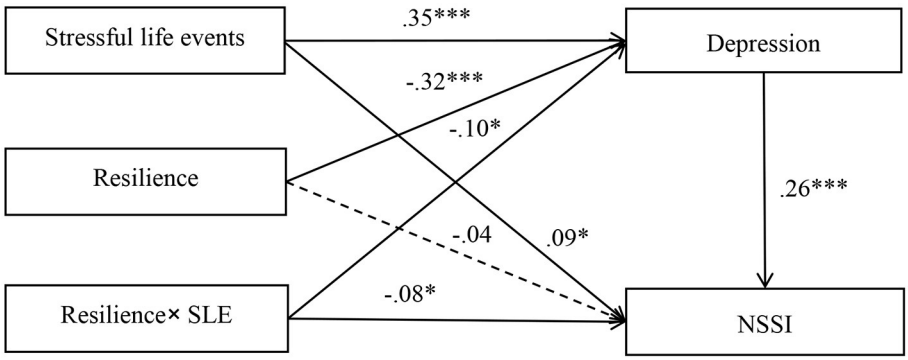

FIGURE 3
Model of the moderating role of resilience on the direct and indirect relationship between stressful life events and NSSI. NSSI, non-suicidal self-injury. The numbers are standardized regression coefficients. Path coefficients between control variables (gender and age) and each of the variables in the model are not displayed. Of the paths involving control variables, gender (dummy coded as 1 = male, 0 = female) was significantly associated with depression ($b = -0.11$, $SE = 0.03$, $p < 0.01$). *$p < 0.05$. ***$p < 0.001$.

Moderated mediation

The moderated mediation model represented in Figure 3 revealed a good fit to the data: $\chi^2/df = 1.36$, CFI = 0.99, TLI = 0.99, RMSEA = 0.02, and SRMR = 0.02. Stressful life events ($b = 0.09$, $SE = 0.04$, $p < 0.05$) and depression ($b = 0.26$, $SE = 0.06$, $p < 0.001$) were significantly associated with NSSI. Stressful life events ($b = 0.35$, $SE = 0.03$, $p < 0.001$) and resilience ($b = -0.32$, $SE = 0.04$, $p < 0.001$) were significantly associated with depression. More importantly, resilience significantly moderated the impact of stressful life events on depression ($b = -0.10$, $SE = 0.04$, $p < 0.05$) and NSSI ($b = -0.08$, $SE = 0.03$, $p < 0.05$).

We conducted simple slopes tests to better understand the results regarding resilience as a moderator. As depicted in Figure 4, the relationship between stressful life events and depression was significant at both high (at 1 SD above the mean) and low (at 1 SD below the mean) levels of resilience, but the association was weaker when resilience was high. To be specific, when youth showed lower resilience, the relation between stressful life events and depression was significant ($b = 0.24$, $SE = 0.03$, $p < 0.001$). However, when youth showed higher resilience, this relation was weaker, although still statistically significant ($b = 0.13$, $SE = 0.03$, $p < 0.001$). Figure 5 shows the relationship between stressful life events and NSSI at low (at 1 SD below the mean) and high (at 2 SD above the mean) levels of resilience. When youth showed lower resilience, the relation between stressful life events and NSSI was significant ($b = 1.44$, $SE = 0.29$, $p < 0.001$). However, when youth showed higher resilience, this relation was non-significant ($b = 0.37$, $SE = 0.32$, $p > 0.05$). Namely, resilience weakened the effects of stressful life events on depression and NSSI.

Discussion

The results showed that the prevalence of adolescent NSSI in our sample was 36.9%, which is similar to the rates of 32% (43) and 40.9% (33) reported in other samples of adolescents during the COVID-19 pandemic. This is higher than the rate of 20.8% (37) reported in a sample of adolescents before the COVID-19 outbreak, in a study using the same NSSI measurement tool as in our study. Because of the high prevalence and clinical significance of these behaviors, the topic is worthy of more attention during the COVID-19 pandemic. In the current study we tested factors that increased and decreased the risk of NSSI in a sample of Chinese adolescents aged 14–17.

Although previous studies have demonstrated that depression could mediate the link between stressful life events and NSSI, resilience as an important moderator is the major strength of this work. Previous research has focused on just parts of the moderated mediation model we test in the current study. Wang and Liu (28) studied whether resilience buffered the association between stressful life events and delinquency. Other researchers (29) showed that that resilience weakened the impact of peer victimization on depression. None of these studies has established that resilience buffered the direct and indirect relations between stressful life events and adolescent NSSI. Guided by the experiential avoidance model of NSSI (22) and the protective factor model of resilience (23), the current research filled in these gaps by examining the mediating role of depression, and the moderating role of resilience, in the links between stressful life events and NSSI. The results supported our hypotheses concerning the environmental context in which NSSI occurs, and the role of individual differences in navigating that environment.

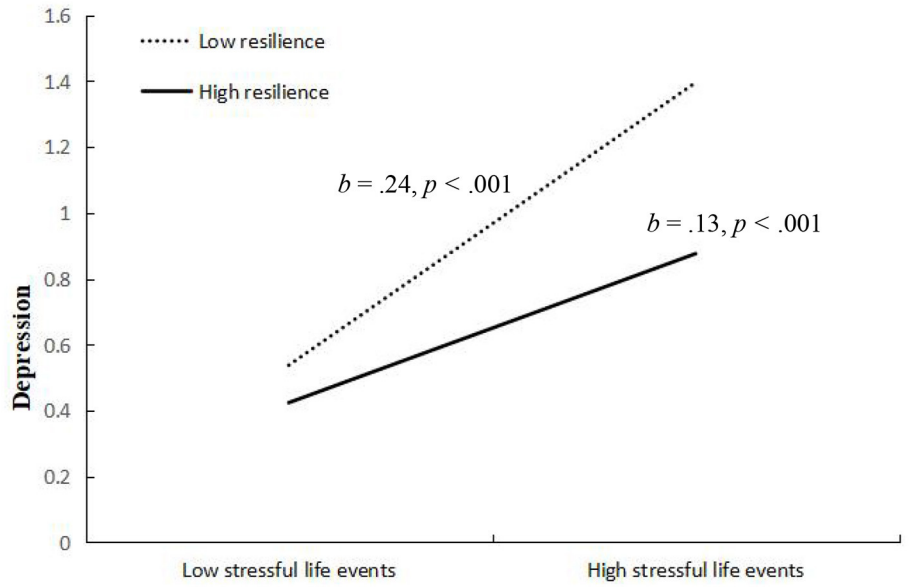

FIGURE 4
Interactive effect of stressful life events and resilience on depression. Resilience is graphed for two groups of participants: high resilience (1 SD above the mean) and low resilience (1 SD below the mean).

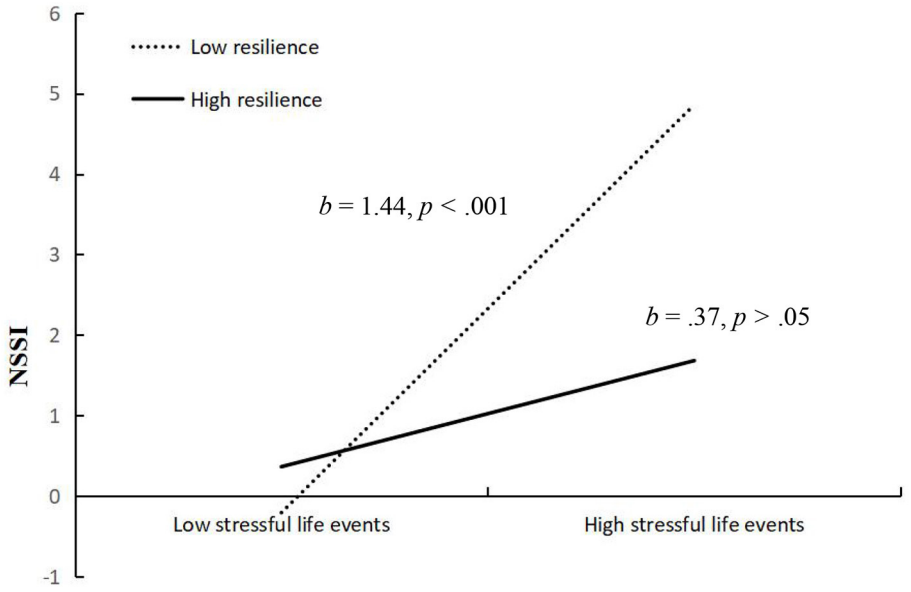

FIGURE 5
Interactive effect of stressful life events and resilience on NSSI. NSSI, non-suicidal self-injury. Resilience is graphed for two groups of participants: high resilience (1 SD above the mean) and low resilience (1 SD below the mean).

Stressful life events and NSSI

The findings supported our hypothesis that adolescents who experienced stressful life events are more likely to engage in NSSI. This result confirmed the findings from previous studies that showed a significant positive correlation between stressful life events and adolescent NSSI (16–18, 44). This result also is consistent with what would be expected based on the general strain theory (15). These findings suggest that reducing stressful life events would be beneficial in reducing adolescent NSSI.

The mediating role of depression

The findings supported our hypothesis that depression mediates the association between stressful life events and adolescent NSSI. Thus, depression appears to be one of the explanatory mechanisms that might explain why adolescents who experience stressful life events are more likely to engage in NSSI. These results are consistent with those from previous studies that found that stressful life events could increase the risk of depression (17, 21, 51, 52). Our results suggest that we should pay more attention to adolescents who have experienced stressful life events and teach them how to alleviate their depressive moods.

Our results also suggest that depression in response to stressful life events could in turn increase the risk of NSSI. According to the experiential avoidance model of NSSI (22), negative emotions usually precede NSSI, and adolescents may engage in NSSI as a means of avoiding these emotions. Our findings are consistent with this model and with other research showing that negative emotions (such as depression, anxiety, and anger expression) are a particularly significant trigger of adolescent NSSI (6, 16, 30, 44, 45, 53). Our results, together with those of earlier research, provide evidence of a mediated pathway in which stressful life events increase the risk of negative emotions, which in turn increases the risk of NSSI.

The moderating role of resilience

Consistent with our hypothesis and with the protective factor model of resilience (23), we found that resilience moderated the mediation effect of depression in the relationship between stressful life events and NSSI. To be specific, high levels of resilience significantly weakened the impact of stressful life events on depression and on NSSI. These findings were in alignment with previous studies that found that resilience buffered the association between stressful life events and adolescents' negative outcomes (28–30).

According to the resilience theory (23), resilience may be a buffer against stress because it helps adolescents who experience stressful life events to mobilize their internal protective resources (such as coping skills and self-efficacy) and external protective resources (such as parental support and adult mentoring). In addition, adolescents with high levels of resilience have a positive outlook on life, and see adversity (such as stressful life events) as temporary (46). These characteristics should leave them less prone to depression and NSSI in the face of stressful life events.

Limitations and future directions

First, this research was conducted using a cross sectional study design. Future studies can adopt a longitudinal design with multiple time points to further explore the bidirectional relationships between stressful life events, resilience, depression and NSSI. Second, because all data were based on adolescents' self-reports, the associations may be inflated due to shared method bias. Future research should use a variety of methods (such as interviews) and information sources (such as peers) to collect data. Third, this study only tested the mediating role of depression in the relationship between stressful life events and adolescent NSSI, and future research can test the mediating roles of other emotions such as anxiety (6), anger expression (16), and shame (47). Moreover, this study only explored one moderator, namely resilience, and future research can test whether other factors such as regulatory emotional self-efficacy (50) protect against the effects of stressful life events on adolescents' depression and NSSI. Fourth, the sample was recruited from one school in Central China, and the results need to be replicated in other Chinese and non-Chinese samples. Finally, Covid-related life events and stress, family status, and financial problems have not been assessed and need to be assessed in further studies.

Implications for practice

The current research has two important implications for prevention and intervention. First, depression appears to be a mechanism linking stressful life events to adolescent NSSI, and reducing depression may help to prevent the influence of stressful life events on NSSI. For instance, schools can teach students to master positive and effective emotion regulation methods by starting mental health courses, which can help reduce depression in time. Second, the results showed that resilience was a protective factor that buffered against the effect of stressful life events. Interventionists can improve the level of adolescents' resilience by developing social skills, self-efficacy, and academic skills (23).

Conclusions

The current study contributes to the relevant literature by highlighting the roles of depression and resilience in the relationship between stressful life events and NSSI among Chinese adolescents. Results showed that depression is a potential mechanism linking stressful life events to adolescent NSSI, and resilience may be a protective factor that buffers against this risk process. Specifically, the adverse impact of stressful live effects on NSSI through depression was weaker in adolescents with higher resilience. These findings can inspire practitioners to pay attention to the interaction of risk factors and protective factors when providing prevention and intervention for adolescent NSSI.

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 Hubei University of Science and Technology. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

CW, ZL, and XJ conceived and designed the research. CW and QX collected and analyzed the data. CW, TM, QX, and CY reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

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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.

Publisher's note

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Generation COVID-19 and bodily disorders: Hyperbolic narratives and a developmental psychopathology perspective

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Starting from spring 2020, newspapers headlines and studies have suggested that the COVID-19 pandemics had a negative impact especially on the mental health of children and adolescents, so that terms like "lost generation" or "generation COVID-19" have been used to define youth in time of pandemic crisis. Similarly, international health agencies reported an increase in depression and anxiety among adolescents in COVID-19 time, but also a rise in bodily disorders, such as non-suicidal self-injury and eating disorders. However, scientific data on this matter are not as clear as they seem and theoretical-clinical proposals regarding the processes involved are lacking. Focusing specifically on bodily disorders in adolescents during COVID-19, the aim of this perspective paper is to review this issue and propose a novel viewpoint on it. Firstly, data regarding frequency and phenomenology of bodily disorders in adolescence before and during the pandemic will be presented to underline possible discrepancies, gaps, or hyperbolic descriptions in the literature published after the COVID-19 outbreak. Secondly, a specific theoretical-clinical perspective will be proposed, that is, a developmental psychopathology perspective which attempts to frame these phenomena in a more nuanced and complex way, taking into account the role of developmental processes in adolescence age and its difficulties in the specific, subjective life-context of the individual, when intertwining with vulnerability factors and stressful life events. As such, the function of the body for the adolescent as a primary mean for regulating the self-other relationship and developing a greater sense of self-agency will be highlighted. The final objective is to help the clinician in developing both a critical thinking about the data that are shared in public outlets and an intervention that takes into account the complexity of contemporary psychopathological phenomena.

KEYWORDS

bodily disorders, non-suicidal self-injury, eating disorders, adolescents, COVID-19, developmental psychopathology

Introduction

Since the beginning of the COVID-19 pandemic in 2020, media and journals have highlighted an increasingly serious alarm regarding its negative effects on the mental health of young people, so that terms like "lost generation" or "generation COVID-19" have been used to identify youth in time of pandemic crisis, that is, those who have had points of transition in their life disrupted (1–5).

Similarly, WHO (6) and other international health agencies (7), together with a certain number of studies (8–14) reported an increase in depression and anxiety among adolescents in COVID-19 time, but also a rise in bodily disorders, such as non-suicidal self-injury and eating disorders. These data, if absolutized, shed a dark light on the future of mental health of youth. However, things are not always as simple as they seem, especially when psychopathology is at stake.

Focusing specifically on bodily disorders in adolescents during COVID-19, the aim of this perspective paper is to review this issue and propose a novel viewpoint on it. Firstly, data regarding frequency and phenomenology of bodily disorders in adolescence before and during the pandemic will be presented to underline possible discrepancies, gaps, or hyperbolic descriptions in the literature published after the COVID-19 outbreak. Secondly, a specific theoretical-clinical perspective will be proposed, that is, a developmental psychopathology perspective which attempts to frame these phenomena in a more nuanced and complex way, taking into account the role of developmental processes in adolescence age and its difficulties in the specific, subjective life-context of the individual, when intertwining with vulnerability factors and stressful life events. As such, the function of the body for the adolescent as a primary mean for regulating the self-other relationship and developing a greater sense of self-agency will be highlighted.

The final objective is to help the clinician in developing both a critical thinking about the data that are shared in public outlet and an intervention that takes into account the complexity of contemporary psychopathological phenomena.

Bodily disorders in adolescents during pandemic time: What do we know so far?

From a quickly glance at the media and newspapers headlines dated 2020–22 (15–17), and especially the Italian ones (18–23), the impression is of a real explosion of psychopathological phenomena related to the body in adolescents, since the COVID-19 pandemic has begun. In particular, non-suicidal self-injury (NSSI) (24), i.e., deliberately injuring one's own body tissue without suicidal intent, such as cutting or burning, and eating disorders (EDs), i.e., disturbed eating-related behaviors, such as anorexia or bulimia nervosa, appear to have increased dramatically in the young population over the past 2 years. But is the current situation really explosive or is there a hyperbole in its narration? To clarify things, it is necessary to look at the data provided by recent scientific literature. The main findings can be divided into three topics: (a) epidemiological data; (b) risk factors; (c) access to healthcare.

First of all, epidemiological data. Regarding NSSI, as underlined by Plener (25), there is currently a lack of knowledge of the impact of COVID-19 specifically on the prevalence of NSSI in adolescents, as most of the studies do not clearly distinct suicidal from non-suicidal behaviors. The few existing ones across different countries find an increase during the pandemic compared to pre-pandemic time, with cutting as the most prevalent method. For example, Zetterqvist et al. (26), analyzing life-time prevalence of NSSI in high school students in Sweden at three different time points, report very similar percentages of NSSI in 2011 and 2014 (17.2 vs. 17.7%), and an increase to 27.6% during the 2020–2021 period; however, authors specify that it is not clear if that increase is due to the pandemic or it appeared already before its onset. Similarly, Tang et al. (27) highlight a NSSI prevalence of 40.9% among 1.060 junior high school students in Taiwan during the COVID-19 outbreak (cutting = 21.6%), a rate estimated as increasingly higher than that found in previous international investigations on adolescent samples (rates between 13 and 36%). However, they also specify that no causal relationships could be determined due to the cross-sectional nature of the study. Interestingly, in most of the studies the prevalence of NSSI is significantly higher in girls and transgender/non-binary adolescents rather than in boys, and this seems valid in both pre- and post-pandemic times.

Regarding EDs, some studies report an increase in the number and severity of new and pre-existing adolescents suffering with eating disorders during the pandemic compared to pre-pandemic time, particularly for anorexia nervosa. For example, Taquet et al. (28), analyzing the electronic health records (EHR) of 5.2 million US people aged under 30 (mean age = 15.4 years), find that, after a decrease in the early portion of 2020 (which could reflect the marked reduction in all diagnoses made in EHR network during that period), the incidence of a first diagnosis of an ED has increased of 15.3% throughout the rest of 2020 compared to previous years, such that the relative risk had exceeded 1.5 by the end of the year. However, authors specify that the increase was limited to girls and mostly related to anorexia nervosa diagnoses. Moreover, Gao et al. (29), in a systematic review of recent studies on ED patients and COVID-19, observe that women and young people had greater concern about their body image and appearance, more difficulties in regulating eating, and a greater risk of worsening ED symptoms during the lockdowns. Conversely, authors also underline that some participants with anorexia nervosa reported relieving symptoms during the same period, probably thanks to e-therapy, more stable family relationships, and fewer social stressors. Finally, Graell et al. (30), conducting a study on Spanish young people with EDs, find that the patients with most severe psychopathology (25%) presented both NSSI and reactivation of ED symptoms.

Secondly, risk factors. Regarding this matter, just a few studies so far have tried to identify the mediating/moderating effect of risk factors in the relationship between pandemic and emerging or worsening of NSSI or EDs. As for NSSI, Robillard et al. (13), for example, using a sample of Canadian adolescents,

report that the relationship between COVID-19 pandemic stress and NSSI was fully mediated by two dimensions of emotion regulation (ER) difficulties, namely non-acceptance of emotional responses and limited access to ER strategies. Similarly, Tang et al. (27), using a sample of Taiwan teenagers, suggest that the NSSI group during the pandemic mostly consisted of girls scoring significantly higher in neuroticism, depression, impulsivity, alexithymia, virtual social support, dissatisfaction with academic performance, and lower in subjective wellbeing, self-esteem, actual social support, as well as family function than the non-NSSI group. As for EDs, Cooper et al. (31), for example, recommend to take into account two types of risk factors that may increase ED risk during and following the COVID-19 pandemic: (a) eating-disorder specific risk factors (i.e., food insecurity, fatphobic messaging, and restricted healthcare access); (b) broader risk factors (i.e., stressful life events, anxiety, social isolation and decreased social support, trauma and abuse, perfectionist expectations, and gender role stress). Similarly, Linardon et al. (32), in a systematic scoping review of research on COVID-19 impact on EDs, find that those most susceptible to symptoms escalation and mental health worsening during pandemic were: confirmed eating disorder patients, at-risk populations (young women, athletes, parent/carers), and individuals highly anxious or fearful of COVID-19.

Thirdly, access to healthcare. Regarding NSSI, findings from different countries report a significative reduction in the use of psychiatric services by children and young people during the early phase of the pandemic. For example, Ougrin et al. (33), in a retrospective cohort study examining the differences in hospital emergency psychiatric presentations for non-suicidal self-injury of children and adolescents during the COVID-19 lockdown in March-April 2020 compared with the same period in 2019, find a noticeable decrease in recorded emergency presentations and in inpatient psychiatric admissions during the COVID-19 lockdown. Similarly, Yunus et al. (34), in a systematic review analyzing studies published between January 2020 and March 2021, show a considerable reduction in the use of psychiatric services by children and young people aged 0–24 during the initial phase of the pandemic, compared to pre-pandemic time. According to Chen (35), this reduction could be merely due to the lockdown restrictions, but also to other reasons, such as fear of being infected by COVID-19 or reduction of psychosocial risk factors during lockdown, such as less academic pressure and peer bullying and increased parental care. However, as highlighted by Plener (25) and remarked by Zetterqvist (26), most of the studies on this topic do not clearly separate suicidal from non-suicidal behaviors, so any specifically inference on the latter is risky and incorrect.

Regarding EDs, available literature is lacking systematic reviews, whereas single published studies report an increase in the healthcare access by teens with eating disorders during the pandemic, compared to pre-pandemic time. For example, Otto et al. (36), collecting data on patients aged 10–23 years admitted to their children's hospital in Michigan for restrictive EDs from March 2017 through March 2021, find that medical admissions among adolescents with EDs increased significantly during the COVID-19 pandemic, with the number of admissions during the first 12 months of the pandemic more than double the mean for the previous 3 years. Similarly, Lin et al. (37), analyzing monthly summary data on ED admissions to young medical services in children's hospital in Boston from January 2018 to February 2021, highlight that inpatient admissions, hospital bed-days, and outpatient care-related inquiries increased on average over time post-pandemic compared to pre-pandemic time. However, outpatient assessments decreased precipitously initially following COVID-19-related limitations, and rose quickly back to baseline. This latter finding is in line with the reduction of access to healthcare services by young people presenting non-suicidal self-injury, reported by the aforementioned studies. Nevertheless, such studies do not allow data generalization, as they reflect the experience of a single institution in a specific geographic area having also specific COVID-19 conditions and restrictions, as the authors themselves specify in their final considerations.

Beyond the pandemic: The role of the body for the adolescent and an integrative framework to understand

This quick and certainly not exhaustive overview of the most relevant data available on bodily disorders in adolescents during the COVID-19 pandemic highlights a far more complex and nuanced scenario than what appears from newspapers headlines.

First of all, increase is not (sudden) explosion. The fact that NSSI and EDs in young people may have increased during the pandemic does not mean that they are born in pandemic time. Rather, it means that such phenomena must be evaluated in a much broader time perspective, as they were already widespread in the young population long before the pandemic, and probably also underestimated due to the social stigma frequently related to these disorders, that might obstruct help-seeking behaviors and contribute to decreased visibility and poor general awareness of these disorders in society (35, 38). The scientific community has been signaling an alarm in this sense for at least 10 years (39, 40), but media attention has only recently risen significantly.

Secondly, correlation is not causation. The fact that bodily disorders in adolescents have potentially increased *during* the pandemic does not mean automatically that they have increased *because of* the pandemic. Various mediating/moderating factors could be involved in this relationship, but they have not been considered in the published studies. This issue brings out another closely related one: significant methodological limits in the clinical studies published during the COVID-19 pandemic years call for caution in interpreting findings (6, 41, 42). In fact, most of them were observational, involved

convenient samples, underwent shorter peer-review evaluation, and made comparison to pre-pandemic experiences that were retrospective recall or comparison to pre-pandemic cohorts without adequate control of differences between samples.

Thirdly, and most importantly, psychopathology is a complex matter involving multiple factors to account for single phenomena. According to cited findings, not all adolescents have experienced bodily disorders during the pandemic, and those who encountered difficulties in this regard have done it in different ways. For example, at-risk subgroups of adolescents (i.e., adolescents with pre-existing mental difficulties) are identified in all studies as the most prone to bodily disorders during the lockdown, although some of them report relieving rather than worsening symptoms during the same period, thanks to better family conditions and fewer social stressors. So, understanding such behaviors is not so simple and there is need to open up the perspective. In other words, psychopathological conditions must be located in the complex intertwining of life-context and mind-body relationship of the individual. Reasons and meanings must also be explored.

For all these reasons and given the urgency of developing a tailored intervention for these contemporary conditions, we propose to place bodily disorders in adolescents during the pandemic within the theoretical-clinical framework of developmental psychopathology perspective. Developmental psychopathology is an interdisciplinary field that has been developed between late 1970 s and early 1980 s (43, 44) and can be defined as "an evolving scientific discipline whose predominant focus is elucidating the interplay among the biological, psychological, and social contextual aspects of normal and abnormal development across the life span" [(45), p.1]. This field is distinct from clinical child psychology and focuses on the origins and courses of individual patters of behavioral maladaptation, with a particular attention to both risk and protective factors that delineate pathways of risk and resilience (46), thus painting a more complicated, flexible picture of psychopathology emerging through the combination of many factors shifting across time, some of which are deeply rooted in our biology (i.e., genetic) and others exist in our outside environments (i.e., parenting). Today developmental psychopathology is considered "an integrative framework that links different scientific disciplines, theories, and research strategies to understand better how individuals adapt and develop risk for psychopathology" [(47), p.19].

This kind of integrative framework is especially useful for understanding psychopathology in youth (47). In fact, adolescence is a particularly compelling phase of development, carrying a heavy load of developmental tasks to perform, due to the intensity of the biological, psychological and social changes faced and calling for a profound reorganization of the identity. Adolescent is no longer a child but not yet an adult. "Consequently, the flux and renegotiation inherent in this developmental period increase the potential for both internal and external conflict" [(48), p.6]. For all these reasons, adolescence has been defined as a period of "storm and stress" (49), and the problems in adjustment presented by a few were generalized as normative experiences for all adolescents (50). Certainly, the storm and stress of adolescence is neither universal nor inevitable (48). Nevertheless, adolescence does generate more psychological turmoil than either childhood or adulthood (51), thus bringing considerable stressors and compromising health (52).

Not surprisingly, literature and research underline a rise in rates of psychopathology during this phase (47, 53). Particularly, externalizing (e.g., aggression and conduct disorders) and internalizing problems (i.e., depression and anxiety) are two empirically derived dimensional constructs that have been used frequently to operationalize adolescent problems (54, 55), and that may be just transient symptoms disappearing in adulthood or, rather, start during childhood and continue into adolescence and beyond (56). Also, new problems such as personality disorders and eating disorders appear for the first-time during adolescence (57, 58). So, adolescence is a period characterized by both continuity and change in psychopathology (47, 56).

The body of the adolescent is the catalyst of all this "continuity and change." As suggested by Diem-Wille [(59), p.4], also referring to Freud (60): "There is no period—aside from the time in the womb—when the body alters as much as in puberty. Bodily changes are subject neither to a person's will nor their control, erupting and eliciting fiery emotions in the adolescent." Especially during this period of fundamental physical change, the body is most intimately linked to the ego (59). As Freud [(61), p.253] underlines: "The ego is always a body ego."

Since all dimensions from the relatively peaceful latency period are in flux, the adolescent now finds a kind of refuge in his body, even though it is also a source of insecurities and fears as it rapidly changes. If he/she suddenly knows nothing about himself /herself (values, desires, position in the world), at least he/she can control his/her own body, or, better, that is the illusion.

Following this perspective, the body can be seen as an instrument -the one closest to hand- for the adolescent to adapt to the many internal/external changes, and its possible symptoms as a way for him/her to regulate the relationship between self and the world in a very turbulent time of life. This could be particularly true and violent in young people experiencing more severe psychopathology, for example those with comorbid internalizing and externalizing problems, who resemble a severe at-risk state in which the predictive value for psychopathology increases over time (56). In fact, in the developmental psychopathology view, disorders and diseases must be seen not as a static condition but as a dynamic transaction between intra and extra organismic forces, or as consequences of the active efforts of each individual to adapt to their environment (62). According to our perspective, bodily disorders (especially NSSI and EDs) can be located within this frame of meaning.

In fact, over the years several authors, clinicians, and scientists from different theoretical points of view have developed reflections and models to understand these behaviors. They all agree that bodily disorders have a specific function in the psychic economy of a person with a specific vulnerability in terms of body-mind integration and living specific environmental challenges. They are an immediately effective method, through the body, of regulating one's affective/cognitive experience and/or influencing one's social environment in a desired way, being maintained by intrapersonal or interpersonal vulnerability factors with reinforcement processes (63–72). In this view, bodily disorders in adolescents during the COVID-19 pandemic acquire a completely different depth compared to what appears from the newspapers: not incomprehensible "bolts from the blue," but emerging phenomena within a complex dynamic of internal-external factors regulation in the subjective experience of a person in effort to relate to his/her life-context. We suggest to explore this whole network of risk and protective factors within a long-time span to understand complex clinical phenomena in present time and their possible course in the future.

Discussion

A number of headlines referring to scientific studies have raised an alarm about a possible increase of bodily disorders, particularly NSSI and EDs, in adolescents during the COVID-19 pandemic. However, as highlighted in this paper, several issues call for caution in interpreting these data.

First of all, the true picture of mental health among young people is more complex than that portrayed in the news headlines (1). A hyperbolic style in recent news dramatically relating increased bodily disorders to the pandemic *per se* risks to obscure the complex network of factors influencing such relationship. The same can be said of studies highlighting the correlation between COVID-19 and increased disturbances without using the methodological complexity necessary to derive cause-and-effect relationships.

Secondly, the social stigma, often connected with this kind of disturbances, has not at all or little been considered in the present circumstances. As previously underlined, considerable stigma and self-stigmatization associated to NSSI and EDs might inhibit help-seeking behavior and contribute to poor general awareness of these disorders in society (38). In this sense, the pandemic might have exacerbated trends already present but not visible in the adolescent population, thus highlighting the status of adolescents' mental health (1) and legitimatizing somehow help-seeking behaviors (e.g., bodily disorders), previously held back by greater shame and fear.

Thirdly, risk and protective factors are imperative to map the course of these disorders and delineate psychopathological patterns that are dynamic and individual, rather than static and collective. So, conceptualizing such disturbances in a developmental psychopathology perspective can be helpful for bringing prevention and developing tailored treatments. It can also be useful for better identification of adolescents who are more prone to be resilient despite increasing current stressors, and those for whom, instead, increased exposure to stress could result in amplified psychological problems.

In conclusion, the pandemic has certainly had wide-ranging effects on young people, but we need to be more accurate to explore reasons and meanings in individual paths in order to understand questions concerning eventual psychopathology, as developmental plasticity and resilience typical of that stage of life give us room for optimism (5).

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author/s.

Author contributions

AD conceptualized the work, designed the paper, and wrote the manuscript. ESG helped in conceptualizing the work, searching for literature and revising the manuscript. CG helped in revising the manuscript and preparing the submission. All authors contributed to the article and approved the submitted version.

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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Tattoo discrimination in Mexico motivates interest in tattoo removal among structurally vulnerable adults

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Tattoos are less prevalent in Mexico and tattooed persons are frequently stigmatized. We examine the prevalence and correlates of interest in receiving tattoo removal services among 278 tattooed Mexican adults living in Tijuana, Mexico who responded to interviewer-administered surveys, including open-ended questions. Overall, 69% of participants were interested in receiving free tattoo removal services, 31% reported facing employment barriers due to their tattoos, and 43% of respondents regretted or disliked some of their tattoos. Having a voter identification card, reporting moderate/severe depression symptoms and believing that tattoo removal would remove employment barriers were independently associated with interest in tattoo removal. Our findings suggest that there is substantial interest in tattoo removal services. Publicly financed tattoo removal services may help disadvantaged persons gain access to Mexico's labor market and it may positively impact other life domains such as mental well-being and interactions with law enforcement.

KEYWORDS

Mexico, tattoo removal, tattoo stigma, migration, deportation

Introduction

Tattooing is practiced around the world and is considered a form of art and body modification (1). Tattoos have been used as a form of self-expression, during rites of passage, to convey information about relational ties among community subgroups and about the tattooed individual; tattoos have also been used as a form of punishment (1). Over the past several decades, tattoos have gained in popularity in the United States (U.S.) and elsewhere (2). In Mexico, an estimated 12 million individuals are tattooed (3). However, tattoos may be associated with anti-social behaviors and tattooed individuals may experience negative reactions from the community (4–10). Tattoo-related stigma may create additional barriers for resettlement, among the thousands of migrants deported from the U.S. (i.e., deportees), many of whom settle in the Mexican border city of Tijuana which lies adjacent to California, U.S. (11, 12). For example, tattooed adults living in Tijuana have reported discrimination in employment, housing, as

well as negative interactions with local law enforcement due to their tattoos (13–16). This study examines interest in receiving tattoo removal among structurally vulnerable adults in Tijuana, as this service may help reduce stigma experienced by tattooed community members.

Deportees residing in Tijuana face a unique risk environment that can challenge their emotional, physical and social well-being (13, 15–19). In addition, politicians and law-enforcement agencies in the U.S. have portrayed undocumented immigrants as a threat to public safety (20–23) influencing Mexicans' perceptions of deportees (9, 15, 24, 25). In Mexico, deportees often face discrimination from community members and the police, who may view them as criminals (13–16, 19). Stigma associated with tattoos may exacerbate the social precarity and vulnerability experienced by deportees in Mexican communities (4, 7–9, 15, 16).

Stigma is recognized to be a socially constructed concept that is characterized by multiple dimensions. Goffman's pioneering work initially documented the ways in which community members' treatment and perception of individuals may vary when individuals' characteristics deviate from what is deemed to be expected and the norm (26). Stigma is thus conceptualized as being created when an individual has a visible or non-visible undesirable trait that modifies an individual's relationship with other community members. Stereotyping may occur because of perceived or actual differences and the affected person's status in society may be adversely impacted (26). Additional work by Link and Phelan advance our understanding of stigma by highlighting the influence of institutions and other power structures, such as policies, in supporting the stigmatization and exclusion of individuals or groups of individuals who are deemed to not conform to the broader society's norms (26, 27). Stigma has been found to extend to the affected individual resulting in self-stigma and to that person's close contacts through stigma by association (28, 29). A growing body of work has recognized that interpersonal and structural discrimination can adversely influence health outcomes and well-being including self-esteem and self-efficacy (27, 30).

Tattoos may be stigmatized when they are visible or contain markers of stigmatized affiliations or images that are viewed as being anti-social (e.g., gang symbols) (1, 31–33). Individuals with tattoos placed near their face or hands may be judged to be of poor character (6, 34, 35), discriminated against by employers (6, 36), or harassed by police (16). Tattoo-related stigma may create feelings of regret, lead some to hide their tattoos in order to avoid discrimination or generate an interest in tattoo removal (15, 16, 37–41). While laser tattoo removal is effective (42), it is also a financially burdensome and time consuming procedure (43). The prohibitive costs of professional tattoo removal services may lead some individuals to resort to amateur methods to remove their tattoos (1, 44), which are often ineffective and can have harmful side effects including pain and scarring (38, 45, 46).

In the United States, a limited number of free or subsidized tattoo removal programs for structurally vulnerable populations (e.g., former gang members, probationers) are available (14, 44, 47). Laser tattoo removal may aid in reducing social stigma, improve social relationships, improve labor market participation, and improve the well-being of structurally vulnerable populations (44, 48, 49). However, less is known about the experiences or characteristics of tattooed Mexicans, including migrants and deportees, the prevalence of tattoo regret, interest in receiving tattoo removal, and reasons for seeking this service. These topics are the focus of this investigation which was conducted with a large sample of economically disadvantaged tattooed Mexican adults in Tijuana, Mexico; a large proportion of whom are migrants. We hypothesized that tattooed deported migrants and unemployed persons would be most interested in undergoing laser tattoo removal. Analyses were stratified by participants' interest in receiving tattoo removal in order to shed light on the characteristics of those who believe they may benefit from this service. Findings can inform the implementation of programs to support tattooed persons' integration into society and may have relevance for other communities where tattooed persons are stigmatized (50–52).

Methods

Participants and data collection

This mixed-methods cross-sectional study is based on data collected between January-May 2013. A convenience sample of 584 Mexican adults ages 18+ participated in the study; persons who were younger than age 18 based on self-report or who could not provide informed consent were excluded from joining the study. This analysis is limited to 278 tattooed Mexican adults (47% of the full sample, data not shown) attending a free healthcare clinic in Tijuana's *Zona Norte* [red light district] <1 mile of the U.S.-Mexico border.

In brief, participants responded to an interviewer-administered questionnaire (15, 16) designed to understand the health and social needs of disadvantaged persons in the region, including migrants (i.e., deported, internal, and cross-national migrants). Eligibility criteria for this analysis were: (1) Mexico-born age ≥18 years old; (2) seeking any service at the study site; (3) speaking Spanish or English, and 4) having ≥1 tattoo. All participants who met these criteria were invited to participate; those interested in joining the study provided their signed informed consent and received refreshments and $10 compensation for their time. This study was approved by the University of California, San Diego Human Research Protection Program and the Ethics Boards of the Health Frontiers in Tijuana Clinic and the Autonomous University of Baja California Medical School.

Measures

Quantitative data

The survey was developed by the researchers, with the exception of the depression scale, for application to this unique setting; it has been used to support prior research (15, 16). Trained bilingual interviewers administered the survey. Data collection lasted ∼45 min and interviewers entered participants' responses in tablet computers utilizing Qualtrics survey software (Provo, UT, US). *Socio-demographic* factors included age, gender, and U.S. migrant status (never migrated; deported migrant; non-deported migrant). *Risk Environment measures* consider the following conditions: recent drug use or injection drug use (i.e., past 6 months; both yes/no), recent trading sex (past 6 months), ever incarcerated in the USA or Mexico or both countries (yes/no). *Social exclusion* variables included: possession of a Mexican federal voter identification card (yes/no), covered by *Seguro Popular* (yes/no) a federal public health insurance program which covers impoverished persons (53), and depression symptoms (none to mild vs. moderate to severe) per the Patient Reported Outcomes Measurement Information System (PROMIS) depression short form (PROMIS-D-8; 8b short form) (54, 55). Recent homeless status was defined by where participants slept most frequently in the prior 6 months: those who slept in migrant shelters, churches, streets, public parks, vacant lots, or the Tijuana River canal were classified as homeless. Participants responded to diverse adverse encounters: "During the last 6 months… a) have you ever been threatened or harassed by police, federal agents or army members in Tijuana? b) denied a job in Tijuana, c) denied access to housing or a shelter or other place that you can sleep or live in Tijuana? Respondents also identified potential access to social support, responding to the question: "Do you have friends or family in Tijuana"? (yes/no). These data are shown in Table 1.

We characterize participants' tattoos (Table 2), including the total number of tattoos (1; 2–3; ≥4), tattoo visibility (forearms, hands, face, neck; versus not on these locations), tattoo imagery/content (text/names; animals/nature-images; religious images; death/skulls; weapons/gang symbols). Participants reported their feelings about the tattoos (i.e., does not like some or all tattoos vs. likes all tattoos or is indifferent about them), whether they believe that they have experienced barriers to employment because of their tattoos (yes/no), and beliefs that removing tattoos would reduce barriers to employment (yes/no).

For the dependent variable, participants were asked: "Imagine that in the next 6 months there was a free service here [at the clinic] to remove tattoos, do you think you would be interested in using those services?" (yes/no).

Qualitative data derived from the survey

The questionnaire included several open-ended questions. Participants interested in removing some or all of their tattoos were asked: "*Currently, what are all the reasons for which you DO want to remove your tattoos*?" Interviewers entered participants' responses ($n = 156$) for those who responded in the affirmative into the survey software verbatim.

Analysis

Descriptive statistics were generated using STATA v16 to characterize participants' sociodemographic, tattoo-related, and vulnerability characteristics; analyses were stratified by interest in receiving free tattoo removal at the clinic where the study was conducted (Tables 1, 2). For categorical variables, we employed Pearson chi-square tests to assess statistical significance between groups. Variables attaining significance levels of $p < 0.10$ in binary analyses were considered for inclusion in multivariable logistic regression models that assessed the relationship between each independent variable and interest in receiving free tattoo removal services at the clinic. We controlled for migrant status given the pervasiveness of tattoos among U.S. migrants (Table 4).

Qualitative text data were entered into a spreadsheet and two authors utilized the methodology of "Coding Consensus, Co-occurrence, and Comparison," based on grounded theory techniques (56, 57) to code responses and identify emergent themes; conflicts in coding were discussed and resolved (56). Some responses were assigned multiple codes. The main themes are described and illustrative quotes are provided in English and Spanish (Table 3). The authors translated all quotes into English. We provide percentages for each theme to illustrate its significance within the text responses (58). Participants who indicated that they did not want to remove their tattoos were asked why they did NOT want to remove their tattoos and themes emerging from participants' responses ($n = 89$) are summarized in the text (data not shown in table). The responses to both questions represent 245 responses (i.e., 88% of tattooed participants); participants were not required to respond to these questions, though most did.

Results

Participant characteristics

Table 1 presents sociodemographic characteristics and exposure to the risk environment among a sample of tattooed Mexicans ($n = 278$), stratified by interest in receiving free tattoo removal at the study site. Overall, 69% of participants were interested in receiving free tattoo removal services. Participants were largely non-elderly between the ages of 18–47 years (77%) and 79% were male. Most participants had a history of migration to the U.S., and 67% of participants reported a history of deportation from the U.S. With respect to the risk environment, 60% of participants reported recent drug use, 36% recently injected drugs and 17% recently traded sex. The

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TABLE 1 Sociodemographic characteristics of Mexican tattooed adults ($n = 278$) receiving free medical care, stratified by interest in receiving free laser tattoo removal at the study site, Tijuana, Mexico, 2013.

			Interested in free tattoo removal at clinic				
	Overall sample ($n = 278$, 100%)		No, not interested ($n = 85$, 31%)		Yes, interested ($n = 193$, 69%)		
Sociodemographics	**%**	***N***	**%**	***N***	**%**	***N***	***p*-value**
Age							
18 to 36	37%	103	41%	35	35%	68	0.63
37 to 47	40%	110	36%	31	41%	79	
≥48	23%	65	22%	19	24%	46	
Gender							
Female	21%	59	16%	14	23%	44	0.20
Male	79%	219	84%	71	77%	149	
US migrant status							
Never migrated to U.S.	15%	43	8%	7	19%	36	0.09
Deported US migrant	67%	186	73%	62	64%	124	
Non-deported US migrant	18%	49	19%	16	17%	33	
Risk environment							
Recent drug use[a]	**60%**	**168**	**69%**	**59**	**56%**	**109**	**0.04**
Recent injection drug use[a]	**36%**	**99**	**45%**	**38**	**32%**	**61**	**0.04**
Recently traded sex[a]	17%	48	15%	13	18%	35	0.56
Ever incarcerated (Mexico, USA, or both)	80%	221	79%	67	80%	154	0.85
Social exclusion							
IFE Mexican voter identification card	**37%**	**104**	**25%**	**21**	**43%**	**83**	**<0.01**
Has *Seguro Popular* (Public Health Insurance)	**33%**	**93**	**25%**	**21**	**37%**	**72**	**0.04**
Has moderate to severe depression	**34%**	**94**	**24%**	**20**	**38%**	**74**	**0.02**
Recently homeless[a]	53%	146	56%	48	51%	98	0.38
Threatened by law enforcement in Tijuana[a]	49%	135	46%	39	50%	96	0.55
Denied employment in Tijuana[a]	44%	122	36%	31	47%	91	0.10
Denied housing in Tijuana[a]	17%	48	15%	13	18%	35	0.56
Lacks friends or family in Tijuana	**67%**	**185**	**64%**	**54**	**68%**	**131**	**0.48**

Percentages may not sum to 100% due to rounding; comparisons which are significant at $p < 0.05$ are denoted in bold type.
[a]Reflects a behavior or experience occurring in the 6 months prior to study participation.

majority of participants (80%) reported ever being incarcerated in the U.S., Mexico, or both countries. Measures of social exclusion are also reported in Table 1. Approximately one-third of participants (37%) reported having an IFE voter card at the time of interview and 33% were enrolled in Seguro Popular which is Mexico's universal health insurance program. Symptoms of moderate to severe depression were reported by 34% of participants. More than one-half of participants (53%) were recently homeless, 17% were recently denied housing, and 49% reported recently being threatened by local law enforcement. Connections to the labor market were also assessed and 44% reported being recently denied employment, while local social support was low: 67% lacked friends or family in Tijuana.

Interest in tattoo removal stratified by participant characteristics

We examined interest in tattoo removal by participants' characteristics. There were no statistically significant differences in interest in tattoo removal by age, gender, or U.S. migrant status (Table 1). Similarly, of the risk environment characteristics examined, there were no differences in interest in tattoo removal among those who recently traded sex or were recently incarcerated. Of Social Exclusion variables, interest in tattoo removal did not vary by report of recent homelessness or threats by law enforcement, being denied access to employment, or lacking friends or family in Tijuana. However, participants interested in tattoo removal were less likely than those who

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TABLE 2 Tattoo characteristics and participants' perceptions, reported by Mexican tattooed adults ($n = 278$) receiving free medical care, stratified by interest in receiving free laser tattoo removal at the study site, Tijuana, Mexico, 2013.

			Interested in free tattoo removal at clinic				
	Overall sample ($n = 278$, 100%)		No, not interested ($n = 85$, 31%)		Yes, interested ($n = 193$, 69%)		
Tattoo characteristics	**%**	***N***	**%**	***N***	**%**	***N***	***p*-value**
Number of tattoos							
1 tattoo	27%	75	33%	28	24%	46	0.29
2–3 tattoos	30%	83	27%	23	31%	60	
≥ 4 tattoos	44%	122	40%	34	46%	89	
Has visible tattoos	37%	102	34%	29	38%	73	0.56
Tattoo imagery/content[a]							
Text or names	70%	195	69%	59	70%	136	0.86
Animals or nature	32%	89	31%	26	33%	63	0.74
Religious	17%	47	19%	16	16%	31	0.57
Death or skulls	12%	32	11%	9	12%	23	0.75
Weapons or gang symbols	8%	22	7%	6	8%	16	0.73
Participant perceptions							
Participant does not like some or all tattoos	**43%**	**120**	**6%**	**5**	**60%**	**115**	**<0.01**
Has experienced barriers to employment because of tattoos	**31%**	**85**	**20%**	**17**	**35%**	**68**	**0.01**
Believes removing tattoos will aid in finding employment in Tijuana	**56%**	**151**	**41%**	**34**	**62%**	**117**	**<0.01**

Percentages may not sum to 100% due to rounding; comparisons which are significant at $p < 0.05$ are denoted in bold type.
[a]Categories are not mutually exclusive and may sum to >100%.

were uninterested in tattoo removal to report recent drug use (56 vs. 69%, respectively, $p = 0.04$) and recent injection drug use (32 vs. 45%, respectively, $p = 0.04$). Those interested in tattoo removal services were more likely to have a voter identification card (43 vs. 25%, respectively, $p < 0.01$) and be enrolled in Seguro Popular (37 vs. 25%, respectively, $p = 0.04$) than those uninterested in receiving tattoo removal. Those interested in tattoo removal were more likely to display symptoms of moderate/severe depression (38 vs. 24% among those uninterested in tattoo removal, $p = 0.02$).

Characteristics of participants' tattoos and stratification by interest in tattoo removal

Participants were asked about the characteristics of their tattoos (Table 2). A minority of participants had only 1 tattoo (27%), 30% reported 2–3 tattoos, and 44% had 4+ tattoos. One-third of participants (37%) had visible tattoos. Tattoo imagery and content varied. Seventy percentage included names or text; animal or nature images (32%), religious (17%), death/skulls (12%), and gang/weapon (8%) tattoos were less commonly reported. Overall, 43% of participants reported disliking some or all of their tattoos; 31% reported experiencing barriers to employment because of their tattoos, and 56% believed that removing their tattoos would help them find employment in Tijuana.

Participants' perceptions of their tattoos and their impact on their lives rather than the characteristics of the tattoos played an important role in participants' interest in removing their tattoos. Specifically, there number or visibility of tattoos or the imagery was not statistically associated with interest in removing the tattoos. Rather, those who reported an interest in tattoo removal were significantly more likely to dislike some or all of their tattoos (60 vs. 6% among those uninterested in tattoo removal, $p < 0.01$), to report barriers to securing employment due to their tattoos (35 vs. 20% of those uninterested in removal; $p = 0.01$), and to believe that tattoo removal would help them find employment (62 vs. 41% among those uninterested in removal, $p < 0.01$).

Qualitative results: Motivations for seeking tattoo removal

Reasons for desiring tattoo removal varied across participants; themes and illustrative quotes are presented in Table 3. Participants most frequently reported experiencing Employment Barriers (31%): they described a local labor

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TABLE 3 Reasons for interest in receiving tattoo removal expressed by Mexican tattooed adults ($n = 156$) receiving free medical care, Tijuana, Mexico, 2013.

	Spanish Language Quote	English Translation of Quote
Employment barriers ($n = 48$; 31%)	4. [Porque] no me dan trabajo por tener tatuajes	4. [Because] they don't give [me] any work because I have tattoos
	20. Por dificultad para conseguir trabajo.	20. Due to difficulties in getting a job.
	77. Porque en muchos lugares no puede trabajar con los tatuajes	77. Because in many places you can't work with tattoos
	43. Porque se me complica conseguir empleo y se miran mal	43. Because it becomes more difficult to get a job and they [tattoos] look bad
	30. Me siento orgulloso de él [tatuaje] porque es el nombre de mi hija, pero me gustaría quitármelo porque me ocasiona problemas para buscar trabajo	30. I feel proud of it [the tattoo] because it is my daughter's name, but I would like to remove it because it creates problems in finding a job
Do not like/regret their tattoos ($n = 44$; 28%)	9. Me arrepiento, eran momentos de mi juventud	9. I regret [it], they were moments of my youth
	23. Ya siento que no son apropiados, no me sirven para nada, ya no tienen un significado para mi	23. I now feel that they are not appropriate, they are useless to me, they no longer have meaning to me
	114. Ya no me gustan, estoy arrepentido de habérmelos puesto	114. I don't like them anymore, I regret having gotten them [tattoos]
Tattoos make a bad impression ($n = 36$; 23%)	15. Porque me marcaron como persona peligrosa por el tatuaje	15. Because they labeled me as a dangerous person because of the tattoo
	24. Me dan mala imagen	24. They make a bad impression
	86. Porque tengo un niño chiquito–no me gusta que me lo vea, no quisiera que él se hiciera un tatuaje, y para que me acepten en los trabajos	86. Because I have a little boy–I don't like him to see me with it [tattoo], I would not want him to get a tattoo, and for me to be accepted for jobs
	113. Para tener mejor aspecto hacia la sociedad porque a veces lo miran a uno feo por los tatuajes	113. To make a better impression toward society, because at times, they look at you badly because of the tattoos
	119. Porque no son buenos, no puede uno encontrar trabajo, no son necesarios, discriminan a las personas con tatuajes, piensan que es ratero, pandillero	119. Because they [tattoos] are not good, one cannot find work, they are not necessary, they discriminate against people with tattoos, they think he is a thief, gang member
	175. Porque ya se ven muy feos, y está uno muy grande y le da a uno vergüenza, y ninguno de mis hijos están rayados y es como una [mala] carta de recomendación	175. Because they look very ugly now, and when a person is very old they are embarrassing, and none of my children are inked and it's like a [bad] letter of recommendation
	187. La gente discrimina a los tatuajes, y se ve mal.	187. People discriminate against tattoos, and it looks bad.
Thinks tattoos are ugly ($n = 29$; 19%)	5. Porque no me gusta como se me ve-fue un tatuaje casero	5. Because I don't like how it looks on me- it was a homemade tattoo
	39. No me gustan	39. I don't like them [the tattoos]
	63. Porque no quedó bien	63. Because it didn't come out right
Think life would be better without tattoos ($n = 25$; 16%)	60. Porque me afectan en muchas maneras, no puedo encontrar trabajos, me ocasionan problemas personales y familiares	60. Because they affect me in many ways, I can't find jobs, they create personal and family problems for me
	79. Porque veo a las demás personas y se me hacen ridículos y yo no me quiero ver así	79. Because I see other [tattooed] people and I think they look ridiculous, and I don't want to look like that
	124. Para vivir mejor y encontrar trabajo	124. To live better and find a job
	141. No me gusta como me trata la gente	141. I don't like how people treat me
Mental health impact ($n = 25$; 16%)	25. No me siento a gusto con el	25. I don't feel comfortable with it [the tattoo]
	38. Por diferentes cosas, porque pienso que ya se miran mal, me agüito cuando voy a mi cantón con mi familia	38. For different things, because I think they look bad now, I get sad when I go to my home with my family

(Continued)

TABLE 3 Continued

	Spanish Language Quote	English Translation of Quote
	73. Me dan vergüenza porque me los hicieron sin que me diera cuenta a los 13 años	73. I am ashamed of them because they put them [tattoos] on me without my knowledge when I was 13 years old
	103. Simplemente me gustaría estar limpio	103. I would simply like to look clean
	128. Uno se cansa de la discriminación	128. One gets tired of discrimination
	163. Pues porque me da pena saludar y se ven	163. Well, because I feel embarrassed to say hi [to people] and they [the tattoos] can be seen
Prevent police interactions ($n = 11$; 7%)	16. Porque hay mucha molestia con la policía	16. Because there is a lot of trouble with the police
	57. Llama mala atención con la ley	57. Attracts bad attention from law enforcement
	65. Me identifican muy rápido los policías	65. The police identify me very quickly [because of the tattoos]

TABLE 4 Factors independently associated with interest in receiving free laser tattoo removal at the clinic among Mexican adult tattooed free clinic patients ($n = 278$), Tijuana, Mexico, 2013.

	Adjusted Odds Ratio	95% Confidence Interval	*p*-value
Migrant status			
Never migrated to U.S.	Reference group	–	
Deported migrant	0.49	0.18, 1.36	0.17
Non-deported US migrant	0.45	0.15, 1.37	0.16
Possesses IFE Mexican voter identification card	**2.01**	**1.04, 3.88**	**0.04**
Seguro popular health insurance	1.41	0.71, 2.78	0.32
Moderate to severe depression	**1.95**	**1.03, 3.70**	**0.04**
Drug use in the past 6 months	**0.49**	**0.26, 0.91**	**0.02**
Has experienced barriers to employment because of tattoos	1.39	0.78, 2.49	0.27
Believes removing tattoos would reduce employment barriers	1.51	0.73, 3.13	0.27
Believes removing tattoos will aid in finding employment in Tijuana	**2.34**	**1.24, 4.42**	**0.01**

Estimates which are significant at $p < 0.05$ are denoted in bold type.

market which wholly rejected tattooed persons. A significant number of participants disliked their tattoos and regretted them (28%). Some participants obtained tattoos as youths or no longer identified with the tattoos or what they represented. Numerous participants felt that tattoos make a bad impression (23%) and contributed to labeling and stereotyping by others. Some participants felt that their tattoos are ugly (19%) and for some participants, this emotion was related to changes in the quality of the image over time. Some participants also believed that their lives would be better without tattoos (16%) and that they negatively impacted participants' mental health (16%), contributing to feelings of discomfort or shame. Other participants identified the toll of discrimination and negative interactions and anxiety/stress resulting from family interactions as motivators for interest in tattoo removal. Negative interactions with law enforcement (7%) were infrequently reported but acknowledged by some participants.

Participants who were uninterested in receiving tattoo removal were asked to explain their reasons and responses fell into three general categories: participants liked their tattoos, or felt that their tattoos are meaningful, or were not interested because they did not have confidence in the results of tattoo removal (Data not shown).

Factors independently associated with interest in receiving free laser tattoo removal

Table 4 presents results from logistic regression analyses identifying factors independently associated with interest in free tattoo removal services at the study site. No demographic factors were associated with interest in receiving tattoo removal. Of Social Exclusion variables, possession of an IFE Mexican

voter identification card was independently associated with being interested in receiving free tattoo removal services at the clinic [Adjusted Odds Ratio (AOR): 2.01; 95% Confidence Interval (CI): 1.04, 3.88; $p = 0.04$], as was reporting moderate to severe depression (AOR: 1.95; 95% CI: 1.03, 3.70; $p = 0.04$). Of Participants' Perceptions regarding the impact of tattoos, believing that tattoo removal would remove barriers to employment (AOR: 2.34; 95% CI: 1.24, 4.42; $p = 0.01$) was also associated with a greater interest in tattoo removal. From Risk Environment variables, drug use in the past 6 months was negatively associated with interest in tattoo removal (AOR: 0.49; 95% CI: 0.26, 0.91; $p = 0.02$).

Discussion

Tattooing is a pervasive practice worldwide, however, to our knowledge, this study contributes previously unavailable data regarding the perceptions and experiences of a diverse sample of tattooed adults in Mexico. The popular press and several studies have identified tattoo-related stigma and discrimination, including among migrants returning to Mexico (16, 59, 60). Our mixed-methods study corroborates anecdotal evidence with quantitative and qualitative data from a large sample; key findings are contextualized below. This study has important public health implications: laser tattoo removal is desired and can assist tattooed adults engage more broadly with Mexican society and potentially overcome tattoo-related stigma and discrimination (17). Findings may have relevance for other migrant-receiving communities.

For many decades, Mexico has been a major migrant sending country to the U.S. due to diverse social and economic ties that have supported migrant flows between both countries (61, 62). Return migration is not uncommon and our research demonstrates that tattoos are pervasive among persons with histories of U.S. migration. Notably, recent changes to immigration enforcement policies have resulted in the forcible expulsion or voluntary return of Mexican nationals: for example, annually between 2013 and 2020, the United States deported between ∼151,000 to ∼307,000 migrants to Mexico (12). Consequently, innovative strategies are needed to reintegrate migrants into Mexican society. Moreover, by reducing social exclusion, stigma and discrimination, migrants returning to Mexico may be able to leverage skills and human capital developed in the U.S. for their benefit as well as that of receiving communities in Mexico (63).

In multivariate analyses, participants who believed that removing their tattoos would assist them in finding employment and those possessing a voter identification card were more likely to be interested in tattoo removal. We interpreted these findings to mean that those with a governmental identification card were more likely to be able to navigate the legal aspects associated with interacting with public and private institutions, including the labor market as a governmental identification is required to join workplaces in the formal economy. The qualitative data collected by this study indicated that tattoos often generated stigma and discrimination which contributed to the exclusion of study participants from the labor market. Thus, removal of unwanted tattoos was believed to support access to employment opportunities.

Individuals lacking a Mexican voter identification card are, in effect, undocumented. Studies examining the experiences of undocumented immigrants in the U.S. have demonstrated that lacking a legal status and identification is associated with social stigma, increased stress, anxiety and situations that create vulnerability (64). An undocumented status is also associated with social, economic and health disadvantages due to reduced access to legal, safe and well-paying employment opportunities (65) or public benefits programs (e.g., health insurance coverage) (64). In Mexico, only adults who also possess a birth or naturalization certificate can access the voter card (formerly IFE, now INE card), which serves as the nation's primary form of national identification (66). While Mexico is currently classified as a Upper Middle Income Country (67) it continues to experience economic and geographic disparities; rural communities especially may encounter challenges in providing timely access to birth certificates to their residents, resulting in an "undocumented" status among some individuals (68). Other nations have implemented diverse strategies to overcome challenges to birth certificate access, including birth registration campaigns, providing birth certificates free of charge, and expediting access to this document (68, 69). These strategies may be implemented more broadly to ensure that individuals' identity can be substantiated across the lifespan. Migrants can benefit from Mexico's "*Programa de Repatriación*" (Repatriation Program) and "*Programa Somos Mexicanos*" (We are Mexicans Program) which can help migrants re-establish their identity (*via* access to birth certificates, temporary identification cards and other documents) and obtain critical services early within the repatriation process (e.g., nutrition, health, housing, employment services, and others) (63, 70). To overcome barriers to legal identity among voluntary and forcibly returned migrants, access to the aforementioned programs should be expanded beyond the repatriation period or to other individuals in need of these services.

We observed that participants reporting mental health challenges (i.e., depression symptoms) were more likely to report an interest in tattoo removal while recent substance users were less likely to be interested in tattoo removal. Tattoos may include images that make the individual uncomfortable or embarrassed, hinder their participation in social or economic pro-social activities, or the images may contribute to personal harm due to interpersonal violence (e.g., gang-related motifs) (71). These findings are concordant with extant studies that report

that tattoos can provoke adverse mental health impacts when personal identities evolve (e.g., older age) or social affiliations change (e.g., withdrawing from gangs) (14, 39, 72). Entities implementing tattoo removal programs should consider the mental health consequences of having unwanted tattoos when defining the eligibility criteria in order to provide the maximum benefit to persons seeking this service. For example, programs may consider removing all tattoos regardless of their source (e.g., prison; gang affiliation) or location on the body; there is precedent for such an approach in the U.S. and preliminary data indicate that this approach has yielded favorable results for participants (73).

Limitations

Findings must be considered in light of the following factors. The study may not reflect the experiences of all migrant receiving communities or migrants from other regions. However, the study recruited a large convenience sample of migrants, including tattooed migrants, which are important strengths of this investigation as the research sheds light not only on the experience of tattoos among migrants but how they perceive these marks impact their integration into receiving communities such as Tijuana, Mexico. This study was conducted in 2013 and should be replicated to explore changes in policies, social views regarding tattoos, and changing migration flows from Central America, Eastern Europe and other countries to the US-Mexico border region. Undertaking a similar study in multiple deportee receiving countries would be helpful to understand the challenges faced by deportees seeking to resettle outside of the United States. While our study included a small sample of women, the experiences of tattooed women are generally under-represented in the literature, thus, this study suggests that additional research is needed to understand the challenges that tattooed women may face in Latin America. The data were based on self-report and may be subject to social desirability bias or recall bias. Nevertheless, our study makes significant contributions to the study of social exclusion in the context of Latin America, including the challenges faced by migrants in the region.

Conclusions

This study explored the issues of tattoo regret, motivations for seeking removal of unwanted tattoos and interest in receiving laser tattoo removal in the U.S.-Mexico border city of Tijuana. Our findings suggest that there is a substantial interest in receiving tattoo removal services, which are quite costly and may be a significant barrier to this service for low income and underserved persons in Mexico (74). A package of services (i.e., governmental identification, tattoo removal) which are publicly financed may assist disadvantaged persons, especially migrants, gain increased access to the labor market, which will aid other life domains (e.g., mental well-being, interactions with law enforcement, income, housing, food insecurity, interpersonal relationships with community members). Similar research should be undertaken elsewhere in order to shed light on the impact of tattoo related stigma across diverse communities and for population subgroups (e.g., forcibly returned migrants, voluntarily returned migrants, asylum seekers, refugees). Findings may shed light on the types of interventions that are needed to overcome tattoo regret and tattoo-related stigma in diverse social context. Longitudinal research is needed to understand whether the social, economic and mental health status of tattooed individuals improves as a result of eliminating unwanted tattoos.

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 California, San Diego, Human Research Protection Program; the Ethics Boards of the Health Frontiers in Tijuana Clinic and the Autonomous University of Baja California Medical School. The patients/participants provided their written informed consent to participate in this study.

Author contributions

VO, JB, and AV-O conceptualized the study and wrote the manuscript. CM and OS assisted with the analyses and preparation of manuscript. All authors prepared and reviewed the manuscript and approved it for submission.

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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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The relationship between negative life events and quality of life in adolescents: Mediated by resilience and social support

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Background: Quality of life has become an important indicator for assessing the health care of adolescents. This study aimed to explore the relationship between negative life events and quality of life in adolescents and the potential mediating roles of resilience and social support.

Methods: A stratified cluster sampling technique was used to select 3,860 adolescents as study participants. The Adolescent Self-Rating Life Events Checklist, the Resilience Scale for Chinese Adolescents, the Social Support Rating Scale, and the Adolescent Quality of Life Scale were used by participants to rate their negative life events, resilience, social support, quality of life, respectively. The correlations between study variables were analyzed by the Pearson correlation analyses. The AMOS 26.0 software was used to explore the mediating roles of resilience and social support in negative life events and quality of life.

Results: There was a negative correlation between negative life events and quality of life (β=-0.745, $P < 0.05$); resilience and social support played an important mediating role in the relationship between negative life events and quality of life ($\beta_{\text{Resilience}} = -0.287$, $P < 0.05$; $\beta_{\text{Social support}} = -0.124$, $P < 0.05$). The emotional adjustment dimension of resilience ($\beta = -0.285$, $P < 0.05$) and the subjective support dimension of social support ($\beta = -0.100$, $P < 0.05$) played the largest mediating roles, respectively.

Conclusion: Negative life events were negatively correlated with adolescents' quality of life. Strengthening resilience and social support is expected to weaken and reduce the adverse effects of negative life events on adolescents and further maintain and improve their quality of life.

KEYWORDS

negative life events, resilience, social support, quality of life, adolescents

Introduction

The World Health Organization (WHO) defines quality of life (QoL) criteria as an individual's perception of their place in life in the context of the culture and value system in which they live and their goals, expectations, standards, and concerns (1). It is generally considered to be a multidimensional structure and its evaluation

usually depends on individuals' subjective evaluation of well-being and/or function in the different domains that make up the overall structure (2). Research on adolescents shows that QoL is about the positive cycles of life. To enter and maintain a positive cycle, a positive self-image, good friends, and strong family relationships are important. Consequently, adolescents' QoL is threatened when these factors are negative (3).

Adolescence is a critical period of transition from childhood to adulthood involving rapid physical, psychological, and social changes that shape adolescents' personality, behavior, and future health (2). Negative life events [NLEs; (4)], such as interpersonal strain and excessive pressure of study, are key risk factors for adolescent development and have a significant impact on the psychological and social outcomes of adolescents (5–7). Although personality characteristics play an important role in an individual's psychological and social development, environmental experience also influences these outcomes. Compared with adults, adolescents are more sensitive to the perception of the environment and more vulnerable to self-evaluation and external factors (8). The experience of NLEs in childhood can stimulate negative cognition and behaviors and become contributing factors to depression and other psychological problems in adulthood (9). The overall results of the current study suggest that NLEs are associated with increased psychological stress and reduced life satisfaction (10, 11). The occurrence of major NLEs directly predicts lower QoL (12, 13).

Resilience is defined as a personal quality that enables a person to thrive in the face of adversity. People with a higher level of resilience are typically characterized by optimism, positive coping, and hardiness, which may help them successfully cope with NLEs and maintain better mental and physical health outcomes (14). Previous studies have shown that NLEs impair resilience (15), and that resilience is a positive predictor of adolescents' QoL (16, 17). According to Kumpfer's mental resilience framework theory (18), people have different degrees of mental resilience due to different cognitive, emotional, and mental states. When feeling the pressures or challenges of the outside world, an individual's resilience will respond to the pressure from the outside world. High resilience individuals can adapt to these pressures but low resilience individuals fare less well. Resilience can also play an intermediary role (18). For example, resilience was found to be a mediator between NLEs and positive social adjustment (15), and between self-compassion and QoL (19). That is, resilience may act as a factor directly affecting health-related outcomes and also play a role as a mediator. Resilience is a multidimensional concept that has recently been identified as a potentially modifiable factor (20) that can be improved through intervention (21). It is our premise that resilience is the mediator between NLEs and QoL. Thus, when individuals experience NLEs, which are often unavoidable, resilience can help them maintain and promote their mental health and QoL (22).

Social support refers to external support from important others and society (23). According to the stress-buffering hypothesis, social support may help individuals redefine stressful situations so that they are no longer perceived as stress and/or supply resources, thereby reducing the severity of stressful events (24). The Convoy model of social relations (25) and Novena's conceptual model of meaning in life (26) further reveal the relationship between life satisfaction, living arrangements, social support, and meaning in life. The Convoy model suggests that social support from different social networks (such as living arrangements) plays an important role in determining individual subjective well-being and life satisfaction (25). According to Novena's conceptual model, conditions such as living arrangements can serve as a foundation for the components that give meaning to life. One study showed that social support plays an intermediary role between living arrangements and life satisfaction (27). Another study showed that social support mediates the relationship between NLEs and depression in adolescents (28). QoL is a response to life events and changes in the living environment; adolescents' social support is positively related to their QoL (29, 30). However, our understanding of the role of social support in NLEs and QoL is rather limited. Thus, our goal is to explore whether social support plays a mediating role in NLEs and QoL. If so, the introduction of social support for adolescents should improve their QoL.

Previous research has examined the relationship between NLEs and QoL, resilience and QoL, and social support and QoL. To the best of our knowledge, no study has investigated the mediating role of resilience and social support in NLEs and QoL, especially among adolescents. Therefore, in 2020, we conducted a population-based survey among primary and middle school students in Chongqing, China, to examine the relationship between NLEs and QoL in children and adolescents, and to explore the mediating role of resilience and social support. Based on previous studies, we hypothesized that (1) NLEs were negatively correlated with QoL in adolescents, (2) resilience and social support were negatively correlated with NLEs and positively correlated with QoL, and resilience and social support played a mediating role between NLEs and QoL. Our hypothesized model can be seen in Figure 1.

Materials and methods

Study design, participants, and process

The stratified cluster sampling method was used to select the study sample in Qijiang District, Chongqing. As per the stratification of urban and rural areas, two primary schools and two middle schools were randomly selected from urban and rural areas of the region, respectively. The study participants—primary school students from grades 4–6 and junior middle

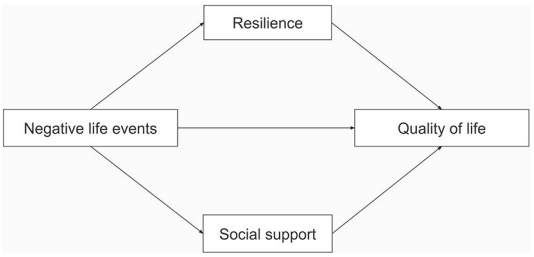

FIGURE 1
The hypothesized model.

school students from grades 7 to 9—were selected from a total of eight schools. The formal survey was conducted in November 2020 with a sample size of 3,860 participants. The inclusion criterion was that students could understand and complete the questionnaire independently. The study was approved by the ethical committee of Chongqing Medical University and written informed consent was obtained from students and their parents before the research study began.

Participants were surveyed using a self-reported questionnaire, which included general demographic characteristics such as gender and grade, as well as scales related to NLEs, resilience, social support, and QoL. The questionnaire investigators were composed of two professors and six graduate students. Before the survey, the investigators were given standardized training by a professor to ensure that they had a clear understanding of the structure of the questionnaire and how to fill in the questionnaire. Under the supervision of the school leaders, the investigators entered each sample class in the school to conduct a field survey of the students. After they explained how the questionnaire should be filled out, the students completed the questionnaire in the classroom with the help of the investigators and the head teacher. Participants were assured that their responses would be confidential and anonymous. After the students completed the questionnaires, the investigators checked and collected the questionnaires one by one and timely returned the questionnaires with missing or logical errors to the participants for supplementary information and modification.

Instruments

General questionnaire

According to the influencing factors of adolescents' QoL (31–33), the following sociodemographic characteristics were collected using the self-designed questionnaires: age (continuous variable); gender (male/female); grade (4–9); whether the individual is a left-behind child (yes/no); family economic status (low/moderate/high); academic stress (low/moderate/high). Left-behind children refer to those who remain at home and are cared for by other family members or caregivers because one or both parents have migrated to jobs outside of their home region (34). All questions were self-reported by the participants.

Negative life events

The Adolescent Self-Rating Life Events Checklist [ASLEC; 15] was used to assess the impact of NLEs on adolescents in the past 12 months. It consisted of 27 items that covered six dimensions—interpersonal relationships, learning pressure, punishment, bereavement and property loss, health and adaptation, and others. Each item was assessed with a 5-point Likert scale to rate the influence of NLEs on adolescents—no influence (1), mild influence (2), moderate influence (3), severe influence (4), and extremely severe influence (5). The higher the total score, the greater the impact of NLEs. The Cronbach's alpha of this measure was 0.889 (95% *CI* [0.884, 0.894]). The Cronbach's alpha coefficients of interpersonal relationships, learning pressure, punishment, bereavement and property loss, health and adaptation, and others were 0.735 (95% *CI* [0.721, 0.748]), 0.594 (95% *CI* [0.574, 0.614]), 0.678 (95% *CI* [0.663, 0.694]), 0.584 (95% *CI* [0.523, 0.572]), 0.414 (95% *CI* [0.383, 0.444]), and 0.581 (95% *CI* [0.559, 0.602]), respectively.

Quality of life

The Adolescent Quality of Life Scale (35) was used to measure QoL. The scale consisted of 39 items, divided into four dimensions, as follows: physical (8 items), psychological (11 items), pubertal (6 items), and social (14 items), which were used to measure the QoL of children and adolescents. Each item was scored on the 5-point Likert scale. If the item was related to the frequency of a certain phenomenon, it was scored from 5 to 1, that is, from "never" to "always". If the item was satisfactory for a certain situation, it was rated from 1 to 5 points, that is, from "very dissatisfied" to "very satisfied." The higher the score, the better the QoL. The overall Cronbach's alpha was 0.923 (95% *CI* [0.920, 0.927]). The Cronbach's alpha coefficients of physical, psychological, pubertal, and social were 0.869 (95% *CI* [0.863, 0.876]), 0.821 (95% *CI* [0.812, 0.829]), 0.878 (95% *CI* [0.872, 0.883]), and 0.606 (95% *CI* [0.586, 0.625]), respectively.

Resilience

The Resilience Scale for Chinese Adolescents (RSCA) (36) was used to measure resilience and included five factors, as follows: target focus, emotional adjustment, positive cognition, family support, and interpersonal assistance. This scale contained 27 items and was scored on a 5-point Likert scale. Positive items were rated on a scale of 1–5, from "completely inconsistent" to "completely consistent." Negative items were rated in reverse. The higher the score, the higher

the psychological resilience. In this study, the Cronbach's alpha value of the overall scale was 0.853 (95% *CI* [0.846, 0.859]). The Cronbach's alpha coefficients of target focus, emotional adjustment, positive cognition, family support, and interpersonal assistance were 0.794 (95% *CI* [0.784, 0.804]), 0.743 (95% *CI* [0.730, 0.755]), 0.747 (95% *CI* [0.733, 0.759]), 0.687 (95% *CI* [0.671, 0.702]), and 0.710 (95% *CI* [0.696, 0.724]), respectively.

Social support

The Social Support Rating Scale [SSRS; 37] was used to detect the degree of support received by participants in social life and their utilization of the support. This scale consisted of 10 items comprised of three dimensions, as follows: objective support, subjective support, and utilization of social support. Items 1–4 and 8–10 were scored on a four-point scale (1–4 points). Item 5 was divided into five sub-questions, and each sub-question was graded from "none" to "full support" on a 1–4 point scale. For items 6 and 7, points were given according to the number of sources in the "following sources." If the answer was "no source," the score was 0. The higher the total score, the higher the overall social support. The overall Cronbach's alpha was 0.717 (95% *CI* [0.704, 0.730]). The Cronbach's alpha coefficients of subjective support, objective support, and utilization of social support were 0.543 (95% *CI* [0.519, 0.566]), 0.497 (95% *CI* [0.468, 0.523]), and 0.600 (95% *CI* [0.578, 0.621]), respectively.

Data analysis

SPSS 24.0 and AMOS 26.0 software were used to analyze the data. Descriptive analyses, including frequency and percentage or mean and standard deviation, were calculated for describing participants' sociodemographic characteristics. The Pearson correlation analysis was used for the correlation analysis of study variables—NLEs, resilience, social support, and QoL. The AMOS 26.0 software was used to explore the mediating roles of resilience and social support in NLEs and QoL. Due to the theoretical crossover between the dimensions of family support and interpersonal assistance in resilience and the three dimensions of social support, the mediating effect model of resilience and social support, directly constructed may lead to multicollinearity between resilience and social support. In this study, the influence of multicollinearity was eliminated by setting a constraint condition to connect the residual term of resilience and social support in the total dimensional analysis. In the dimensional analysis, the residual terms of the two dimensions of family support and interpersonal assistance in resilience and the three dimensions of social support were connected to eliminate the influence of multicollinearity. The 2,000 bias-corrected samples were extracted to calculate the path coefficients and their significance. A confidence interval (*CI*) without 0 indicated a significant mediating effect. A *P*-value (two-tailed) <0.05 was considered statistically significant.

TABLE 1 Sociodemographic characteristics of participants ($n = 3,860$).

Characteristics	Mean or *n*	SD or %
Age (years)	12.51	1.66
Gender		
Male	1,925	49.87
Female	1,935	50.13
Educational degree		
Primary school	1,756	45.49
Middle school	2,104	54.51
Left behind children		
Yes	1,579	40.91
No	2,281	59.09
Family economic status		
Low	425	11.01
Moderate	2,138	55.39
High	1,297	33.60
Academic stress		
Low	538	13.94
Moderate	2,027	52.51
High	1,295	33.55

Quantitative data were expressed by "mean" and "standard deviation (SD)", qualitative data were expressed by "n" and "percentage (%)".

Results

Descriptive data and correlations

Descriptive statistics of the sociodemographic characteristics of the participants are shown in Table 1. The sample consisted of 1,925 (49.87%) male and 1,935 (50.13%) female students with an average age of 12.51 years. There were 1,756 (45.49%) primary school students and 2,104 (54.51%) junior high school students, including 1,579 (40.91%) left-behind students. Among them, 2,138 (55.39%) students assessed their family economic status as "moderate", 1,297 (33.60%) students assessed their family economic status as "high," and 425 (11.01%) students assessed themselves as "low". The self-rated learning pressure of students was as follows: 2,027 (52.51%) students rated their learning pressure as "moderate", 538 (13.94%) students as "low", and 1,295 (33.55%) students as high.

The correlation analysis of each variable is shown in Table 2. As previously assumed, all variables were significantly correlated. The NLEs were negatively correlated with resilience, social support, and QoL. Resilience was positively correlated with social support and QoL. Social support was positively correlated with QoL.

TABLE 2 Correlations, means, and standards deviations of study variables.

	Mean	SD	NLEs	*R*	SS	QoL
NLEs	40.71	11.25	1			
R	91.67	17.01	−0.480*	1		
SS	40.94	7.02	−0.393*	0.585*	1	
QoL	148.07	20.45	−0.636*	0.627*	0.527*	1

SD, standard deviation; NLEs, negative life events; R, resilience; SS, social support; QoL, quality of life.
*P < 0.05.

TABLE 3 The mediating effect of NLEs on QoL through R and SS.

Outcome	Mediation analysis paths	Estimated	95% bias-corrected *CI*	
			Lower	Upper
QoL	Total effect	−1.157	−1.219	−1.093
	Direct effect	−0.745	−0.805	−0.690
	Indirect effect	−0.411	−0.448	−0.381
	NLEs → R	−0.726	−0.777	−0.674
	R → QoL	0.396	0.356	0.433
	NLEs → SS	−0.246	−0.267	−0.225
	SS → QoL	0.504	0.413	0.598
	NLEs → QoL	−0.745	−0.805	−0.690

NLEs, negative life events; R, resilience; QoL, quality of life; SS, social support; CI, confidence interval.

Mediation analyses

As shown in Table 3, the mediating effect (indirect effect) of NLEs on QoL was significant ($\beta = -0.411$, 95% *CI* [−0.448, −0.381]). The direct effect of NLEs on QoL was also significant ($\beta = -0.745$, 95% *CI* [−0.805, −0.690]). Specifically, both resilience and social support mediated the relationship between NLEs and QoL. NLEs significantly predict decreased mental resilience ($\beta = -0.726$, 95% *CI* [−0.777, −0.674]), social support ($\beta = -0.246$, 95% *CI* [−0.267, −0.225]), and lower QoL ($\beta = -0.745$, 95% *CI* [−0.805, −0.690]). The mediating effect of resilience ($\beta = -0.287$, 95% *CI* [−0.322, −0.255]) and social support (β =-0.124, 95% *CI* [−0.149, −0.100]) accounted for 24.85% and 10.72% of the total effect, respectively (Figure 2).

Table 4 further demonstrates the mediating effects of various dimensions of resilience and social support on the relationship between NLEs and QoL. Among them, emotional adjustment in resilience had the greatest mediating effect on the relationship between NLEs and QoL ($\beta = -0.285$, 95% *CI* [−0.317, −0.257]). In social support, the subjective support dimension had the largest mediating effect ($\beta = -0.100$, 95% *CI* [−0.123, −0.079]).

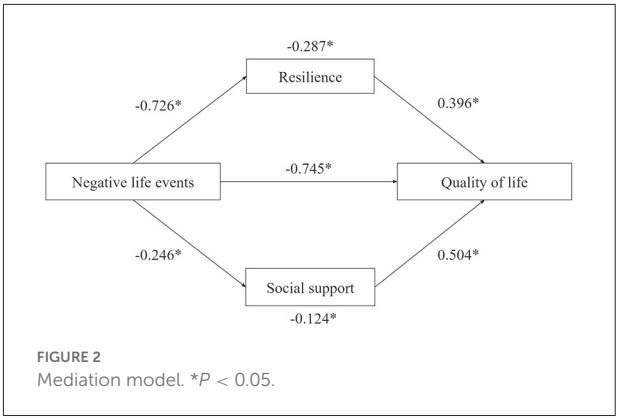

FIGURE 2
Mediation model. *P < 0.05.

Discussion

The purpose of this study was to explore the influence of NLEs on adolescent QoL and its potential mediating mechanism. As hypothesized, our results show a significant negative association between NLEs and adolescent QoL, which is consistent with previous studies (10, 11). Importantly, we found that resilience mediated the relationship between NLEs and QoL in adolescents. The mediating effect value was −0.287, accounting for 24.85% of the total effects. Most people will inevitably be exposed to traumatic experiences during their lives, which have been shown to negatively impact physical and mental health (37–39).

Resilience is becoming an increasingly popular concept for research and application in the field of prevention (18). Adolescence is the developmental period with the highest risk for experiencing multiple types of NLEs, such as academic stress, injuries, interpersonal violence, and chronic diseases (40–42). Studies have shown that frequent exposure to NLEs in childhood and adolescence is associated with poorer, health-related QoL (43, 44). With reduced funding for services to help children and families at risk, there is an urgent need for information on low-cost ways to increase children's resilience to negative life events. A better understanding of ways to increase the resilience of all children holds great promise for improving the effectiveness of prevention services in communities, schools, and families (18). Resilience is considered an important aspect of health and well-being and refers to the ability to cope with difficulties, stress, and trauma while maintaining or restoring normal function. It is regarded as a complex dynamic process (45) that is influenced by psychological, social, and biological factors (46). The higher the resilience, the lower the vulnerability and risk of disease (47).

The results of this study showed that resilience was positively correlated with QoL (16), and negatively correlated with NLEs

TABLE 4 The mediating effect of NLEs on quality of life through various dimensions of R and SS.

Outcome	Mediation analysis paths	Estimated	95% bias-corrected *CI*	
			Lower	Upper
QoL	NLEs → R_1 → QoL	−0.040	−0.054	−0.029
	NLEs → R_2 → QoL	−0.285	−0.317	−0.257
	NLEs → R_3 → QoL	0.006	−0.002	−0.011
	NLEs → R_4 → QoL	−0.049	−0.070	−0.029
	NLEs → R_5 → QoL	0.016	0.035	0.002
	NLEs → SS_1 → QoL	−0.100	−0.123	−0.079
	NLEs → SS_2 → QoL	0.008	−0.001	0.016
	NLEs → SS_3 → QoL	−0.054	−0.070	−0.039

NLEs, negative life events; R_1, target focus; R_2, emotional adjustment; R_3, positive cognition; R_4, family support; R_5, interpersonal assistance; QoL, quality of life; SS_1, objective support; SS_2, subjective support; SS_3, utilization of social support; CI, confidence interval.

(17), which is consistent with the results of previous studies. Therefore, it is reasonable to infer that NLEs could reduce the level of resilience and further predict lower QoL. In addition, the results suggest that a targeted intervention for improving resilience can help individuals to resist the negative impact of NLEs on QoL and maintain and improve QoL. In this study, emotional control of resilience played the most important mediating role. Previous studies have found that the tendency to feel and share positive emotions, especially those related to pleasant events, has a strong interpersonal component that can improve QoL (48). In contrast, the negative emotions of sadness, anger, guilt, disgust, shame, and embarrassment affect the way stressors are assessed and can have a damaging effect on life satisfaction (49, 50). Thus, it is expected to reduce the negative impact of NLEs on QoL by improving the individual's ability to manage their emotions with respect to resilience.

Social support is described as "the support an individual receives through social networks with others" (51). In this study, we found that social support was not only significantly associated with NLEs and QoL but also mediated the effects on the relationship between NLEs and QoL in adolescents. The mediating effect value was −0.124 and accounted for 10.72% of the total effects. Adolescence is the main transitional period of an individual's life and is characterized by biological, behavioral, and psychological changes under the influence of social conditions and family characteristics (52). With the change and expansion of social relations among family members, teachers, and friends, the interdependence and influence between individuals and different social groups are increasing, and social support is closely related to the emotional and social development of adolescents (53). According to social support theory, the stronger a person's social support network, the better able they are to cope with environmental challenges. Social support may influence adolescents' assessment of situations, improve their problem-solving skills, and promote adaptive behavior (54). Previous studies have demonstrated that social support can buffer the impact of NLEs on depression, anxiety, and other psychological problems (24, 28, 55). Social support from the school, family, and other environments is a positive predictor of adolescents' QoL (29, 56).

In this study, social support, as a protective factor of QoL, is a mediator between NLEs and QoL and can buffer the negative impact of NLEs on QoL in adolescents. Among them, the subjective support dimension plays the strongest intermediary role. Subjective support is also called perceived social support, that is, the emotional support experienced by individuals, and the emotional experience and satisfaction of individuals who are respected, supported, and understood in society. Perceived social support is closely related to the subjective feelings of individuals (57). Crockett et al. (58) found that having a strong family social support network can enable individuals to have better emotional regulation and protect them from external stress. Social work with a social support theory orientation emphasizes the intervention of an individual's social network to change its role in the individual's life. Individuals with insufficient social support resources or insufficient ability to use social network need social workers to work with them to reduce the negative impact of NLEs on QoL. Specifically, social workers can help these individuals to expand their social support resources, enhance their emotional support, and improve their ability to use social networking networks.

Adolescence is a time of many changes characterized by an increasing trend in exposure to NLEs (59), and a gradual

decline in life satisfaction in terms of cognitive evaluation of overall life (60, 61). In 2015, the H6 agencies (United Nations Program on HIV/AIDS, United Nations Population Fund, United Nations Children's Fund, UN Women, WHO, and the World Bank Group) launched the Global Strategy for Women's, Children's and Adolescent's Health (2016–2030), which identifies adolescents as central to achieving the United Nation's Sustainable Development Goals [SDGs; (62)]. In 2019, China issued the Healthy China Action plan (2019–2030), which aims to promote the health and well-being of children and adolescents through a series of steps and programs (63). These policies emphasize the importance of adolescents' QoL. To better promote teenagers' QoL, it is urgent to find and use effective intervention approaches. Given that the NLEs experienced by adolescents are not always avoidable, traditional education alone may not be effective. Based on the results of this study, targeted interventions on resilience and social support may reduce the impact of NLEs on adolescents so they can enjoy a better QoL.

Limitations of the study

This study has some limitations that need to be considered. Firstly, this study was based on participants' self-reports of data that may be more subjective than objective. Secondly, the sample was drawn only from Chongqing, China and most of the adolescents were in early adolescence. Thus, the representation of older adolescents and the generalizability of the result are limited. Thirdly, this study was a cross-sectional survey, so causal conclusions cannot be drawn. Future studies will need a longitudinal research design to verify our findings. In addition, the relationship between NLEs and QoL is complex and future research should explore additional variables such as the mediating variables between NLEs and QoL.

Conclusion

There was a significant negative correlation between NLEs and adolescents' QoL. Resilience and social support played an important mediating role between NLEs and QoL. Schools and society should strengthen health interventions that enhance adolescents' resilience and social support that in turn can improve their QoL.

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 author/s.

Ethics statement

The study was approved by the Ethical Committee of Chongqing Medical University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

HW and YT: conceptualization and writing-review and editing. HW, YT, and YM: methodology. HW, YT, YM, and JZ: formal analysis and investigation. YT: writing-original draft preparation. HW: funding acquisition. All authors read and approved the final manuscript.

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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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Body mass index and quality of life in individuals with polycystic ovary syndrome: Dysmorphic concerns and eating disorders as mediators

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Objective: Weight issues, dysmorphic concerns and eating disorders are common among individuals with polycystic ovary syndrome (PCOS) and are linked to poor quality of life (QoL). The goal of the current study was to examine whether the association between body mass index (BMI) and QoL was mediated by dysmorphic concerns, examining also the relations with eating disorder symptomatology.

Methods: Questionnaires were administered to 435 individuals with PCOS aged between 18 and 40 years ($M = 27.62$; $SD = 4.83$) to measure dysmorphic concerns, eating disorder symptoms and QoL. Participants were also asked to report their height and weight to compute their BMI.

Results: Structural equation modeling was used to observe the relationship between the variables. The results revealed a direct relationship between QoL, BMI, dysmorphic concerns and eating disorder symptomatology. In addition, dysmorphic concerns were related to BMI and eating disorder symptomatology. Furthermore, the results showed the mediating role of dysmorphic concerns and eating disorder symptoms in the relationship between BMI and QoL.

Conclusion: The current results highlight the potential importance of harmful relationships with one's own body and food, explaining why weight issues may be linked to different levels of QoL in PCOS individuals. The implications of these findings are discussed.

KEYWORDS

body mass index, dysmorphic concerns, eating disorders, health-related quality of life, polycystic ovary syndrome

Polycystic ovary syndrome

Polycystic ovary syndrome (PCOS) is a disabling endocrinopathy affecting approximately 6–10% of women of childbearing age (1). The condition is multifactorial and often difficult to diagnose due to the existence of different diagnostic criteria (2), mainly based on the presence of a combination of clinical signs of anovulation or menstrual irregularities, polycystic ovaries and androgen excess (3). Weight management issues exacerbate the clinical significance of the disease, leading to important clinical concerns such as diabetes and cardiovascular disease (4, 5). Not surprisingly, research has shown that weight problems are among the most burdening symptoms of this condition, whereas others, such as infertility or menstrual irregularity, have a moderately negative impact on individuals' quality of life (QoL) (6).

Past findings showed how patients with PCOS are more likely to be overweight compared to controls and that PCOS is common in obese women (7, 8). Likewise, previous research has found that the prevalence of PCOS in women with weight problems is about 25% and it is widespread in patients undergoing bariatric surgery (9, 10). The research emphasized how a problematic body mass index (BMI) may foster a negative self-view (11–13) and may negatively influence one's own perceived body image. For instance, past findings showed how BMI is related to dissatisfaction with one's own body in both normal (14–17) and clinical populations (12, 18); furthermore, longitudinal research (19) revealed that BMI was a risk factor for decreased body satisfaction at the time of initial assessment and 5 years later.

Adherence to a healthy lifestyle, namely, proper nutrition and adequate physical activity, is therefore an important part of optimal PCOS management (20). Thus, lifestyle interventions focused on weight and diet to reduce symptoms and improve health outcomes have been indicated as first-line treatment for individuals with PCOS (20). However, previous research observing these kinds of treatments suggested that they provide small or short-term effects (21). It is thus necessary to identify alternative target areas to improve their clinical efficacy.

Given that people with PCOS who have a high BMI are more likely to report poor health status (22, 23) and that having a problematic body weight can lead to fear of social evaluation and perceptions of flaws in appearance (24–26), it is reasonable to assume that dysmorphic concerns are likely to occur.

The interplay between dysmorphic concerns and eating disorder symptomatology in PCOS

Dysmorphic concerns refer to perceived aesthetic flaws and the use of strategies to disguise them, withdrawal from social events due to appearance concerns and also reassurance-seeking about one's own appearance from significant others (27). While body dissatisfaction refers to a negative subjective evaluation of a person's physical body size and/or shape (28–30), dysmorphic concern is a more specific concept that encapsulates not only behavioral, emotional, and cognitive components related with negative body image (27, 31) but also the presence of maladaptive behaviors aimed at altering one's body (32, 33). One of the components of dysmorphic concerns is in fact the presence of potentially harmful behaviors aimed at altering the body through excessive fasting and physical exercise, performance enhancing substances, engaging in excessive grooming, and undergoing cosmetic surgical treatments (34, 35). As such, dysmorphic concerns entail distorted beliefs that one's body is defective that lead to marked social withdrawal (32, 33) and they seem more recurrent in women (36). Previous findings showed a strong association between PCOS and dysmorphic concerns (37–39), and showed that patients with PCOS have worse dysmorphic concerns than individuals without this condition (37). In particular, concerns about weight have been identified as a major component of self-perceived impairment in patients with PCOS (20). In effect, negative thoughts and feelings, such as those associated with dysmorphic concerns, are closely related to impaired QoL (40). The nature of the relationship between dysmorphic concerns and QoL in individuals with PCOS was examined in a meta-analysis by Bazarganipour et al. (41), who found that QoL impairment was exerted by dysmorphic concerns through a significant link with the physical manifestations of hyperandrogenism. Furthermore, dysmorphic concerns have been correlated to a variety of risk factors for poor QoL in people with PCOS, including appearance evaluation, body area satisfaction, overweight preoccupation and higher self-classified weight (42, 43).

Of note, body image disturbances such as dysmorphic concerns are key components of eating disorders (44, 45). Eating disorders are a set of pathologies based on abnormal food intake and preoccupation with weight that can hinder a person's functioning (46). The burden of eating disorder symptomatology on many spheres of a person's life is well documented, with studies revealing diminished interpersonal functioning (47, 48) and increased morbidity and healthcare costs (49). It is thus reasonable to argue that more severe eating disorder symptoms may be positively related to worsened QoL. A connection between PCOS and eating disorders has been suggested by a few studies (50) and some insights have shown that individuals with PCOS display altered dietary intakes and higher odds of presenting with food cravings (42–45, 47–52). For instance, Bernadett and Szemán (53) underlined that the prevalence of clinical and subclinical bulimia nervosa is higher among individuals with PCOS compared to controls. In addition, those with PCOS appear to be more likely to report food restriction and weight concerns, which are also key factors in eating disorders, compared

with healthy individuals (50, 54, 55). The development of disordered eating in individuals with PCOS seems to be significantly linked to distorted perceptions and beliefs about one's own body image (56–58). In particular, body self-evaluation and drive for thinness appear to be among the most prominent components in the maintenance and development of eating disorders, even in individuals with PCOS (59, 60).

The present study

The above studies underline how interactions between biopsychosocial factors may account for different levels of QoL in individuals with PCOS. There is, in fact, good evidence that body dissatisfaction and/or eating-disordered behavior mediate the association between (elevated) BMI and impairment in quality of life among both women and men in the general population and among both young people and adults (29, 61) and thus is reasonable to infer that said interactions are likely to occur in individuals with PCOS as well. Indeed, it has been highlighted that BMI is a biological dimension that is closely associated with lower body dissatisfaction (62, 63), thereby suggesting that problematic body fatness may constitute a plausible antecedent accounting for individual variation in the preoccupation with one's own physical characteristics (25, 64) and thus dysmorphic concerns. Dysmorphic concerns are in fact a constellation of preoccupations with perceived defects in one's own body that previous findings have shown to foster harmful relationships with food and weight management.

PCOS, as a chronic condition associated with unhealthy BMI and several psychosocial impairments (65–67), is thought to impair one's own QoL. For these reasons, the aim of the current study is to test the hypothesis that an association between BMI and QoL in women with PCOS would be mediated by dysmorphic concerns, examining also the relations with eating disorder symptomatology. Specifically, the goal of this research was to test a model in which higher BMI predicts higher levels of dysmorphic concerns, which in turn lead to higher levels of eating disorder symptomatology that consequently lowers the QoL. It is also expected that higher BMI and dysmorphic concerns predict lower QoL.

Method

Participants

Questionnaires were administered to 435 individuals with PCOS aged between 18 and 40 years (M = 27.62; SD = 4.83).

Measures

Quality of life

Polycystic Ovary Syndrome Health-Related Quality of Life Questionnaire (PCOSQ; (68)). It is a self-report questionnaire designed to s assess specifically the QoL of individuals with PCOS. The questionnaire consists of 26 items that investigate the impact of the disease on several aspects of one's quality of life (e.g., "Concerned with infertility problems"). Individuals must respond on a seven-point Likert scale (7 = optimal function, 1 = poorest function). High scores indicate good HRQoL. In our study, Cronbach's alpha was 0.91.

Eating disorders

Eating Attitudes Test [EAT-26; (69)]. It is a 26-item self-report questionnaire designed to assess eating disorders symptomatology (e.g., "I am terrified about being overweight"). Participants are asked to respond using a six-point Likert scale ranging from zero (= "Never") to five (= "Always"). High scores indicate abnormal eating behaviors. In our study, Cronbach's alpha was 0.88.

Dysmorphic concerns

Italian Body Image Concern Inventory (I-BICI; (31)). It is a self-report questionnaire that evaluates dysmorphic concerns (e.g.: "I spend a significant amount of time checking my appearance in the mirror"). Participants are asked to respond on a five-point Likert-type scale ranging from one (= "Never") to five (= "Always"). Higher scores indicate greater dysmorphic concerns. This questionnaire was widely used to assess PCOS patients (70–72) and it was previously used in cross-sectional research in the Italian context to observe dysmorphic concerns (73, 74). In our study, Cronbach's alpha was 0.93.

Procedures

The protocol was created using an online survey and participants were recruited through social networks by targeted posts on individuals suffering from PCOS in thematic groups from 21 December 2021 to 22 March 2022. Inclusion criteria were: having physician-diagnosed PCOS for at least 1 year, being $\geq$18 years of age and being able to speak Italian. Participants were considered ineligible if the following were present: lack of a PCOS diagnosis from a health professional, the presence of gynecological or endocrinological comorbidities, pregnant at the moment of protocol administration, insufficient fluency in Italian or <18 years of age.

All participants declared that they voluntarily participated in the research and filled out the questionnaire anonymously, with consent implied by submission. The protocol took about

30 minutes to be completed. All questions in the survey were set as mandatory, hence there were no missing answers. The data were then analyzed using IBM SPSS and RStudio. This study was conducted in accordance with the recommendations of the ethical code of the Italian Association of Psychology (AIP) and the ethical standards described in the 1964 Declaration of Helsinki. The materials and procedures used in this study were approved by the Ethical Committee for Scientific Research at the authors' institution (Ethics Committee Num. 36360).

Data analysis

A hybrid Structural Equation Modeling (SEM), with BMI as an observed variable and dysmorphic concerns, eating disorders, and QoL as latent variables was used to examine a model in which BMI is considered the predictor variable, dysmorphic concerns the first mediator, eating disorders the second mediator, and QoL the outcome.

A parceling approach to obtain the indicators of the latent variables present in the current model was used, which consists of the aggregation of items (randomly selected) from the questionnaires in three indicators of each latent variable (75). Parcels are more likely to meet the assumptions of normality and less likely to be influenced by method effects (75, 76). The lavaan Package for R with the integration of RStudio were used to carry out the analysis of the covariance matrices and solutions were generated on the basis of maximum-likelihood estimation.

Results

Demographics and sample characteristics

Fifty nine percentage of the sample was on medication and median duration of PCOS diagnosis was 7.43 (5.69) years. Most of the individuals had medium-high educational qualifications. Specifically, 39% had a high school diploma, 56% had a university degree, and 2% had a post-graduate degree, whilst the remaining 3%, had a middle school certification. Concerning occupational status, 45% were employed, 14% were self-employed, 33% were students, 7% were unemployed, and 1% were housewives. With regard to marital status, 31% of individuals were single, 27% were engaged, 25% were living with a partner, 16% of individuals were married, and 1% were divorced. Furthermore, the participants reported having the following symptoms associated with PCOS: 88% had an irregular cycle, 75% had hirsutism, 58% were overweight or had difficulty maintaining a healthy weight, 55% had acne, 32% had infertility problems, and 21% had alopecia. Finally, concerning BMI, 57% had normal weight, 23% were overweight, 11% had obesity class I, 6% had obesity class II, and 3% had obesity class III (Table 1).

TABLE 1 Demographics and sample characteristics.

Variables	Percentage (*N* subjects)
Educational qualification	
Middle school certification	3% (12)
High school diploma	39% (172)
University degree	56% (242)
Post-graduate degree	2% (9)
Occupational status	
Student	33% (142)
Housewife	1% (7)
Unemployed	7% (30)
Employed	45% (196)
Self-employed	14% (60)
Marital status	
Single	31% (135)
Engaged	27% (117)
Cohabitating	25% (110)
Married	16% (72)
Divorced	1% (1)
Bmi	
Normal weight	57% (246)
Overweight	23% (101)
Obesity class I	11% (49)
Obesity class II	6% (28)
Obesity class III	3% (11)
Pcos symptoms	
Irregular cycle	88% (383)
Hirsutism	75% (327)
Overweight	58% (251)
Acne	55% (238)
Infertility	32% (138)
Alopecia	21% (91)

Descriptive results and correlations

The values of skewness and kurtosis were examined to explore the distribution of the data (Table 2), suggesting that no problems were observed regarding the violation of the normal distribution. Furthermore, Table 2 shows the correlations among the dimensions of the questionnaires. Furthermore, Table 2 illustrates the correlations among the observed dimensions. BMI positively correlated with dysmorphic concerns and eating disorders, while negatively related with HRQoL. Furthermore, a positive association was found between dysmorphic concerns and eating disorders, while a negative correlation was observed between dysmorphic concerns and HRQoL. Finally, there was a negative correlation between eating disorders and HRQoL.

TABLE 2 Descriptive analysis and correlations.

	α	M	SD	Skew	Kurt	1	2	3
1. Body mass index	–	25.62	5.93	1.12	0.96	–	–	–
2. Dysmorphic concerns	0.93	3.04	0.95	−0.05	−0.89	0.37*	–	–
3. Eating disorders	0.88	19.72	12.89	0.72	−0.24	0.24*	0.65*	–
4. Quality of life	0.91	3.59	1.23	0.23	−0.43	−0.36*	−0.58*	−0.46*

N = 435; *$p < 0.01$.

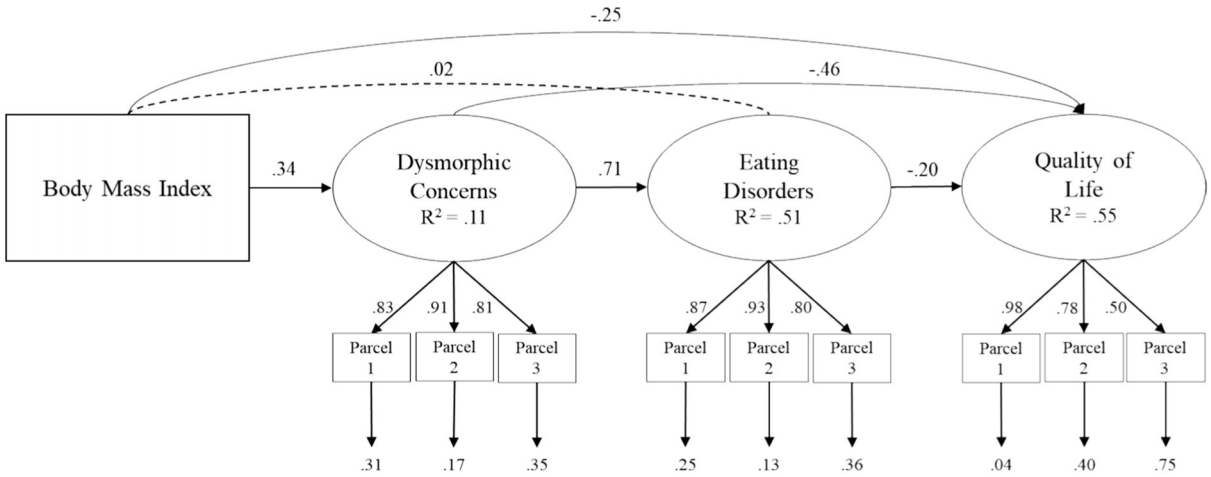

FIGURE 1
Structural model of association between body mass index, dysmorphic concerns, eating disorder and quality of life of life in individuals with PCOS. Coefficient shown are standardized path coefficients. Dotted lines represent not significance relations.

Mediation model

The model showed acceptable fit indices: $\chi 2(30) = 167.93$; $p < 0.001$, CFI =0.95, RMSEA =0.10 (90% CI =0.09 −0.12), SRMR =0.04 (Figure 1).

Significant paths were found from BMI to dysmorphic concerns ($\beta = 0.34$; $p < 0.001$) and HRQoL ($\beta = -0.25$; $p < 0.001$). Furthermore, the results showed a significant path from dysmorphic concerns to eating disorders ($\beta = 0.71$; $p < 0.001$) and HRQoL ($\beta = -0.46$; $p < 0.001$). Finally, eating disorders was related to HRQoL ($\beta = -0.20$; $p < 0.001$).

To explore the significance of the indirect effects that emerged (i.e., drop from the total to direct effect) we used the bootstrap-generated bias-corrected confidence interval approach (77, 78). A statistically significant indirect association was found from BMI to eating disorders by dysmorphic concerns ($\beta = 0.24$; $p < 0.001$) and from BMI to HRQoL by dysmorphic concerns ($\beta = -0.15$; $p < 0.001$). In addition, there was a significant indirect association from dysmorphic concerns to HRQoL by eating disorders ($\beta = -0.14$; $p < 0.001$). Finally, a statistically significant indirect relationships was found from BMI to HRQoL by dysmorphic concerns and eating disorders ($\beta = -0.05$; $p = 0.002$) (Table 3).

Discussion

The current study tested a mediation model in which the relationship between BMI and QoL in individuals with PCOS is mediated by dysmorphic concerns, examining also the relations with eating disorders. In line with the expectations, the results showed that BMI was related to QoL not only directly but also indirectly through the mediation of dysmorphic concerns. In line with other studies supporting the relationship between body weight and body dissatisfaction (79, 80), the present findings corroborate the concept that excess body weight is one of the main factors contributing to impaired physical and mental functioning (81) and highlight how dissatisfaction with some aspect of one's own appearance contributes to shaping self-reported health status (82, 83). This may be due to the fact that a higher BMI fosters weight stigma and discrimination (84–86), which in turn may encourage

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TABLE 3 Path estimates, SEs and 95% Cis.

	β	*p*	SE	Lower bound (BC) 95% CI	Upper bound (BC) 95% CI
Direct effect					
BMI → dysmorphic concerns	0.34	<0.001	0.07	0.03	0.05
BMI → eating disorders	0.02	0.67	0.00	−0.01	0.01
BMI → quality of Life	−0.25	<0.001	0.01	−0.09	−0.04
Dysmorphic concerns → eating disorders	0.71	<0.001	0.04	0.38	0.52
Dysmorphic concerns → quality of life	−0.46	<0.001	0.14	−1.26	−0.73
Eating Disorders → quality of life	−0.20	<0.001	0.19	−1.07	−0.32
Indirect effect via dysmorphic concerns					
BMI → eating disorders	0.24	<0.001	0.01	0.01	0.02
BMI → quality of life	−0.15	<0.001	0.01	−0.06	−0.03
Indirect effect via eating disorders					
BMI → quality of life	−0.01	0.69	0.00	−0.01	<0.01
Dysmorphic concerns → quality of life	−0.14	<0.001	0.09	−0.48	−0.14
Indirect effect via dysmorphic concerns and eating disorders					
BMI → quality of life	−0.05	0.002	0.00	−0.02	−0.01

SE, Standards errors; BC 95% CI, Bias Corrected-Confidence Interval; p, level of significance.

social alienation and loneliness and thus decreased psychosocial adjustment. It may also be that weight problems due to PCOS negatively influence thoughts about attractiveness (87) and thus concerns about one's own potential appearance flaws are likely to occur.

Moreover, the present findings showed that individuals with PCOS reported lower QoL when dysmorphic concerns and eating disorders were higher because greater dysmorphic concerns involve fear of others' evaluations and constant approval-seeking, predisposing the person to a sense of incompetence and diminished social functioning (88–92). At the same time, given that eating disorder symptomatology impairs several dimensions of one's own functioning (47, 48), a lowered QoL is likely to occur. These results confirmed a plausible role for both variables in defining different levels of QoL and deepened their effects in the context of a burdensome condition such as PCOS. Furthermore, these findings support the hypothesis that BMI is connected to one's own QoL *via* the mediation of both dysmorphic concerns and eating disorders. Women with PCOS are more likely to have problems losing weight due to the metabolic features of the disease (93) and to have other comorbidities, including acne and hirsutism, which can cause dysmorphic concerns (39). These may foster maladaptive compensatory strategies used as a means of controlling food intake and body size, such as eating disorders. In the long run, this may alter individuals' functioning and result in impaired social, physical and mental adjustment. Moreover, the results of this study show that dysmorphic concerns, in addition to an indirect association with QoL by eating disorder symptomatology, have a direct link with this outcome dimension. Apprehensions of perceived defects in appearance may lead to increased dietary restriction and the use of compensatory strategies aimed at controlling body size and shape (73, 79, 94), contributing to an increased likelihood of disordered eating behaviors (79, 94). Consonant with previous findings revealing the direct link between body image dissatisfaction and disordered eating in women with PCOS (37, 57), the present study also found that dysmorphic concerns were related to eating disorder-related symptomatology. PCOS is often associated with a body shape that is culturally described as undesirable due to difficulties in weight management, which may lead individuals to undertake unhealthy dieting behaviors in an attempt to adhere to the idealized slim female figure, believed to be sexually attractive and healthy (63, 95, 96). In the long run, this may favor maladaptive eating habits used as a means for shaping one's own body (97). Overall, the results of the present study are consistent with the insights provided by Dokras et al. (98), who showed that health-related QoL scores are consistently reduced in PCOS, with difficulties in weight management playing a significant role in determining this condition. Interestingly, these results are consonant with recent advances that postulated from a biopsychosocial perspective that upregulated activation of the central HPG axis leading to PCOS may be epigenetically altered by abnormal eating patterns (55). Additionally, problematic body size, which typically denotes abnormal eating patterns, may

hinder normal appetite signaling regulated by leptin and ghrelin, two important hormones controlling hunger and fullness (55). The present research has some limitations. First, it is a cross-sectional study, therefore future research could attempt to verify the findings and the direction of the hypothesized associations using a longitudinal design. Furthermore, the exclusive use of self-reports may introduce measurement bias and future studies may want to use a multi-informant approach to reduce this possibility. In addition, the research was conducted by reaching participants through social networks, so there may be problems with generalization in that only individuals with access to the Internet could be reached. It should be noted that the current results showed a higher number of women with problematic body sizes than those reported in a recent study based on the Italian population (99), which reported that the prevalence of obesity is about eight percent and 30 percent for overweight. PCOS often results in difficulties with weight management (7, 8), and this may partially explain the higher number of individuals with PCOS who reported overweight or obesity. Of note, the current study did not account for the different phenotypes of PCOS and focused only on the presence of dysmorphic concerns and eating disorder symptoms in this clinical population. Future studies should replicate this model for different PCOS phenotypes in order to provide a more nuanced description of the disease. Furthermore, although our study reported the number of participants currently on medication, it did not take into account important factors such as the type of medication used and adherence to the treatment plan. Future studies are needed in which the influence of drug treatment on individual quality of life is also observed. However, our study advances the current state of knowledge by explaining the relationships between BMI and QoL in individuals with PCOS. It would be thought-provoking to implement future studies in which a retrospective approach is used to observe the potential influence of the COVID-19 pandemic scenario (100, 101) because recent findings observed that during isolation due to the COVID-19 outbreak, weight gain was slightly more pronounced in individuals suffering from PCOS and this may be due to impaired sleep quality and eating habits rather than reduced physical activity (102). In a similar vein, future studies may assess how different eating patterns ad caloric restriction protocols like ketogenic diet (103, 104) may interact with individuals' perception of the condition of their own health. Similarly, future studies may benefit from the implementation of other biological variables, such as energy expenditure and fat mass (105), as they may influence adaptations of metabolism and body composition. More importantly, this study contributes to the evidence by investigating the role that dysmorphic concerns and eating disorder symptomatology may have in explaining the individual differences in the association between BMI and QoL in individuals with PCOS. In light of the findings of this study, there may be important clinical and research implications. This study highlights how people with PCOS and problematic weight have a poorer QoL. Individuals suffering from PCOS would benefit from a multidisciplinary intervention aimed at managing weight and dealing with problematic thoughts concerning appearance and weight. In addition, our results show how both dysmorphic concerns and eating disorders are relevant in the context of PCOS. Individuals with PCOS may benefit from periodic assessments aimed at detecting disordered eating (98). Practitioners should therefore screen individuals with the condition for a problematic relationship with food or excessive concerns about their bodies. Intervention and prevention programmes may also want to include women's partners in order to improve their effectiveness, as the disease may negatively affect women's intimate relationships (67). From a public health perspective, these results emphasize the detrimental effects of dysmorphic concerns and eating pathology on PCOS patients and require the urgent implementation of health promotion interventions. Policy makers and health institutions should thus create health promotion interventions aimed at improving knowledge, communication, and beliefs about the impact of PCOS on quality of life. This is consonant with recent advances arguing that mental health literacy may help promote individuals' psychosocial functioning (106). In addition, these programmes should not only involve PCOS patients, but also socialization agents such as family, peers, and the media through the transmission of messages aimed at raising awareness about appearance-related pressures that may come from social sources to prevent the onset of unhealthy body image (28). Finally, this study provided a holistic approach to the understanding of complex conditions such as PCOS.

Data availability statement

The data that support the findings of this study are available from the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the Center for Research and Psychological Intervention of the University of Messina. The patients/participants provided their written informed consent to participate in this study.

Author contributions

NB assisted with manuscript preparation, study design, data analysis and interpretation and data were gathered on-line under her supervision. DC assisted with manuscript preparation and data interpretation. MC assisted with manuscript preparation and data interpretation and served as corresponding author.

VV assisted with concept and study supervision. All authors contributed to the article and approved the submitted version.

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.

Publisher's note

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Symptom association between social anxiety disorder, appearance anxiety, and eating disorders among Chinese University students: A network analysis to conceptualize comorbidity

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Background: Incidences of social anxiety disorder (SAD), appearance anxiety, and eating disorders (ED) show an increased prevalence among young people. However, symptoms' associations between these disorders have not been investigated in depth. Network analysis is an approach that can be used to explain the relationship(s) between symptoms of different psychological disorders. Using network analysis, this study aimed to explore the association and potential interacting mechanisms between SAD, appearance anxiety, and ED.

Methods: This study included 96,218 University students from Jilin Province, China. SAD, appearance anxiety and ED were assessed using the Social Anxiety Subscale of the Self-Consciousness Scale (SASS), the Appearance Anxiety Scale Brief Version (AASBV), and the Sick, Control, One, Fat, Food questionnaire (SCOFF), Chinese versions. Network analysis was employed to investigate the symptom associations, while the stability of the network model was analyzed using statistical measures.

Results: The prevalence of ED among the total sample was 38% (95% CI: 38.1–38.8%), while this figure was 31.2% (95% CI: 30.7–31.6%) in males and 43.6% (95% CI: 43.2–44.0%) in females. Additionally, the total score of SAD was significantly higher in females (11.83 ± 5.37) than it in males (10.02 ± 5.46) ($P < 0.001$). While the total score of appearance anxiety was also different significantly in gender (39.21 ± 9.49 in females vs. 38 ± 9.42 in males) ($P < 0.001$). Results showed that ED was associated with

all three aspects of appearance anxiety, including "appearance concern," "appearance satisfaction," and "wish for good looks." Appearance anxiety and SAD were also associated; specifically, symptoms of "appearance satisfaction" were significantly associated with the symptoms "easily talk to strangers" and "appearance concern", which was also significantly associated with "embarrassed". Compared with males, females showed significantly stronger associations with appearance anxiety symptoms, while ED symptoms were associated with "troubled by being watched" and "appearance concern".

Conclusion: Appearance anxiety was associated with both ED and SAD symptoms. ED may have a potential relationship with SAD, affecting appearance anxiety indirectly. Significant differences were found among males and females in symptom associations between appearance anxiety and SAD. This study therefore clarified that young people should have body-positive interventions and challenge the normative body image discourse, which may help alleviate symptoms of SAD and ED.

KEYWORDS

social anxiety disorder, appearance anxiety, eating disorder, network analysis, young adults

1. Introduction

Social anxiety disorder (SAD), also known as social phobia, is a persistent fear of being exposed to strangers in one or more social or professional situations, where people might feel they are being observed by others, and is marked by a fear of engaging in embarrassing situations or behaviors (1, 2). SAD is common in young people and can severely impair their social functioning (3). The onset of SAD is around 15.5 years old, with the prevalence being between 4.0–8.7% among 14 and 24 years old (4, 5). Young people with SAD often experience excessive or unreasonable anxiety when exposed to social or performance-based stimuli (6). Studies have shown that SAD is often accompanied by extreme attention to appearance and frequently repeated observations of appearance (7). People with SAD have deficits of self-cognition and tend to criticize their own social abilities and physical appearance, resulting in problems such as appearance anxiety (8).

Individuals with SAD are prone to negative self-evaluation when it comes to their appearance; this deficit in perception of appearance can also exacerbate poor body image development (9–11). Appearance anxiety refers to individuals who pay excessive attention to their appearance due to perceived social standards and perceptions of other people's evaluations, which consequently generate insecurity, doubt, and anxiety about their appearance (12). Several studies have suggested that appearance anxiety can positively predict SAD among normal samples, and even among eating disorder samples (8, 13, 14). In turn, SAD symptoms also predict appearance anxiety and other body image disorders (13, 15). Furthermore, appearance anxiety is highly correlated with eating disorders such as anorexia nervosa and bulimia nervosa (16), and appearance-related comments can increase appearance anxiety and directly or indirectly affect eating disorders (17–19). Eating disorders (ED) are a group of psychiatric disorders characterized by abnormal eating behaviors and emotional disturbances, accompanied by significant weight changes and symptoms of physiological dysfunction syndrome (20). Previous studies have proposed there is an association between appearance anxiety and ED. For example, Li found that appearance anxiety positively predicted ED in 2,509 high school students (21). Levinson and Rodebaugh demonstrated that appearance anxiety symptoms predicted ED symptoms up to 6 months later and vice versa (22). In addition, ED may be closely related to anxiety disorders and thus may lead to negative emotions and interpersonal difficulties among individuals (23). Fredrickson and Roberts (24) noted that individuals might pander to or resist social appearance comments, subsequently increasing their maladaptive ED behaviors. This suggests that those affected by the ideal body shape promoted within a society may display negative emotions related to social appearance anxiety, and then develop maladaptive reactions and restrictions, including EDs (25, 26).

Although appearance anxiety is a common risk factor for SAD and ED, the overall mechanism of action of the three remains to be explored. For instance, difficulty in public eating is a bridge symptom between ED and SAD, with appearance anxiety playing a transitional role (27). Thus, there is a potential association between SAD and ED symptoms as expressed through appearance anxiety. Research also indicates a high

comorbidity between SAD and ED (8). According to the results from the literature reviewed, the comorbidity rate of SAD and ED is 68% (28). Moreover, appearance anxiety may increase the risk of ED and SAD (14, 29). Research further points to the increased risk of appearance anxiety in ED patients (16), and that appearance-related comments can increase appearance anxiety, directly or indirectly affecting ED (17–19). However, the potential symptoms' associations between ED, SAD and appearance anxiety still require additional exploration.

Network analysis is an approach that can explain the symptoms individuals experience as part of their diagnosis. The method can explore the complexity of psychological symptoms and focus on the adjustment of dynamic feedback between different symptom items on a scale (30–32). In the network model, symptoms of the disorders are defined as nodes, while associations between symptoms are defined as edges (33). When there are significantly strong associations between symptoms in two disorders, these specific symptoms would be described as bridge symptoms. These bridge symptoms result in a transformation from one disorder to another, playing an essential role in maintaining the network model, which occurs simultaneously. Therefore, as a visualized method, network analysis can identify strong links between symptoms of different psychological disorders and provide evidence for pathogenesis research (34, 35). For example, among young people with childhood sexual abuse experience, associations between psychosis and post-traumatic stress disorder (PTSD) symptoms include hypervigilance, intrusive thoughts, and physiological and emotional reactivity (36). Other studies also found connections between depression and anxiety (37), anxiety and insomnia (38), and other mental health disorder symptoms (39, 40). The discovery of bridge (joining) symptoms can improve the efficiency of monitoring young people and help provide targeted interventions among young people with psychological disorders (40, 41).

Thus, network analysis is applied to investigate the following complexities: first, to explore the symptom association between appearance anxiety, SAD, and ED as three separate groups. Second, to explore the potential relationship between ED and SAD, and the role of appearance anxiety as the mechanism of action. More comprehensive guidance and targeted interventions need to provide for patients with appearance anxiety, SAD, and ED to improve their quality of life.

2. Methods

2.1. Study design

From October to November 2021, an online questionnaire was distributed to students in 63 Universities in Jilin province, China. Cross-sectional questionnaires were collected from 117,248 students. All participants signed an online informed consent form before answering the online questionnaire. The Ethics Committee of Jilin University approved this study.

2.2. Measurements

2.2.1. Appearance anxiety

Appearance anxiety was measured by the Appearance Anxiety Scale Brief Version (AASBV). The Appearance Anxiety Scale has 14 items in the abbreviated version (12). Items are scored on a Likert scale of 1 (not at all) to 5 (very good)—the total score of this subscale ranges from 14 to 70 points. The three factors of the scale include: "appearance concern," "appearance satisfaction," and "wish for good looks" (42, 43). The Chinese version of the Appearance Anxiety Scale Brief Version (AASBV) has reliable internal consistency, with a Cronbach's alpha of 0.83 in females and 0.78 in males (44).

2.2.2. Social anxiety disorder

The Social Anxiety Subscale of the Self-Consciousness Scale (SASS) has six items and uses a 5-point Likert scale. The total score ranges from 0 to 24 points (45). The higher the total score, the more severe the level of social anxiety. This scale measures subjective anxiety, verbal, and behavioral difficulties. The Chinese version has good reliability and validity, with a Cronbach's alpha of 0.72 (46).

2.2.3. Eating disorder

The Sick, Control, One, Fat, Food (SCOFF) questionnaire contains five characteristics of eating disorders: Sick, Control, One, Fat, and Food (47). A score of 0 means no, and 1 means yes. The total score of this subscale ranges from 0 to 5 points. The scale had a sensitivity of 73.1% and a specificity of 77.7% for ED (47). Scale scores with more than two points were considered as displaying ED tendencies.

2.3. Statistical analysis

2.3.1. Network estimation

Partial correlation networks were used to assess the association between appearance anxiety, SAD, and ED among participants. The Graphical Gaussian Model (GGM) was applied to build the network model. Then the graphic least absolute shrinkage and selection operator (LASSO) algorithm was used to perform a sparse network model by deleting unimportant associations. This approach was performed using the R package "qgraph" (48, 49). For each node, excepted influence (EI) represents the summed weight of all its edges,

positive and negative, with its immediate neighbor nodes in the network (53). Predictability indicates how much variation in a node can be predicted by variation in the nodes connected to it. If a node has a high degree of centrality and predictability, this lends credence to the interpretation of its network importance.

2.3.2. Network accuracy and stability

To examine the robustness of results, three procedures were performed. First, the accuracy of edge-weights was determined using the non-parametric bootstrapping approach to compute confidence intervals (CIs) (51). The main dataset was then randomly re-sampled to generate additional data points from which the 95% CIs were determined. Second, using subset bootstraps, the correlation stability coefficient (CS-C) was determined to examine the stability of the EI centrality (48, 52). Finally, bootstrapped difference tests were used to assess differences in the attributes of the network (53).

2.3.3. Network comparison

The Network Comparison Test (NCT) was performed to examine statistical differences among the networks between the males and females. This methodology assesses differences in network structure, global strength and each edge between the two networks using Holm-Bonferroni correction (50). The significant edge differences for each pair of the groups were plotted after statistical testing. These tests were analyzed using the R-package "NetworkComparisonTest" (54).

3. Results

3.1. Study sample

A total of 96,218 young people met the inclusion criteria and answered all the required questions included in the analysis to be included in the data set; more than half of them were young females (58.4%) and lived in urban cities (50.9%). The prevalence of ED among the total sample was 38% (95% CI: 38.1–38.8%), this figure was 31.2% (95% CI: 30.7–31.6%) in males and 43.6% (95% CI: 43.2–44.0%) in females. Additionally, the total score of SAD was significantly higher in females (11.83 $\pm$ 5.37) than in males (10.02 $\pm$ 5.46) ($P < 0.001$). While the total score of appearance anxiety was also different significantly in sex (39.21 $\pm$ 9.49 in females vs. 38 $\pm$ 9.42 in males) ($P < 0.001$). Significant differences in sociodemographic variables between males and females are shown in Table 1. The items of the three scales are displayed in Supplementary Table S1.

3.2. Network estimation between symptoms of ED, appearance anxiety, and social anxiety

The network models among the total sample, as well as the network models for both male and female participants, are presented in Figures 1, 2. As shown in Figures 2, 3, network structures in males and females were similar to the structure of the total population. In the total sample, as seen in Figure 1, several items in the same scale were connected strongly, such as "fear of the crowds" connected to "fear of talking to group", and "troubled by being watched" connected to "embarrassed", among those with SAD. The SAD items were significantly associated with appearance anxiety, for example, "appearance satisfaction" was significantly associated with "easily talk to strangers", and "appearance concern" was significantly associated with "embarrassed". "Appearance satisfaction" and "appearance concern" were connected to appearance anxiety. ED was associated with all three aspects of appearance anxiety including "appearance concern," "appearance satisfaction," and "wish for good looks." ED was also connected with SAD indirectly by affecting appearance anxiety symptoms. Predictability estimations are displayed in the network analysis (Supplementary Table S2). "Fear of talking to group," "fear of the crowds," and the "appearance concern" nodes were best explained by the associated nodes in the three groups. This result indicated that the three symptoms were therefore more likely affected by other connected symptoms.

3.3. Network accuracy and centrality

As measured by non-parametric CIs, the precision of edges was found to be satisfactory, with lower CIs suggesting more accurate edge estimates (Supplementary Figure S1). A considerable number of edge weight comparisons were statistically significant, according to the bootstrapped difference tests (Supplementary Figure S3). Even when a large portion of the sample was dropped, the betweenness, closeness, and strength values remained steady using the case-dropping subset bootstrap approach (Supplementary Figure S2). Strength, betweenness, and closeness showed an excellent level of stability (CS-C = 0.75) among the three groups (SAD, appearance anxiety, ED).

3.4. Network comparison results

The comparison of network models between males and females was conducted. There was no significant difference in network global strength ($p = 0.45$) between the sexes. However, there was a significant difference between males and females

TABLE 1 Descriptive statistical analysis.

Variables	Total ($N = 96,218$)	Male ($N = 40,065$)	Female ($N = 56,153$)	x^2/T	P-value
Residence					
City	48,932 (50.9)	19,804 (49.4)	29,128 (51.9)	55.83	<0.001
Town and county	47,286 (49.1)	20,261 (50.6)	27,026 (48.1)		
Ethnic					
Han	86,111 (89.5)	36,257 (90.5)	49,855 (88.8)	72.99	<0.001
Others	10,107 (10.5)	3,808 (9.5)	6,299 (11.2)		
Family type					
Nuclear family	66,888 (69.5)	27,259 (68.0)	39,630 (70.6)	300.2	<0.001
More than three generation	17,622 (18.3)	8,320 (20.8)	9,302 (16.6)		
Others	11,708 (12.2)	4,486 (11.2)	7,222 (12.8)		
Current annual income					
Under ¥6,000	28,624 (29.8)	11,284 (28.2)	17,341 (30.9)	233	<0.001
¥6,000–13,999	31,212 (32.4)	12,677 (31.6)	18,535 (33)		
¥14,000–22,999	16,061 (16.7)	6,752 (16.9)	9,309 (16.6)		
¥23,000 and above	20,321 (21.1)	9,352 (23.3)	11,069 (19.7)		
Only-child					
Yes	45,660 (47.5)	22,349 (55.8)	23,311 (41.5)	1,909	<0.001
No	50,558 (52.6)	17,716 (44.2)	32,843 (58.5)		
Age	19.59 ± 1.74	19.64 ± 1.80	19.56 ± 1.70	6.52	<0.001
SCOFF	1.31 ± 1.33	1.1 ± 1.29	1.46 ± 1.33	−42.3	<0.001
SASS	11.08 ± 5.48	10.02 ± 5.46	11.83 ± 5.37	−51.3	<0.001
AASBV	38.71 ± 9.42	38 ± 9.28	39.21 ± 9.49	−19.6	<0.001

SCOFF, the Sick, Control, One, Fat, Food questionnaire; SASS, the Social Anxiety Subscale of the Self-Consciousness Scale; AASBV, Appearance Anxiety Scale Brief Version.

in edge weights ($p < 0.001$). Figure 4 shows the significant differences in edge weights between males and females and the significant differences are described as follows. Compared with males, females showed stronger associations between "troubled by being watched" and "appearance concern", between "wish for good looks" and "easily talk to strangers", and finally between ED and "troubled by being watched". Compared with females, males showed stronger associations between "easily talk to strangers" and "appearance concern", between "easily talk to strangers" and "appearance satisfaction", and between ED and "easily talk to strangers".

4. Discussion

This is the first study to use network analysis to explore symptom associations and potential mechanisms between SAD, ED, and appearance anxiety in a large sample of 96,218 in Jilin Province, China. The results among the three groups (total population, male, and female participants) showed that appearance anxiety was associated with both ED and SAD. The result indicates that there might be a potential relationship between ED and SAD by affecting the mechanism of appearance anxiety indirectly in young people. Furthermore, there are significant differences between the total scores of these three disorders, as well as the symptom associations between appearance anxiety, ED, and SAD in male and female participants.

The results of this study showed that ED was associated with all three aspects of appearance anxiety, including "appearance concern," "appearance satisfaction," and "wish for good looks." These results were consistent with previous studies. For example, a study demonstrated a moderate correlation between appearance anxiety and ED, and the mediating effect of appearance anxiety on body esteem and ED in a structural equation model (21). Another study found that among 518 American University students, which measured sociocultural attitudes toward appearance, these attitudes significantly predicted ED in male students (55). Levinson and Rodebaugh examined the interaction between appearance anxiety and ED using follow-up studies 6 months apart,

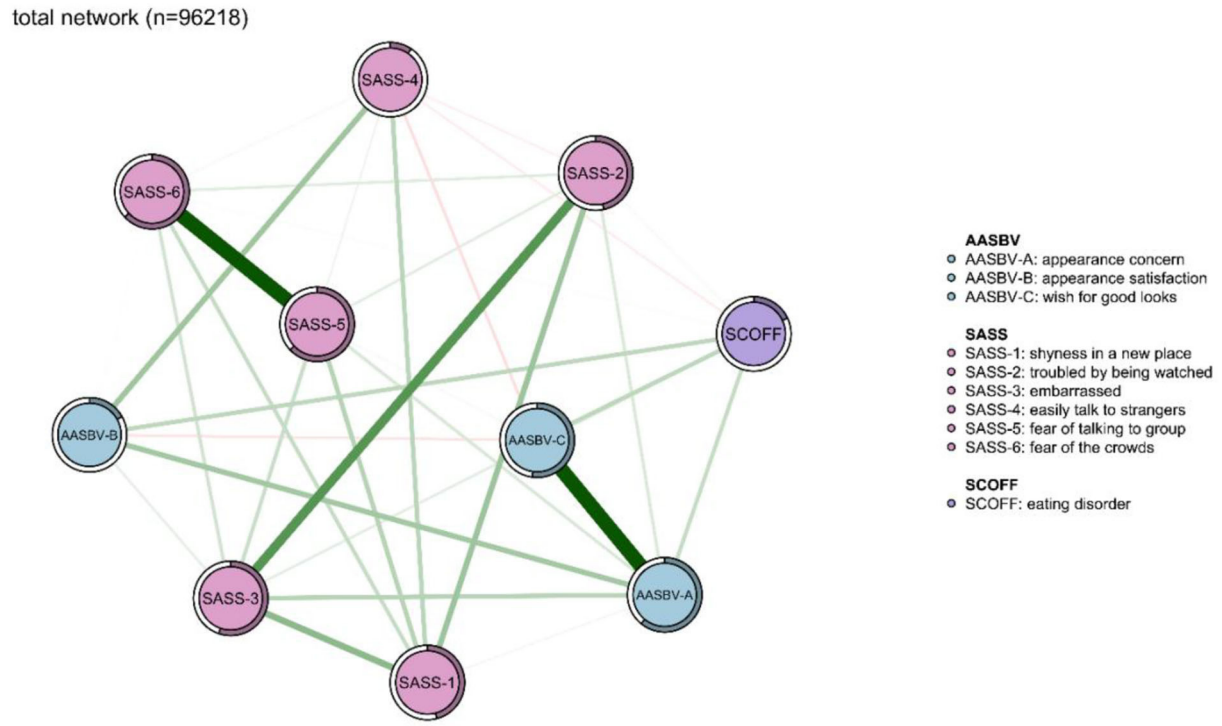

FIGURE 1
Network analysis between symptoms of eating disorder, appearance anxiety, and social anxiety in the total sample (n = 96,218). The thickness of the edges indicates the magnitude of the association. Green edges referred to positive associations, while red edges showed negative ones. The circle around the item represents the amount of predictivity.

finding that appearance anxiety positively predicted ED and vice versa (22). These results could be explained by various other studies. First, University students were found to be more susceptible to social media perfection/pressures. This might lead them to develop a tendency to compare their appearance to others' perfect appearance, with negative self-appearance perceptions and appearance anxiety arising as a result of the comparison. They are more likely to develop ED to conform to social perfection (56). Second, fear of negative evaluation(s) may also be one of the reasons for the close relationship between appearance anxiety and ED symptoms (57). Third, studies have also suggested that individualized social ideals of appearance aggravate the link between appearance anxiety and ED (58). Similarly, and finally, negative emotions resulting from the comparison of actual and the perceived socially ideal appearance would increase the individual's negative perceptions of appearance and somatic disgust, thereby inducing ED-based symptoms. Since in our study appearance anxiety symptoms were closely related to ED symptoms, improving appearance anxiety might effectively reduce ED symptoms. Therefore, these results would help researchers develop interventions for ED patients to reduce appearance anxiety. Furthermore, positive emotions such as increased bodily appreciation might improve intuitive eating and promote relief of ED symptoms (59).

Symptom associations of appearance anxiety and SAD included connections between "appearance satisfaction" and "easily talk to strangers", "appearance concern" and "embarrassed", and "wish for good looks" and "easily talk to strangers". These findings were also consistent with previous studies. In a 2-year follow-up study, it was reported that SAD was associated with the frequency of appearance comparisons, self-perceived attractiveness, and social media comparisons. Furthermore, appearance comparison behavior significantly predicted SAD 1 year later (60). Another study showed that self-expression, willingness to communicate and non-verbal communication were all significantly related to appearance anxiety (61). This significant relationship was also supported in the results of the current study. Moreover, a study further confirmed that negative evaluation of appearance is closely related to SAD symptoms and confirmed the positive mutual prediction between the two disorders (8).

On the other hand, the results showed that individuals who do not value appearance might be more likely to converse with strangers. Actually, if an individual worries too much about their appearance, it is possible to cause embarrassment in interpersonal communication. This phenomenon could be explained from the following perspectives. University is a prominent time of increased attention to appearance while the

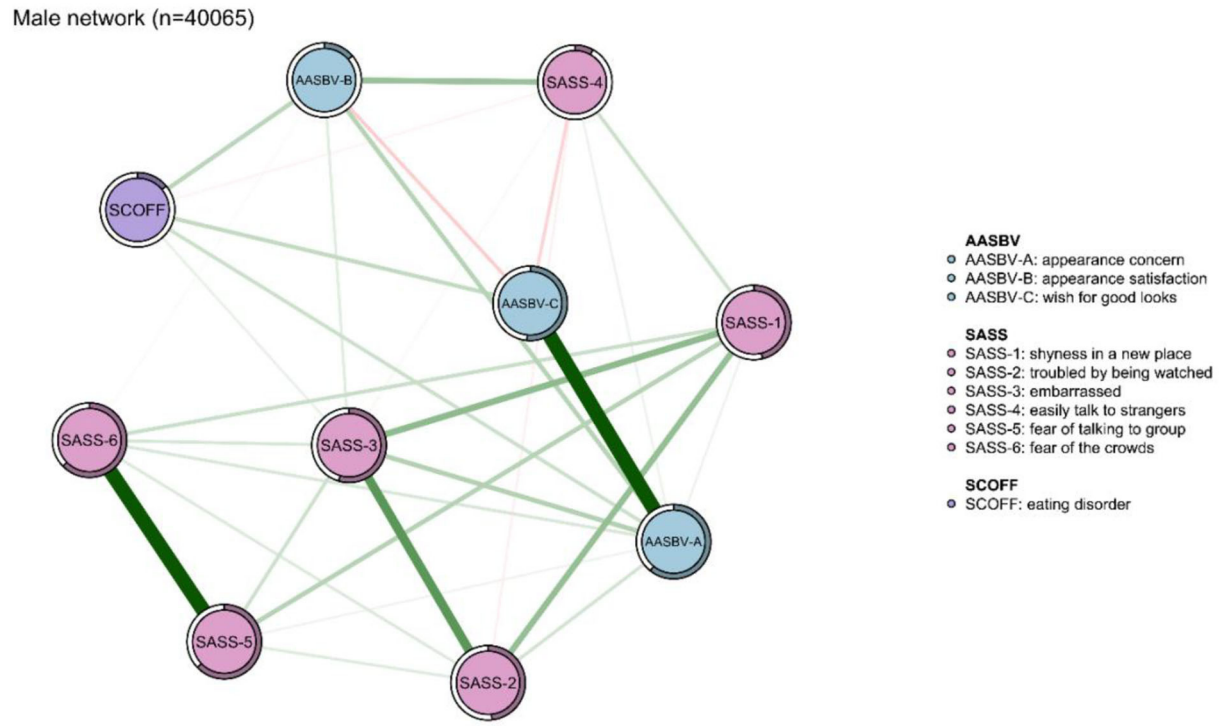

FIGURE 2
Network analysis between symptoms of eating disorder (ED), appearance anxiety, and social anxiety disorder (SAD) in the male sample (n = 40,065). The thickness of the edges indicates the magnitude of the association. Green edges referred to positive associations, while red edges showed negative ones. The circle around the item represents the amount of predictivity.

individual develops across the life course (62). Young adults with SAD are more likely to make inappropriate appearance comparisons, such as comparing themselves to a socially perfect image, which might exacerbate negative perceptions of appearance (63). In addition, individuals with SAD might have a vaguer self-concept, more negative cognitions about self-appearance, and quickly form the belief that others are more attractive than themselves (64, 65). This might also explain the results in this study, where symptoms of concern about appearance were more likely to be associated with symptoms of social embarrassment. A study also pointed out that positive peer relationships can negatively predict an individual's appearance comparison behaviors (64). Peer relationships are particularly important in the process of individual adolescent cognition and the formation of the basic social system; it is also one of the critical factors in the development of SAD (66). Difficulties with peer relationships might maintain and further develop negative appearance perceptions in individuals with SAD (67). The results of the present study further clarified the association between appearance anxiety symptoms and SAD symptoms. This is significant for guiding young people to establish a positive appearance that is not based on comparison. University students might rebuild their peers' social confidence if they develop a body positive perception discourse of self-appearance. All of these factors contributed to the prevention and intervention of SAD among young adults. The results of this study confirmed that ED might have a potential relationship with SAD by affecting appearance anxiety indirectly. Appearance anxiety was a common risk factor for SAD and ED. Previous studies also confirmed this result. For example, Levinson et al. (22, 27) found that appearance anxiety was a bridge symptom between SAD and ED. Positive prediction of appearance anxiety in SAD and ED also have been suggested in a previous study (8). The findings could also help patients with SAD and ED comorbidities by conducting cognitive behavioral therapy or virtual reality exposure therapy (9, 68).

There were also significant differences in the total scores, as well as the symptom associations between appearance anxiety, ED, and SAD in male and female participants. Compared with males, females showed significantly stronger associations between appearance anxiety symptoms, as well as ED with "troubled by being watched" and "appearance concern". Previous studies also have reported that females are more likely to be concerned with the importance of their appearance than males (55, 60, 69). For instance, a study found that SAD and appearance anxiety were significantly higher in females than in males (60). Women also tend to make more physical comparisons than men (70). When individuals suffers from

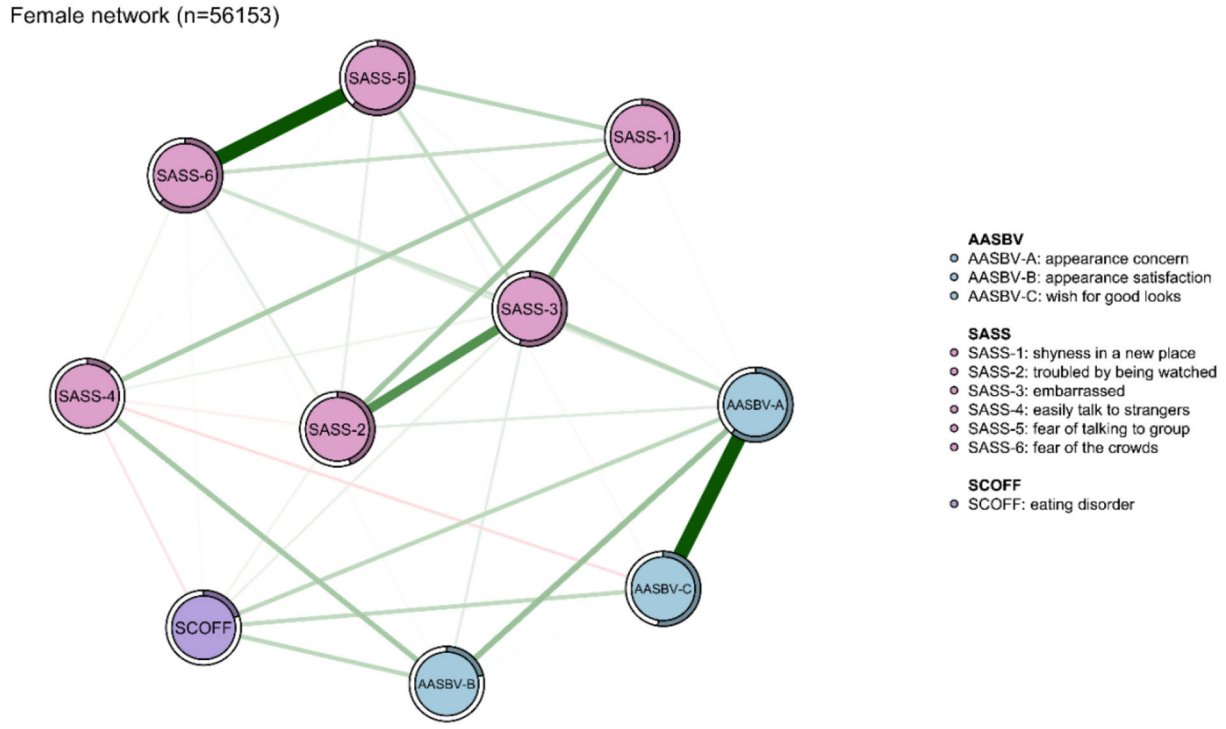

FIGURE 3
Network analysis between symptoms of eating disorder, appearance anxiety, and social anxiety in the female sample (n = 56,153). The thickness of the edges indicates the magnitude of the association. Green edges referred to positive associations, while red edges showed negative ones. The circle around the item represents the amount of predictivity.

appearance anxiety, including body image dissatisfaction and concerns about shape and weight, they are prone to have ED symptoms concurrently (29). Moreover, the associations between body dissatisfaction, having positive feeling about thinness, and ED have also been established (71, 72). In actuality, both males and females are under significant pressure from sociocultural factors, including messages from family, peers, the media, and the general public. These factors may be crucial in determining how males and females perceive themselves in terms of their physical attractiveness and beauty. Furthermore, because of the social acceptability signals that are shown in society and the media to form the ideal body image, women also consequently equate physical appearance—often in the form of thinness—with success, power, and pleasure (73). In order to maintain a certain social standing and to compete for societal advantages, it is therefore believed that the propensity for dieting and the desire to reduce weight are important values for females (74, 75). On the other hand, dissatisfaction in appearance anxiety is not merely the result of an individual's personal dissatisfaction with their body image, but is also influenced by the fear of negative evaluation by others. University women are the most susceptible population to negative evaluation by others. For example, in comparison to University males, University females are more affected by parental comments on their body image (76). Slater and Tiggemann (42, 77) also found that appearance-related comments can lead to appearance anxiety in females. Significant gaps between actual and ideal types could lead to negative emotions, body shame, and anxiety in women, all of which are risk factors for psychiatric disorders such as ED (78–80). All these factors might explain the more serious symptoms of appearance anxiety and ED in females compared with males.

This study explored the association of symptoms between SAD, ED, and appearance anxiety through network analysis. It was determined that ED might have a potential relationship with SAD by affecting appearance anxiety indirectly. Moreover, the dynamic relationship between SAD and appearance anxiety symptoms also revealed the maintenance and development of ED symptomology. Our results also provide more detailed information for interventions for the related psychological disorders. The possible development of interventions and symptoms of the disorders discussed, provide the basis for the mechanism of action in this research. This study has limitations to note. First, the study design was a cross-sectional study. Therefore, the causal relationship between ED, SAD, and appearance anxiety may not be representative. Second, this study mainly focuses on the interaction between SAD, ED, and appearance anxiety. The researchers did not measure all the potential variables that may affect these disorders, such

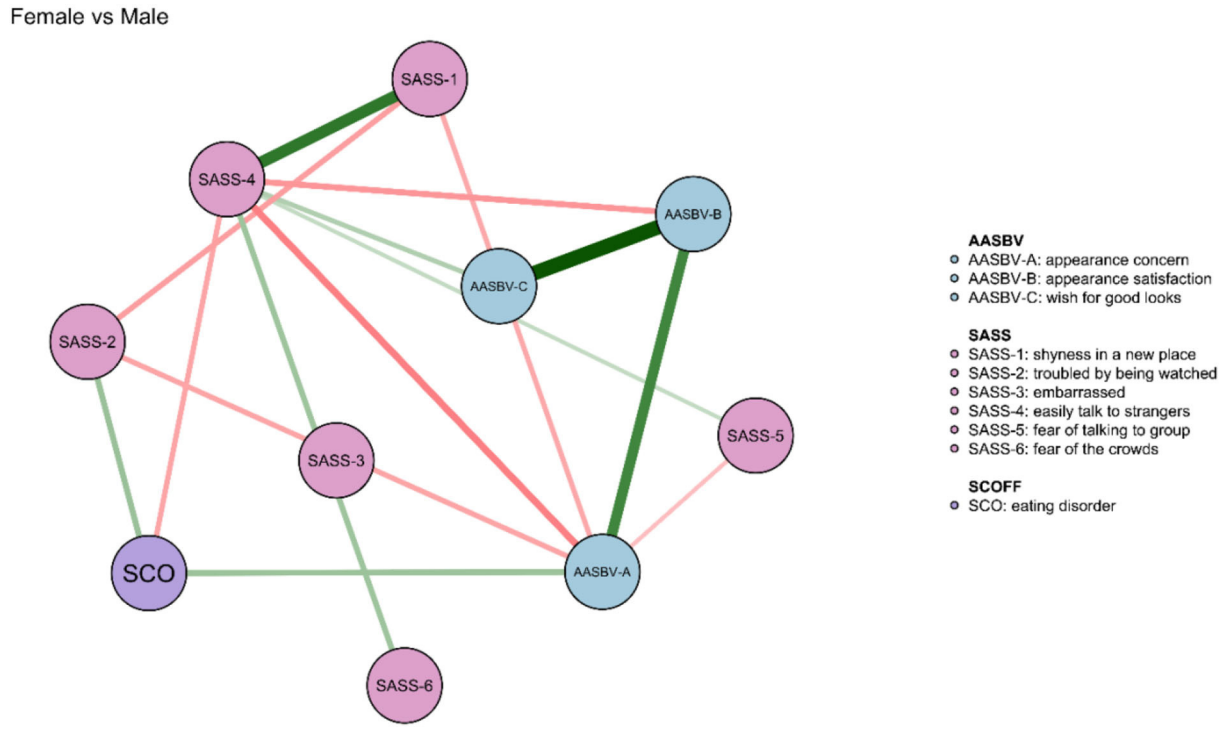

FIGURE 4
Comparison of symptom network model between the male and female sample. The green edges denote the stronger connections between symptoms in females when compared with males.

as depression and self-loathing as found by Szymanski and Henning (81), as well as appearance anxiety also affecting an individual's level of depression. While appearance anxiety was found to be associated with more incredible self-loathing in individuals (14), other variables, such as differences between urban and rural China and being an only child, could be examined in future research. Third, ED, SAD, and appearance anxiety were measured using self-report scales online, which may have resulted in recall bias. However, in order to avoid the impact of the pandemic, sending questionnaires online allowed for health and safety measures, and has been proven to be an effective method of recruitment (40). Moreover, while the Jilin Province was not in lockdown during the period of study, there still could have been an effect of COVID-19, particularly symptoms of anxiety which might bias the results of this study, inflating the resulting symptomology. Fourth, appearance anxiety can also exacerbate neurological symptoms (82). Therefore, in future research, neurological measurement should be added to explore relationships between appearance anxiety and neurological functioning. Finally, measures of body positivity should be used in the future to begin understanding the feasibility of creating an intervention for appearance anxiety.

5. Conclusion

Appearance anxiety was associated with both ED and SAD. ED may have a potential relationship with SAD by affecting appearance anxiety indirectly. Significant differences in symptom associations between appearance anxiety and SAD were further found among males and females. Females showed stronger associations between when being watched, worrying about their appearance, and symptoms of ED, and they tended to expect to be more attractive to reduce anxiety when talking to other people. The results of this study can help to guide the formation of body-positive interventions for young people and also provide additional ideas for intervening with SAD and ED.

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 study involving human participants was reviewed and approved by Jilin University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

YaJ, YW, and SX: study design. SX, DG, YaJ, and XS: data collection and methodology. YuJ, YW, SX, AW, and CC: manuscript writing. All authors contributed to the article and approved the submitted version.

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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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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1044081/full#supplementary-material

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Association between subjective degree of influence in class and thinness among adolescents in Japan

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Social status in school, measured by subjective degree of influence in class (DOI), may influence thinness among adolescents. This study examined the association between subjective degree of influence in class and thinness among Japanese adolescents. Data were obtained from the Kochi Child Health Impact of Living Difficulty (K-CHILD) study in 2016, which Was a population-based study targeting 5th, 8th and 11th grade adolescents living in Kochi Prefecture, Japan (N = 9,998). DOI was assessed by adolescents *via* questionnaire. Weight and height were given by caregivers for 5th grade adolescents, whilst they were self-reported for 8th and 11th grade adolescents. Collected data on weight and height were used to calculate body mass index z-scores of WHO standards. Models included grade, gender, number of friends, household income, location of school and depressive symptoms as covariates. The results showed that both high and low DOI were positively associated with thinness after adjustment for other individual covariates (high DOI, OR = 1.59, 95% CI 1.05–2.43; low DOI, OR = 2.04, 95% CI 1.36–3.06). Further stratification by gender revealed that low DOI was positively associated with thinness (OR = 2.14, 95% CI 1.34–3.44) among boys, but there was no association among girls. Both high and low DOI were associated with the risk of being thin in adolescents. Focusing on DOI for adolescents may be important to address thinness among adolescents. Further studies are needed to examine the causality between DOI and thinness in adolescents.

KEYWORDS
degree of influence, thinness, social comparison, adolescence, school

Introduction

Thinness in adolescence can affect health in many aspects; it can affect individual's physical health (1) and mental health, including eating disorder (2–5), which increases the risk of anxiety disorders and depressive disorders (1). Thinness could also affect the health of the future generation through various mechanisms; one of which is small-for-gestational age (SGA) (6). That is, low maternal pregravid BMI increases the incidence of SGA (6, 7), and SGA is associated with childhood poor neurological development including poor school performance as well as adulthood physical and psychological health (6, 8–10). Although further studies are required, paternal thinness may also

affect SGA (11, 12). Thus, thinness in adolescence is not only a problem for adolescents themselves but also for the future generation.

To prevent thinness, it is needed to elucidate its determinants. Well-known determinants of thinness include socioeconomic status and subjective social status. For example, one study has shown a positive association between high subjective social status and thinness among South Korean women (13). Other studies in developed countries such as England (14) and Scotland (14, 15) reported that children living in more deprived areas were more likely to be thin than those living in the least deprived areas. Furthermore, number of studies in developing countries showed association between low socioeconomic status and thinness (14, 16).

However, there is no previous study exploring the association between thinness and social status unique to adolescents in developed countries. We propose the use of subjective degree of influence in class (DOI), an indicator of social status within school classroom, to determine its relationship with thinness in adolescence. DOI can measure social status of adolescents, which is largely influenced by social comparison between peers at school. According to social comparison theory, social comparison is the tendency to compare oneself to others to understand where and how one fits in society and it can possibly cause changes in individuals (17–19). As peers can be extremely important targets of social comparison for adolescents (19, 20), peers shape many behaviors and cognitions of adolescents, including setting norms and expectations related to appearance concerns (19, 21).

We hypothesize that both low and high DOI would be associated with thinness for girls and muscularity for boys, albeit with different mechanisms. Adolescents with low DOI may have a higher risk of being thin, compared to those with moderate DOI. This is because women tend to evaluate their appearance against women who they perceive to be superior to themselves (18), (i.e., peers with higher DOI) and past studies reported that common ideal regarding appearance is thinness for women and muscularity for men (22, 23). From these findings, social comparison targets of adolescents with low DOI are likely to be peers who are thinner or muscular than themselves, and they may take extreme measures to lose weight, eventually becoming thin.

Adolescents with high DOI, on the other hand, could compare their appearances to peers in the same social groups, such as within friendship groups (i.e., peers with same DOI). Previous study suggested that in high-income countries, school friends tend to have similar Body Mass Index (BMI), and an individual belonging to a friendship group with a high frequency of reported dieting and weight loss reported the following more frequently on average: dieting and peer pressure to lose weight to become thin (24). Additionally, girls are more prone to peers' dieting and weight control behaviors (25). Therefore, girls in the high DOI group could be pressured heavily to be thin through comparison with other slim members of the same DOI group as well as to maintain peer likeability (26). For boys with high DOI, although there are scarce literature on boys' thinness and body image (26), a preceding study revealed that among boys there were significant associations between friends' muscle-enhancing behaviors (25). Thus, we hypothesize that girls with high DOI will have a higher prevalence of being thin, and boys with high DOI will gain muscle whilst losing fat, resulting in a higher prevalence of being thin compared to those with moderate DOI.

To summarize, we hypothesize that adolescents with higher or lower DOI than average will have a higher risk of being thin. It is important to elucidate the association between DOI and thinness in adolescents for the following reasons. First, DOI is a measure that can be easily measured by adolescents themselves (21), allowing them to monitor the risk of thinness by themselves. Second, if DOI is modifiable through internvention at school, it will be possible to prevent thinness among adolescents. Third, DOI is a measure applicable to children from elementary to high school. Thus, it allows an early intervention of thinness at the start of puberty, minimizing the negative effects of thinness on development.

To investigate the association between DOI and thinness, Japan is one of the most appropriate countries, because, among the OECD countries, its proportion of thinness is one of the highest (5, 6), which results in the second-highest prevalence of low-birth-weight infants (27, 28). In addition, self-esteem of adolescents is low, possibly due to high peer pressure (29), which is strongly related with DOI. Thus, this study aimed to examine the association between DOI and thinness amongst adolescents, for both boys and girls, in Japan.

Materials and methods

Study designs and subjects

We used cross-sectional data collected in 2016 in the Kochi Child Health Impact of Living Difficulty (K-CHILD) study, which was a population-based study established to evaluate the determinants of health among children and their caregivers in Kochi Prefecture, Japan (30). Self-report questionnaires were distributed to adolescents enrolled in 5th, 8th and 11th grade in Kochi prefecture except for those enrolled in correspondence high schools and special needs schools. In total, 18,290 adolescents received the questionnaires. In Kochi City, the questionnaires were returned *via* mail, and outside of Kochi City, they were collected and returned *via* school. A total of 11,200 returned the questionnaires (participation rate: 61.2%) and 11,184 of them contained a valid response (valid response rate: 61.1%). Among these valid responses, 1,902 responses were excluded

as the outcome of interests and exposure (i.e., data on thinness and DOI) were missing, and 4 responses of adolescents in 11th grade with invalid birth year values were excluded, resulting in the analytic sample size of 9,278 (see **Figure 1**).

Measurements

Thinness

Weight and height were reported by caregivers for 5th grade adolescents, whilst they were self-reported for 8th and 11th grade adolescents. BMI was calculated according to the WHO Child Growth Standards and was expressed as z-scores, representing the deviations in standard deviation units from the mean of a standard normal distribution of BMI specific to age and sex (31, 32). Following the cut-off point recommended by the WHO, BMI-for-age z-score < −2SD was defined as thinness among adolescents (33, 34). To see the components of BMI, height was also used as a secondary outcome, converting z-scores specific to age and sex according to the WHO Child Growth Standards (33). For analysis, as we are interested in thinness, i.e., taller height, height-for-age z-score >=1SD was defined as tallness among adolescents.

Degree of influence (DOI)

DOI was assessed by adolescents *via* a questionnaire, which was used in the previous study (30). We asked the question "How influential are your opinions and behaviors on your classmates?" and the answer choices were "1 = not at all", "2 = a little", "3 = to some extent", "4 = very much". For analysis, we categorized them into three divisions: high, moderate, and low. In the current study, "4 = very much" was categorized as high, "3 = to some extent" and "2 = a little" as moderate, and "1 = not at all" as low.

Covariates

Covariates in the models included grade (5th, 8th, 11th), gender (boy, girl), number of friends one can share their worries with, household income, location of school (within Kochi City, outside Kochi City), and depressive symptoms. The rationale of these covariates is as follows. First, a previous study showed that the distribution of DOI was different for each grade (30), and in a different study conducted in Japan the prevalence of thinness differed with age in adolescents (35). Second, there was a difference in

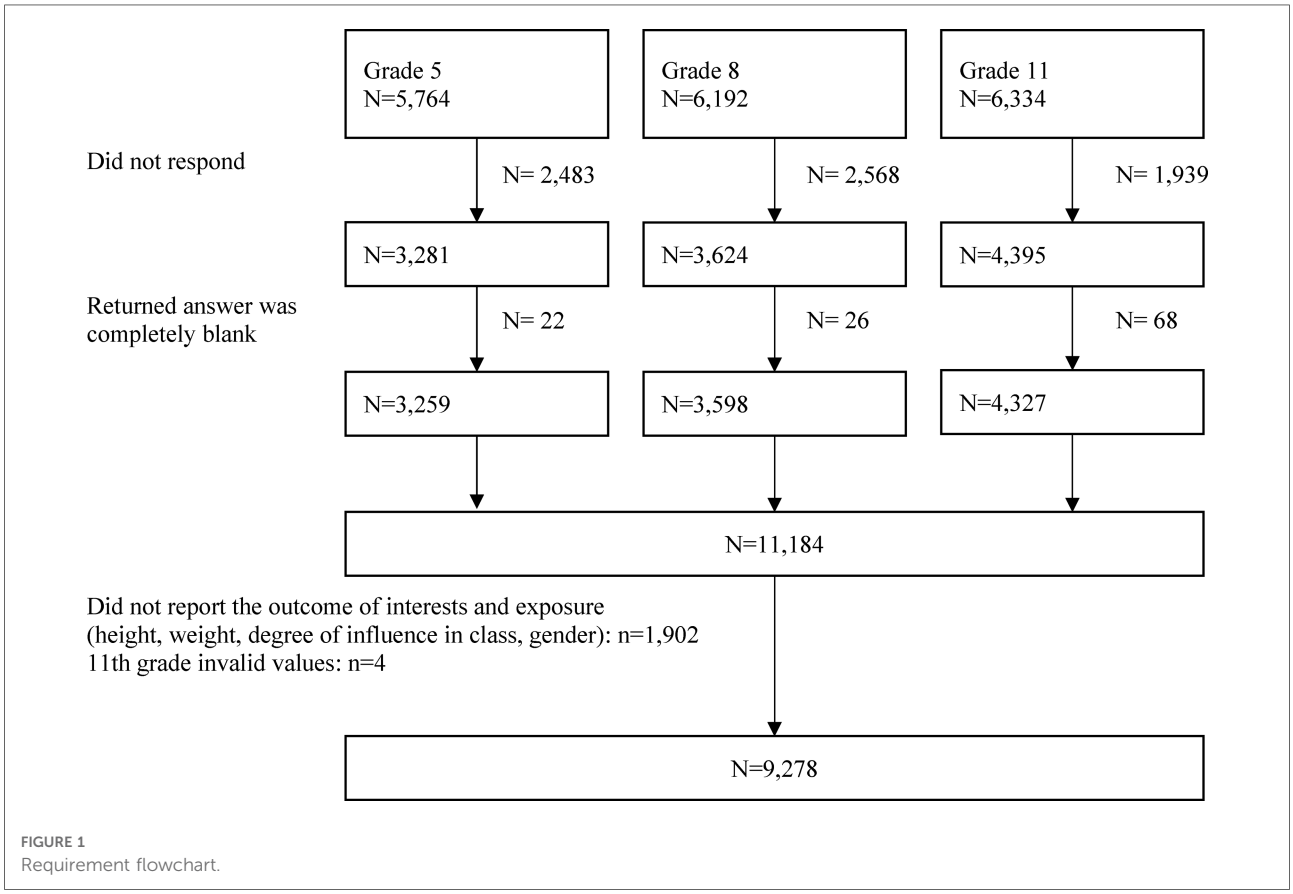

FIGURE 1
Requirement flowchart.

DOI distribution between boys and girls (30), and women tend to have a drive for thinness whilst men have a greater drive for muscularity, suggesting that pathways leading to thinness vary by gender (22, 23). Third, self-reported number of friends is positively associated with DOI (30), and weight status was also associated with the number of confidants in adolescents (36). Fourth, although inconsistent, previous studies reported that thinness is associated with household income (37–39). Household income also impacts one's perceived social rank (40), which is one's perceptions of the degree to which one feels inferior to others and looked down on (41). The link between household income and social rank may be weak in adolescents (30); nonetheless, awareness of one's economic status in class could influence DOI especially for adolescents of older age. Fifth, DOI distribution differed by location of school in the previous study (30), and many studies have shown that distribution of body weight in adolescents was associated with urban/rural difference (42). Lastly, females with thinness were more likely to show depressive symptoms (43), and adolescents with low self-reported social status were at higher risk of depression compared to those reporting medium or high social status (44). Thus, depression can be a confounder in this study. To assess depressive symptoms, we used the Japanese version of the Depression Self-Rating Scale (DSRS), modified from the English version (45). The total score ranged from 0 to 30, and a higher score indicated more severe depressive symptoms.

Statistical analyses

To examine the association between DOI and thinness among adolescents, multiple logistic regression analyses were used. For Model 1, the following covariates were included: grade, gender, number of friends, household income, and location of the school. In addition to covariates in Model 1, depressive symptoms were added in Model 2. Further stratification by gender was conducted for both analyses on the associations between DOI and thinness and DOI and height, as these associations may differ by gender due to the following reasons. Women tend to have a drive for thinness, whilst men tend to have a drive for muscularity (22, 23). Analyses were performed with STATA SE statistical package, version 15 (StataCorp LP, College Station, TX, USA).

Result

Demographic characteristics of the analytical sample are shown in **Table 1**. The percentages of boys and girls were similar (49.9% to 50.2%). More than half of the households reported a household income of JPY3.00–8.99 million (USD1= JPY110, as of Oct 2016). The percentage of children attending schools within Kochi City, the capital city of Kochi prefecture, and those attending schools outside Kochi City were 47.5% and 52.6%, respectively. More than half (58.5%) of the children reported that the number of friends one can share their worries with was above 3. Thinness was observed in 290 (3.1%) of the sample (boys 185 (2.0%), girls 105 (1.1%)). Around one-tenth reported that their DOI was "high" or "low". There were no major differences in the distribution of DOI for boys and girls. DOI progressively decreased with age; in the high DOI group, proportion of 5th grade children was the highest (41.6%), and 11th grade children was the lowest (28.5%). On the other hand, proportion of low DOI group was the highest in the 11th grade children (49.9%). Furthermore, urban/rural difference in DOI distribution was observed. High DOI was more likely found among children outside Kochi City (61.5%) compared to children in Kochi City (38.5%). High DOI children had larger number of friends, that is, 50.6% of the high DOI group reported that they have more than 5 friends one can share their worries with, which was higher than moderate DOI group (38.5%) and low DOI group (15.8%). Moreover, depressive symptoms were higher among children in low DOI group compared to moderate DOI group, and moderate DOI children showed higher depressive symptoms than high DOI group.

Table 2 shows the association between DOI and thinness among all children and stratified by gender. Interestingly, we found a U-shaped association between DOI and thinness; both children with high and low DOI showed significant association with thinness (high DOI, odds ratio (OR) = 1.65, 95% confidence interval (CI) 1.16–2.35; low DOI, OR = 2.32, 95% CI 1.68–3.18) in comparison with children with moderate DOI in the crude model. After covariate adjustment, both high and low DOI remained significantly associated with thinness (high DOI, OR = 1.59, 95% CI 1.05–2.43; low DOI, OR = 2.04, 95% CI 1.36–3.06). As for gender stratification, we found different associations between DOI and thinness; among boys, low DOI was positively associated with thinness (OR = 2.13, 95% CI 1.34–3.43), while high DOI did not show significant association with thinness (OR = 1.55, 95% CI 0.89–2.70). Among girls, high and low DOI were not statistically significantly associated with thinness in adjusted model (high DOI, OR = 1.63, 95% CI 0.85–3.13; low DOI, OR = 1.58, 95% CI 0.69–3.64).

Table 3 shows the association between DOI and height. High DOI was positively associated with greater height (OR = 1.55, 95% CI 1.14–2.12), whilst low DOI was not associated with greater height (OR = 0.89, 95% CI 0.57–1.40). High DOI was positively associated with greater height for boys (OR = 1.94, 95% CI 1.42–2.66). No significant association was seen between DOI and greater height for girls (high DOI, OR = 1.05, 95% CI 0.60–1.86; low DOI, OR = 0.97, 95% CI 0.47–2.00).

TABLE 1 Sample characteristics ($N = 9,278$).

Variables		Degree of influence						Total ($N = 9,278$)	
		High ($N = 878$) 9.5%		Moderate ($N = 7,563$) 81.5%		Low ($N = 837$) 9.0%			
		N or Mean	% or SD	*N* or Mean	% or SD	*N* or Mean	% or SD	*N* or Mean	% or SD
School Grade	5th	365	41.6	2,155	28.5	152	18.2	2,672	28.8
	8th	263	30.0	2,476	32.7	267	31.9	3,006	32.4
	11th	250	28.5	2,932	38.8	418	49.9	3,600	38.8
Gender	Boy	496	56.5	3,706	49.0	423	50.5	4,625	49.9
	Girl	382	43.5	3,857	51.0	414	49.5	4,653	50.2
Household Income	0 JPY	13	1.5	105	1.4	19	2.3	137	1.5
	1-2.99M JPY	146	16.6	1,311	17.3	189	22.6	1,646	17.7
	3.00–5.99 M JPY	256	29.2	2,402	31.8	252	30.1	2,910	31.4
	6.00–8.99 M JPY	213	24.3	1,558	20.6	134	16.0	1,905	20.5
	≧9.00 M JPY	88	10.0	767	10.1	69	8.2	924	10.0
	Unknown/missing	162	18.5	1,420	18.8	174	20.8	1,756	18.9
Location of School	Within Kochi City	338	38.5	3,594	47.5	470	56.2	4,402	47.5
	Outside Kochi City	540	61.5	3,969	52.5	367	43.9	4,876	52.6
No. of friends you can share your worries with	0	63	7.2	813	10.8	283	33.8	1,159	12.5
	1–2	172	19.6	1,896	25.1	255	30.5	2,323	25.0
	3–4	156	17.8	1,642	21.7	140	16.7	1,938	20.9
	≧5	444	50.6	2,915	38.5	132	15.8	3,491	37.6
	Missing	43	4.9	297	3.9	27	3.2	367	4.0
Depressive symptoms (0-30)		6.57	5.2	9.37	5.2	14.03	6.1	9.53	5.5
Thinness[a]	+	38	4.3	202	2.7	50	6.0	290	3.1
	–	840	95.7	7,361	97.3	787	94.0	8,988	96.9
Tallness[b]	+	70	8.0	345	4.6	33	3.9	448	4.8
	–	808	92.0	7,217	95.4	804	96.1	8,829	95.2

[a]Thinness was defined as BMI-for-age z-score WHO Growth reference 5–19 years < –2SD.
[b]Tallness was defined as height-for-age z-score WHO Growth reference 5–19 years >= 1SD.
Abbreviation: JPY, Japanese Yen.

Discussion

In the current study, adolescents with both high and low DOI were more likely to be thin compared to moderate DOI. Furthermore, when stratified by gender, low DOI showed a significant positive association with thinness among boys. In addition, high DOI showed a positive association with greater height, and when stratified by gender, high DOI showed a positive association with greater height among boys, whilst no association was seen among girls.

Our findings on the positive association between high DOI and thinness accorded with the previous studies examining associations between social status and thinness in adults, such as the positive association between high subjective social status and thinness among South Korean women (13).

However, we could not deny the existence of unmeasured confounders, such as personality traits unique to high DOI children. A previous study has shown that in early adolescents, having energy and openness, both measured by the Big Five Personality Test, positively influence one's

TABLE 2 The association between degree of influence and thinness.

		Thinness[a]					
		Crude		Model 1		Model 2	
		OR	95% CI	OR	95% CI	OR	95% CI
Total ($N = 9,278$)							
Degree of influence	High	**1.65**	(1.16–2.35)	**1.57**	(1.03–2.38)	**1.59**	(1.05–2.43)
	Moderate	ref.		ref.		ref.	
	Low	**2.32**	(1.68–3.18)	**2.12**	(1.44–3.13)	**2.04**	(1.35–3.06)
Boy ($N = 4,625$)							
Degree of influence	High	1.43	(0.91–2.25)	1.45	(0.84–2.51)	1.55	(0.89–2.70)
	Moderate	ref.		ref.		ref.	
	Low	**3.07**	(2.11–4.45)	**2.36**	(1.50–3.71)	**2.13**	(1.34–3.43)
Girl ($N = 4,653$)							
Degree of influence	High	**1.93**	(1.10–3.38)	1.73	(0.91–3.29)	1.63	(0.85–3.13)
	Moderate	ref.		ref.		ref.	
	Low	1.17	(0.60–2.27)	1.42	(0.63–3.20)	1.58	(0.69–3.64)

Bold indicates $p < 0.05$.
[a]Thinness was defined as BMI-for-age z-score WHO Growth reference 5–19 years < –2SD.
Model 1 adjusted for grade, gender, no. of friends, income, location of school.
Model 2 adjusted for depressive symptoms in addition to Model 1.

TABLE 3 The association between degree of influence and tallness.

		Tallness[a]					
		Crude		Model 1		Model 2	
		OR	95% CI	OR	95% CI	OR	95% CI
Total ($N = 9,278$)							
Degree of influence	High	**1.80**	(1.37–0.59)	**1.61**	(1.19–2.18)	**1.55**	(1.14–2.12)
	Moderate	ref.		ref.		ref.	
	Low	0.85	(0.59–1.22)	0.92	(0.60–1.43)	0.89	(0.57–1.40)
Boy ($N = 4,625$)							
Degree of influence	High	**1.94**	(1.42–2.66)	**1.90**	(1.31–2.73)	**1.83**	(1.25–2.68)
	Moderate	ref.		ref.		ref.	
	Low	0.95	(0.62–1.47)	0.86	(0.49–1.51)	0.78	(0.43–1.40)
Girl ($N = 4,653$)							
Degree of influence	High	1.24	(0.73–2.09)	1.04	(0.59–1.82)	1.05	(0.60–1.86)
	Moderate	ref.		ref.		ref.	
	Low	0.66	(0.35–1.27)	0.97	(0.48–1.97)	0.97	(0.47–2.00)

Bold indicates $p < 0.05$.
[a]Tallness was defined as height-for-age z-score WHO Growth reference 5–19 years >= 1SD.
Model 1 adjusted for grade, gender, no. of friends, income, location of school.
Model 2 adjusted for depressive symptoms in addition to Model 1.

perceived social acceptance (46). In other words, early adolescents who are social and have high intellectual curiosity are likely to regard themselves as being socially accepted by their schoolmates. Due to these traits, children with high DOI could gather information related to weight loss and beauty standards from media and friends. Frequent exposure to such topics along with their high intellectual curiosity may result in them attributing their popularity to their physical appearances, i.e., being thin, as extraversion is related to thin-ideal internalization (47). Thus, they are likely to lose weight to maintain their social position. Furthermore, there could be reverse causation. As friendship groups tend to mimic weight-related behaviors (25), comparing one's weight to the thin group members will induce thinness in those who were not thin before.

The positive association between low DOI and thinness was also in line with the previous findings, such as the positive association between low economic status and thinness among children in England (14) and Scotland (14, 15), and can be explained by low self-esteem and psychological distress. Low DOI children may have low self-esteem, and it is known that compared to peers with high self-esteem, those with low self-esteem perceive more pressure from the media and peers regarding physical appearances, such as losing weight (48). However, these children will likely remain in the low DOI group even after losing weight, as their social standing in the classroom is already set. Similarly, psychological distress from being in the low DOI group could lead to thinness. Those with low social rank will have mental health problems such as depression and social anxiety (25, 44), and a recent study has revealed that chemogenetic inhibition of the same neurons induces anxiety, depression, and reduced feeding (49). Furthermore, neglect is a possible confounder which was unexplored in this study. Prior studies have shown that child neglect resulted in failure to thrive in infants and children (50). It is also reported that children who were victims of neglect reported lower self-esteem (51), limited peer interactions (51, 52), and unpopularity from peers (51, 53), which may lead to low DOI. Although current study to examine the association between DOI and thinness, an adolescent-unique measurement of social status, and thinness in adolescents, future studies including further assessments of potential confounders as well as longitudinal design were warranted.

We also found that the positive association between low DOI and thinness for boys remained significant when stratified by gender, whilst no association was seen between thinness and the following: high DOI for boys, high DOI for girls, and low DOI for girls. The positive association between low DOI and thinness for boys was in accordance with our hypothesis that boys with low DOI were driven to extreme musclebuilding behavior, which resulted in thinness. We noted the potential reverse causation related to the sociocultural ideal body of boys, known as a V-shaped muscular build (26, 54, 55). That is, boys who are thin and not muscular, could report low DOI as they do not meet the sociocultural ideal. No statistically significant association between high or low DOI and thinness for girls may be an indication that social status may not be heavily influenced by body type for girls. However, as point estimates of the other associations were similar to all children samples, small sample size matters for non-significant associations. In addition, high DOI was positively associated with greater height for boys. This result was supported by past studies reporting that men who were taller often took on leadership roles within groups (56), and were often perceived as competent and talented by others (49, 56). Considering that there was no association between high DOI and thinness for boys, this result indicates boys may have a greater drive to be tall than to be thin.

There are several limitations to this study. First, due to a cross-sectional study, the causality of DOI and thinness could not be examined. Further longitudinal study is warranted to evaluate this causality. Second, the questionnaire was self-reported; measures such as weight and height used to calculate BMI were either reported by the parents or children themselves. However, the validity of self-reported BMI values of children has been proven previously (57). Third, there was no measurement of personality, such as the use of Big 5 personality test, needed to understand the pathway of DOI and thinness.

Despite these limitations, this is the first study to report the importance of the subjective social rank of children on their health using DOI, with both high and low levels of DOI positively associated with thinness among adolescents, suggesting that both high and low levels of DOI could be a precursor of thinness for adolescents. This study has several key implications. First, DOI could be a measure of social rank within classroom for adolescents, as the result of this study is consistent with previous studies which reported positive association between high subjective social status among adults and thinness (13), as well as low socioeconomic status among children and thinness (14, 15). Therefore, further investigation of the causal association between DOI and thinness can be conducted. Second, because DOI can be easily measured by adolescents themselves (21), measuring DOI will lead to prompt intervention and evaluation of the risk population. Lastly, it will be possible to prevent thinness among adolescents on a wide scale using DOI, a measure applicable to teenagers. DOI is a concept that is understandable for elementary school children, allowing prevention of thinness before the growth spurt. Furthermore, DOI will be an important measure not only for Japan but also for other countries, where students spend majority of their school life with their classmates.

In conclusion, both high and low DOI were associated with the risk of being thin in adolescents, which is one of the

important risk factors of eating disorders. Focusing on DOI for adolescents may be important to address thinness among adolescents, and further studies are needed to examine the causality between DOI and thinness in adolescents.

Data availability statement

The datasets presented in this article are not readily available because it is the part of population-based study conducted by the corresponding author. However, upon a reasonable request, the datasets would be available from the corresponding author. Requests to access the datasets should be directed to TF, *fujiwara.hlth@tmd.ac.jp*.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the Tokyo Medical and Dental University (M2017-243). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

NI: Conceptualization, Methodology, Formal analysis, Writing – Original Draft. YK: Writing – Review and Editing. SD: Investigation, Resources, Data Curation. AI: Investigation, Resources, Data Curation. TF: Supervision.

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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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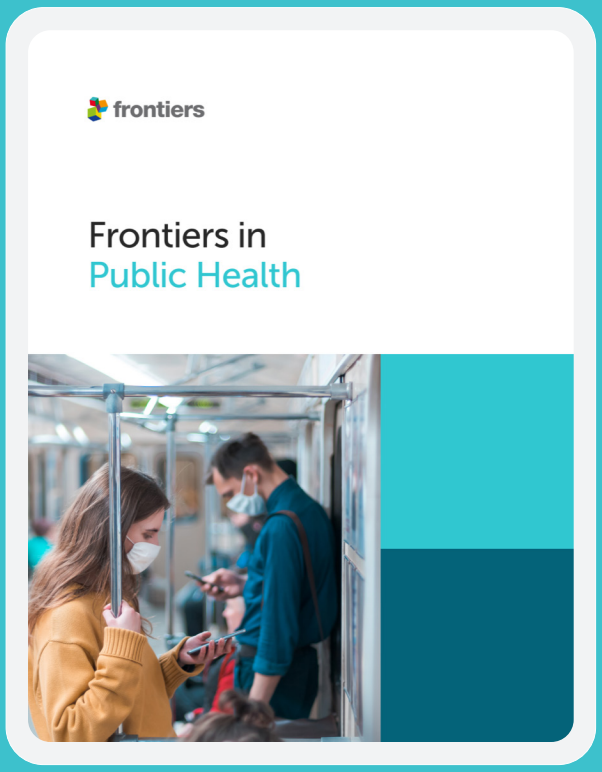

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