frontiers | Research Topics

Insights in adolescent and young adult psychiatry 2023

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David Cohen

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Insights in adolescent and young adult psychiatry: 2023

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Editorial: Insights in adolescent and young adult psychiatry: 2023

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Editorial on the Research Topic
Insights in adolescent and young adult psychiatry: 2023

The "Adolescent and young adult psychiatry" section of Frontiers in Psychiatry is young, but the needs in the field are enormous (1). The post-COVID-19 pandemic is reminding practitioners every day of the huge numbers of referrals to emergency rooms they have to deal with (2). The 2023 Insights that gather 'works from our Editorial Board members reflect several heterogeneous issues embracing the discipline at large. This is not surprising given the complexity of our discipline. I am pleased that accepted manuscripts come from many countries and cultures.

First, Laporte et al. from Canada describe the ethical dilemma many face when dealing with referrals for acute mental health issues in children and adolescents. They explore how the triage model, on one hand, and the crisis model, on the other, have been proposed to solve it within emergency rooms. They compare the two models and discuss their merits (Laporte et al.).

Second, four contributions are dealing with mood and anxiety disorders in teens. In a large representative sample, Song et al. illustrate how body characteristics (objective height and subjective perceived obesity) are associated with suicide ideation in Korean adolescents, the effect being more prominent in female teens (Song et al.). This study highlights the need for more studies exploring gender effects in juvenile psychiatry. In an elegant quantitative study, Qin et al. explored how parents dealing with teens who exhibit repeated non-suicidal self-injury, accumulate a wealth of experience during their long-term care. Specifically, the authors investigated both the motivation to share these experiences and the barriers to doing so (Qin et al.). Next, Huang et al. explored the mediating role of anxiety and depression on perceived stress and quality of sleep among medical students during the COVID-19 pandemic. They highlight the need for a preventive approach in this at-risk population. Medical students have been repeatedly identified as a vulnerable population to mood disorders and suicide (3). Finally, Chen et al. explored the association between domestic violence and cyberbullying behavior in school and evidenced the mediating role of depression in school students. Maltreatment and bullying for children and adolescents have been identified as key factors for increasing the risk of mood disorders. The current study investigates the complexity of children's trajectories by underlining the possibility of being both victim and perpetrator to some extent (Chen et al.).

Third, the large Jamaican study on Marijuana use in teens confirmed in this unique sample that the main correlates are similar to those in other countries. They include individual psychosocial risks (e.g., loneliness, frequent worry, suicidal ideation, physical attacks, early initiation, and school absenteeism); and family factors (e.g., parental smoking, parental support). Similarly, to studies in other contexts, the study insists on the co-occurrence of poly consumption and at-risk behaviors (4, 5). They conclude with the need for holistic intervention and policies (Dadras).

The next two studies investigate original therapeutic interventions that usually receive less interest in clinical research. Winds et al. report how a professional photoshoot intervention affects self-esteem and emotions in girls and boys from child and adolescent psychiatry clinics differentially. This is an original proposal as the assessment of cultural mediation as a therapeutic intervention is limited in our field. Most studies are descriptive or qualitative (e.g., 6). Then, Meng et al. reported a promising pilot trial of systematic couple group therapy for families of depressed adolescents. This is encouraging as the family approaches that many professionals in the field consider central to common practice do not receive enough attention in research compared to individual psychotherapy (7).

We end this brief overview of the Research Topic with a study exploring the neurobiology of depression. The serotonin theory hypothesis of depression has been explored for decades. The last large umbrella review of the evidence has shown some deception. The main areas of serotonin research provide no consistent evidence of an association between serotonin and depression, and no support for the hypothesis that depression is caused by lowered serotonin activity or concentrations. Some evidence supports that long-term antidepressant use reduces serotonin concentration (8). In their report, Ilavská et al. investigated how kynurenine and serotonin pathways interact after supplementation with omega-3 fatty acids that may improve depressive symptoms in children (9). They found that omega-3 FAs stimulated both kynurenine (kynurenine/tryptophan ratio) and serotonin (5-hydroxytryptophan) pathways, whereas omega-6 FAs only increased the kynurenine/tryptophan ratio. The meaning in terms of pathophysiology and/or use as a biomarker needs to be explored more in depth to claim any relevance in clinical practice.

Author contributions

DC: Writing – original draft, Writing – review & editing.

Conflict of interest

The author declares 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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Height and subjective body image are associated with suicide ideation among Korean adolescents

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Introduction: Suicide is the leading cause of death among Korean adolescents. Suicide has been found to be associated with body mass index (BMI), height, and subjective body image among adults, but investigations of these associations among adolescents are limited. Thus, we aimed to examine to what extent suicide ideation is associated with height, BMI, and subjective body image among Korean adolescents.

Methods: This study examined the data of 6,261 adolescents, selected from a nationally representative survey. The participants were divided into subgroups by sex, suicide ideation, and subjective body image. Logistic regression analyses were performed to examine the association of suicide ideation with height, BMI, and subjective body image.

Results: The proportion of perceived obesity was high in the total sample; the height Z-score was lower for the group with suicide ideation than the group without suicide ideation; the height Z-scores were also lower for female participants with suicide ideation than those female participants without suicide ideation. The proportions of depressed mood, suicide ideation, and suicide attempts were higher among the total sample and female participants with perceived obesity than among those with a normal body image. On logistic regression, perceived obesity was positively associated with suicide ideation even after adjusting for age, height Z-score, weight Z-score, and depressed mood, whereas height Z-score was negatively associated with suicide ideation. These relationships were more prominent among female participants than among male participants.

Conclusion: Low height and perceived obesity, not real obesity, are associated with suicide ideation among Korean adolescents. These findings indicate that the need for an integrated approach to growth, body image, and suicide in adolescents is warranted.

KEYWORDS

height, body image (MeSH), suicide, obesity, adolescent

1. Introduction

According to the WHO, suicide is the third leading cause of death among adolescents globally (1). Moreover, the suicide rate in South Korea is the highest among the Organization for Economic Co-operation and Development countries, and suicide is the leading cause of death among Korean adolescents (1–3). In global studies, the prevalence of depression and suicide ideation among adolescents has been reported at 12.0 and 14.0%, respectively (4, 5). Among Korean adolescents, these rates increased to 13.6 and 19.1%, respectively (6, 7). Although it is impossible to prevent all suicides because of the multifactorial complexity, it is important to clarify the modifiable factors of suicide (8).

Short stature, that is, height below the third percentile or more than 2 standard deviations below the corresponding mean height for those of the same sex, age, and race (9), is associated with psychosocial problems and medical conditions, such as poor diet, genetic predisposition, physical activity, and underlying diseases (10, 11). In children and adolescents, regardless of cause, short stature leads to functional impairment in daily life (12). Youths with short stature tend to have behavioral problems as well as negative social experiences, including teasing, lower social acceptance, and lack of friends (13, 14). Although short stature often represents a normal variation in the general population, negative social stereotypes associated with short stature still exist, resulting in poor psychosocial performance in short children who are actually normal (15). A negative association between all-cause mortality and adult height in a cohort study implied that short stature was positively associated with mortality risk owing to genetics, socioeconomic factors, nutritional factors, or a previous infection marker in childhood (10, 11). In a Swedish study, short height was associated with an increased risk of suicide attempts among young men (11). A systematic review reported that depression might be related to relevant neurobiological dysfunctions, in particular, immune-inflammatory abnormalities (16). However, few studies in the literature have examined the exact association between height and suicide among adolescents.

Obesity is a complex disease associated with medical conditions, including chronic diseases as well as psychological distress (17, 18). Bjerkeset et al. (19) reported that body mass index (BMI) was positively associated with the risk of depression among adults (19). Moreover, a population-based study demonstrated that BMI was positively associated with suicide ideation among women (20). Given that the global prevalence of obesity among youth increased from 0.9 to 7.8% in male subjects and from 0.7 to 5.6% in female subjects from 1975 to 2016, the attention paid to the association between obesity and mental health has increased (18). Similar to obese adults, obese adolescents also appear to engage higher in suicide ideation (21). Despite the association between BMI and suicide ideation, it is still unclear if these aspects are directly affected by each other or not.

Obesity usually has a negative influence in the form of psychological distress on weight stigma (22). A meta-analysis reported that negative weight stigma is related to psychological distress, including depression and anxiety (23). Owing to negative attitudes, including prejudice and discrimination, which are widely prevalent in media, healthcare, and educational settings, obese individuals are vulnerable to psychological distress (22): negative attitudes typically stem from the social stereotype that obese people are lazy and unmotivated (24). Although weight stigma can motivate some people to lose weight, it can also worsen obesity by decreasing physical activity and increasing binge eating, owing to social isolation (24). Hunger et al. (25) reported that weight-based discrimination was positively related to suicide ideation among adults. Gavin et al. (26) showed that body image dissatisfaction as well as obesity might be risk factors for depression among women. Body image is strongly related to the self-esteem of young adults, and perceived poor body image is usually prevalent among women. Body image dissatisfaction is known to be associated with being overweight (27), and it can mediate the relationship between obesity and depression (26, 27). Moreover, body image is related to eating disorders. A population-based study reported that disordered eating behaviors are related to body image as well as body weight and BMI among adolescents (28). Calugi et al. (29) reported that the assessment of body image should be considered in the treatment of anorexia nervosa. While obesity, body image, and depression seem to be correlated, studies investigating the association between BMI and subjective body image with suicide ideation among adolescents are limited.

Despite several reviews of the associations among height, body weight, subjective body image, and suicidal ideation, it is still unclear which of these factors could be primary targets of suicide prevention. Therefore, this study aimed to investigate the associations between suicide ideation and BMI, height, and subjective body image among Korean adolescents using data from the Korea National Health and Nutrition Examination Survey (KNHANES). We aimed to test the following: (1) height, BMI, and body image are associated with psychological distress including suicidal ideation among adolescents and (2) negative body image might affect mental health even in adolescents without obesity.

2. Methods

2.1. Study population

We conducted a cross-sectional study of 6,261 adolescents aged 12–18 years included in four phases of the KNHANES: IV (2007–2009), V (2010–2012), VI (2013–2015), and VII (2016–2018). Figure 1 shows a flowchart for the study design and patient inclusion.

The KNHANES is a nationally representative cross-sectional survey, with a stratified and multistage sampling design, conducted by the Korea Centers for Disease Control and Prevention, based on the National Health Promotion Act (30). This cross-sectional survey involves a two-step stratified sampling method using sampling units and households as the primary and secondary sampling units, respectively. The sample weights for sample participants are constructed by accounting for the complex survey design, survey non-response, and post-stratification with a multistage and stratified systematic sampling design, considering non-responders to represent the Korean population. The data from health interviews, health examinations, and nutrition surveys provide information about health status and behavior,

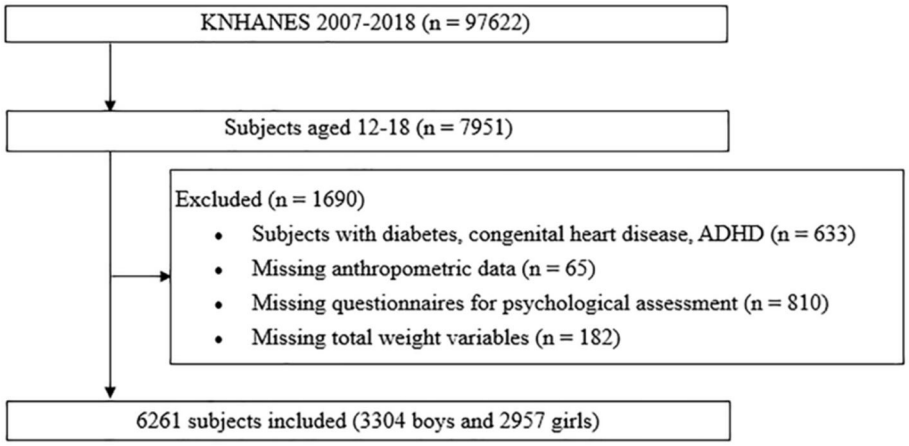

FIGURE 1
Design and flowchart of the study population. KNHANES, Korea National Health and Nutrition Examination Survey; ADHD, attention deficit hyperactivity syndrome.

socioeconomic demographics, and laboratory tests. Trained interviewers and medical technicians conduct interviews using a structured questionnaire.

2.2. Data collection and study variables

Data on demographic, anthropometric, and behavioral characteristics were collected. Height and weight were measured using standard protocols, and BMI was calculated as weight (kg) divided by height squared (m^2). Height and BMI were presented as Z-scores based on the 2017 Korean National Growth Charts (31). Short stature was defined as a height Z-score below −2.0.

Depressed mood, suicide ideation, suicide plans, and suicide attempts were assessed *via* participants' responses to the following questions (possible responses were "yes" and "no"): "During the past year, did you ever face a period of 2 weeks or more when you felt sad, blue, or depressed nearly every day?," "During the past year, did you think about dying by suicide?," "During the past year, did you seriously plan a suicide attempt(s)?," and "Have you attempted suicide during the past year?" These questions are included in the WHO Composite International Diagnostic Interview-Short Form, which has been validated as a cost-effective screening method for public surveys and is a well-documented predictor of suicide attempts that have been previously used in other surveys (32, 33). Subjective body image was assessed by asking, "In your opinion, how do you perceive your body?" The possible responses included "lean," "normal," and "obese."

2.3. Statistical analyses

The sampling weights were considered in all analyses to report representative estimates of the Korean population. The data were analyzed using SAS version 9.4 (SAS Inc., Cary, NC, USA). All continuous variables were expressed as weighted means with standard errors, whereas categorical variables are expressed as weighted percentages with standard errors. We divided the participants into subgroups according to sex, height Z-score, suicide ideation, subjective body image, and KNHANES phase. Independent two-sample *t*-test and analysis of variance were used to compare the mean values of continuous variables, and the Rao–Scott chi-square test was used to compare the weighted percentages of categorical variables. Logistic regression analyses were performed to explain the relationship between suicide ideation as a dependent variable and various markers. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline characteristics of the participants according to sex

Among the participants, 9.55% reported depressed mood, 9.20% reported suicide ideation, 1.21% had a suicide plan, and 1.99% had attempted suicide (Table 1). Among male participants, 7.62% exhibited depressed mood, 6.42% exhibited suicide ideation, 0.76% had a suicide plan, and 1.50% had attempted suicide. Among female participants, 11.77% reported depressed mood, 12.40% reported suicide ideation, 1.69% had a suicide plan, and 2.47% had attempted suicide. The proportion of participants with obesity was higher among male participants than female participants, whereas the proportion of those with perceived obesity was higher among female participants (all $p < 0.001$). The proportion of the underweight and those with a lean body image was higher among male participants than in female participants ($p < 0.001$). In contrast, the proportions of those with depressed mood and suicide ideation were

TABLE 1 Baseline characteristics according to sex.

	Total (n = 6,261)	Male (n = 3,304)	Female (n = 2,957)	p
Age, y	15.11 (0.03)	15.11 (0.04)	15.11 (0.04)	0.974
Height Z-score	0.21 (0.02)	0.23 (0.02)	0.19 (0.02)	0.229
Height group				0.389
Z-score < −2	1.63 (0.19)	1.82 (0.28)	1.41 (0.25)	
−2 ≤ Z-score < 0	40.05 (0.77)	39.68 (1.04)	40.47 (1.04)	
0 ≤ Z-score < 2	54.14 (0.78)	53.96 (1.05)	54.35 (1.07)	
Z-score ≥ 2	4.18 (0.30)	4.54 (0.43)	3.77 (0.41)	
Weight Z-score	0.08 (0.02)	0.06 (0.03)	0.10 (0.03)	0.291
BMI Z-score	−0.05 (0.02)	−0.09 (0.03)	0.00 (0.03)	0.024
BMI percentile				<0.001
Underweight	8.98 (0.44)	10.66 (0.64)	7.06 (0.53)	
Normal	71.26 (0.66)	69.18 (0.94)	73.64 (0.95)	
Overweight	9.06 (0.41)	8.96 (0.56)	9.18 (0.59)	
Obesity	10.70 (0.48)	11.20 (0.67)	10.12 (0.68)	
Subjective body image				<0.001
Lean	26.00 (0.67)	34.62 (1.00)	16.10 (0.78)	
Normal	42.56 (0.72)	37.13 (0.98)	48.80 (1.10)	
Obese	31.44 (0.69)	28.25 (0.87)	35.10 (1.07)	
Depressed mood	9.55 (0.46)	7.62 (0.57)	11.77 (0.72)	<0.001
Suicide ideation	9.20 (0.44)	6.42 (0.52)	12.40 (0.68)	<0.001
Suicide plan	1.21 (0.24)	0.76 (0.29)	1.69 (0.40)	0.070
Suicide attempt	1.99 (0.29)	1.50 (0.38)	2.47 (0.43)	0.098

Continuous variables are presented as means (standard error) and categorical data as percentages (standard error). BMI, body mass index.

higher among female participants than in male participants (all $p < 0.001$).

3.2. Characteristics of the participants according to suicide ideation

In the subgroup analysis, according to suicide ideation, the height Z-score was lower, and the proportions of individuals with perceived obesity, depressed mood, and a suicide plan and attempt were higher among the participants with suicide ideation than those without suicide ideation ($p = 0.025$ for height Z-score, all other $p < 0.001$) (Table 2). Among male participants, the proportions of individuals with depressed mood and a suicide plan and attempt were higher among those with suicide ideation than those without (all $p < 0.001$). For female participants, the height Z-scores were lower, and the proportions of individuals with short stature, perceived obesity, depressed mood, and suicide plan and attempt were higher in the group with suicide ideation than in the group without ($p = 0.033$ for height Z-score vs. $p = 0.047$ for short stature, all other $p < 0.001$).

3.3. Characteristics of the participants according to subjective body image and height Z-score

In the subgroup analysis, according to subjective body image, the proportions of depressed mood, suicide ideation, and suicide attempts were higher among all participants with perceived obesity than those with a normal body image ($p = 0.027$ for suicide attempts, all other $p < 0.001$) (Table 3). Among all participants with perceived obesity, 41.1% had a normal BMI. Among male participants with perceived obesity, 34.58% had a normal BMI.

The proportions of depressed mood, suicide ideation, and suicide attempts were higher among female participants with perceived obesity than those with a normal body image ($p = 0.020$ for suicide attempts, all other $p < 0.001$). Among female participants with perceived obesity, 47.17% had a normal BMI. In the subgroup analysis, according to the height Z-score, the proportion of female participants with suicide ideation decreased with an increase in the height Z-score ($p = 0.047$) (Figure 2).

TABLE 2 Comparison of subjects according to suicide ideation.

	Total			Male			Female		
	Yes	No	*P*	Yes	No	*P*	Yes	No	*P*
Age, y	15.207 (0.086)	15.097 (0.030)	0.223	15.262 (0.139)	15.098 (0.039)	0.254	15.175 (0.110)	15.095 (0.045)	0.505
Height Z-score	0.106 (0.051)	0.226 (0.018)	0.025	0.169 (0.075)	0.236 (0.025)	0.393	0.069 (0.066)	0.215 (0.024)	0.033
Height group			**0.208**			**0.967**			**0.047**
Z-score <-2	2.45 (0.756)	1.53 (0.198)		2.23 (1.030)	1.80 (0.296)		2.58 (1.040)	1.20 (0.249)	
−2 ≤ Z-score < 0	42.74 (2.481)	39.76 (0.799)		38.59 (3.975)	39.79 (1.070)		45.21 (3.033)	39.72 (1.092)	
0 ≤ Z-score < 2	51.39 (2.487)	54.46 (0.812)		54.51 (4.028)	53.90 (1.090)		49.54 (3.057)	55.15 (1.129)	
Z-score ≥ 2	3.42 (0.722)	4.25 (0.316)		4.66 (1.387)	4.51 (0.452)		2.68 (0.810)	3.93 (0.449)	
Weight Z-score	0.118 (0.064)	0.073 (0.020)	0.495	0.128 (0.112)	0.053 (0.027)	0.516	0.112 (0.075)	0.098 (0.028)	0.857
BMI Z-score	0.077 (0.068)	−0.056 (0.021)	0.061	0.048 (0.127)	−0.095 (0.028)	0.274	0.094 (0.075)	−0.009 (0.030)	0.200
BMI percentile			**0.169**			**0.534**			**0.349**
Underweight	7.12 (1.355)	9.14 (0.462)		10.48 (2.994)	10.69 (0.653)		5.12 (1.203)	7.23 (0.581)	
Normal	69.89 (2.221)	71.42 (0.689)		64.57 (4.079)	69.49 (0.959)		73.07 (2.513)	73.79 (1.015)	
Overweight	11.40 (1.481)	8.82 (0.418)		11.78 (2.362)	8.75 (0.580)		11.18 (1.921)	8.90 (0.620)	
Obesity	11.58 (1.502)	10.62 (0.501)		13.18 (2.840)	11.07 (0.678)		10.63 (1.711)	10.08 (0.736)	
Subjective body image			**<0.001**			**0.123**			**<0.001**
Lean	23.30 (2.196)	26.27 (0.701)		37.01 (4.190)	34.45 (1.019)		15.14 (2.189)	16.22 (0.830)	
Normal	35.83 (2.229)	43.26 (0.769)		29.57 (3.440)	37.66 (1.018)		39.56 (2.813)	50.13 (1.180)	
Obese	40.87 (2.426)	30.48 (0.715)		33.42 (4.052)	27.89 (0.888)		45.30 (2.968)	33.65 (1.124)	
Depressed mood	38.10 (2.45)	6.66 (0.40)	<0.001	36.76 (3.99)	5.62 (0.50)	<0.001	38.90 (2.87)	7.93 (0.65)	<0.001
Suicide plan	27.29 (4.56)	0.00 (0.00)	<0.001	21.86 (6.83)	0.00 (0.00)	<0.001	31.08 (6.28)	0.00 (0.00)	<0.001
Suicide attempt	11.75 (1.59)	0.01 (0.01)	<0.001	11.96 (2.81)	0.00 (0.00)	<0.001	11.62 (1.91)	0.01 (0.01)	<0.001

Continuous variables are presented as means (standard error) and categorical data as percentages (standard error). BMI, body mass index.

3.4. Risk factors for suicide ideation in logistic regression analysis

On logistic regression, the odds ratios (ORs) (95% confidence intervals [CIs]) of height Z-score, perceived obesity, and depressed mood in relation to suicide ideation were 0.898 (0.818–0.986), 6.304 (5.903–7.803), and 6.304 (5.903–7.803), respectively, among all participants (Table 4). Among male participants, the ORs (95% CIs) of perceived obesity and depressed mood in relation to suicide ideation were 1.526 (1.019–2.284) and 6.590 (4.676–7.803), respectively. Among female participants, the ORs (95% CIs) of height Z-score, perceived obesity, and depressed mood were 0.874 (0.773–0.987), 5.685 (4.342–7.444), and 5.685 (4.342–7.444), respectively. In addition, female participants with height Z-scores of above 2 were less likely to express suicide ideation than those with height Z-scores below −2 (OR = 0.317, 95% CI = 0.104–0.965).

After adjusting for age, height Z-score, and weight Z-score, the ORs (95% CIs) of perceived obesity for suicide ideation were 1.886 (1.699–2.528) for all participants, 1.277 (0.745–2.189) for male participants, and 2.080 (1.456–2.971) for female participants (p = 0.375 for male participants, all other $p < 0.001$) (Figure 3A). After adjusting age, height Z-score, weight Z-score, and depressed mood, the ORs (95% CIs) of perceived obesity for suicide ideation were 1.575 (1.175–2.111) for all participants, 1.168 (0.686–1.989) for male participants, and 1.706 (1.192–2.441) for female participants ($p = 0.002$ for the total number of participants, $p = 0.568$ for male participants, and $p = 0.003$ for female participants) (Figure 3B).

In the subgroup analysis, according to BMI, the ORs (95% CIs) of perceived obesity for suicide ideation were 1.889 (1.426–2.501) for the participants with normal BMI or underweight and 1.202 (0.551–2.622) for the participants who were overweight or obese (Figure 4).

In the subgroup analysis, according to the KNHANES phase, the OR (95% CI) of height Z-score for suicide ideation was 0.757 (0.582–0.985) for KNHANES VI (Supplementary Table 1). The ORs (95% CIs) of subjective body image for suicide ideation were significant for KNHANES IV, V, and VI, and the ORs (95% CIs) of depressed mood for suicide ideation were significant for KNHANES IV, V, VI, and VII. Interaction p-values were not significant for variables.

4. Discussion

This study demonstrated the following: (1) perceived obesity was positively associated with the proportion of suicide ideation in adolescents, even among those who fell within the normal BMI

TABLE 3 Comparison of subjects according to subjective body image.

	Total				Male				Female			
	Lean	Normal	Obese	*p*	Lean	Normal	Obese	*p*	Lean	Normal	Obese	*p*
Age, y	15.13 (0.06)	15.03 (0.04)	15.20 (0.05)	0.025	15.27 (0.07)	15.06 (0.06)	14.97 (0.07)	0.006	14.76 (0.10)	14.99 (0.06)	15.41 (0.07)	<0.001
Height Z–score	0.17 (0.03)	0.20 (0.02)	0.28 (0.03)	0.013	0.15 (0.04)	0.23 (0.04)	0.33 (0.04)	0.005	0.20 (0.06)	0.17 (0.03)	0.23 (0.04)	0.423
Weight Z–score	−1.06 (0.02)	−0.10 (0.02)	1.25 (0.03)	<0.001	−1.02 (0.03)	0.04 (0.03)	1.41 (0.04)	<0.001	−1.16 (0.04)	−0.22 (0.02)	1.11 (0.04)	<0.001
BMI Z–score	−1.38 (0.02)	−0.24 (0.01)	1.33 (0.03)	<0.001	−1.34 (0.02)	−0.12 (0.02)	1.49 (0.04)	<0.001	−1.47 (0.03)	−0.35 (0.02)	1.18 (0.04)	<0.001
BMI percentile				<0.001				<0.001				<0.001
Underweight	32.25 (1.42)	1.31 (0.23)	0.05 (0.05)		30.19 (1.66)	0.60 (0.25)	0.00 (0.00)		37.34 (2.46)	1.92 (0.38)	0.09 (0.09)	
Normal	67.65 (1.42)	95.78 (0.42)	41.10 (1.33)		69.67 (1.66)	95.05 (0.69)	34.58 (1.80)		62.66 (2.46)	96.42 (0.50)	47.14 (1.80)	
Overweight	0.10 (0.08)	2.54 (0.32)	25.29 (1.12)		0.14 (0.11)	3.75 (0.59)	26.55 (1.68)		0.00 (0.00)	1.47 (0.32)	24.12 (1.46)	
Obesity	0.00 (0.00)	0.38 (0.13)	33.56 (1.33)		0.00 (0.00)	0.60 (0.26)	38.86 (1.91)		0.00 (0.00)	0.18 (0.09)	28.65 (1.72)	
Depressed mood	9.01 (0.84)	8.13 (0.60)	11.92 (0.89)	<0.001	8.20 (1.00)	6.65 (0.82)	8.20 (1.05)	0.379	11.02 (1.61)	9.43 (0.89)	15.37 (1.39)	<0.001
Suicide ideation	8.25 (0.89)	7.74 (0.57)	11.96 (0.84)	<0.001	6.86 (0.97)	5.11 (0.67)	7.60 (1.09)	0.123	11.67 (1.73)	10.04 (0.88)	16.00 (1.28)	<0.001
Suicide plan	1.04 (0.51)	0.86 (0.29)	1.79 (0.51)	0.261	0.94 (0.62)	0.43 (0.31)	0.98 (0.57)	0.662	1.27 (0.90)	1.22 (0.47)	2.49 (0.82)	0.324
Suicide attempt	2.16 (0.67)	1.14 (0.29)	2.90 (0.59)	0.027	2.07 (0.82)	0.94 (0.41)	1.55 (0.70)	0.429	2.36 (1.14)	1.30 (0.41)	3.94 (0.90)	0.020

Continuous variables are presented as means (standard error) and categorical data as percentages (standard error). BMI, body mass index.

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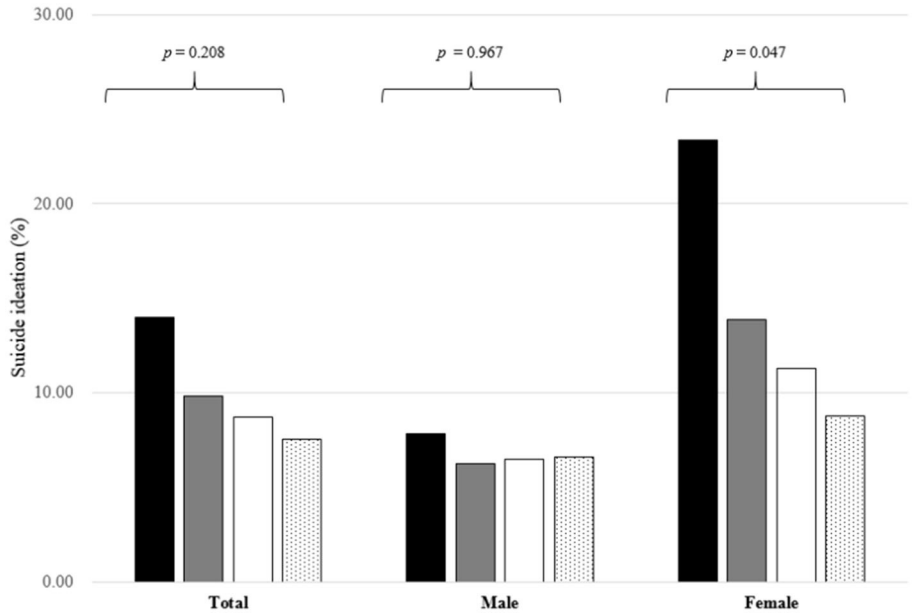

FIGURE 2
Proportions of individuals with suicide ideation according to height Z-score among the participants. The black bar represents individuals with a height Z-score below −2, the gray bar, with a height Z-score between −2 and 0, the white bar, with a height Z-score between 0 and 2, and the bar with the dotted pattern, with a height Z-score above 2. The number on the bar is the *p*-value of the analysis of variance.

TABLE 4 Logistic regression for suicide ideation.

	Total		Male		Female	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Age, y	1.030 (0.982–1.079)	0.225	1.044 (0.969–1.126)	0.257	1.021 (0.960–1.087)	0.506
Height Z-score	0.898 (0.818–0.986)	0.024	0.943 (0.825–1.079)	0.392	0.874 (0.773–0.987)	0.030
Height group						
Z-score <-2	ref		ref		ref	
−2 ≤ Z-score < 0	0.671 (0.339–1.326)	0.251	0.780 (0.287–2.119)	0.626	0.529 (0.210–1.328)	0.175
0 ≤ Z-score < 2	0.589 (0.298–1.163)	0.127	0.813 (0.300–2.207)	0.685	0.417 (0.1660–1.050)	0.063
Z-score ≥ 2	0.502 (0.226–1.117)	0.091	0.832 (0.264–2.625)	0.854	0.317 (0.104–0.965)	0.043
Weight Z-score	1.029 (0.948–1.117)	0.492	1.045 (0.916–1.193)	0.512	1.010 (0.905–1.128)	0.857
BMI Z-score	1.079 (0.998–1.165)	0.055	1.078 (0.946–1.228)	0.261	1.067 (0.968–1.177)	0.193
BMI percentile						
Underweight	0.797 (0.525–1.209)	0.286	1.055 (0.548–2.032)	0.873	0.717 (0.429–1.198)	0.204
Normal	ref		ref		ref	
Overweight	1.322 (0.972–1.797)	0.075	1.449 (0.893–2.350)	0.133	1.268 (0.839–1.916)	0.260
Obesity	1.114 (0.818–1.516)	0.493	1.281 (0.772–2.126)	0.337	1.065 (0.723–1.568)	0.749
Subjective body image						
Lean	1.071(0.817–1.403)	0.619	1.368 (0.923–2.027)	0.119	1.183(0.812–1.724)	0.381
Normal	ref		ref		ref	
Obese	1.619 (1.294–2.026)	<0.001	1.526 (1.019–2.284)	0.040	1.706 (1.305–2.230)	<0.001
Depressed mood	6.304 (5.903–7.803)	<0.001	6.590 (4.676–9.288)	<0.001	5.685 (4.342–7.444)	<0.001

OR, odds ratio; CI, confidence interval; BMI, body mass index.

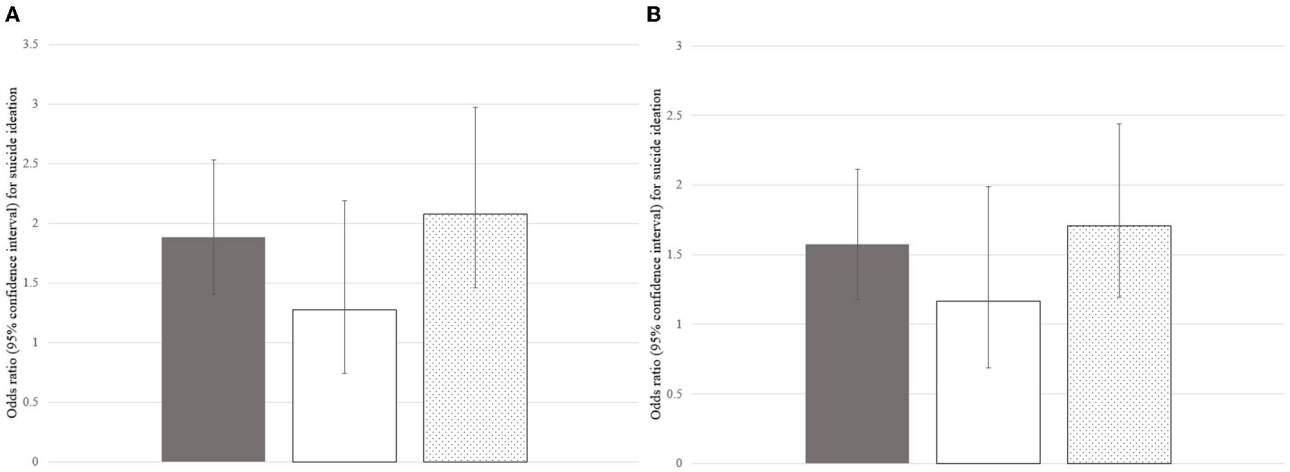

FIGURE 3
ORs (95% CIs) of perceived obesity for suicide ideation after adjusting for confounding factors. **(A)** ORs (95% CIs) of perceived obesity for suicide ideation after adjusting for age, height Z-score, and weight Z-score. **(B)** ORs (95% CIs) of perceived obesity for suicide ideation after adjusting for age, height Z-score, weight Z-score, and depressed mood. The gray, white, and dotted bars represent the ORs (95% CIs) of perceived obesity for suicide ideation among all participants, male participants, and female participants, respectively. OR, odds ratio; CI, confidence interval.

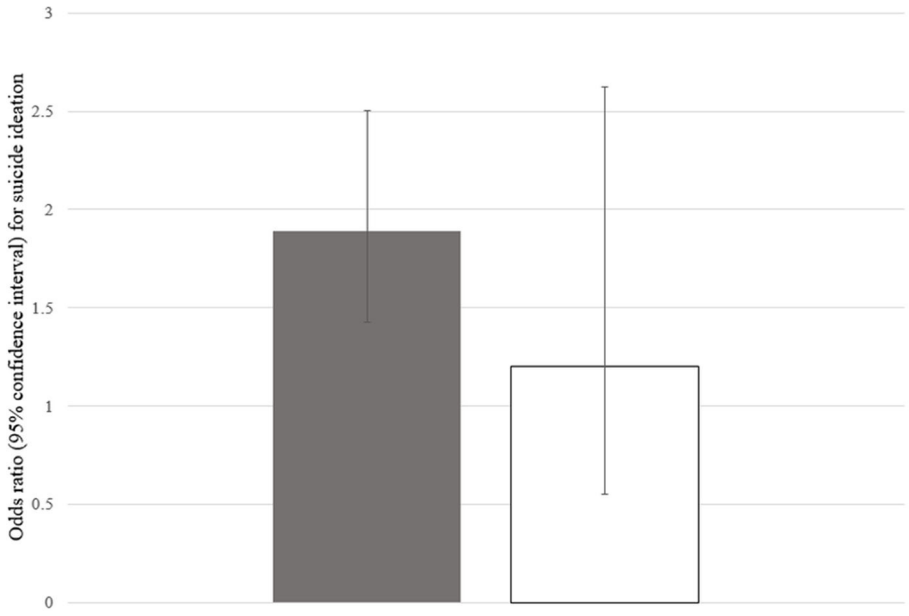

FIGURE 4
ORs (95% CIs) of perceived obesity for suicide ideation according to BMI. The gray bar represents ORs (95% CIs) of perceived obesity for suicide ideation among the participants with normal BMI or underweight and the white bar among the participants with overweight or obesity. OR, odds ratio; CI, confidence interval; BMI, body mass index.

range or were underweight; (2) shorter height, even if not of short stature, was associated with suicide ideation in adolescents. These relationships were more prominent among girls than boys. Additionally, a substantial proportion of the participants perceived themselves as being obese even though they were not technically obese or overweight. The proportion of perceived obesity was higher among girls than boys, although the proportion of actual obesity was lower among girls.

In our study, suicide ideation was associated with perceived obesity rather than actual obesity or BMI Z-score, possibly because of weight stigma. Interestingly, research suggests that the perceptions of body weight in adolescents are more important than actual body weight (23, 34). In this study, perceived obesity was positively associated with suicide ideation after adjusting for age, height Z-score, body weight Z-score, and depressed mood. Importantly, weight stigma is not restricted only to obese adolescents. Indeed, Puhl et al. (35) reported that 19% of US adults of normal weight perceived themselves as being overweight. Cruz-Sáez et al. (36) reported that 12.3% of normal-weight women had extreme weight-control behaviors.

We noted that a relatively short height was negatively associated with suicide ideation among adolescents even though they were not particularly short. Considering previous reports suggesting that short stature has no relationship with psychosocial burden (37), we think it would be controversial to insist that short stature induces suicide ideation or vice versa. Nevertheless, short stature in childhood and adolescence can lead to life dissatisfaction and poor subjective health experiences (38). The association between short stature and suicide ideation may be more psychological in nature, such as due to negative self-image, than endocrinological.

As reflected in our results, the association between suicide ideation and perceived obesity or short stature seems to be related to negative body image, although the causality could not be explained. Negative body image should be considered both in psychological and environmental aspects. First, negative body image is related to a distorted perception of body image and is associated with low self-esteem, which can lead adolescents to have a negative self-image (23, 39). A negative self-image can be a predictor of not only psychological problems but also emotional distress (40, 41). Emotional distress is known to be linked to diverse negative cognitive patterns, such as selective processing of depressive information, making dysfunctional attributions, and engaging in negative automatic thinking (42). Moreover, adolescents, especially girls, with major depression tend to have a poorer self-image (43, 44). Considering that body image might be established in early adolescence, careful monitoring of emotional distress in children and adolescents is necessary to prevent negative outcomes as a result of negative body image (45, 46). Second, the influence of media tends to encourage a distorted body image since slim characteristics are often portrayed as being popular and attractive, whereas obese characteristics are depicted as being unpopular and in a negative light (24). In this regard, the association between negative body image and suicide ideation can be explained by the interpersonal theory of suicide, namely, perceived burdensomeness and thwarted belongingness are predictors of the desire to engage in suicide (47). Hunger et al. (25) reported that perceived burdensomeness can mediate weight stigma, and suicide ideation and negative weight stigma could be more powerful risk factors for suicide than BMI itself. Third, especially in adolescence, the association between weight stigma and psychological distress can be stronger, owing to teasing by peers (24, 48). Weight-based teasing is widespread and one of the risk factors for body dissatisfaction (48–50). A population-based study reported that weight-based harassment was associated with low self-esteem, depression, and body dissatisfaction among girls (51). A US study with a nationally representative survey reported that perceived obesity was positively related to suicide ideation, planning, and attempts among adolescents (48).

In our study, the proportion of participants exhibiting suicide ideation and depressed mood was higher among girls than boys; the relationship between perceived obesity and psychological stress was also more prominent among girls than boys. These findings may be attributed to gender differences in emotional expression and the fact that the burden of weight stigma is greater for female participants than for male participants with regard to attractiveness. A KNHANES-based study reported that women with an overweight body image had a higher level of depressive symptoms than those without; this finding was not observed in men (52). Carpenter et al. (20) reported that BMI was negatively related to suicide ideation and attempts in men, whereas it was positively related to both in women. A school based-study reported that obesity was related to psychological distress among girls but not among boys (53).

This study has some limitations. First, this was a cross-sectional study limited to South Korea, which limits the generalizability and causality of our results. In addition, the onset age of suicidal ideation and obesity was not specified in this study. Second, we could not consider confounding factors such as puberty, teasing, and sexual orientation because this information was not provided in the KNHANES. Third, environmental factors including familial factors were not considered in this study. Fourth, it was impossible to conduct structured interviews or use measurement instruments, as this study was based on a large-scale adolescent survey. Self-reported items cannot entirely represent an adolescent's mental health, and our study did not include every psychiatric disorder. To evaluate the effect of psychiatric disorders precisely, structured interviews such as the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (DSM) should be considered (54). Psychometric instruments such as the Beck depression inventory for depression (55) and the Columbia-suicide severity rating scale for suicidal ideation could be useful for evaluating psychiatric disorders (56). Fifth, we considered only diabetes, congenital heart disease, and attention deficit hyperactivity disorder among chronic diseases associated with psychological distress. Sixth, we could not assess the effect of treatment for depression and suicide ideation because the KNAHNES provides information on medical treatment for psychiatric disease, although pharmacotherapy including antidepressants such as buprenorphine is the recommended treatment strategy for depression (57). However, the study assessed the association of suicide ideation with BMI, height, and subjective body image using nationally representative data from a large number of adolescents.

5. Conclusion

Our study demonstrated that perceived obesity was associated with suicide ideation among adolescents even though they were not really obese. In addition, a relatively short stature was associated with suicide ideation among adolescents even though they were not really short. These associations were more apparent among girls than boys. The findings emphasize a mutual relationship between psychological distress, negative body image, and height and subjective body image in adolescents. In addition, our results emphasize the importance of assessing the risk of suicide ideation in adolescents with perceived obesity and those with relatively short stature. Moreover, adolescents, especially girls, with psychological problems due to body image dissatisfaction, need attentive care from physicians and family members even though they may not be obese. Therefore, it is necessary to determine subjective feelings and psychological distress during the assessment of obesity and growth in adolescents to prevent suicide ideation.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board of the Yonsei University Gangnam Severance Hospital. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

KS, JL, SL, and HC: conceptualization. KS, JL, and HC: design, methodology, and conducted the study. KS, JL, SJ, and HL: statistical analysis and interpretation. KS and JL: writing—original draft preparation. HC: writing—reviewing and editing. KS: resources. H-SK: 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

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1172940/full#supplementary-material

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Striking a balance: triage and crisis intervention models within the pediatric emergency room

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1. Introduction

Upwards of 500,000 pediatric patients visit emergency rooms (ER) annually for psychiatric crises (1), with rates recently increasing (2, 3), necessitating an examination of ER treatment approaches, including triage and crisis interventions. Nurses and pediatricians without specialized psychiatric training often apply a triage approach to such youth's care (4–8), rapidly admitting or discharging them depending on risks of auto- or hetero-aggression. Alternatively, a crisis intervention model emphasizes diagnosis, immediate treatment and orientation to either inpatient and/or outpatient resources on discharge (9–19). This approach is often multimodal (18), including nurses and social workers experienced in pediatric mental health, thus requiring additional resources compared to triage approaches. The triage (4–8) and crisis intervention (9–16) models have mostly been considered in isolation. When considered in tandem (17–20), there is little elaboration on treatment variables (e.g., alliance, the patient and physician's emotional responses and time limitations). This article compares the two models and the interplay of these variables with respect to each. A composite case highlights the differences.

2. Triage model

A triage model is time-limited, guided by assessment of suicide acuity as reflected by answers to core questions that expeditiously discern those most at risk of attempting or completing suicide (4–8). This model could begin with a nurse's assessment of the acuity of the suicidal phenomena on a scale of simple ideation to a threat, mild attempt, severe attempt and/or plan, and communicating those results to a pediatrician, who spends 15 min exploring those factors and deciding upon the need for hospitalization (5–8). The brevity of these assessments is suitable for busy ERs, scarce in mental health workers (2, 3). This time-restricted ER triage approach provides only limited information about the origins of the youth's psychiatric disorder, the presence of adversity and treatment options, and opportunities for symptom resolution. With such limitations, a triage approach could yield higher rates of ER return (4, 6). Repeated visits strain the ER, reducing time clinicians allot to youth, diminishing health professional's senses of self-efficacy, thus contributing to apathetic attitudes toward such patients and their families (21), perhaps leading to worse outcomes (22). By contrast, improved training in such youth's care, although rarely available (23), enhances staff's self-efficacy, engagement with and treatment of this population (21). Despite this model's limitations, it may contribute to resolution of negative feelings surrounding the

youth's adversity (24), soothed by the security of the ER and an empathetic ear, although potentially offset by the ER's fast pace (25).

3. Crisis intervention model

A crisis intervention model would include a multidisciplinary team approach to treating youth and family distress, including diagnosis, treatment planning and community referral (9–19). The first component of this model is identical to the triage model, differing only insofar as the pediatrician subsequently refers the youth and family to a multimodal mental health team, including a psychiatric nurse, psychiatrist and social worker, working together to alleviate distress. This model requires an additional 1–3 h, depending on the needs of the case. Elements central to this intervention could include understanding the underpinnings of the crisis, defining the youth's psychiatric disorder and prescribing psychotherapeutic and/or pharmacologic interventions for its management, identifying and arresting abuse, and developing a treatment plan addressing the underlying disorder and adversity. A mental re-framing of identified core beliefs could reduce the youth's dysphoria, using techniques such as a narrative shift, for example guiding a child from a sense of low self-worth due to a learning disorder to one of normal intelligence, simply learning differently. Such a narrative shift would also help youth perceive themselves as strong and courageous for surviving despite considerable challenges, rather than feeling weak due to past toxic chronic emotional abuse (24). The crisis thus serves as an opportunity to change how youth and caregivers think and feel about themselves and each other, at a time when emotions are heightened and defenses are low, rendering those youth accessible to interventions aimed at reducing their psychological distress. Such an approach can also reduce inpatient admissions (17) and depressive symptomatology (11, 14) and increase adherence to outpatient referrals (9, 10, 13, 16); although findings are mixed (9, 10, 12, 15). Multimodal ER interventions may therefore reduce patient's subsequent emergencies and return visits (18). The repeated reassessment of the child's suicidality using this approach would allow for a more informed perspective on their suitability for hospitalization or outpatient management.

4. The development of an alliance

Alliances with pediatric patients are critical in mental health services. They are characterized by the quality of relationship and trust between clinicians and youth/families, strengthened by empathy and active listening (26). Good alliances manifest in a triage model when youth honestly reveal their reasons for ER presentation, maximizing chances that decisions for hospitalization or outpatient management would be best informed. Alliances are critical for an outpatient ER crisis intervention model to enhance the intervention's impact. That outpatient process can be informed by crisis interventions with similar hospitalized high-risk youth. These usually places an emotional burden on youth, family, and health professionals, thus requiring the rapid building of alliance. Strong alliances are associated with treatment adherence (27), reduction in re-admission rates (28) and positive psychotherapy outcomes (29). Alliance building is challenging in any environment but is particularly so in an ER setting, using either model, as the ensuing rapid assessment creates a pressured environment, compromising the clinician's empathetic stance (25). Adverse Childhood Experiences (ACEs) could also developmentally lead to youth's mistrust of caregivers (24), aggression and unpredictability, thus disrupting alliances with healthcare professionals and engendering anxiety and vigilance among them (30).

5. The clinician's emotional experience

Occasionally, clinicians experience feelings or thoughts when interacting with youth that surprise them as these were absent prior to the assessment. Such experiences could be named countertransferences. They are often stimulated by the child's early relationships with primary caregivers and then repeated in sessions with the therapist. This is called a transference and has little to do with the clinician themselves. The clinician's unwelcome feelings, absent prior to interactions with youth, probably emanated from the child and/or family (31, 32). Understanding this process can lead to insight into the youth's difficulties and relieve distress. This interplay of emotions, particularly relevant when associated with emotionally dysregulated youth in their pattern of interpersonal difficulties (33, 34), might commonly occur with those exposed to ACEs (24). For example, projective identification occurs when individuals attempt to extricate bad feelings or conflicts by projecting them into another who then acquires the rejected feelings or conflicts as their own (35). Using the clinician's emotional experience and self-awareness, projective identification becomes apparent as it draws the clinician into the youth's emotional orbit beyond simple empathy. Such primitive defenses could be anticipated by ER clinicians when working with youth experiencing intensely negative feelings (e.g., anger, guilt and feelings of incompetence) often resulting from family dysfunction and unattuned and rejecting parents. This interplay of emotions between youth and clinicians, contributing to the therapeutic process, will manifest in both models, but is more elaborated in the crisis intervention model. It would be of benefit to ER staff, although rarely the case (23), to receive mental health training to improve their awareness of such processes. Balint groups could facilitate discussions of these emotionally charged cases and have improved patient-staff communication and empathy and reduced burnout (36).

6. Time limitations

The rapid pace and associated ER time constraints must be managed in both triage and crisis intervention approaches (17). Limited time may detract from the validity of observations, negatively impacting decisions to hospitalize/discharge and may impair a perception of a youth's diagnosis and treatment plan. Although the crisis intervention model vs. the triage approach provides more observation time (9–19), neither approach benefits to the same extent from multiple observations over extended periods characterizing an outpatient setting. That setting engenders

several evaluations, improving the likelihood of diagnostic and treatment clarity and accuracy.

7. Reluctance to accept healthcare

The youth or caregivers' reluctance to accept healthcare may impair an ER clinician's effectiveness. When obliged by family or police to submit to an ER assessment, youth may lack motivation for help-seeking (19). As well, a caregivers' reluctance to submit to evaluation may stem from unwillingness to acknowledge their contribution to the adversity (37). Abusive parents, themselves often victims of childhood abuse, may also be blinded to the adversity they are perpetuating (38). Stopping the adversity can reassure the child of security, contrary to their previous adverse home environment, thus relieving reluctance to change and lessening the youth's suicidality. The child could potentially be discharged to a safer environment, avoiding hospitalization. Adversity resulting in suicidality within a triage context would not likely be addressed prior to hospitalization.

8. Case study

Mary was a 14-year-old female, residing with her biological mother and father and 12-year-old sister. She presented to the ER after having told a friend she ingested 15 pills of aspirin 2 days previously while thinking ambivalently about suicide. She had not previously discussed this overdose with anyone nor sought help. The friend informed the mother who brought her to the ER. She had not confided to anyone her two prior attempts within the past 6 months.

8.1. Triage model

The clinicians were concerned about her multiple recent ingestions even in the absence of her distress. Without further data characterizing this case in the triage model, the clinicians could legitimately hospitalize this youth awaiting a full multimodal evaluation on an inpatient service.

8.2. Crisis intervention model

On further evaluation, the youth revealed that her grades were in the passing range, aside from her customary failures in math. She loved her friends and boyfriend, enjoyed drawing for which she had talent and wanted an art career.

She was easily angered when her father typically called her "stupid" and "lazy" upon failing math exams and when he requested she perform household chores leading to shouting matches. Suicidal feelings would ensue as well as low self-esteem associated with struggles in math, self-perception as an angry young woman and the thought that her parents would be better off without her, as revealed to the psychiatrist. She also noticed frequent distractions during class, fidgeting and having a restless leg.

The youth appreciated an awareness of an underlying ADHD with impulsivity, its treatability and its genetic etiology (39), thereby partially absolving her of guilt related to her angry episodes. Awareness of the factors that leading to suicidal feelings contributed to their resolution. The father acknowledged to the social worker the toxicity of his verbal putdowns, expressing wishes to find alternative ways to communicate with his daughter, thus diminishing her dysphoria.

The youth was informed about strategies to manage future suicidal feelings and was referred to community mental health services. Ideally, an ER follow-up team would provide follow-up services 2–3 days post discharge, absent which the patient's general practitioner/pediatrician was guided in using Guanfacine to manage her irritability and she and her father were referred to dyadic therapy to improve their relationship. Contact with team members 1 month post ER discharge ensured community follow-up, at which point pharmacologic management was confirmed, the irritability had reduced and the relationship with her father and self-esteem had improved while the suicidality had abated.

8.3. Relative merits of the two models

The triage model, although ensuring the youth's security through hospitalization, could have benefited from further questioning. For example, the crisis model provided more extensive evaluation of dynamics leading to her suicidality, which were driven by her exposure to adversity and her negative self-esteem reflective of a fast temper. The more elaborated multimodal crisis evaluation also led to identification of resilience factors, understanding of her reasons for distress and their resolution while in the ER, leading to discharge and follow-up care. Although we contrast the two ends of the spectrum between the triage and crisis intervention models in caring for youth in suicidal crisis, evaluations of such patients are usually an amalgam of the two models (20). Their deployment, in a given setting, probably reflects the availability of emergency resources (18).

9. Conclusion

Both triage and crisis intervention models share challenges of creating an alliance in a short period while overcoming reluctance to change. The crisis intervention model might provide more opportunities of evoking strong emotions from the youth and family and analogously from the treating clinician. Where resources are available, a crisis intervention model provides the luxury of either a multimodal team and/or a more extensive evaluation while the youth and family are still in the ER, working out suitable treatment plans and potentially reducing the need for hospitalization. A trans-Canadian study is currently underway to measure client satisfaction for youth and families who experience either model. We await that study's results.

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Perspectives of parents of adolescents with repeated non-suicidal self-injury on sharing their caretaking experiences with peers: a qualitative study

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Background: The prevalence of non-suicidal self-injury among adolescents has increased over the years. Most parents, however, are poorly informed and confused about this behavior. Sharing caretaking experiences with parents in similar situations seems to be beneficial. Nevertheless, few researchers have explored the views of parents who share their caretaking experiences with peers.

Aim: This study aimed to investigate the perspectives of parents of adolescents with repeated non-suicidal self-injury on sharing their caretaking experiences with peers as well as the motivations for and barriers to this behavior.

Methods: This qualitative study adopted a purposive sampling method. Participants (16 mothers and 2 fathers) were recruited from the mental health center of a tertiary hospital in Chengdu, Sichuan, China. A total of 18 semistructured face-to-face individual interviews were conducted. All interviews were audio-recorded and analyzed thematically using NVivo 11.

Results: Three themes and nine subthemes were identified: (1) sharable caretaking experiences: reflection and transformation, self-emotional management, and diversified support; (2) motivations for sharing: empathy, reciprocity, and meaning; and (3) barriers to sharing: inadequate knowledge, low self-identity, and concerns for children.

Conclusion: Parents accumulate a wealth of experience during their long-term care of adolescents with repeated non-suicidal self-injury. Although most parents are willing to share their caretaking experiences with peers, there are several barriers. Therefore, in order to increase parents' motivation to share, psychological education is necessary.

KEYWORDS

non-suicidal self-injury, adolescents, parents, share, peers, qualitative study

Introduction

Non-suicidal self-injury (NSSI) refers to behaviors in which individuals directly and deliberately damage their body tissues with no intention of suicide (1), including actions such as cutting, biting, burning, hitting, and scratching (2, 3). Although the functions of self-injury remain unclear, a prior review reported various motivations for this behavior, including reducing distress, inflicting self-punishment and/or signaling personal distress to others (4). NSSI is particularly prevalent in adolescence (5). Some data suggest that the prevalence of NSSI has increased over the years (6), and a recent meta-analysis revealed that the global prevalence in a nonclinical sample of adolescents between 2010 and 2021 was 23.2% (7). In a sample of Chinese adolescents, the prevalence rate of at least one incident of NSSI was as high as 29% (8). Additionally, NSSI often occurs repeatedly (9). A case–control study on NSSI found that approximately 45.24% of cases reported recurrent NSSI (10). Consequently, these behaviors are related to higher rates of lifetime NSSI among adolescents (11). Moreover, the presence of NSSI is associated with a considerable risk of future suicidality (2, 12). A cross-sectional study of 600 adolescents found that more than half of adolescents with NSSI presented a significant suicide risk (13). In addition, findings from school-based studies indicate that high family conflict is a significant risk factor for NSSI and suicide (14).

NSSI is a transdiagnostic behavior that co-occurs with many mental diseases, including depressive disorder, anxiety disorder, borderline personality disorder, panic disorder, schizophrenia, and posttraumatic stress disorder (15, 16). Adolescent NSSI is strongly associated with complex factors such as social contagion, interpersonal stressors, neurobiological background, emotional dysregulation, and adverse experiences in childhood (5). There is also evidence that factors related to the family are associated with the occurrence and maintenance of adolescent NSSI (17), such as poor family functioning (18) and problematic parent–child relationships (19). Notably, a negative coping style among parents predicts increased odds of NSSI onset (20), which is closely related to repeated NSSI and severe NSSI in adolescents (21).

The impacts of young people's self-injury on their families can be devastating. Many parents describe feelings of emotional distress, anger, shame, and blame (22). These reactions aggravate their children's negative emotions and lead to serious consequences (23). According to a previous study, social isolation has been reported as parents withdraw from social contact due to the perceived stigma associated with NSSI (24). A qualitative study showed that parents of adolescents who engage in self-injury often experience significant distress and functional impairment, resulting in hypervigilance that adversely affects their mental health and social functioning (25). While social support (26) and professional support (27) are recommended for parents, there are numerous barriers (28). Previous studies have reported that stigma associated with mental illness, negative perceptions of healthcare services, a shortage of professionals, and long waiting times for professional assistance are common interpersonal barriers that prevent parents from seeking professional help (29, 30). These testimonies highlight the need for additional resources that better align with the needs of parents and that supplement professional assistance.

Peers are people with similar life experiences (31). Previous studies have shown that peers offer support outreach, engagement, knowledge, and care coordination to caregivers of adolescents with mental health problems (32, 33). Contact with peers also helps to establish trusting relationships between families, reduces the stigma of mental illness (34) and negative emotions (35), and improves coping mechanisms (36). According to a previous study, parents of adolescents with NSSI often feel ashamed to consult other parents with normal children. Instead, they tend to seek help from other parents in similar situations (37, 38). Sharing allows them to exchange caretaking experiences and improve their understanding of NSSI from different perspectives (38). Nonetheless, it is unclear how parents' views are expressed through the sharing of caretaking experiences with peers.

Previous qualitative studies of parents of adolescents with NSSI have focused on experiences with and attitudes toward NSSI (22, 24, 38–40), with little attention to parents' views on sharing caretaking experiences with peers. Therefore, this study aims to investigate the perspectives of parents of adolescents with repeated NSSI on sharing their caretaking experiences with peers as well as their motivations for and barriers to sharing. We hope to provide more accessible intellectual and emotional support resources to supplement professional assistance.

Materials and methods

Study design and setting

This descriptive, qualitative interview study was performed with parents of adolescents with repeated NSSI behaviors. The study was conducted from August 2022 to November 2022 at a 208-bed-capacity mental health center of a tertiary hospital in Chengdu, Sichuan, China. The center specializes in providing multidisciplinary mental health services for children and adolescents with various mental health problems.

Research team

The research team consisted of two graduate students and three psychiatric nurses with 8 years, 12 years, and 20 years of experience in psychiatry. All researchers received qualitative research training before the interviews.

Recruitment of participants

Purposive sampling was used to recruit the participants. The recruited participants were fathers and mothers of adolescents (age 13–18) with a history of at least two episodes of NSSI. The participants were required to have lived with the adolescents since the first self-injury. Informed consent was obtained from all participants for their own participation. The forms, frequency of NSSI, and parental mental state were determined by clinical data recorded by psychiatrists at the first consultation. Diversity in gender, age, residence, educational background, and marriage was considered in the sampling. Interviews were conducted until data saturation was attained. Eighteen participants completed interviews, including 16 mothers and 2 fathers.

Data collection

Eighteen semistructured face-to-face individual interviews were conducted in private rooms in the hospital. The interviews were audio recorded and began with open-ended questions. Data were collected following a flexible thematic outline. The interview outline was developed based on previous literature and was revised after consultation with psychiatrists and psychiatric nurses. Subsequently, a pre-interview was conducted with two participants to evaluate the applicability of the outline. The outline included the following content: (1) What useful caretaking experiences have you had that can be shared with parents of adolescents with NSSI? (2) Would you like to share your caretaking experiences? (3) What factors motivate you to share your caretaking experiences? (4) What factors deter you from sharing your caretaking experiences? Depending on the participants' preferences, the interviews were conducted in Mandarin or the Sichuan dialect. To ensure the privacy of the participants, they were referred to as P1 ~ P18. Each interview lasted 45 to 60 min.

Data analysis

The audio recordings were transcribed into text and analyzed using NVivo 11. Braun and Clarke's six-phase thematic analysis was conducted, which is an accessible and theoretically flexible approach to analyzing qualitative data and identifying themes or patterns (41). In the first phase, two researchers read the raw transcripts multiple times to familiarize themselves with the data and identify relevant ideas. In the second phase, these relevant ideas were reviewed several times and categorized according to their nature and frequency, and meaningful codes were developed from the transcript by two independent researchers. The reliability of coding was assessed by evaluating the degree of consensus. In case of disagreement on the codes, all researchers compared and discussed the coding to achieve consensus. In the third phase, related codes were grouped into categories and potential themes, which were labeled with the closest available approximation to the meaning. Two researchers reviewed different clustering conditions and searched for negative cases. The use of negative case analysis allows for the exploration and discussion of all data, including those that were inconsistent with the developed themes, which results in a more thorough understanding and fairness of the data (42). In the fourth phase, the codes, categories, and themes were compared between cases to ensure comprehensiveness and accuracy. The relationships between each theme were explored to generate a "thematic map" for the entire data set. In the fifth phase, each theme's label was defined by an explanatory statement that unified its codes in terms of consistency and meaning. At several time points across the entire coding process, all researchers met to discuss, review, and triangulate the codes and themes to form the final codebook. The last phase involved writing the reports and ensuring their effectiveness for clinical implementation. To calculate interrater reliability, we used percentage agreement (#inter-rater agreements/total #extracts coded; mean = 96%; range = 92–100%). The final set of themes and subthemes was organized by all researchers, and disagreements were discussed until all members reached a consensus. When reporting the results, quotes from participants were used to explain the results. We have tried to approach the literal translation, and errors specific to the native language have been corrected to improve readability.

Ethics

The study was ethically approved by the Ethics Committee of Chengdu Fourth Hospital on 24 March 2022: [2022] Lun Shen Zi No. (02), and the registration number of the Chinese Clinical Trial Registry was ChiCTR2200059437. Before each interview, written informed consent was obtained from all participants, and all of them were informed of the purpose, procedure and voluntary nature of the interview.

Trustworthiness

Credibility, dependability, and transferability were considered to assess trustworthiness in this study (43). To achieve credibility, at the beginning of the interviews, the interviewer explained to the participants that their experiences were valuable and that they could express these experiences freely. Additionally, credibility was ensured through the diversity of participants, in-depth interviews with participants, and member checking by returning the transcripts to the participants for clarification. Dependability was established by external checks with advisory experts, including the transcripts, codes, categories, and themes, to identify any disagreement in the process of data collection and data analysis. In addition, we asked questions on the same subjects for all participants, and an observer observed the conduct of the interviews to record the participants' non-verbal communication (e.g., facial expressions, tone, and mood). Transferability was achieved by purposeful sampling with maximum variation and a clear description of the data. In addition, all phases of the study were explained in detail to the participants. The participants' statements were faithfully translated into English with intact preservation of the original statements.

Results

Table 1 shows the demographic characteristics and relevant information on NSSI. Based on the eighteen interviews, three themes and nine subthemes were identified: (1) sharable caretaking experiences: reflection and transformation, self-emotional management, and diversified support; (2) motivations for sharing: empathy, reciprocity, and meaning; and (3) barriers to sharing: inadequate knowledge, low self-identity, and concerns for children. For each subtheme, we calculated the percentage of participants who mentioned it (Figure 1).

Theme 1: sharable caretaking experiences

Subtheme 1: reflection and transformation

Some participants showed an understanding of NSSI in adolescents during long-term care. They pointed to the need for parents to reflect on the potential causes of NSSI from their perspective.

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TABLE 1 Demographic characteristics and relevant information on NSSI.

		Adolescent			Participant				
No.	Age	Gender	NSSI method	NSSI frequency	Age	Gender	Residence	Education level	Marital status
1	15	Female	a	>5	44	Female	City	Bachelor degree	Married
2	14	Female	a	2–5	39	Female	City	Primary school	Married
3	15	Male	a	>5	39	Female	City	Bachelor degree	Married
4	16	Female	a, b	>5	51	Female	Countryside	Primary school	Remarried
5	15	Female	a, c	>5	44	Male	City	Primary school	Divorced
6	14	Female	a, c, d	2–5	55	Female	City	Bachelor degree	Married
7	16	Female	a	>5	51	Female	City	Some college	Married
8	14	Female	a, c, e	>5	45	Female	Countryside	Primary school	Remarried
9	13	Female	a	>5	34	Female	Countryside	Primary school	Remarried
10	14	Female	c, e	2–5	51	Female	Countryside	Middle school	Married
11	13	Female	a	2–5	51	Female	City	Some college	Married
12	17	Female	a, c, b	2–5	50	Female	Countryside	Middle school	Married
13	15	Male	a, c, d	2–5	49	Female	City	High school	Married
14	16	Female	a, b	>5	39	Male	City	High school	Married
15	14	Female	a, d	>5	45	Female	City	High school	Married
16	17	Female	a	>5	41	Female	City	Middle school	Married
17	18	Female	a	>5	47	Female	City	Middle school	Divorced
18	13	Male	a, d, f	2–5	34	Female	City	Middle school	Married

a, cutting; b, overdosing on medication; c, scratching; d, pinching; e, head banging; f, biting.

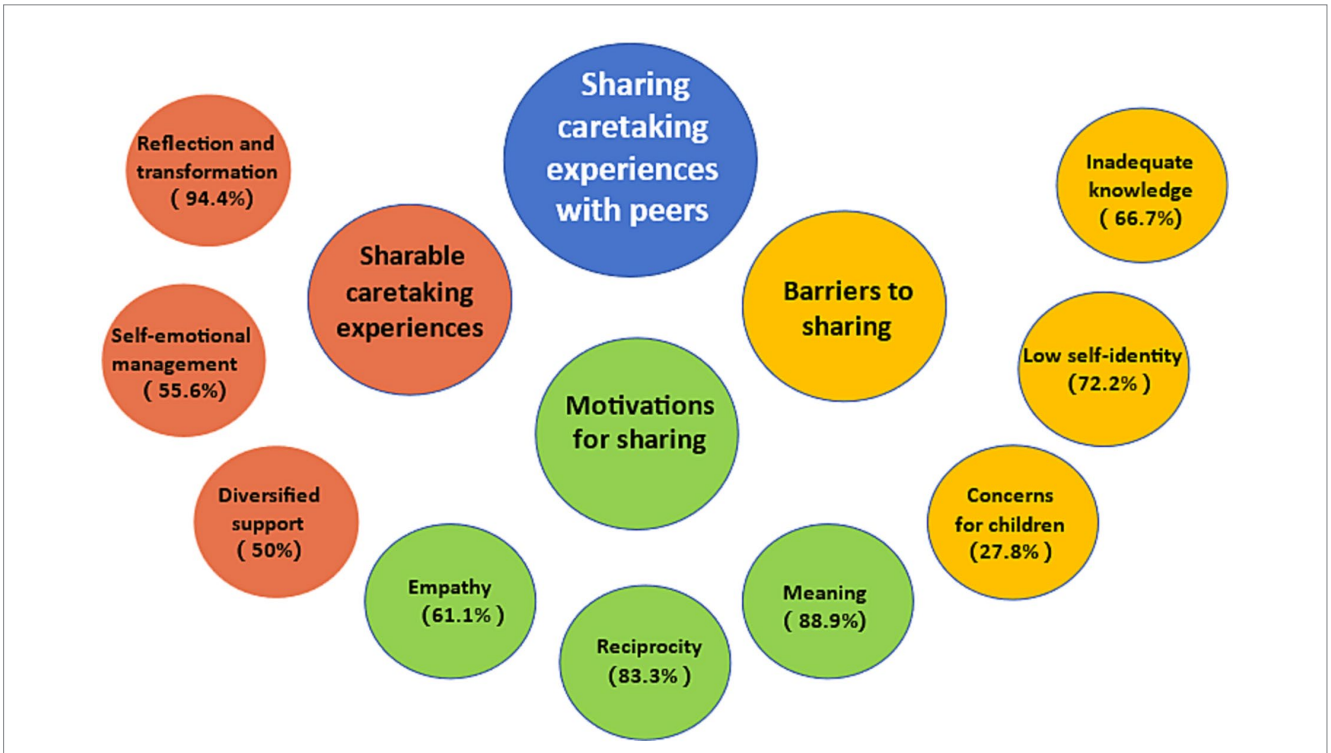

FIGURE 1
Thematic map for three major themes (middle circle) and nine subthemes (small circle).

> *"… These problems also prompted us to reflect on why our children injured themselves. The surface phenomenon of self-injury is not the most important, but the root cause.." (P13)*

> *"… Self-injury should be taken seriously from the first time. I think we should take more care of our children in all aspects and promptly discover the state of our children in any situation …"(P15)*

Many participants emphasized the importance of parents learning about NSSI and psychology.

> *"… I think we should learn something about NSSI, such as coping methods and ways to relieve children's negative emotions …" (P9)*

> *"… I used to communicate with her rudely. After I learned the relevant psychological knowledge, I realized that some of my previous methods ignored my child's feelings, which reflected a lack of parenting skills, so I think parents must learn something about it.." (P12)*

> *"… I think what we have to learn is how to communicate with adolescents and deal with NSSI …" (P2, P5, P15)*

Subtheme 2: self-emotional management

Most parents described negative emotions toward their adolescent who was self-injuring, including shock, anger, blame, and guilt. These reactions may worsen the situation. Therefore, some participants noted the need to manage their negative emotions.

> *"… Many parents may blame themselves when learning about their children's self-injury. But I want to advise parents not to blame themselves excessively in this situation because the more we blame, the harder it is for the child to get out." (P3)*

> *"… I used to lose my temper and lash out at my kids (crying), but I realized it was wrong. We have to control our emotions; only in this way can the children get better …" (P4)*

> *"… At that time, my emotions affected her and made her feel guilty, so she hurt herself again. Only when parents are stronger and control their emotions can children feel better …" (P14)*

Subtheme 3: diversified support

Many participants commented that it was impossible to help children with NSSI by relying only on themselves; the combined efforts of the whole family were required.

> *"… Indeed, the family atmosphere is very important; both parents and grandparents need to make progress. The whole family should support her …" (P6)*

Some participants explained that school had a great influence on children and that teachers' attitudes were crucial. Parents should maintain close contact with teachers and seek their support.

> *"… The influence of the school environment should not be ignored. I wanted to arouse the teachers' attention, so I exaggeratedly communicated with teachers …" (P2)*

> *"… I talked to teachers and explained that my child was sick and may hurt himself when he got upset, so I hoped teachers would pay more attention to his emotions rather than academic performance. He needed his teachers' support at this stage …" (P13)*

> *"… I told the teacher about the situation of the child's self-injury and asked her not to put too much pressure on my child …" (P17)*

When parents initially learned that their children had NSSI behaviors, many of them were reluctant to admit that their children were ill and refused to take them to a psychiatrist. They expressed regret for this behavior and suggested that other parents seek timely professional help.

> *"… It may have been two or three years since the first time my child hurt herself, but we did not notice. It was only when it got worse that we realized that we should take her to the hospital. So I suggest that other parents should bring their children to psychiatrists as soon as possible …" (P6)*

> *"… If I had brought my child to the doctor when she began to hurt herself, it would not have been as serious as it is now. I advise that parents ought to seek medical help as soon as possible when they find something wrong with their children …" (P10)*

Theme 2: motivations for sharing

Subtheme 1: empathy

Having experienced similar situations, many participants expressed empathy for the pain and helplessness of other parents of adolescents with NSSI.

> *"… Since my child was hospitalized recently, I have found that too many children have self-injury behaviors. It breaks my heart (frowning), and I wonder what I would do if I were the mother of this child …" (P1)*

> *"… Many parents were confused, and they did not know what to do, nor did I. I am willing to share my experience with other parents to prevent them from taking some detours …" (P2)*

> *"… Some parents just need the help of parents with similar experiences; otherwise, they do not understand their children's self-injury behaviors at all. It upsets me to see them in pain …" (P11)*

Some participants emphasized the importance of emotional communication, noting that sharing their caretaking experiences with peers could provide them with hope and emotional support.

> *"… In a course I attended before, there was a session in which parents with similar life experiences shared some experiences of caring for adolescents with self-injury. I was deeply inspired, and I saw hope in them. I think that parents in similar situations can encourage each other in this way …" (P4)*

> *"… Knowing the fact about my child's transition from severe self-injury to ceasing self-injury may increase their confidence …" (P16)*

Subtheme 2: reciprocity

Many participants expressed that sharing was a process of mutual learning that may encourage parents in similar situations to move forward together.

> *"… I think I learned a lot every time I communicated with other parents. Because each child and each family are different, the approach adopted may be different, and I can learn useful strategies from them …" (P1)*

> *"… In fact, this is a process of joint growth …" (P7, P17)*

Some participants admitted that they had significant deficits in dealing with their children's NSSI behaviors, and they hoped to receive advice from other parents.

> *"… I would like to share some changes in the way I get along with my child, and I am also glad that other parents can point out my deficiencies …" (P5)*

> *"… Sharing my experiences in caring for my child with other parents, I think that other parents can apply what I did well, and I also hope that they provide some suggestions on my shortcomings …" (P14)*

Furthermore, given the stigma associated with mental illness, parents of adolescents with NSSI are commonly self-isolated. Some of the participants mentioned that sharing caretaking experiences with peers effectively reduced their level of isolation.

> *"… Most parents are afraid to discuss this with parents of normal children, and they are frequently in isolation. Communication between parents of children exhibiting self-injury is necessary …" (P8)*

> *"… I think the form of sharing is very useful. At least, It makes parents feel like they're not alone. …" (P13)*

Subtheme 3: meaning

Many participants found it meaningful and rewarding to help peers by sharing their caretaking experiences, and they strongly endorsed the process of sharing.

> *"… If other parents benefit from my experience, it is a good thing …" (P8)*

> *"… It is positive, right, and meaningful; how can I not do it?" (P10)*

> *"… It would be great if I shared my experience with other parents and gave them some experience. It makes sense to help them …"(P15)*

Several participants considered this action fulfilling, as helping other parents may boost their sense of self-worth.

> *"… I am willing to share because doing that is very meaningful. Although I am a full-time mother, I also want to realize my value …" (P2)*

Some participants expressed hope that more people would recognize NSSI behaviors in adolescents through sharing, thereby drawing society's attention to the psychological problems of adolescents.

> *"… I just think there should be a person with such consciousness to arouse more attention from society and make some improvements …" (P1)*

> *"… Due to the lack of publicity and awareness of NSSI, most people have no understanding of these behaviors, including teachers. We want to share it so that more people recognize it and ultimately increase the government's and public's awareness of it …" (P8)*

Theme 3: barriers to sharing

Subtheme 1: inadequate knowledge

Many participants reported that their low educational level was the main factor that impeded their willingness to share caretaking experiences with peers.

> *"… I am not well educated, and I do not know what to share …" (P4, P12)*

> *"… My low level of education results in me having nothing to share …" (P16)*

Other participants believed that their understanding of NSSI was not sufficient for them to share their experiences and expressed concerns that they would not be able to share useful knowledge.

> *"… I think it is necessary to study systematically. Because what I learned may only scratch the surface, just some of my own experience …" (P4)*

> *"… I do not think I have anything to share because I am just rich in theoretical knowledge, which has not been applied to practice …" (P13)*

> *"… What I can share is my own experience, which is not professional. I am afraid I cannot say anything professional …" (P18)*

Subtheme 2: low self-identity

Many participants believed that they had failed after learning about their children's NSSI behaviors, and they expressed a lack of confidence in sharing their caretaking experiences with peers.

> *"… I think the main reason for my child's self-injury was that I put too much pressure on her and did not care about her. So I think I am a failure as a parent …" (P2)*

> *"… I feel like a failure, and I do not know what I can share with other parents …" (P7, P12)*

Some participants obtained relevant psychological knowledge but still felt helpless due to their children's uncooperation.

> *"… I have learned something about psychology, but now I have no clue because he is not willing to communicate with me (sighing). So I feel I have no experience to share …" (P3)*

> *"… I have learned about nonviolent communication with my child, but I think it does not work. He is so resistant that he does not talk to me at all …" (P13)*

Most participants expressed concerns about sharing their caretaking experiences with peers due to their limited communication skills.

> *"… The main reason is that I am not eloquent; if I am asked to share my experience with other parents formally, I think I may not be able to say anything …" (P8)*

> *"… I think my oral expression ability is poor, I am afraid I cannot say anything …" (P9, P16)*

Subtheme 3: concerns for children

Some participants reported that their children's attitudes had a strong influence on their willingness to share, and they worried that sharing their experiences may negatively impact their children.

> *"… The main thing is that my child is very sensitive. I am afraid that she will be angry if she finds out I'm sharing with other parents. …" (P10)*

> *"… She would not allow me to tell anyone about her condition, not even the doctor, let alone anyone else …" (P17)*

Discussion

To the best of our knowledge, this study is the first to investigate the perspectives of parents of adolescents with repeated NSSI on sharing their caretaking experiences with peers. We identified three themes: sharable caretaking experiences, motivations for sharing, and barriers to sharing. During their long-term care for adolescents with repeated NSSI, many parents accumulated a wealth of experience that they believed could be shared with their peers. These topics included reflection and transformation, self-emotional management, and diversified support. Most of them expressed great willingness to share with their peers due to their empathy for the difficulties and helplessness that other parents faced, and they believed that sharing was reciprocal and meaningful. However, there were some barriers to sharing, such as inadequate knowledge, low self-identity, and concerns for children.

In agreement with a previous study (44), the present study revealed that many parents develop significant caretaking experiences during the long-term care of adolescents with NSSI. Most parents initially viewed NSSI as a manifestation of rebellion in the context of puberty (39). They also perceived NSSI as a way for children to threaten their parents or achieve certain goals (22). As the symptoms aggravate gradually, many parents began to reflect on themselves. They also mentioned the importance of making changes and continuous learning (39). In addition, some parents claimed that paying too much attention to this behavior may aggravate children's guilt and blame (44). Parents also suggested to adjust their own negative emotions by participating in self-care activities, such as hobbies, mindfulness skills, spirituality techniques, and breathing exercises (38). Parents may benefit from diversified assistance, including formal resources and informal resources. On the one hand, parents may receive professional help to deal with the pressures and difficulties they face. On the other hand, parents may benefit from the support of friends, relatives, and peers to manage the impact of NSSI behaviors on their lives (37).

The majority of parents were willing to share their experiences of caring for adolescents with NSSI with peers. Considering the stigma related to mental disorders, they tended to be reluctant to seek psychological assistance for their child but sought a more general helping response from people close to them (22). Sharing has been reported to reduce the internalized stigma associated with mental illness and promote empowerment and hope (45) as well as a sense of belonging (46). In this study, many participants stated that sharing caretaking experiences with peers was meaningful because most parents struggle to understand or know how to react when their child self-injures (47). In previous studies, the importance of trust, respect, and empathy in this process was emphasized, and communication

between parents facing similar challenges served as a source of information and emotional support (47, 48). Furthermore, sharing was considered reciprocal; for peer providers, sharing helped them obtain valuable advice from other parents (34). Specifically, sharing was beneficial for improving mental illness management and general health and enhancing parents' emotional lives and self-awareness. Moreover, it helped parents reshape their sense of meaning, life perspective, and personal development as well as interpersonal relations (49).

Although most parents reported motivations and intentions to share their caring experiences with peers, there were several barriers. In agreement with Tang et al. (8) the majority of parents of adolescents with NSSI had low levels of education. Many parents stated that they had not heard of this behavior before their child hurt himself/herself for the first time. It was only after they realized the seriousness, they began to reflect and adapt (39). Consequently, they feared that they were not equipped with the abilities to appropriately support other parents. Consistent with Krysinska's research (38), many parents had a low sense of self-identity, and they considered themselves failures. This lack of confidence is considered to be the main obstacle for them to share with peers (50). In addition, given that many adolescents with NSSI refuse to disclose these behaviors to others (51), many parents fear that sharing information about their children without their consent may increase family conflict and thus lead to severe NSSI in adolescents. Parents' attitudes toward adolescents who self-injure can make a considerable difference in engagement and motivation (52). Given the evidence that psychoeducation can improve communication, increase knowledge, and change attitudes (47), providing parents with relevant psychoeducation may enhance their motivation to share.

Currently, psychotherapy is considered the main treatment for NSSI (53). However, a prior survey indicated that approximately 56.2% of adolescents with NSSI have not received formal psychiatric therapy (54). Additionally, there is a shortage of psychotherapists in China, and the distribution of psychotherapists is uneven (55). Therefore, making supplementary resources available to parents is essential. The interviews with parents of adolescents who repeatedly engaged in NSSI allowed us to summarize the key points of the caretaking experiences, which may equip concerned parents with appropriate knowledge by sharing. Furthermore, parents' motivations and barriers to sharing were explored. This study provides a basis for parents of adolescents with NSSI to seek additional resources and emotional support.

Limitations

Despite the promising results of this study, there are some limitations. First, our findings can only be generalized to a certain extent since the participants consisted of 16 mothers and 2 fathers, and their perceptions might reflect parents' views rather than the perspectives of a wider range of relatives. Second, because most adolescents were accompanied by their mothers while hospitalized, the majority of participants were mothers. Therefore, our findings might be more representative of mothers' views, which may create significant biases in the research results and generalizability. Third, all participants were parents of hospitalized patients. Interviewing parents of adolescents with NSSI who have not received any professional assistance would provide a more comprehensive understanding of parents' sharing of caretaking experiences with their peers. Future research should compensate for the shortcomings mentioned above.

Conclusion

The current study highlights the perspectives of parents of adolescents with repeated NSSI on sharing their caretaking experiences with peers as well as their motivations and barriers. In view of the general lack of NSSI knowledge among parents, psychoeducation is necessary to overcome barriers to sharing. It is suggested that professionals recruit experienced parents as volunteers to teach them theoretical knowledge and practical skills in the future. In this way, these parents will be capable of providing additional intellectual and emotional support to complement professional assistance, thereby increasing parents' access to assistance.

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 humans were approved by the Ethics Committee of Chengdu Fourth Hospital. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

DW was responsible for study design and quality control section. YQ and JL were responsible for data collection and analysis. JP and CL were responsible for recruiting and screening participants and revised the interview outline. YQ drafted the manuscript, DW revised the manuscript. All authors reviewed the manuscript and gave final approval of the version to be published.

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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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The association between domestic violence exposure and cyberbullying behavior among secondary school students

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Introduction: Cyberbullying could have a severe and long-term impact on the physical and mental health of secondary school students because of its characteristics of being hidden, repetitive, and exceeding the limitations of time and space, thus attracting widespread attention. Among the many environmental factors, family was the immediate environment where secondary school students live. Violent behaviors such as aggression displayed by other subjects in the family environment could trigger aggressive behaviors among secondary school students, and the indirectness of the online environment intensifies this tendency.

Methods: This study used the Cyberbullying Scale, the Domestic Violence Exposure Scale, the Depression Scale, and the Brief Self-Control Scale to conduct a questionnaire survey of 10,273 secondary school students in 12 secondary schools from Liaoning, Zhejiang, and Henan provinces in China to explore the relationship and internal mechanisms between domestic violence exposure and cyberbullying behavior among secondary school students.

Results: This study found that (1) domestic violence exposure has a significant positive associated with cyberbullying behavior among secondary school students; (2) the mediating effect of depression partially exists between domestic violence exposure and cyberbullying behavior among secondary school students; (3). self-control alleviated the effects of domestic violence exposure on cyberbullying among secondary school students but intensified the effects of depression on cyberbullying among secondary school students.

Discussion: The results suggest that while focusing on the association of domestic violence exposure with cyberbullying among secondary school students, it is also necessary to pay attention to the mediating effect of depression and the mitigating and intensifying mechanisms of self-control, resulting in a notable weakening effect on cyberbullying among secondary school students.

KEYWORDS

cyberbullying behavior, domestic violence exposure, depression, self-control, secondary school students

1 Introduction

The *51st Statistical Report on China's Internet Development* showed that as of December 2022, the number of Internet users in China reached 1.067 billion, and youths aged 10–19 accounted for 14.3% of Internet users (1). A UNICEF online survey showed that 24% of students aged 10–18 in China were subjected to cyberbullying, which has become a social and public health problem that requires great attention (2). Cyberbullying includes both the perpetrator and the victim, and this study focused on preventing and reducing cyberbullying from the perspective of the perpetrator. Cyberbullying refers to aggressive behavior by an individual or group of individuals who repeatedly convey hostile or offensive messages through electronic or digital media to cause harm or discomfort to others (3). Adolescents were socially connected to others through communication tools, and these tools became a new vehicle for bullying behavior.

Cyberbullying happens mainly through verbal and relational bullying, including harassment, defamation, impersonation, ostracization, and online spectating (4). The new existing forms made bullying ubiquitous, occurring at a high rate during adolescents' school, home, or travel. Bullies hidden behind communication tools could not perceive the direct reaction of the bullied, reducing the empathy generated by seeing the pain of the bullied and weakening the inhibitory effect on the infliction of pain, resulting in a greater tendency for bullying to occur. Studies showed that compared to physical bullying, cyberbullying could cause more severe and longer-lasting psychological trauma for the victim (5). Therefore, an in-depth discussion of the influencing factors of cyberbullying behavior was vital for preventing and reducing such deviant behaviors and enhancing students' psychological health.

Previous studies often had problems with small samples and limited quantity. The uniqueness of this study lay in the following: first, as a vast country, China had significant differences in the natural geographic environment, historical legacy, religious beliefs, regional dialects, and economic development of different regions, resulting in significant differences in cultural values, customs, and behaviors across different regions (6). The sample of this study covered three different provinces, namely, the northern part of the country (Liaoning Province), the central plains of the country (Henan Province), and the southern part of the country (Zhejiang Province), which ensured the geographic heterogeneity of the sample; second, the sample is scientifically selected by proportion for the number of secondary schools and students in each province, and the sample size was greater than 10,000, which made the research results more robust and credible; Finally, using integrated combinations of different variables could innovatively improve the effectiveness for explaining the models. The result could support and inspire more similar empirical studies in this field.

Violence exposure (VE) was the individual's exposure to information related to violence as a stimulus in their lives (7). Ecological system theory (EST) addressed that several behavioral systems would influence adolescent development. The family was a microsystem closely related to the individual (8). Scholars argued that negative factors in the family were significantly associated with adolescent aggressive behavior (9), especially domestic violence exposure (10–12). For secondary school students, the main pathways of exposure to domestic violence included witnessing and experiencing domestic violence firsthand. Witnessing violence was when an individual saw violence being committed or suffered by a family member (e.g., parental physical conflict), and experiencing violence was when an individual is personally victimized by violence (e.g., physical abuse) (13).

According to social learning theory, adolescents learn parental or adult behaviors through observation and imitation (14). Adolescents who had witnessed or experienced domestic violence tended to view violence as an acceptable approach to resolving interpersonal conflicts and internalize this as a stable personality trait, increasing the likelihood that they would engage in bullying behaviors in the future (15, 16). A meta-analytic study showed that exposure to domestic violence significantly impacted both emotional and behavioral problems in adolescents (17), and witnessing inter-parental violence was more significant than witnessing other forms of destructive conflict (18, 19).

In addition, a family-tracking study found that among multiple interpersonal violence exposures, aggression between parents and parents toward their children significantly increased adolescents' internalizing (e.g., depression) and externalizing (e.g., bullying behavior) problems (20).

Based on this, this study proposed H1:

> H1: Domestic violence exposure is significantly associated with cyberbullying behavior among secondary school students.

Depression was a negative emotional response. According to the general strain theory, a bad external environment can trigger psychological stress in an individual, which in turn could cause the individual to restore a balanced psychological state by committing cyberbullying behaviors (19). A domestic violence background was a potential risk factor for mental health problems such as depression in adolescents (21). Growing up in a domestic violence environment could cause adolescents to subjectively develop negative emotions such as a sense of pain and despair. The repeated stimulation of violent cues dragged adolescents under a tremendous psychological burden, which would develop and accumulate a large amount of depression (22, 23) and may initiate bullying behavior during online social interactions to release or alleviate psychological stress. Empirical studies have shown that adolescents exposed to violent cues have significantly higher levels of depression than normal individuals (24), and those who reported high levels of depressive symptoms tended to have difficulties in suppressing impulsive behaviors and obtaining effective emotion adjustment strategies (25). Thus, depressive symptoms have a significant effect on cyberbullying behavior (26, 27). Accordingly, this study proposes H2.

> H2: The mediating effect of depression exists between domestic violence exposure and cyberbullying behavior among secondary school students.

Self-control signified an individual's ability to consciously control impulsive behavior to resist satisfying immediate needs and desires to obtain long-term benefits (28). According to the dual-system model, both the impulsive and reflective systems influence an individual's behavior in response to stimuli when facing external lures (29). Specifically, individuals with high levels of aggression would generate aggressive impulses due to cognitive preferences when exposed to violent stimuli.

However, external personal criteria (reflective system) would limit the aggressive impulses, and self-control would then play a corresponding role in the conflict process of the dual systems. Individuals with high self-control were more likely to be influenced by external personal criteria, self-regulating negative emotions, reinforcing delayed gratification, and trying to avoid behaviors detrimental to their self-interest. Individuals with low self-control were more affected by internal impulses, experiencing cognitive biases, impaired emotion regulation, and accumulated negative emotions, which in turn triggered aggressive behaviors (30). Therefore, due to the "reflective" role of personal criteria, adolescents with a high level of self-control tended to proactively inhibit the triggering process of cyberbullying behavior by violent stimuli and vice versa. This study proposes H3:

> H3a: Self-control moderates the association of domestic violence exposure and cyberbullying behavior among secondary school students.
>
> H3b: Self-control moderates the association of domestic violence exposure and depression among secondary school students.
>
> H3c: Self-control moderates the association of depression and cyberbullying behavior among secondary school students.

All hypothesized routes for this study can be found in Figure 1.

2 Method

2.1 Participants

In this study, screening criteria were established based on the level of economic development, geographic location, demographic characteristics, the number of secondary schools, and the number of enrolled students, respectively. Liaoning, Henan, and Zhejiang Provinces were selected as the sampling sites for secondary school studenrs, ranging from middle school to high school, i.e., grades 7 to 12. Based on the principle of purposive stratified cluster sampling and the proportion of the number of secondary schools and students in the three provinces (approximately 1:2:3), two secondary schools in Liaoning Province, four secondary schools in Zhejiang Province, and six secondary schools in Henan Province were ultimately selected as the sampling schools for this study. The questionnaire for this study was approved by the Ethics Committee of the People's Public Security University of China, and a confidentiality and ethics statement was provided at the top of the questionnaire with the notification informing that submitted questionnaires indicated the voluntary consent of the participants.

The questionnaires were distributed through class-based self-organized social media groups via online links (URLs) to "Wen Juan Xing (lit. Questionnaire Star, www.wjx.cn)" or in paper form during free study hours at school under the researcher's on-site guidance. As a result, a total of 10,640 questionnaires were collected from 12 secondary schools, and after excluding invalid questionnaires, 10,273 valid questionnaires were retained, with a completion rate of 96.6%. Of the valid samples, 1883 were from Liaoning Province, 5,125 from Henan Province, and 3,265 from Zhejiang Province.

2.2 Measures

2.2.1 Cyberbullying scale

The Cyberbullying Scale was from the Cyberbullying Subscale in the Bullying Scale for secondary school Students developed by Olweus (31), edited by Ji, YanTing (32). The questionnaire consisted of five items. It includes five types of cyberbullying behaviors, including text intimidation, public texting, kicking out of group chats, spreading rumors, and verbally abusing others online. The scale was a 5-point scale (1 = did not occur, 2 = occurred once or twice, 3 = two or three times a month, 4 = once a week, 5 = several times a week), and a higher score indicated that an individual was committing cyberbullying to a more severe degree. The Cronbach's α coefficient for this scale in this study was 0.957.

2.2.2 The domestic violence exposure scale

The Domestic Violence Exposure Scale (DVES) from the Multiple Forms of Violence Scale (MFVS) developed by Ho et al. (7) was used, which was divided into two dimensions: exposure to witnessing violence and exposure to experiencing violence. The questionnaire consists of 16 items and is based on a five-point scale (1 = never, 2 = once, 3 = several times, 4 = multiple times, and 5 = every day), with

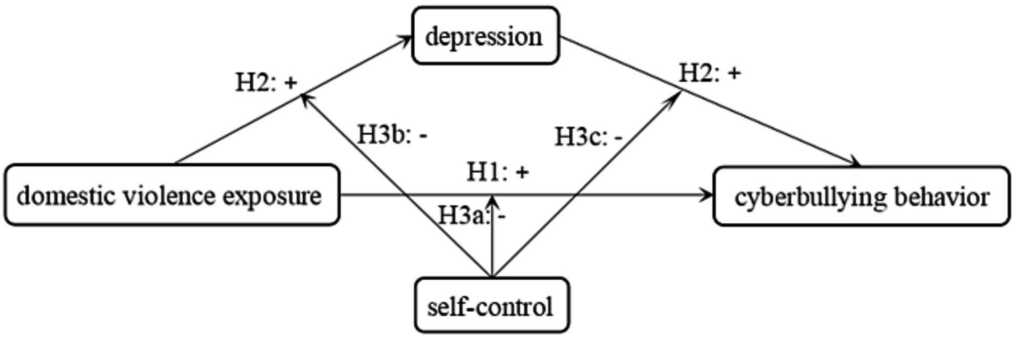

FIGURE 1
Hypothesis map.

higher scores indicating that the individual has been exposed to violent situations to a greater extent in their lives. The Cronbach's α coefficient for this scale in this study was 0.930.

2.2.3 The depression scale

The *Depression Scale* (DS) developed by Radloff and revised by Chen, Zhiyan et al. was used in the Chinese version of Radloff's *The Center for Epidemiological Studies Depression Scale (CES-D)* (33). The questionnaire consists of eight items and is scored on a five-point Likert scale (from 1 = strongly disagree to 5 = strongly agree), with higher scores indicating higher levels of depression in individuals. The Cronbach's α coefficient for this scale in this study was 0.954.

2.2.4 The brief self-control scale

The *Brief Self-Control Scale* (*BSCS*) (34) developed by Morean (35) and revised by Luo, Tao et al. was used, which consists of 7 items and includes two dimensions: Self-Discipline and Impulse Control. The scale was scored on a 5-point Likert scale (1 = not at all to 5 = fully match), with items 2, 4, 6, and 7 being reverse-scored questions. The total sum score is calculated for all items, with higher scores indicating a higher level of individual self-control. The Cronbach's α coefficient for this scale in this study was 0.803.

2.3 Data analysis

Reliability tests, common method bias tests, descriptive statistics, and Pearson's correlation analyses were performed using the SPSS 26.0 software. Mediation and moderation were examined using Model 59 in the Process 3.3 plug-in of the SPSS 26.0 software and the Johnson-Neyman method (J-N method).

2.4 Common method bias test

In this study, common method bias was procedurally controlled by taking measures such as anonymous surveys and reverse scoring of some items. The collected data were examined for common method bias using the Harman one-factor test, and the results of the unrotated exploratory factor analysis extracted a total of seven factors with an eigenroot greater than 1, with a maximum factor variance explained rate of 27.89% (less than 40%) (36). Therefore, the approach of the questionnaire used in this study does not have a serious problem of common method bias.

3 Result

3.1 Descriptive statistics analysis

In total, 10,273 (5,352 were male, 4,921 were females) usable responses were obtained. The average age of the participants was 14.96 years (SD = 1.86 years). Table 1 shows the demographic characteristics of the sample. In addition, the average scores of text intimidation, public texting, kicking out of group chats, spreading rumors, and verbally abusing others online reported by the participants in the last three months were 1.04, 1.05, 1.07, 1.04, and 1.06, respectively.

3.2 Correlation analyses

Correlation analyses were conducted for cyberbullying, domestic violence exposure, depression, and self-control, and the correlation matrix for each variable was shown in Table 2.

The results showed that cyberbullying behavior was positively correlated with domestic violence exposure and depression and negatively correlated with self-control; violence exposure was positively correlated with depression and negatively correlated with self-control, and depression was negatively correlated with self-control.

3.3 Moderated mediation effects test

First, by controlling the seven demographic variables, namely gender, grade, family income, family residency, only child status, left-behind children status, and parent's divorce status, Model 59 was used to examine the direct effects of domestic violence exposure on cyberbullying, the mediating role of depression between domestic violence exposure and cyberbullying, and the moderating role of self-control on both the direct and indirect pathways, where the scores substituted into the model for the calculations were the average scores for each variable.

Results of bias-corrected thousandths Bootstrap Analyses showed (Table 3) that domestic violence exposure scores were positively associated with cyberbullying scores ($\beta = 0.20$, $p < 0.001$), **H1 was supported**; there was a positive association between domestic violence exposure exposure scores and depressed mood scores ($\beta = 0.25$, $p < 0.001$) and a positive association between depressed mood scores and cyberbullying scores ($\beta = 0.06$, $p < 0.001$), thus, depression partially mediated the relationship between domestic violence exposure and cyberbullying scores and **H2 was supported**; The coefficient of the interaction term between domestic violence exposure scores and self-control scores was negatively associated with cyberbullying scores ($\beta = -0.09$, $p < 0.001$), suggesting that self-control buffers the effects of domestic violence exposure on cyberbullying, and **H3a was supported**; The relationship between the coefficient of the interaction term between domestic violence exposure scores and self-control scores and depression scores was not significant, and **H3b was not supported**; There was a positive association between the coefficient of the interaction term between the depression score and the self-control score and the cyberbullying score ($\beta = 0.03$, $p < 0.001$), suggesting that self-control intensified the effect of depression on cyberbullying, **H3c was rejected**.

Finally, the visualization of the moderating effect of the J-N method was conducted. The effect plot of self-control moderating the relationship between exposure to domestic violence and cyberbullying is shown in Figure 2. When the value of self-control was taken to be less than 1.64, the confidence interval did not contain 0. The moderating effect was statistically significant, and the positive correlation between secondary school students' perceived level of exposure to domestic violence and cyberbullying weakened with the increase in the level of self-control. The effect plot of self-control moderating the relationship between depression and cyberbullying is shown in Figure 3. When the value of self-control was taken to be greater than −1.11, the confidence interval did not contain 0. The moderating effect was statistically significant. The positive correlation between the level of depression and

TABLE 1 Frequency statistics of demographic variables in the sample ($N = 10,273$).

Variables		Frequency	Percentage	*M*	*SD*
Sex	Male	5,352	52.10%	0.48	0.50
	Female	4,921	47.90%		
Grade	7 grade	1972	19.20%	3.39	1.71
	8 grade	1800	17.50%		
	9 grade	1,378	13.40%		
	10 grade	1896	18.50%		
	11 grade	1823	17.70%		
	12 grade	1,404	13.70%		
Family income/monthly	Less than 1,000 Yuan	1,032	10.00%	3.99	1.70
	1,000 Yuan – Less than 2000 Yuan	1,359	13.20%		
	2000 Yuan – Less than 3,000 Yuan	1708	16.60%		
	3,000 Yuan – Less than 4,000 Yuan	1803	17.60%		
	4,000 Yuan – Less than 5,000 Yuan	1,368	13.30%		
	5,001 Yuan and above	3,003	29.20%		
Household registration	Rural	3,577	34.80%	0.65	0.48
	Urban	6,696	65.20%		
Only child	Yes	7,903	76.90%	0.23	0.42
	No	2,370	23.10%		
Left-behind child	Yes	3,583	65.10%	0.35	0.48
	No	6,690	34.90%		
Parental divorce	Yes	725	92.90%	0.07	0.26
	No	9,548	7.10%		

"Less than" in this table does not include the number, "and above" includes the number.

TABLE 2 Pearson's correlation between variables.

Variable	1	2	3	4
1.Cyberbullying behavior	1			
2.Domestic violence exposure	0.266***	1		
3.Depression	0.131***	0.310***	1	
4.Self-Control	−0.087***	−0.146***	−0.405***	1

***$p < 0.001$.

cyberbullying among secondary school students increased with the level of self-control.

4 Discussion

Previous studies on domestic violence exposure and bullying have focused on physical bullying behavior (37, 38), yet cyberbullying, as an extension of bullying phenomena in the online world, also deserves special attention. This study completes the expansion of the established empirical findings by exploring the relation of domestic violence exposure and cyberbullying behavior, the mediating effect of depression between domestic violence exposure and cyberbullying, and the moderating effect of self-control.

This study found that domestic violence exposure is positively associated with cyberbullying behavior among secondary school students. The results are consistent with the findings of previous studies (10–12) and support the idea of social learning theory. Violence in a family setting usually manifests in physical conflict between intimate partners or physical abuse to the adolescents themselves. It provides adolescents with behavioral patterns to observe and learn from. Adolescents who are repeatedly exposed to violent situations subconsciously develop learning and internalization of aggressive knowledge structures by observing the behavior of role models during violent events, which activates and reinforces the individual's aggression schema and will increase the likelihood of using violence in real life and online life. Ultimately, the individual acquires aggressive beliefs and patterns of aggressive behavior and gradually develops aggressive personality traits.

Stimulating violent messages at home also leads to the rupture of the parent–child bond, weakening the individual's internal desire to suppress anger and aggression. In real life, attacking others is considered immoral, and the Internet provides a "cover" for this with its nature of being anonymous and exceeding the limitations of time and space. As a result, adolescents growing up during the Internet age are more likely to use cyberbullying in the virtual space to resolve interpersonal conflicts. The results suggest that family members should manage their own emotions and behaviors well to avoid all kinds of psychological and physical harm caused by violent attitudes and behaviors to their children.

The test of depression's mediating role indicated that it partially mediated the relationship between domestic violence exposure and

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TABLE 3 Result of moderated mediation model test.

Variable	Outcome variable: depression			Outcome variable: cyberbullying		
	β value	*t* value	95% CI	*β* value	*t* value	95% CI
Sex	−0.27***	−15.58	−0.31 ~ −0.24	0.13***	6.94	0.10 ~ 0.17
Grade	0.01	0.01	−0.01 ~ 0.01	0.01	1.50	−0.01 ~ 0.02
Family income	−0.01	−1.07	−0.02 ~ −0.01	−0.01	−0.54	−0.02 ~ 0.01
Household registration	−0.01	−0.46	−0.05 ~ 0.03	0.01	0.60	−0.03 ~ 0.06
Only child status	0.04	1.55	−0.01 ~ 0.08	0.01	0.55	−0.04 ~ 0.06
Left-behind child status	0.03	1.58	−0.01-0.07	0.01	0.18	−0.04 ~ 0.05
Parental marital status	0.12**	3.38	0.05 ~ 0.19	0.01	0.25	−0.06 ~ 0.08
Family violence exposure	0.25***	23.36	0.23 ~ 0.27	0.20***	16.74	0.18 ~ 0.23
Self-control	−0.34***	−37.81	−0.36 ~ −0.32	−0.04**	−3.41	−0.06 ~ −0.02
Domestic violence exposure*self-control	0.01	0.17	−0.02 ~ 0.02	−0.09***	−6.54	−0.11 ~ −0.06
Depression				0.06***	5.01	0.04 ~ 0.08
Depression*self-control				0.03**	2.68	0.01 ~ 0.05
R^{Square}	0.22			0.08		
F	293.28***			76.80***		

*$p < 0.05$. **$p < 0.01$.***$p < 0.001$.

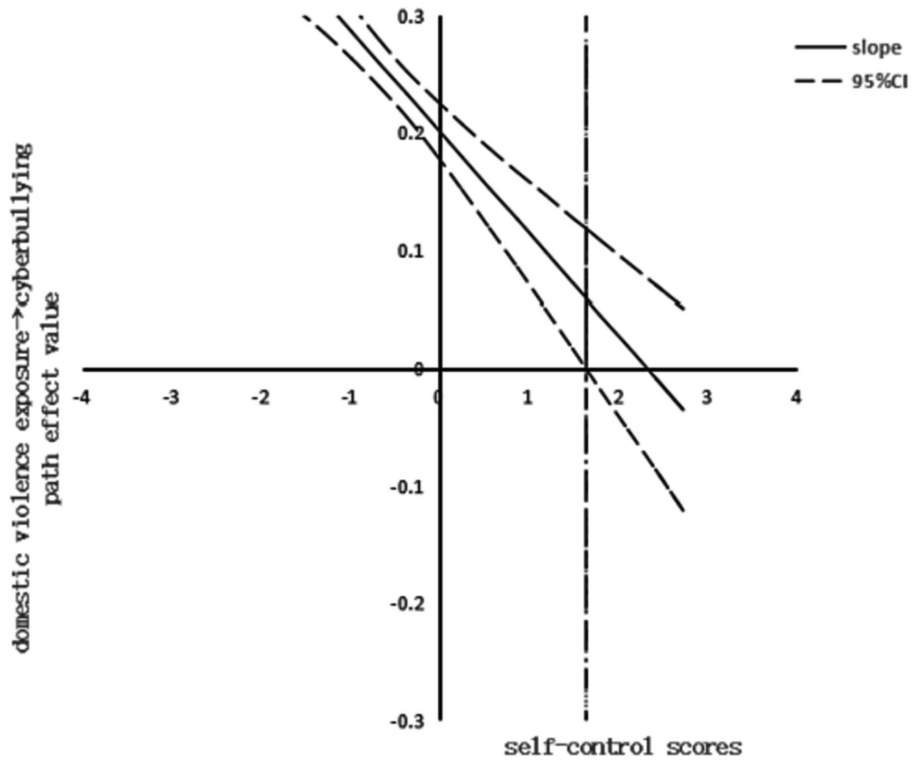

FIGURE 2
The moderating effect of self-control between domestic violence exposure and cyberbullying.

cyberbullying among secondary school students. Domestic violence exposure can either directly affect cyberbullying among secondary school students or indirectly affect cyberbullying among secondary school students through depression. At the same time, this finding validates the general strain theory that stress reinforces aggressive behavior in individual adolescents by increasing negative emotional experiences (e.g., depression) (39).

Specifically, exposure to long-term violence at home creates negative stimuli for adolescents. Adolescents are exposed to such "harmful" stressful situations and cannot legitimately disengage from

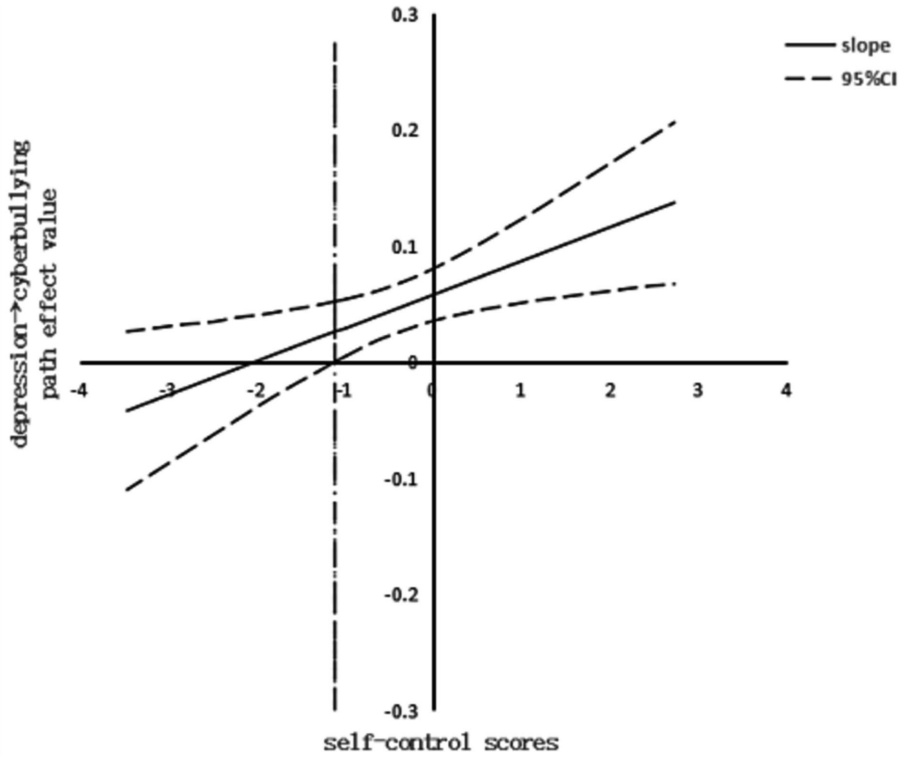

FIGURE 3
The moderating effect of self-control between depression and cyberbullying.

them in the same way as adults are. They are susceptible to developing depressive symptoms such as distress, hopelessness, and negative perceptions of self and the world, which in turn reduces the ability to regulate emotions and can lead to cyberbullying.

The study found that self-control significantly moderated the relationship between domestic violence exposure and cyberbullying among secondary school students. This predictive effect was stronger at low levels of self-control. This finding supports the dual-systems model that suggests violent cues witnessed and experienced by secondary school students at home serve as accelerating "catalysts" for cyberbullying behavior. The self-control system enhances or weakens this catalytic process. The results suggest that parents and teachers should pay attention to their children's emotion condition and channel negative emotions in time to avoid serious psychological and behavioral problems.

The self-control system, on the other hand, enhances or weakly regulates this catalytic process (40) secondary school students with high self-control will fully utilize their cognitive resources to assess the appropriateness and risk of cyberbullying behavior during the process of using the Internet. His internalized moral beliefs, social customs, and other reflective systems will make rational assessments, and even if they are repeatedly exposed to violent cues, they will limit their aggressive impulses. In other words, high levels of self-control alleviate the catalytic effect of domestic violence exposure on cyberbullying.

On the contrary, when secondary school students with low levels of self-control use the Internet, their cognitive resources are under-called, their egos are more depleted, they tend to seek stimulation and risky behaviors without considering the long-term consequences of their behaviors, and they are susceptible to cognitive impulses. Instead, they are unable to assess risks rationally, so they are less likely to consider more profound moral beliefs and tend to fail in self-control, which can lead to committing bullying behaviors in cyberspace, thus exacerbating the catalytic effect of exposure to domestic violence on cyberbullying among secondary school students.

However, the moderating effect of self-control on the relationship between domestic violence exposure and depression among secondary school students is not significant. On the one hand, it may be due to the strong and stable psychological trauma caused by witnessing or experiencing domestic violence stimuli (41). On the other hand, the self-control of middle school students is not complete enough to develop the power to resist the generation of depression caused by domestic violence (42), and the strong impact of domestic violence exposure and the weak self-control resulted in the moderating effect failing to show statistical significance.

It is worth noting that the moderating effect of self-control on the relationship between depression and cyberbullying among secondary school students was contrary to the hypothesis, i.e., self-control would exacerbate the effect of depression on cyberbullying. This effect was not difficult to understand in the context of Chinese culture, which is traditionally based on Confucianism and has developed a strong introverted national character. Adolescents with a high level of self-control are more inclined to suppress the expression of negative emotions (43), and are more likely to accumulate large amounts of depression. When depression reached the threshold, secondary school students who were under great pressure to go to higher education were more likely to develop aggressive behaviors if they did not receive effective social support (prolonged exposure to domestic violence stimuli weakens perceptions of family support) (44). The anonymous

environment of the Internet contained a disinhibition effect, which made adolescents tend to show high moral excuses and low guilt, and it was easier for them to distort the consequences of their own immoral behaviors and adjust the attribution to excuse and defend themselves. Therefore, it could be a coping strategy for adolescents with a high level of self-control to resolve their depression. The results suggest focusing on different mechanisms of self-control in order to better prevent cyberbullying behaviors among secondary school students.

5 Research limitation

This study has several limitations. First, the self-report method used in this study to measure cyberbullying may have underestimated the occurrence of bullying, and future research could integrate a variety of measures such as peer, parent, or teacher ratings. Second, given the cross-sectional nature of the study, we were able to capture the influence of self-control on the contemporaneous effects of their regulation. However, the long-term effects of perceived domestic violence on cyberbullying are still unknown, and future research could examine the study results using a longitudinal follow-up design. Finally, due to the limited length of the questionnaire, we were not able to cover other vital characteristics of the respondents, such as other psychological and physiological differences among individuals, and we may not have been able to observe other confounders affecting cyberbullying. Future studies could be more well-developed by adding more information or in-depth interviews.

6 Conclusion

This study obtained the following conclusions:

(1) Domestic violence exposure has a significant positive associated with cyberbullying behavior among secondary school students, i.e., the higher the perceived domestic violence exposure of secondary school students, the more likely cyberbullying is to occur;
(2) The mediating effect of depression partially exists between domestic violence exposure and cyberbullying behavior among secondary school students, i.e., the higher the perceived domestic violence exposure of secondary school students, the stronger the depressed mood, and the more likely cyberbullying would occur; and
(3) Self-control alleviated the effects of domestic violence exposure on cyberbullying among secondary school students but intensified the effects of depression on cyberbullying among secondary school students.

Data availability statement

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

Author contributions

DC: Writing – original draft. BX: Writing – review & editing. JC: Writing – review & editing.

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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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Marijuana use and its correlates among school-going Jamaican adolescents: a finding from a national survey

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Introduction: The recent data indicate almost a fifth of Jamaican adolescents used marijuana in the past 30 days. To ensure the optimal allocation of resources, a country-specific understanding of factors associated with marijuana use among adolescents is essential. Therefore, this study aimed to address this gap among adolescents aged 13–17 years in Jamaica.

Methods: We analyzed data from the recent Jamaica Global School-Based Student Health Survey conducted in 2017. The sample consists of school-going Jamaican adolescents of 7th–12th grades. The prevalence of recent marijuana use was assessed and compared across different demographics, substance use, and risk behaviors using bivariate and multivariable logistic regression analyses.

Results: Older adolescents and men had a higher likelihood of recent marijuana use. Psychosocial risks, such as loneliness, frequent worry, suicidal ideation, physical attacks, and school absenteeism, were associated with higher marijuana usage. Parental smoking increased the odds, whereas strong parental support and awareness decreased it. Other substance uses, especially amphetamine and tobacco products, had strong associations with marijuana use. Early initiation of substances was associated with a higher risk of marijuana use. Sexually active adolescents, especially those initiated before the age of 14 years, had higher rates of marijuana use.

Conclusion: The intricate link between harmful and supportive psychosomatic and risk behaviors with recent marijuana use highlights the importance of holistic interventions and policies focusing on emotional health, parental guidance, substance education, and sexual activity implications.

KEYWORDS

cannabis, marijuana, Jamaica, adolescents, substance use, risky behaviors

Introduction

Cannabis, commonly known as marijuana, holds a prominent position in the cultural and socioeconomic fabric of Jamaica. Historically rooted in the practices of the Rastafarian movement, its use has expanded beyond religious rituals to become a part of recreational activities among various age groups, particularly adolescents (1). With the increasing discussions surrounding the potential benefits and harms of cannabis use, understanding its prevalence and the factors associated with its consumption becomes particularly critical. Adolescence, marked by the age group of 13–17 years, is a crucial developmental phase characterized by physical, psychological, and social changes (2). During this period, the propensity for risky behaviors, including substance use, tends to rise due to a combination of curiosity, peer pressure, and brain development processes (3).

The Global School-based Student Health Survey (GSHS), a collaborative surveillance project designed to help countries to measure and assess behavioral risk factors and protective factors among students, has been pivotal in shedding light on such behaviors in various countries, including Jamaica (4). Given unique sociocultural context of Jamaica and its historically complex relationship with cannabis, understanding the landscape of cannabis use among its adolescents is essential [3]. The 2017 GSHS report reveals that nearly one in five Jamaican adolescents aged 13–17 years has used marijuana minimum once in their lives. This prevalence is more pronounced among older adolescents and is almost twice as high among men compared with their female counterparts (5).

To ensure the optimal allocation of resources for prevention and treatment, a country-specific understanding of the correlated demographic, substance use, and risk behaviors with marijuana use among adolescents is essential. Therefore, this study aimed to address the correlates of cannabis use among adolescents aged 13–17 years in Jamaica using secondary data from the GSHS 2017. The findings could also provide policymakers, educators, and health professionals with insights into the local dynamics of cannabis consumption, aiding in the formulation of targeted interventions and policies. By shedding light on this critical issue, the study aimed to contribute to the broader dialogue surrounding adolescent health and wellbeing in the Caribbean region.

Methods

Study setting

This study entails secondary data analysis using data from the 2017 Jamaica Global School-based Student Health Survey (GSHS). The Jamaica Global School-based Student Health Survey (GSHS) is a nationally representative sample survey of students in secondary schools. It is conducted in collaboration with the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). The survey focuses on various health-related behaviors and protective factors among students, such as dietary behaviors, hygiene, physical activity, mental health, and the use of substances such as tobacco and alcohol.

Participants

The 2017 Jamaica Global School-Based Student Health Survey employed a two-stage cluster sample design. This method was chosen to yield data that would be representative of all students of grades 7th−12th in Jamaica. The use of a two-stage cluster sampling design ensures that the sample accurately reflects the characteristics of the target population, i.e., students in the specified grades in Jamaica. The school response rate was 84%, the student response rate was 71%, and the overall response rate was 60%. A weighting factor was applied to each student record to adjust for non-response and varying selection probabilities, and more details about the weighting factor calculation are provided in the GSHS Data User's Guide (6).

Data collection

During a regular class session, students were given the standard GSHS questionnaire, including questions about demographics (age, sex, and grade), anthropometric characteristics (weight and height), dietary habits, personal and oral hygiene, mental health, violence and unintentional injuries, bullying, substance use (tobacco, alcohol, and illegal drugs), sexual and reproductive health, parental support, and physical activity. Before conducting the survey, students were briefed on its contents, ensured their confidentiality, and made aware that their participation was entirely voluntary.

Outcome variables

Recent marijuana use was assessed by the question, "During the past 30 days, how many times have you used marijuana (also called ganja or weed)?," and the answers were coded as binary variable (yes = 1; no = 0).

Explanatory variables

Demographic variables

Age (11–18 years), sex (male or female), and grades (7–12) are the demographic variables.

Psychosocial risks and protective factors

Felt lonely was assessed by the question, "During the past 12 months, how often have you felt lonely?," and the answers were coded as 1 (never/rarely), 2 (sometimes), 3 (most of the time), and 4 (always). Felt worried was assessed by the question, "During the past 12 months, how often have you been so worried about something that you could not sleep at night?," and the answers were coded as 1 (no), 2 (1 time), and 3 (≥ 2 times). Suicide ideation was assessed by the question, "During the past 12 months, have you ever seriously considered attempting suicide?," and the answers were coded as binary variable (yes = 1; no = 0). Suicide attempt was assessed by the question, "During the past 12 months, how many times did you actually attempt suicide?," and the answers were coded as binary variable (yes = 1; no = 0). Physically attacked was assessed by the question, "During the past 12 months, how many times were you physically attacked?," and the answers were coded as 0 (no) and 1 (yes). Bullying history was assessed by the question, 'During the past 30 days, how many days were you bullied?', and the answers were coded as binary variable (yes = 1; no = 0). Missed school was assessed by the question, "During the past 30 days, how many days did you miss classes or school without permission?," and the answers were coded as 1 (no), 2 (1–2 days), and 3 (≥ 3 days). Parental smoking was assessed by the question, "Which of your parents or guardians use any form of tobacco?," and the answers were coded as binary variable (yes = 1; no = 0). Parental support was assessed by the question, "During the past 30 days, how often did your parents or guardians understand your problems and worries?," and the answers were coded as 1 (never/rarely), 2 (sometimes), 3 (most of the time), and 4 (always).

Parental awareness was assessed by the question, "During the past 30 days, how often did your parents or guardians really know what you were doing with your free time?," and the answers were coded as 1 (never/rarely), 2 (sometimes), 3 (most of the time), and 4 (always).

Substance use variables

Ever amphetamine use was coded as 0 (no) and 1 (yes). Age at drug/cigarette/alcohol, as previous studies emphasized ages <14 as a time of heightened vulnerability for mental issues (7, 8), this variable was coded as 0 (<14) and 1 (≥14). The current use of cigarette/other tobacco products/alcohol drinking was coded as 0 (no) and 1 (yes). Got drunk/troubled drunk was assessed by the questions, "During your life, how many times did you drink so much alcohol that you were really drunk?" and "During your life, how many times have you got into trouble with your family or friends, missed school, or got into fights, as a result of drinking alcohol?," and the answers were coded as 0 (no) and 1 (yes).

Risky sex behaviors

Ever had sex was coded as 0 (no) and 1 (yes). Age at first sex was coded 0 (<14) and 1 (≥14). Sexual partnership was assessed by the question, "During your life, with how many people have you had sexual intercourse?," and the answers were coded as binary variable (yes = 1; no = 0). Condom use in the last sex was also coded as 0 (no) and 1 (yes).

Statistical analysis

The descriptive statistics were employed to describe the distribution of sample demography, psychosocial risks and protective factors, substance use, and risky sex behaviors, and corresponding prevalence of recent marijuana use among Jamaican adolescents of grades 7–12. Logistic regression analysis was used to examine the likelihood of recent marijuana use across the explanatory variables, accounting for age and sex, and the results were reported as adjusted odds ratios (AOR) and 95% confidence intervals (95% CIs). This approach allowed for the estimation of the independent effects of the study variables on recent marijuana use, regardless of the potential confounding effects of age and sex (9), therefore allowing for targeted school-based interventions and preventive strategies for all students in grades 7–12 while providing valuable policy insight (10). Sampling design and weights were applied by defining the survey strata, primary sampling unit, and weight using STATA 17. The statistical significance level was set at $p < 0.05$.

Results

The associated demographic factors with marijuana use

Table 1 provides an overview of the characteristics and their association with recent marijuana use. Adolescents who were older than 14 years had a prevalence rate of 15.06% for marijuana use, which was significantly higher than their counterparts (8.00%). The odds of using marijuana for those older than 14 years were more than twice as high as for those aged 14 years and younger. Male adolescents exhibited a prevalence rate (16.78%) of marijuana use compared with female counterparts (9.18%). The odds of men using marijuana were double that of women.

TABLE 1 Demographic characteristics and their association with marijuana use among Jamaican adolescents in 7th–12th grades.

Variable	Recent marijuana use		
	N (weighted %)	N (weighted %)	OR (95%CI)
Age group			
≤14	628 (31.36)	49 (8.00)	Ref
>14	1,031 (68.64)	146 (15.06)	2.04 (1.21–3.42)*
Sex			
Male	755 (49.15)	111 (16.78)	2.00 (1.48–2.69)*
Female	900 (50.85)	83 (9.18)	Ref
Grade			
7th	41 (2.11)	3 (9.18)	Ref
8th	412 (22.07)	33 (8.31)	0.90 (0.28–2.88)
9th	557 (25.34)	66 (13.57)	1.55 (0.59–4.09)
10th	388 (23.99)	67 (17.64)	2.12 (0.88–5.12)
11th	208 (21.97)	22 (13.02)	1.47 (0.54–4.07)
12th	44 (4.51)	3 (6.34)	0.67

*p-value < 0.05.

The associated psychosocial risks and protective factors with marijuana use

Table 2 presents the association of psychosocial risks and protective factors with recent marijuana use. Adolescents who reported always feeling lonely had more than two-fold higher odds of marijuana use as compared with those who never or rarely felt lonely. Adolescents feeling worried most of the time were more likely to report marijuana use in comparison with their counterparts who never or rarely felt worried. The odds of recent marijuana use were approximately 2 and 2.5 times higher among adolescents with suicidal ideation and attempt, respectively, as compared with their counterparts. Adolescents who had been physically attacked in the last 12 months had 83% increased odds of using marijuana when compared with those who had not been attacked. Adolescents who missed school for 3 or more days in the past month were almost three times more likely to use marijuana in comparison with those who did not miss school. Adolescents with parents who smoked had more than 2-fold higher odds of using marijuana as opposed to those whose parents did not smoke. Notably, increased parental support and awareness were associated with lower odds of marijuana use. Adolescents who reported always having parental support were 46% less likely to use marijuana.

TABLE 2 Psychosocial risks and protective factors and their association with marijuana use among Jamaican adolescents in 7th–12th grades.

Variable	Recent marijuana use		
	N (weighted %)	N (weighted %)	AOR (95%CI)
Felt lonely (last 12 months)			
Never/rarely	837 (51.79)	97 (12.55)	Ref
Sometimes	500 (29.57)	51 (11.30)	0.95 (0.62–1.44)
Most of the time	208 (12.16)	19 (9.95)	0.89 (0.50–1.59)
Always	110 (6.48)	25 (22.98)	2.22 (1.27–3.86)*
Felt worried (last 12 months)			
Never/rarely	1,032 (62.79)	109 (11.45)	Ref
Sometimes	398 (24.31)	47 (13.53)	1.27 (0.69–2.33)
Most of the time	146 (8.79)	25 (18.24)	1.97 (1.05–3.72)*
Always	70 (4.10)	10 (15.8)	1.75 (0.76–4.04)
Suicidal ideation			
No	1,178 (75.06)	121(11.08)	Ref
Yes	422 (24.94)	62 (16.48)	1.94 (1.35–2.79)*
Suicidal attempt			
No	1,322 (82.08)	135 (11.20)	Ref
Yes	314 (17.92)	61 (21.78)	2.51 (1.66–3.80)*
Physically attacked (last 12 months)			
No	1,207 (73.44)	116 (10.41)	Ref
Yes	448 (26.56)	79 (19.66)	1.83 (1.23–2.73)*
Bullying history (last 30 days)			
No	1,180 (76.11)	124 (11.69)	Ref
Yes	395 (23.89)	60 (15.49)	1.37 (0.94–2.04)
Missed school (last 30 days)			
No	1,192 (71.43)	108 (9.75)	Ref
1–2 days	254 (16.49)	42 (15.98)	1.50 (0.87–2.59)
≥3 days	183 (12.09)	44 (26.52)	3.10 (1.69–5.68)*
Parental smoking			
No	1,056 (75.61)	93 (9.31)	Ref
Yes	363 (24.39)	63 (19.79)	2.38 (1.52–3.72)*
Parental support			
Never/rarely	759 (46.87)	107 (15.18)	Ref
Sometimes	354 (22.46)	37 (11.18)	0.64 (0.36–1.15)
Most of the time	193 (11.89)	20 (11.15)	0.64 (0.38–1.08)
Always	316 (18.78)	27 (9.13)	0.54 (0.29–1.00)*
Parental awareness			
Never/rarely	591 (37.79)	95 (17.99)	Ref
Sometimes	381 (22.76)	47 (13.25)	0.74 (0.54–1.01)
Most of the time	261 (16.12)	28 (10.61)	0.58 (0.36–0.95)*
Always	388 (23.33)	21 (5.64)	0.30 (0.17–0.53)*

*p-value < 0.05.

TABLE 3 Substance use disorders and their association with marijuana use among Jamaican adolescents in 7th–12th grades.

Variable	Recent marijuana use		
	N (weighted %)	N (weighted %)	AOR (95%CI)
Ever amphetamine use			
No	1,534 (97.02)	155 (10.87)	Ref
Yes	46 (2.98)	35 (7.69)	24.49 (8.63–69.49)*
Age at drug initiation (years)[a]			
<14	140 (67.32)	132 (94.06)	0.46 (0.15–1.46)
≥14	64 (32.68)	62 (98.11)	Ref
Current cigarette use			
No	1,397 (85.29)	91 (6.83)	Ref
Yes	237 (14.71)	96 (49.77)	12.95 (8.17–20.52)*
Current use of other tobacco products			
No	1,458 (88.77)	109 (7.86)	Ref
Yes	179 (11.23)	85 (56.90)	14.29 (7.95–25.70)*
Age at cigarette initiation (years)[b]			
<14	62 (27.51)	72 (54.55)	2.14 (1.24–3.70)*
≥14	172 (72.49)	22 (37.61)	Ref
Currently, drink alcohol			
No	837 (51.43)	37 (4.66)	Ref
Yes	754 (48.57)	150 (22.22)	5.19 (1.24–3.70)*
History of drunk (lifetime)			
No	1,157 (68.25)	85 (8.01)	Ref
Yes	510 (31.75)	113 (25.14)	3.33 (2.22–5.00)*
Troubling drunk			
No	1,419 (84.79)	131 (9.56)	Ref
Yes	248 (15.21)	67 (34.32)	4.64 (2.55–8.47)*
Age at first drink (years)[c]			
<14	170 (23.94)	129 (26.12)	3.32 (1.75–6.29)*
≥14	578 (76.06)	19 (10.42)	Ref

[a]Among those who had ever used drugs using marijuana, amphetamines, cocaine, inhalants, cocaine, crack, ecstasy, glue, and ganja. [b]Among those who had ever used cigarette. [c]Among those who had ever drunk. *P-value < 0.05.

Additionally, those who always experienced parental awareness had 70% lower odds of using marijuana.

The associated substance use with marijuana use

Table 3 presents the association between recent marijuana use and various substance use. A significant association was observed between amphetamine use and recent marijuana use. Specifically, those who use amphetamine were approximately 25 times more likely to use marijuana use compared with those who did not use amphetamine. Individuals currently smoking cigarettes were 13 times more likely to use marijuana, while those using other tobacco products were 14 times more likely, compared to peers who did not smoked cigarettes or used any other tobacco products. Additionally, those who started smoking cigarettes before the age of 14 years were twice as likely to use marijuana compared with those who initiated after 14 years. Alcohol use was associated with more than five times higher odds of recent marijuana use. Additionally, those with a history of getting drunk and troubling drunk were three to five times more likely to use marijuana as compared with those who had not, indicating a pronounced association with recent marijuana use. Adolescents who had their first drink before 14 years old also had approximately 3-fold higher odds of marijuana use than their counterparts.

TABLE 4 Risky sex behaviors and their association with marijuana use among Jamaican adolescents in 7th–12th grades.

	N (weighted %)	N (weighted %)	OR (95%CI)
Ever had sex			
No	858 (51.91)	39 (4.65)	Ref
Yes	677 (48.09)	129 (20.75)	4.54 (2.55–8.06)*
Age at first sex[a]			
<14	370 (57.43)	39 (14.52)	2.45 (1.60–3.75)*
≥14	251 (42.57)	84 (26.55)	Ref
Sexual partnership[a]			
Single partner	200 (30.72)	44 (25.37)	Ref
Multiple partners	418 (69.28)	79 (19.65)	0.74 (0.43–1.26)
Condom use in last sex[a]			
No	389 (64.71)	76 (20.38)	1.30 (0.81–2.07)
Yes	195 (35.29)	41 (23.36)	Ref

[a]Among those who had ever sex. *P-value < 0.05.

The associated risky sex behaviors with marijuana use

Table 4 presents the association between risky sex behaviors and various substance use. The odds of marijuana use were four times more likely among adolescents who have ever had sex compared with those who have not. Adolescents who engaged in sexual activity before the age of 14 years were approximately twofold more likely to have recently used marijuana than those who initiated after 14 years. No association was observed between the number of sexual partners and condom use in the last sex with marijuana use.

Discussion

Our study revealed notable findings exploring the demographic factors associated with marijuana use among Jamaican adolescents from 7th to 12th grades. First, age appeared to be a significant predictor of recent marijuana use, with adolescents older than 14 years showing a substantially higher prevalence than those of 14 years and younger. This is in line with the findings from a study conducted by van den Bree, M (11) who noted that marijuana use typically began during the mid-adolescent years, particularly when peer influence and experimentation become more prominent. Additionally, sex differences in marijuana use were evident, with men showing a considerably higher prevalence than women. A similar sex pattern has been observed in several studies in various settings (12–14). According to this, societal norms and sex roles may play important roles in the observed differences. Interestingly, while our study highlighted that adolescents of 10th grade had the highest prevalence of marijuana use, this did not statistically differ from adolescents of 7th grade. However, adolescents of 12th grade had the lowest prevalence, contrary to the assumption that older adolescents may have increased exposure and opportunity to use substances such as marijuana. This discrepancy might be due to heightened awareness or preventive measures introduced in schools.

Our findings shed light on the multifaceted psychosocial risks and protective factors that are associated with marijuana use among Jamaican adolescents. The significant positive association between feelings of loneliness and increased marijuana use is congruent with the findings of research in other settings (15–17). For instance, a study by Savolainen et al. discovered that feelings of loneliness among adolescents were strongly linked to increased substance use, indicating a global trend (18). Similarly, the pronounced association between persistent worry and suicidal behaviors with marijuana use reflects the findings from other studies. These studies have consistently highlighted the connection between emotional distress and substance use, highlighting the idea that adolescents might use substances such as marijuana as a coping mechanism (19–21). An alarming revelation from our study is the increased marijuana use among adolescents who had been physically attacked, which highlights the need to investigate the complex interplay between trauma, substance use, and mental health among this population (22). Interestingly, the parental dimension in this study yielded striking insights. The findings indicated that adolescents with parents who smoke have increased odds of using marijuana, likely due to the tendency of children to emulate parental behaviors, especially those related to substance use (23). However, the protective role of parental support and awareness in deterring marijuana use cannot be understated. It reaffirms the power of a strong parental bond in shielding adolescents from potential harms (24). Based on these findings, policy recommendations might focus on creating more supportive environments for adolescents. Schools and communities could implement programs, such as emphasizing emotional wellbeing and ensuring adolescents to have avenues to discuss and express their feelings of loneliness, worry, or suicidal thoughts. Importantly, initiatives aiming to bolster parental awareness and support should be prioritized, given their pivotal role in mitigating marijuana use.

In our study, we observed several significant associations between various substance use behaviors and recent marijuana use among Jamaican adolescents from 7th to 12th grades. Notably, amphetamine use was found to have the strongest correlation with an adjusted odds ratio (AOR) of 24.49. This echoes the findings of previous research, indicating that polydrug use is prevalent among adolescents and that the co-use of substances can lead to increased risks of problematic behaviors and health outcomes (25). Furthermore, this study highlights the interconnectedness of substance use behaviors; the strong association between the use of current cigarette and other tobacco products and marijuana consumption is congruent with the previous research, suggesting that marijuana and tobacco often serve as gateway substances to one another (26). Alcohol consumption and early initiation of substance use (before the age of 14 years) were also identified as significant correlates. Adolescents with a history of getting drunk or troublingly intoxicated showed pronounced odds of recent marijuana use. Early substance initiation has been consistently linked with a higher risk of developing substance use disorders later in life (27, 28). Based on these findings, it is evident that early interventions targeting substance use education and prevention should be a priority. Policymakers might consider comprehensive substance use prevention programs that address a broad spectrum of substances rather than isolating marijuana. Additionally, future research could explore the underlying sociocultural and psychological factors contributing to these patterns among Jamaican adolescents, allowing for more tailored interventions.

With regard to risky sex behaviors and marijuana use among Jamaican adolescents, adolescents who had ever in sexual activity were more than four times as likely to have recently used marijuana compared with their counterparts who had not engaged in such behaviors (AOR = 4.54). Additionally, adolescents initiating sexual activity before the age of 14 years demonstrated higher propensity (AOR = 2.45) toward recent marijuana use compared with those starting after the age of 14 years. This trend is similar to previous studies, which indicated that early sexual debut correlates with elevated marijuana use (29, 30). Our study revealed no significant relationship between adolescents with multiple partners or those abstaining from condom use in their last sexual encounter and recent marijuana use, contributing to the complex interplay of sexual behaviors and substance use (29, 31, 32). Given the observed association between early sexual initiation and marijuana use, policymakers should consider joint interventions that address both early sexual debut and substance use among adolescents. Education programs in schools could be implemented, highlighting the implications of early sexual activity and the potential risks associated with substance use, particularly marijuana.

The results of the present study should be interpreted in light of several limitations. First, the data primarily come from secondary school students in Jamaica, potentially limiting the generalizability of our findings to broader age groups or different cultural contexts. The association between sex and the age of initiation of cannabis was notably significant in this demographic but might not be pronounced in other populations. Second, while we found a relationship between adolescents' perception of the harms and benefits of marijuana and their actual usage, the study did not delve deeper into the reasons for these perceptions, leaving potential motivational factors unexplored. Moreover, the data were drawn from the National Secondary School Survey of 2017, and given the rapidly evolving landscape of cannabis perception and legalization, the data might not be reflective of the current scenario. Finally, the survey indicated that a significant portion of adolescents of 8th grade did not perceive occasional cannabis use as harmful; however, the parameters for "occasional use" and "regular use" were not clearly defined, leading to potential ambiguities in the interpretation of these findings.

Conclusion

This study delves into the multifaceted factors associated with marijuana use among Jamaican adolescents of 7th to 12th grades. The key findings highlight age and sex as significant determinants, with emotional distress markers such as feelings of loneliness, persistent worry, and suicidal behaviors having a notable positive correlation with marijuana use. Additionally, traumatic experiences and parental influence, both positive and negative, play pivotal roles in marijuana consumption patterns of adolescents. Furthermore, the intertwined relationship between early sexual debut, other substance use behaviors, and marijuana use highlights the need for comprehensive interventions that address a broad spectrum of substances and behaviors. To effectively mitigate marijuana use, policies should prioritize emotional wellbeing, parental support, early substance use education, and awareness of the implications of early sexual activity.

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.

Author contributions

OD: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares 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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Association of perceived stress and sleep quality among medical students: the mediating role of anxiety and depression symptoms during COVID-19

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COVID-19 has intensified the influence on medical students by changing the lifestyle, online study and clinical practice which bring out series of stress, sleep disturbance and mental health problems. This cross-sectional study aim to explore the association between perceived stress and sleep quality among medical students and investigated whether anxiety and depression mediated this association during pandemic. A total of 1,021 medical students in two universities who were from Guangdong Province, China participated this study and from January to September 2020 through the online question are, with 28.80% reporting sleep disturbances. The medical students were finished various self-reported questionnaires, including the Perceived Stress Scale-10, Pittsburgh Sleep Quality Index, Generalized Anxiety Disorder-7 Scale, and Patient Health Questionnaire-9, the study found positive correlations among sleep quality, perceived stress, anxiety, and depression. The data was analyzed with The Amos 26.0 system. Result demonstrated that perceived stress was associated with poor sleep quality. Anxiety and depression partially mediated the association between perceived stress and poor sleep quality, explaining 73.08% of the association. This study's structural equation model offers a useful framework for assessing mechanisms mediating associations between perceived stress and sleep quality. The findings emphases the importance of addressing psychological factors in high-pressure situations, which can exacerbate sleep disturbances among medical students. It is important to screen the level of stress, mental health problems and investigate the risk factors of sleep quality among medical students during emergency public health events.

KEYWORDS

medical student, perceived stress, sleep quality, anxiety, depression

Introduction

When the COVID-19 outbreak that changes our daily lives. Universities were constrained to close which disturbed their regular clinical practice unexpectedly (1). COVID-19 had intensified the impact ton medical students regular teaching condition and bring a unique position in the front-line of pandemic. It brought a big challenges for medical students to adapt to the new online learning platform and an increasing worried

about the delay of medical training and the risk of clinical infection during pandemic among them (2). Along with this, Medical students tend to experience higher stress levels that above for the base threshold because of the pandemic (3). However, previous study has demonstrated that higher level of stress were directly linked to poor sleep quality (4). Sleep disturbances among medical students are rapidly worsening by the impact of COVID-19 pandemic globally (5).

Stress is a high risk factor for sleep quality by affecting the sleep pattern. Previous study indicated that stress has been found interrupting sleep rhythm (low wave and rapid eye movement phases) by decreasing sleep efficiency and increasing wakefulness (6). Additionally, acute and chronic stress reactions affect the secretion of cortisol through the hypothalamic–pituitary–adrenal (HPA) axis, further affecting the changes in circadian rhythms and the quality of sleep (7). It may lead to maladaptation of the HPA axis, such as causing cortisol levels to rise and disrupting the sleep–wake cycle, further affecting the individual's sleep quality. Among medical students, it intimated that the increasing in stress maybe due to poor sleep quality during the pandemic.

Sleep disturbance is interrelated with psychological, behavioral, physiological, and environmental factors (8). According to the cognitive model of insomnia, negative emotions (mainly depression and anxiety) can trigger people's cognitive biases regarding stressful life events, making them excessively alert, gradually affecting sleep quality (9).However, medical students often experience long-day study, internship duration, night shifts, and high-pressure work environments, which can severely impact their sleep quality. Furthermore, Studies have reported that anxiety and depression has a clinically significant effect on sleep quality during the pandemic among adult (10).depression symptoms were shown to decrease sleep quality among medical students (11).The emotional states can negatively impact sleep quality, and sleep problems can further exacerbate mental health problems. So, it is important to screen mental health problems and investigate the risk factors of sleep quality among medical students.

Government responded to the pandemic by limiting or cancel the daily gathering which enhanced public isolation. Medical students were appear to be stressful, which not only because of the academic stress and exam pressures, but also confused about the future that they need to continue clinical practice rotations in an unknown public health event. These pressures can lead to anxiety, depression, fatigue, and other mental health problem. However, Studies were conducted that psychological impact was linked with high perceived stress among college students during the COVID-19 pandemic (12).In addition, Previous studies have reported stress symptoms related to depression, anxiety among medical students over year during the public health emergency (13).

So far, Anxiety and depression are susceptible to changes among medical students in the public health events because of the stress of academic, clinical mission, health concern and social isolation. We found that previous studies were limited in a small sample size among medical students during pandemic. More importantly, the relationship between stress, sleep and mental health were rarely among medical student in a large sample in the early stage of pandemic. The previous studies provided the worth insight on identifying the mental and health problem among medical students to provide further helpful intervention. This study aimed to clarify whether perceived stress was associated with sleep quality among medical students during pandemic. Additionally, we analyzed the perceived stress, sleep quality and mental health data through structural equation model which in order to identify pandemic-associated stress affected sleep quality through anxiety and depression among medical students.

Methods

Participants

This study calculated the sample size based on the Monte Carlo mediation effect statistical power analysis method. Using the standard that the statistical power of the mediation effect test was 0.95, and calculated the sample size by using M plus software to perform Monte Carlo SEM statistical power analysis (14). The final sample size obtained was 700. Taking into account the 10% recovery error, the required sample size was at least 770 people. Data were obtained from medical students enrolled in two universities in Guangdong Province, China, from January to September 2020. The inclusion criteria were (1) participating in the study voluntarily and signing the informed consent form and (2) actively attending the university. The exclusion criteria were (1) having a history of mental illness, (2) taking anti-psychotic or sedative hypnotic drugs regularly for the previous 6 months, (3) overseas students, and (4) non-attending students and those studying abroad. In total, 1,619 medical students were selected to complete questionnaires through the Questionnaire Star app, which can be used on a computer or mobile phone. Of the returned questionnaires, 1,021 were considered valid; that is, they were completed without response inconsistencies (overall effective response rate: 63.06%).

Before commencing the study, the researchers explained to the participants the purpose and significance of the investigation, that participation was anonymous, that the data obtained would be kept strictly confidential, and that the data would be used solely for research purposes. This approach helps alleviate the anonymity concerns of research participants and ensures data reliability. This study follows the principle of informed consent and anonymously saves the original information and data for the sole purpose of this study. The Ethics Committee of the First Affiliated Hospital of KY-2020-086 reviewed and approved this study (ethics review number: KY-2020-086).

Assessment of covariates

We considered the following characteristics as potential covariates. Participants completed a sociodemographic questionnaire that included information on sex (male and female), education level (college or postgraduate or doctor), education (full-time, part-time), birthplace (rural, township, city), lunch break habit or not, accommodation or not (living arrangement or living with parents), time spent watching TV or surfing the Internet (<1 h, 1–2 h, ≥3 h), smoking or not, health status, family monthly income (≤ 2,500, 2,501–5,000, 5,001–7,500, 7,501–10,000, > 10,001), BMI (< 18.5, 18.5–23.9, > 23.9), among others. Detailed information is provided in Table 1.

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TABLE 1 Demographic characteristics of medical students.

Variables	N	%
Sex		
Male	322	31.53
Female	699	68.47
Educational level		
Undergraduate	481	47.11
Postgraduate	502	49.17
Doctoral	38	3.72
Form of education		
Full-time	967	94.71
Part-time	54	5.29
Birthplace		
Rural	496	48.58
Township	258	25.27
City	267	26.15
Lunch break habit		
Yes	785	76.89
No	236	23.11
Accommodation		
Yes	816	79.92
No	205	20.08
Time spent watching TV or surfing the Internet		
< 1 h	73	7.15
1–2 h	304	29.78
≥ 3 h	644	63.07
Smoking		
Yes	22	2.15
No	999	97.85
Only child		
Yes	266	26.05
No	755	73.95
Health status		
Well	985	96.47
Chronic disease	36	3.53
Monthly income (RMB)		
≤ 2,500	218	21.35
2,501–5,000	360	35.26
5,001–7,500	204	19.98
7,501–10,000	98	9.60
> 10,001	141	13.81
BMI		
< 18.5	231	22.62
18.5–23.9	661	64.74
> 23.9	129	12.64
PSS-10	17.01	12.20–21.81
PSQI		
No sleep disturbance (PSQI <8)	727	71.20
Sleep disturbance (PSQI ≥8)	294	28.80

(Continued)

TABLE 1 (Continued)

Variables	N	%
PHQ-9		
No depression (0–4)	490	48.00
Mild depression (5–9)	376	36.83
Moderate depression (10–14)	100	9.79
Severe depression (15–27)	55	5.38
GAD-7		
No anxiety (0–4)	516	50.53
Mild anxiety (5–9)	393	38.49
Moderate anxiety (10–14)	81	7.93
Severe anxiety (15–21)	31	3.05

PSQI, Pittsburgh Sleep Quality Index; PSS-10, Perceived Stress Scale; BMI, body mass index; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7 Scale.

Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality in the previous month. This index has been widely used to assess sleep quality and comprises 19 self-evaluated items and 5 other-evaluated items; of these, 18 of the self-evaluated items are used for scoring (15). These scoring items are combined into seven components: subjective sleep quality, time to fall asleep, sleep time, sleep efficiency, sleep disorders, hypnotics, and daytime dysfunction. The maximum PSQI score is 21 points, and the higher the score, the worse the sleep quality. A score > 5 points indicates sleep disturbance. In this study, Cronbach's alpha was 0.765.

Perceived stress

Perceived stress was assessed using the Perceived Stress Scale (PSS-10) (16), which evaluates stress levels in the last month. The Chinese version of the PSS-10 scale has high reliability and can be applied to college students (17). The scale has 10 items with total scores ranging from 0 to 40 points. The higher the total score, the greater the stress experienced by the individual. In this study, Cronbach's alpha was 0.642.

Anxiety symptoms

Anxiety symptoms were evaluated using the Generalized Anxiety Disorder-7 Scale (GAD-7), which is used to evaluate emotional distress in the past 2 weeks (18). The scale has seven items that are rated on a 4-point scale, yielding a maximum total score of 21 points. Scores are divided into no anxiety (0–4 points), mild anxiety (5–9 points), moderate anxiety (10–14 points), and severe anxiety (15–21 points). Cronbach's alpha was 0.927 in this study.

Depressive symptoms

Depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 is a 9-item self-assessment tool based on major depressive disorders as per the *Manual of Diagnosis and Statistics of Mental Disorders (4th Edition)*. The scale has nine items that are rated on a 4-point scale (19). The maximum total score for the scale is 27, and the scores are divided into no depression (0–4 points), mild depression (5–9 points), moderate depression (10–14 points), and severe depression (15–27 points). In this study, Cronbach's alpha was 0.905.

Statistical analysis

To describe the data means and standard deviations were used for measurement tool data, and frequencies and percentages were used for countable data. Pearson's correlation (normally distributed data) and Spearman's correlation (non-normally distributed data) coefficients were used to analyze the correlation between perceived stress and sleep quality indicators. Statistical tests were 2-sided, with $p < 0.05$ indicating statistical significance.

The mediating role of anxiety and depression in the relation between perceived stress and sleep quality was analyzed with IBM SPSS Amos 24.0. We first estimated the proportion of each path coefficient and assessed the direct and indirect effects in the model. Second, we analyzed the model fit of the hypothesized equations. The goodness of fit indices considered were $\chi^2/df < 5$; comparative fit index, goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index >0.90, and root mean square error of approximation (RMSEA) < 0.08, in compliance with the standards for structural equation modeling (20). By using a bootstrap test with 5,000 samples, 95% confidence intervals were calculated. A confidence interval excluding 0 indicates that the mediation effect is significant.

Results

Demographic characteristics

The demographic information of participants and the scores of perceived stress and sleep quality are shown in Table 1. In total, 1,021 medical students were enrolled in this study; 322 (31.53%) were male, 699 (68.47%) were female, 481 (47.11%) were undergraduate students,

TABLE 2 Correlations between sleep quality, perceived stress, anxiety, and depression.

	Sleep quality	Perceived stress	Anxiety	Depression
Sleep quality	1	–	–	–
Perceived stress	0.305**	1	–	–
Anxiety	0.503**	0.426**	1	–
Depression	0.576**	0.401**	0.811**	1

**$p < 0.01$, *$p < 0.05$.

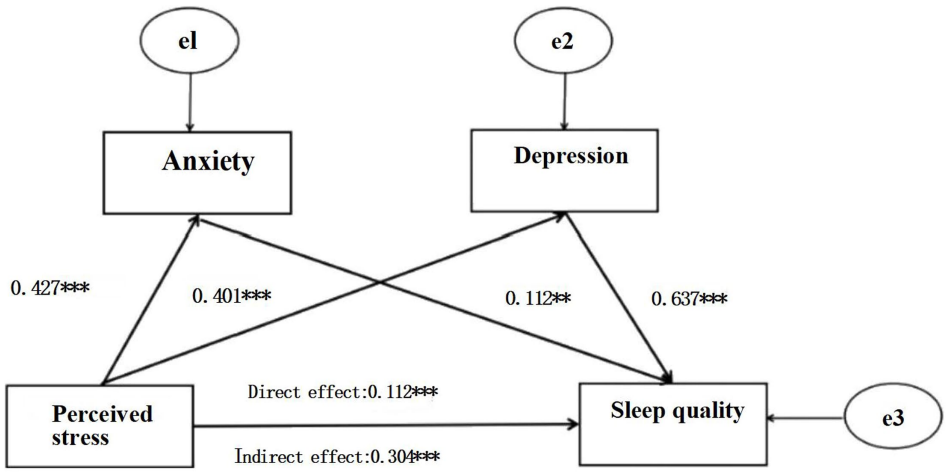

FIGURE 1
Serial mediation model for perceived stress, anxiety, depression, and sleep quality. Path coefficients are shown in standardized regression coefficient form. **$p < 0.01$, ***$p < 0.001$.

502 (49.17%) were postgraduate students, and 38 (3.72%) were doctoral students.

Correlation analysis

The correlations between the four variables are presented in Table 2. Perceived stress was positively related to sleep quality ($r = 0.305$, $p < 0.01$), anxiety ($r = 0.426$, $p < 0.01$), and depression ($r = 0.401$, $p < 0.01$).

Measurement model

Sleep quality was entered as the dependent variable, anxiety and depression as the mediating variables, and perceived stress as the independent variable. As shown in Figure 1, perceived stress had a direct positive effect on sleep quality ($\beta = 0.112$, $p < 0.001$). The model showed appropriate fit, as per the following fit index results: $\chi^2/df = 2.985$, $p < 0.005$, AGFI = 0.969, GFI = 0.985, RMSEA = 0.043, NFI = 0.976, IFI = 0.984.

Structural model

The path coefficients of the three indirect and direct paths were significant, as shown in Tables 3, 4. The results of the path analysis showed that perceived stress had a positive effect on anxiety, as indicated by the path coefficient ($\beta = 0.427$, $p < 0.001$). Perceived stress had a positive effect on depression ($\beta = 0.401$, $p < 0.001$), depression had a positive effect on sleep quality ($\beta = 0.637$, $p < 0.001$), and anxiety had a positive effect on sleep quality ($\beta = 0.112$, $p = 0.018$). The first indirect path was that the effect of perceived stress on sleep quality was mediated by anxiety, with an effect size of 0.048. The second indirect path was that the effect of perceived stress on sleep quality was mediated by depression, with an effect size of 0.043. The third indirect path was that the effect of perceived stress on sleep quality was significantly mediated by both anxiety and depression, with an effect size of 0.213. Furthermore, a direct effect of perceived stress on sleep quality was demonstrated, with an effect size of 0.112.

Discussion

This study investigated the relationship between perceived stress, sleep quality, anxiety, and depression among medical students in larger sample during the COVID-19. We found that anxiety and depression mediated the relationship between perceived stress and sleep quality. Additionally, the present study demonstrated that perceived stress directly affected sleep quality that brought sleep difficulties among medical students that was similar as hypotheses and prior reaches of pandemic (21). On the other hand, Perceived stress also indirectly affected sleep quality by the mediating effect of anxiety and depression. These findings are comparable to those of previous

TABLE 3 Standardized path coefficient analysis results of the model.

Variables			B	Non-standardized coefficient	Standardized coefficient	S.E.	*p*
Perceived stress	→	Anxiety	0.427	0.380	0.427	0.025	$p < 0.001$
Perceived stress	→	Depression	0.401	0.069	0.067	0.021	$p < 0.001$
Perceived stress	→	Sleep quality	0.112	0.014	0.144	0.003	$p < 0.001$
Depression	→	Sleep quality	0.637	0.061	0.637	0.005	$p < 0.001$
Anxiety	→	Sleep quality	0.112	0.012	0.112	0.005	0.018

S.E, standard error.

TABLE 4 Results for the mediating effects of anxiety and depression.

Variables	B	S.E.	Bias-corrected 95% CI			95% CI			Effect size
			Lower	Upper	*p*	Lower	Upper	*p*	
stdind1	0.048	0.022	0.007	0.094	0.018	0.006	0.093	0.021	11.54%
stdind2	0.043	0.014	0.018	0.071	0.001	0.017	0.069	0.001	10.34%
stdind3	0.213	0.022	0.173	0.259	0.000	0.171	0.258	0.000	51.20%
Total indirect effect	0.304	0.025	0.255	0.351	0.000	0.255	0.351	0.000	73.08%
Direct effect	0.112	0.050	0.016	0.215	0.019	0.014	0.213	0.021	26.92%
Total effect	0.416	0.062	0.299	0.542	0.000	0.296	0.538	0.000	100.00%

stdind1, perceived stress–anxiety–sleep quality; stdind2, perceived stress–depression–sleep quality; stdind3, perceived stress–anxiety–depression–sleep quality; S.E, standard error; CI, confidence interval.

studies on medical students, which found that mental distress (including stress, anxiety, and depression) directly predicts poor sleep habits (22).

Our study profound medical students were in a stressful condition, not only for academic pressure, but also adapt to the new study surrounding, unique lifestyle during the pandemic period. Prior research indicated that medical students adopted a pattern of 'sleeping late and getting up early' to meet academic demands and that this lifestyle affected their sleep quality, resulting in daytime sleepiness and insomnia (23). In particular, At the beginning of pandemic, it had been reported that more under-graduated students feel more stress because of the doubts about the future (24). Besides, One study in America found that the increasing stress disturbed college students' sleep duration and led to poor sleep quality (25). Moreover, the change of study style including online environment, coursework delivery and social contact that is difficult for students to adjust themself at the first time which established consequences on stressful condition and poor sleep. In addition, it has reported similar results among adolescents under long-term stress; affected individuals' sleep quality and responsiveness, resulting in more sleep problems (26). Hence, It is important to identified the severity of sleep quality and perceived stress during public health events to ensure retain a healthy lifestyle and alleviate the stressful condition among them.

Base on structural model, our study has identified that anxiety and depression mediated the relationship between perceived stress and sleep quality. Therefore, stress may not be driven to poor sleep quality by directly, and emotional reactions may play an important mediating role in contributing toward sleep disturbance among medical students during pandemic. The links between perceived stress, poor sleep quality, depression and anxiety were well verified. From a neurophysiological perspective, stress responses can cause emotional changes, and emotional stimulation affects sleep through the interaction between brain regions that process emotions and those that control sleep and arousal, disrupting the circadian rhythm balance (27). Research evidence suggested that the indirect path from stress to sleep quality through psychological factors.

Several potential mechanisms may explanation the association between perceived stress, poor sleep quality, depression and anxiety. First, Previous study reported that individual experienced studies-related stress events will increase anxiety symptoms through the activation of HPA axis and led to sleep disturbance (28). Second, according to Lazarus' stress and coping theory, individuals who have been in high-pressure situations for a long time cannot adapt to or deal with working under pressure, which causes them anxiety and affects their sleep quality (29). Furthermore, A systematic review found that emotion regulation is closely related to sleep duration among adolescents (30). Hence, it may be that, through perceived stress, depression can negatively affect the rapid eye movement phase, disrupting the sleep rhythm and affecting the normal sleep cycle, finally affecting an individual's sleep quality.

The results of the mediating effect test indicated that medical students' stress to the impact of sleep quality was mediated by mental health during COVID-19 pandemic. Recent data conducted in Spain demonstrated that university students had a high level of stress linked with depression and anxiety when city lockdown (31). Students showed strongly concern about the health, academic and social situation. The result is consistent with our study. Another study concluded that healthcare workers have a high related between perceived stress, depression and anxiety (32). Indeed, stressful life events was pointed out as risk factors for depression. In addition, a finding supported that someone who were depression, they were sensitive to sudden events, and contribute to stress during COVID-19 (33). With this background, it is important to concerned about public

heath events maybe the sensitive incident bring a lot stress and due to the depression and anxiety symptoms among medical students.

Worsened sleep may result in adverse effects. That is, sleep disturbance is closely related to emotional stability. Previous reviews reported that psychological distress was strongly associated with sleep disturbances among healthcare professionals, the general population, and COVID-19 patients during pandemic (34). Research has found that the relationship between emotional stability and insomnia symptoms is mediated by anxiety and depression (35). Negative emotions may lead to unhealthy behaviors, such as excessive worrying about the future, excessive caffeine intake, and daytime sleepiness, among others, due to sleep dysfunction. In addition, this study supported that higher anxiety levels were associated with poorer sleep quality, which is consistent with previous studies during COVID-19 among Chinese participants (36). In particular, because of the remote learning, students lacked of social connection, outdoor activities, more time in using internet tools, the uncertainty of infection and COVID-related worries that interfere the sleep quality.

Limitations

The current study has several limitations. First, causal relationships could not be verified because of the study's cross-sectional design and SEM are recommended for prospective studies. Besides, longitudinal designs are needed to verify those mental symptoms, stress condition and sleep quality. Second, using convenience sampling is non-optimal, as it may lead to a non-representative study population, and causality cannot be confirmed. Furthermore, only two universities were selected as the study sites; hence, future researchers should use larger, more representative samples. Moreover, only a self-assessment questionnaire was employed to measure sleep quality in this study. Other objective measurements should be used to investigate sleep quality in future research.

Conclusion

The findings of the present study suggest that associations between perceived stress and sleep quality can be explained by anxiety and depression symptoms. The findings contribute to an understanding of the psychological factors (anxiety and depression symptoms) linking perceived stress and sleep quality among students during COVID-19. We suggest that further research is needed to comprehensively evaluate stressful situations, sleep quality, and psychological factors among students when there is outbreak public health events. We also acknowledge that medical students should screen and take measures to cope with pressure and focus on relieving anxiety and depression symptoms to improve sleep quality during the unexpected emergency public health disease.

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 humans were approved by This study was approved by the hospital's Ethics Committee (Reference number: KY-2020-086). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

WH: Writing – original draft, Writing – review & editing. XW: Data curation, Writing – review & editing. YL: Data curation, Investigation, Writing – review & editing. CL: Formal analysis, Funding acquisition, Project administration, Writing – review & editing.

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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 kynurenine and serotonin pathway, neopterin and biopterin in depressed children and adolescents: an impact of omega-3 fatty acids, and association with markers related to depressive disorder. A randomized, blinded, prospective study

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Depressive disorder is a severe mental condition. In addition to genetic factors, immunological-inflammatory factors, oxidative stress, and disturbances in neurotransmitter metabolism, kynurenine and serotonin pathways may play a role. The exact mechanisms, especially in depressed children and adolescents, are not fully understood. Our primary hypothesis was whether the metabolites of tryptophan degradation in children and adolescents with depressive disorder might be influenced by omega-3 FAs compared to omega-6 FAs during a 12-week supplementation. A secondary hypothesis was to investigate whether tryptophan metabolites in children and adolescents are associated with markers of inflammatory response, oxidative stress, cortisol, and the serum omega-6/omega-3 FA ratio. Metabolites of tryptophan degradation and pteridines, neopterin, and biopterin in urine were analyzed with an HPLC system. Surprisingly, omega-3 FAs stimulated both kynurenine (kynurenine/tryptophan ratio) and serotonin (5-hydroxytryptophan) pathways, whereas omega-6 FAs only increased the kynurenine/tryptophan ratio. Neopterin and biopterin were not different from the healthy controls. Biopterin increased after omega-3 FA supplementation. Serotonin was positively correlated with lipoperoxidation and a marker of oxidative protein damage. Of the monitored tryptophan metabolites, only 5-hydroxyindolacetic acid was positively correlated with the severity of depression, total cholesterol, and negatively with brain-derived neurotrophic factor and glutathione peroxidase. In conclusion, in children and adolescents, both supplemented FAs stimulated the kynurenine pathway (kynurenine/

tryptophan ratio) and kynurenine formation. However, the serotonin pathway (5-hydroxytryptophan) was stimulated only by omega-3 FA. Tryptophan metabolism is associated with oxidative stress, inflammation, total cholesterol, and cortisol. We are the first to point out the association between the kynurenine pathway (KYN/TRP ratio) and the omega-6/omega-3 FA ratio. The metabolite 5-HIAA could play a role in the pathophysiology of depressive disorder in children and adolescents.

Clinical Trial Registration: https://www.isrctn.com/ISRCTN81655012, identifier ISRCTN81655012.

KEYWORDS

depressive disorder, kynurenine and serotonin pathways, neopterin, biopterin, oxidative stress, omega-3 fatty acids, children and adolescents

1 Introduction

The depressive disorder (DD) in children and adolescents is a significant public health concern, given its detrimental outcomes that can result in serious health and socio-economic consequences in adulthood. The prevalence of depressive disorder in adolescents is approximately 5.7%, with a female-to-male ratio of 1.3:1 (1, 2). The primary symptoms of childhood depression include persistent sadness, loss of interest and joy, increased fatigue, sleep problems, or suicidal attempts (3). The precise causes of the onset and development of a depressive disorder are not fully understood. In addition to genetic factors, disorders in neurotransmitter metabolism, an inflammatory response to various stimuli, activation of the hypothalamic-pituitary-adrenal axis (HPA), oxidative stress, insufficient levels of omega-3 fatty acids (FA), disturbances in cell membrane composition (fluidity), and other factors can contribute to the development of a depressive disorder. Specifically, an imbalance in the catabolism of the amino acid tryptophan is a focal point of research interest (4–7).

Tryptophan (TRP) is an essential amino acid obtained from food. It can be catabolically degraded via the kynurenine or serotonin pathway (Figure 1). TRP undergoes oxidation by the rate-limiting enzymes indoleamine 2,3-dioxygenase (IDO, found in various organs, including nerve cells) or tryptophan 2,3-dioxygenase (TDO, present in the liver), leading to the formation of kynurenine (KYN), 3-hydroxykynurenine (3-HK), and other products, ultimately resulting in quinolinic acid (QUIN) (8, 9).

Serotonin (SER, also known as 5-hydroxytryptamine, 5-HT) is a neurotransmitter synthesized in small amounts from TRP in the brain and approximately 90% in the gastrointestinal tract (10). TRP is hydroxylated to 5-hydroxytryptophan (5-HTP) and further decarboxylated to SER. In the brain, the unstable SER is rapidly metabolized by mitochondrial monoamine oxidase (MAO) to the final and stable product – 5-hydroxyindole acetic acid (5-HIAA) (Figure 1). The formation of SER from TRP is crucial for the physiological transmission of signals between neurons. One hypothesis regarding depressive disorders is based on a decrease in serotonergic activity (11).

A decrease in the level of SER can be caused by a decrease in consumption of food rich in proteins, or by redirecting the catabolism of tryptophan to the kynurenine pathway. As MAO activity increases in depressed patients, the level of 5-HIAA increases and the level of SER decreases (12).

Oxidative stress is closely associated with inflammation (13), activating IDO and consequently triggering KYN production. Stress is another initiator of the kynurenine pathway: it activates the HPA axis, which in turn initiates the production of pro-inflammatory mediators such as cortisol (14, 15) and thereby activates the IDO enzyme (Figure 1).

KYN can also produce kynurenic acid (KA), which under physiological conditions, is attributed to neuroprotective effects. KA is a glutamate receptor antagonist that blocks the NMDA receptor of glutamate and acts as a scavenger of free radicals, such as the hydroxyl radical or superoxide (16). Under physiological conditions, there must be a balance between the formation of QUIN and KA, as QUIN is neurotoxic and KA neuroprotective in low micromolar concentrations (8, 17, 18).

In the pathophysiology of depressive disorders, the involvement of the kynurenine pathway is more likely when reactive oxygen species are generated from 3-HK and QUIN acid. Increased oxidative stress activates inflammatory pathways, leading to the production of pro-inflammatory mediators and the activation of IDO. This amplifies the pathophysiology of tryptophan degradation through the kynurenine pathway (19). The activity of IDO is also initiated by psychological stress through the HPA axis and inflammation (Figure 1).

The relationship between kynurenine or serotonin pathway metabolites and depressive disorder in children and adolescents is not fully understood.

Neopterin (NEO), a marker of cell-mediated immunity, and biopterin (BIO), an oxidation product of tetrahydrobiopterin (BH4), belong to the group of pteridines (20). Inflammation,

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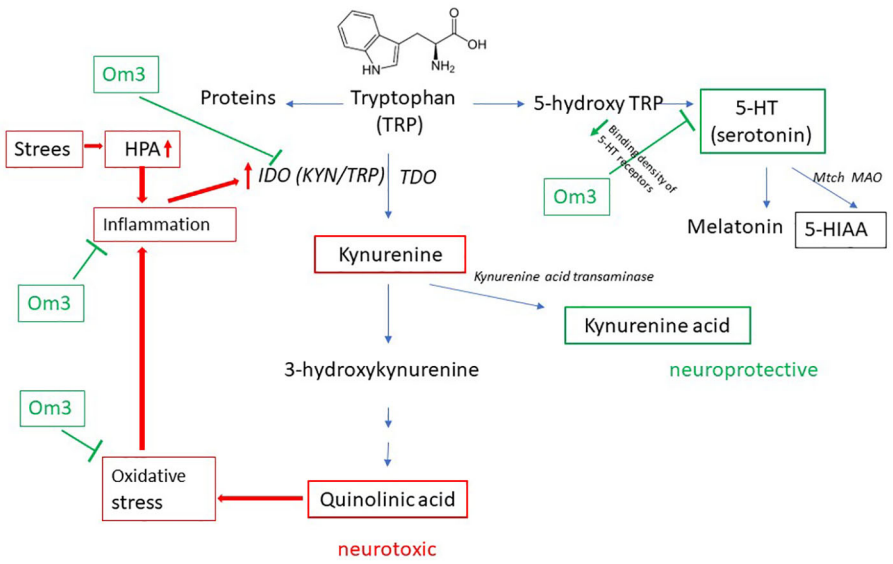

FIGURE 1
Catabolism of TRP. TDO, tryptophan 2,3-dioxygenase; IDO, indoleamine 2,3-dioxygenase; 5-HT, 5-hydroxytryptamine; 5-HIAA, 5-hydroxyindolacetic acid; Om3, omega-3 fatty acid; HPA, hypothalamic-pituitary-adrenal axis.

specifically through the cytokine interferon-gamma, stimulates not only IDO activity and TRP catabolism but also the production of neopterin. Neopterin is non-enzymatically synthesized after inflammatory activation in monocytes, macrophages, and dendritic cells. In contrast, BH4 can be formed through the reduction of BIO. It also serves as a cofactor for nitric oxide synthases, which produce NO.

The pathways of tryptophan (TRP) catabolism and pteridine metabolism have been extensively studied in relation to regression, primarily in depressed adults. However, in children and adolescents, knowledge about these processes is lacking.

In our previous study (7), we observed that omega-3 fatty acids, in contrast to omega-6 fatty acids, reduced the severity of depression in children and adolescents. Our primary hypothesis was whether the metabolites of tryptophan degradation in children and adolescents with depressive disorder could be influenced by omega-3 fatty acids compared to omega-6 fatty acids during a 12-week supplementation. A secondary hypothesis was to investigate whether tryptophan metabolites in the kynurenine pathway (KYN and the KYN/TRP ratio representing IDO activity), the serotonin pathway (5-HTP, SER, and 5-HIAA), as well as pteridines (neopterin and biopterin) in depressed children and adolescents are associated with markers of inflammatory response, oxidative stress, cortisol, and the serum omega-6/omega-3 fatty acid ratio.

2 Materials and methods

This work is a part of the DEPOXIN project (ISRCTN81655012). A detailed description of the study design, recruitment of patients, inclusion and exclusion criteria, interventions, and previous study results are presented in recent publications (7, 15, 21–23). For readers' convenience, key information about the design of the project is given in Supplements as Supplement - Study design.

2.1 Subjects

Briefly, 60 patients with depressive disorder aged 10-18 years and 20 age- and gender-matched healthy controls were included in this randomized, blinded, prospective study. 31 patients with depressive disorder (DD) and 29 patients with mixed anxiety and depressive disorder (MADD) were registered at the Department of Paediatric Psychiatry of the Faculty of Medicine of Comenius University and The National Institute of Children's Diseases in Bratislava and met the inclusion criteria (age 8-18 years, diagnosis of DD or MADD). Diagnosis were established according to the ICD-10 (International Classification of Diseases).

Inclusion criteria included the diagnosis of depressive disorder (F32.0, F32.1, F32.2) or mixed anxiety and depressive disorder (F41.2), age 8-18 years, with normal eating habits and no indication of chronic somatic disease. The diagnoses were determined according to the International Classification of Diseases, 10th edition (ICD 10).

Exclusion criteria were chronic somatic diseases (endocrine, metabolic, autoimmune), dietary restrictions (vegetarians, lactose intolerance, celiac disease), psychotic disorders, eating disorders, substance use disorders, personality disorders, organic mental disorders and pervasive developmental disorders.

Healthy children registered at the Pediatric Center Juvenalia, Dunajská Streda, Slovakia were included in the control group. The control group did not use any supplements. Blood, urine and saliva were collected from healthy children and adolescents at the time of their inclusion in the study (Week 0). All healthy girls in the control group were menstruating. From the patient group of 48 girls, 47

were menstruating. The process of enrolment of patients is shown in the CONSORT flow diagram (Figure 2).

2.1.1 Institutional review board statement

The human study was performed in accordance with the ethical standards outlined in the 1975 Declaration of Helsinki and its later amendments (2013). The study was approved by the Ethics Committee of the National Institute of Children's Diseases and the Faculty of Medicine, Comenius University Bratislava (20 March 2013).

2.1.2 Informed consent statement

Written informed consent was obtained from parents or legal guardians and children provided verbal assent before participation in the study. Details that might disclose the identity of the subject under study were omitted.

2.2 Study intervention

Patients were randomly divided into two groups. One group, referred to as the Om3 group, received omega-3 FA, while the other group, referred to as the Om6 group, received omega-6 FA as an active comparator/placebo. Both groups received these supplements in addition to their standard treatment with antidepressants, specifically selective serotonin reuptake inhibitors (SSRI). The omega-3 FA was sourced from a fish oil emulsion (Cultech Ltd, Port Talbot, UK), with a daily dose containing 2400 mg of total omega-3 FA (1000 mg of eicosapentaenoic acid (EPA) and 750 mg of docosahexaenoic acid (DHA)), maintaining an EPA : DHA ratio of 1.33:1. The omega-6 FA was sourced from a sunflower oil emulsion (Cultech Ltd, Port Talbot, UK), with a daily dose comprising 2467 mg of linoleic acid in triacylglycerol form. The dose of omega-3 FA used was determined based on a review of the

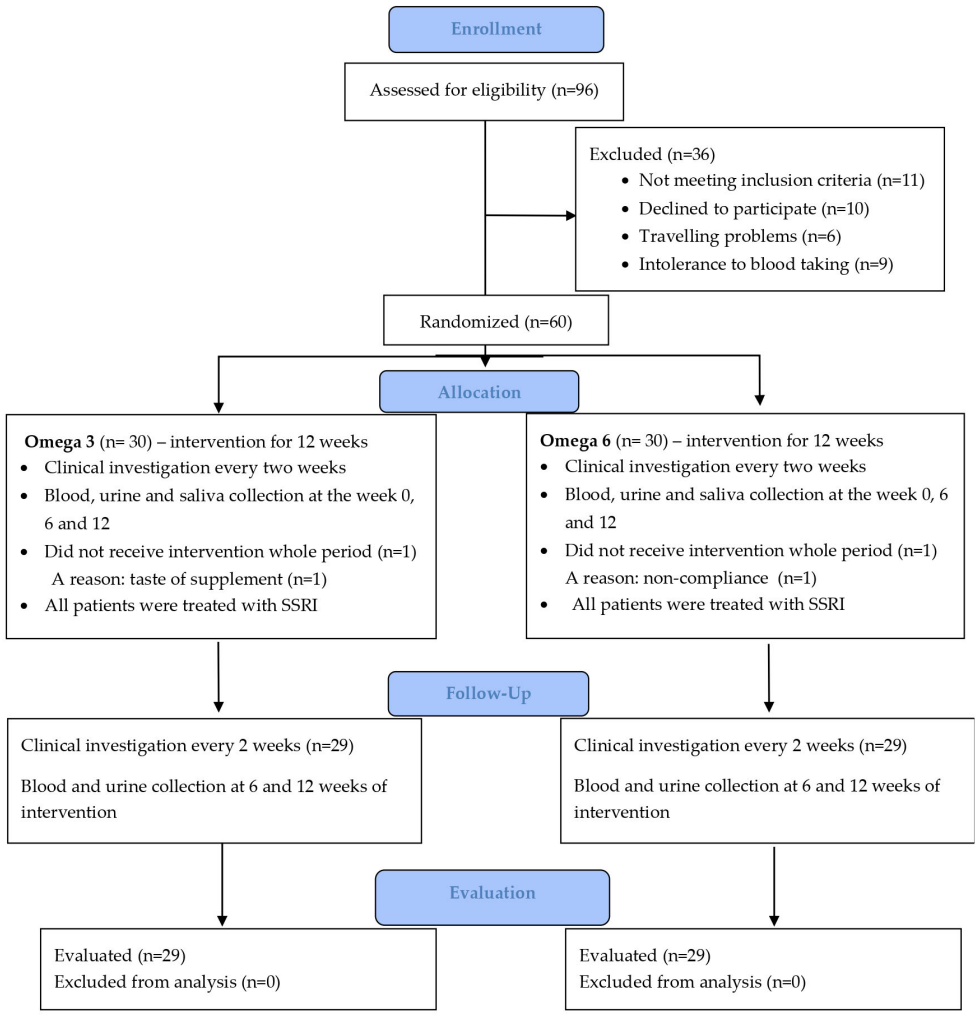

FIGURE 2
CONSORT flow diagram.

literature. Patients in both groups (Om3 and Om6) received a daily dose of 20 mL of emulsion during the 12 weeks of supplementation.

2.3 Biological material sampling

Blood, urine, and saliva were collected from patients at the baseline (week 0) and after 6 weeks (week 6) and 12 weeks of supplementation (week 12).

Venous blood was collected from patients and healthy controls after a 12-h overnight fast. Serum and plasma were obtained by centrifuging the blood (1200 g, 10 min) with or without EDTA as an anticoagulant within 1 h of blood collection. To the remaining volume of whole blood with anticoagulant, primarily containing erythrocytes, a saline solution (0.15 mol/L NaCl) was added. This was followed by centrifugation at 1200g for 7 minutes, and the procedure was repeated two more times. The serum and plasma were aliquoted and stored at −80°C until further use. Washed erythrocytes were diluted 1:3 with chilled distilled water. After 15 min, the hemolysate was stored at −20°C until further use. In the hemolysate, hemoglobin was determined by the Drabkin method and expressed in g/L.

Second-morning urine samples were collected by spontaneous micturition and stored at −28°C. For analysis, each urine sample was thawed at room temperatures and centrifuged at 3000 g for 10 min, followed by filtration of supernatant through a 0.22 µm membrane Syringe Filter PTFE (AZ Chrom s.r.o., Bratislava, Slovak Republic).

Saliva samples were collected from each subject to determine cortisol concentrations. Sampling took place in the morning and at midday. Regarding the group of healthy children, saliva samples were taken in the morning and at midday at the baseline without any intervention. Children were asked to gently chew cotton swabs from Salivette sampling tubes (Salivette® device, Sarstedt, UK) for 1 min. The samples were stored at −20°C until analyzed. Details of saliva collection are described in our paper (15).

2.4 Markers of the kynurenine and serotonin pathways, neopterin, biopterin, and creatinine in urine

From an ethical standpoint, we opted for non-invasively collected urine (in contrast to invasive blood collection) to determine TRP degradation metabolites, considering the observed concordance between peripheral levels and levels in the central nervous system (24).

Levels of urine metabolites (creatinine, TRP, KYN, 5-HTP, SER, 5-HIAA, NEO, BIO) were determined using reversed-phase high-performance liquid chromatography (RP-HPLC system, Prominence 20A, Shimadzu Corporation, Japan) equipped with UV-VIS absorption (module SPD-20A) and fluorescence (module RF-10AXL) detectors. The system temperature was adjusted to 25°C. LC solution software (Shimadzu Co., Kyoto, Japan) was used for analysis and processing of chromatograms.

To determine the concentration of tryptophan and its metabolites, a Nucleosil 100-5 C18 column (150 × 4.6 mm; 5 µm particle size) (Macherey-Nagel, Düren, Germany), mobile phase KH_2PO_4 with a concentration of 10 mmol/L and 4% methanol, pH 7.0 and a flow rate of 1 mL/min. TRP, 5-HTP, SER, 5-HIAA were detected using a fluorescence detector with an excitation wavelength of 280 nm and emission at 340 nm. Creatinine and KYN were detected using a UV-VIS absorption detector at 240 nm. To determine the concentration of neopterin and biopterin, a alphaBond™ C18 column (150 × 3.9 mm; 10 µm particle size) (Supelco, USA), mobile phase KH_2PO_4 with a concentration of 10 mmol/L and 3% methanol, pH 2.5 and a flow rate of 0.8 mL/min. were applicated. NEO and BIO were detected using a fluorescence detector with excitation wavelength of 350 nm and emission at 450 nm.The concentrations of the studied metabolites were determined based on the areas of the peaks using external calibration curves. The concentrations of metabolites were expressed in µmol/mmol creatinine.

2.5 Clinical assessment of patients' condition

The severity of depressive disorder symptoms expressed as CDI scores (the Children's Depression Inventory) was assessed every two weeks before and during the intervention by the study psychiatrist. A higher CDI score corresponds to a worse clinical condition for the patient. The results of the evaluation of CDI scores, the omega-6/omega-3 FA ratio, as well as the effects of fatty acids on symptoms in the same cohort of patients have already been published elsewhere (7).

2.6 Markers of oxidative stress, inflammation, and other indicators

Oxidative stress and inflammatory markers, BDNF, fatty acids, and cortisol were determined in the same cohort of patients as follows: (i) 8-isoprostanes (8-IsoP), the inflammation marker thromboxane (TXB) in urine; (ii) lipoperoxides (LP), advanced oxidative protein products (AOPP), nitrotyrosine (NT), trolox equivalent antioxidant capacity (TEAC), homocysteine (HCy), brain derived neurotrophic factor (BDNF), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), omega-6/omega-3 FA ratio in serum; (iii) superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase (CAT) activities in erythrocyte hemolysate; and (iv) cortisol in saliva. The detailed methods, procedure descriptions, and results of the same cohort of patients are mentioned in our recent papers (7, 15, 21–23). For readers' convenience, details of individual markers analyzes obtained from the same cohort of patients listed in Table 1 are given in Supplements as Supplement - Methods.

2.7 Statistical analyses

StatsDirect® 2.8.0 (StatsDirect Sales, Sale, Cheshire, M33 3UY, UK) and GraphPad Prism 9.5.1 (Insightful Science, California, USA) software were used for statistical processing and graphical display of data. We used mean ± standard deviation to describe normally

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TABLE 1 Baseline levels of TRP catabolism metabolites as well as neopterin and biopterin in urine in depressed patients and healthy controls.

Metabolite [µmol/mmol CR]	Patients				Healthy Controls				P vs. C
	all	F	M	*p* F vs. M	all	F	M	*p* F vs. M	
	n=57	n=46	n=11		n=20	n=12	n=8		
TRP	3.16 (2.65; 4.12)	3.20 (2.65; 4.32)	3.15 (2.54; 3.92)	0.963 [b]	4.41 (3.31; 7.16)	4.19 (2.86; 5.05)	6.63 (3.48; 9.40)	0.270 [b]	**0.017** [b]
KYN/TRP	0.75 (0.60; 1.02)	0.76 (0.63; 0.91)	0.66 (0.48; 1.15)	0.699 [b]	0.52 (0.37; 0.60)	0.49 (0.37; 0.63)	0.53 (0.36;0.56)	0.657 [b]	**< 0.0001** [b]
KYN	2.48 (2.10; 3.01)	2.48 (2.10; 2.97)	2.64 (1.92; 3.13)	0.825 [b]	2.52 (1.65; 3.53)	2.78 (1.12; 3.26)	3.2 (1.91; 3.59)	0.613 [b]	0.944 [b]
5-HTP	0.070 (0.054; 0.090)	0.070 (0.054; 0.094)	0.065 (0.046;0.090)	0.616 [b]	0.116 (0.072; 0.264)	0.093 (0.072;0.173)	0.136 (0.087; 0.383)	0.263 [b]	**0.003** [b]
SER	0.143 (0.081; 0.287)	0.151 (0.078; 0.315)	0.140 (0.113; 0.162)	0.792 [b]	0.225 (0.151; 0.456)	0.209 (0.115; 0.513)	0.306 (0.184; 0.456)	0.473 [b]	**0.021** [b]
5-HIAA	1.68 ± 0.37	1.72 ± 0.37	1.49 ± 0.27	0.062 [a]	2.03 ± 0.60	2.04 ± 0.54	2.01 ± 0.71	0.909 [a]	**0.023** [a]
NEO	0.19 (0.14; 0.27)	0.19 (0.15; 0.27)	0.14 (0.11; 0.19)	0.142 [b]	0.20 (0.17; 0.29)	0.21 (0.17;0.29)	0.20 (0.14; 0.30)	0.689 [b]	0.228 [b]
BIO	0.40 ± 0.12	0.40 ± 0.13	0.35 ± 0.09	0.227 [a]	0.42 ± 0.12	0.42 ± 0.10	0.43 ± 0.16	0.881 [a]	0.414 [a]

CR, creatinine; TRP, tryptophan; KYN, kynurenine; 5-HTP, 5-hydroxytryptophan; SER, serotonin; 5-HIAA, 5-hydroxyindole acetic acid; NEO, neopterin; BIO, biopterin; p, significance; F, female; M, male; P, patients; C, healthy controls; a, unpaired t-test; b, Man-Whitney U test.
Bold values indicate significant p value.

distributed data. For data not normally distributed, we used the median, first and third quartile. We tested the normality of data with the Shapiro-Wilk test. To compare the control group and the group of depressed patients, we used the unpaired Student's t-test (normally distributed data) or the Mann-Whitney U test if the data were not normally distributed. We tested the effect of supplementation using one-way ANOVA with repeated measures and Tukey's *post-hoc* test or Friedman's test with Dunn's test. We used Spearman's correlation coefficient to evaluate the dependence of two variables. For all statistical tests, a $p < 0.05$ was considered as statistically significant.

3 Results

3.1 Baseline data

Baseline characteristics of patients and healthy controls, such as age, weight, height, and BMI (kg/m2) were published previously (22), for readers' convenience, the data are provided in Supplements as Supplementary Table 1. No differences in basic characteristics were found between the patients and the control group. However, in patients, but not in controls, significant differences were found between male and female in patient weight and height.

3.2 Metabolites of kynurenine and serotonin pathways in depressed patients and controls

Baseline levels of metabolites from the kynurenine and serotonin pathways, as well as NEO and BIO in urine are presented in Table 1. We observed significantly higher values of the KYN/TRP ratio in patients compared to healthy controls ($p < 0.01$). Additionally, TRP ($p = 0.02$) and its serotonin pathway metabolites—5-HTP ($p < 0.01$), SER ($p = 0.02$), and 5-HIAA ($p = 0.02$)—were significantly lower in patients than in controls (Table 1). At the baseline, no significant differences were found in the levels of NEO and BIO between patients and healthy controls. After dividing patients and healthy controls according to gender, we did not find significant differences between male and female in both groups of children and adolescents.

3.3 Effect of FA supplementation

The effect of omega-3 and omega-6 fatty acids on markers of the kynurenine pathway, as well as NEO and BIO, is presented in Table 2. Baseline TRP levels were not significantly different between the Om3 and Om6 groups. Administration of omega-3 FA did not affect the TRP level during the 12 weeks of supplementation. However, omega-6 FA administration significantly reduced TRP levels after 6 weeks and marginally significant after 12 weeks. Administration of the omega-3 FA emulsion induced an increased KYN/TRP ratio (representing IDO enzyme activity) and the level of KYN after 12 weeks of supplementation. Administration of omega-6-FA lead to an increase of the KYN/TRP ratio by week 6, but by week 12 the increase was marginally significant ($p = 0.051$). Comparison of metabolite levels in the Om3 and Om6 groups showed a significant difference in the KYN/TRP ratio by week 6, and in KYN at both the 6- and 12-week study points (Table 2).

Serotonin pathway metabolites were significantly influenced only by omega-3 FA. The first metabolite, 5-HTP, shoved a slight elevation at week 6 (13%) and week 12 (15%). However, no

differences between the Om3 and Om6 groups were observed in individual weeks (Table 2).

The level of NEO was not affected by the supplementation of either omega-3 or omega-6 FAs. However, the BIO level increased after 12 weeks (19%) of omega-3 FA supplementation (p=0.023), but not with omega-6 FA supplementation (Table 2).

3.4 Correlations between metabolites of tryptophan catabolic pathways, as well as neopterin and biopterin, and markers of oxidative stress and other markers related to depressive disorder

We investigated the association between metabolites of TRP catabolism, NEO, and BIO, and oxidative stress markers (8-isoP, LP, AOPP, NT, TEAC, SOD, GPx, CAT), as detailed in our published paper from the same patient cohort (22). Additionally, we explored correlations with inflammation markers (TXB, HCy), BDNF (23), lipid profile markers (21), EPA, DHA, omega-6/omega-3 FA ratio, CDI score (7), and salivary cortisol (15) (refer to Table 3). Only significant and marginally significant correlations are presented in Table 3, as other markers did not exhibit a notable correlation.

In terms of the correlations between the severity of depression, as measured by CDI scores, and the studied metabolites at baseline, only the correlation of CDI with 5-HIAA was found to be significant (r=0.334, p=0.011, n=57).

4 Discussion

In this paper, we focused on tracking the associations between TRP metabolites, pteridines (neopterin, biopterin), and selected markers from the same cohort of depressive children and adolescents already published [markers of lipid profiles and oxidative stress (21, 22), markers of inflammation response (23), omega-6/omega-3 FA ratio, and CDI score (7), and cortisol (15)].

The molecular mechanisms of depressive and anxiety disorders in children are not completely known (5, 6, 25). In our group of patients with depressive disorder, we found a lower level of TRP in urine compared to controls (Table 1). Both, increased (19, 26) and decreased (27, 28) TRP levels as well as heterogeneous results of KYN and KYP/TRP ratio (19, 26) were found in adult patients. Savitz et al. (29) reported unaltered levels of TRP metabolites in the kynurenine pathway in adult patients with depressive disorder and patients in remission compared to healthy controls.

Only a few results on tryptophan catabolism in children and adolescents with depressive disorder are available. DeWitt et al. (25) found no difference in the KYN/TRP ratio and kynurenic acid between depressed adolescents and healthy controls. In our study of depressed children and adolescents, we found decreased urinary TRP levels (Table 1). However, the KYN/TRP ratio, by Öztürk et al. (8), was higher compared to the controls (Table 1). The redirection of TRP metabolism to the kynurenine pathway rather than to the serotonin pathway in our cohort of patients is supported by the negative correlation between KYN/TRP and SER (r = − 0.273, p = 0.041). The levels of KYN were not significantly different between

TABLE 2 The effect of omega-3 and omega-6 FA on the metabolites of tryptophan, NEO and BIO in urine.

Metabolite [µmol/ mmol CR]	Om3 (n = 27)					Om6 (n = 27)					*p* between Om3 and Om6		
	Week 0	Week 6	*p* between 0 and 6	Week 12	*p* between 0 and 12	Week 0	Week 6	*p* between 0 and 6	Week 12	*p* between 0 and 12	Week 0	Week 6	Week 12
TRP	3.28 ± 1.14	3.40 ± 1.28	0.832 [b]	3.23 ± 1.01	0.964 [b]	3.39 ± 1.04	3.03 ± 0.97	**0.050** [b]	3.07 ± 0.85	0.066 [b]	0.712 [c]	0.249 [c]	0.514 [c]
KYN/TRP	0.88 ± 0.32	1.00 ± 0.35	0.128 [b]	1.06 ± 0.39	**0.045** [b]	0.72 ± 0.18	0.91 ± 0.30	**0.035** [b]	0.91 ± 0.34	0.051 [b]	0.132 [c]	**0.031** [c]	0.157 [c]
KYN	2.65 ± 0.59	3.10 ± 0.72	**0.021** [b]	3.09 ± 0.77	**0.048** [b]	2.41 ± 0.61	2.58 ± 0.63	0.534 [b]	2.48 ± 0.56	0.882 [b]	0.137 [c]	**0.007** [c]	**0.002** [c]
5-HTP	0.071 (0.056; 0.104)	0.080 (0.065; 0.144)	**0.008** [a]	0.082 (0.058; 0.108)	**0.035** [a]	0.070 (0.051; 0.090)	0.071 (0.053; 0.116)	0.742 [a]	0.062 (0.053; 0.094)	0.999 [a]	0.452 [d]	0.144 [d]	0.059 [d]
SER	0.145 (0.097; 0.299)	0.167 (0.089; 0.311)	0.829 [a]	0.149 (0.082; 0.298)	0.999 [a]	0.094 (0.069; 0.266)	0.134 (0.099; 0.286)	0.353 [a]	0.144 (0.096; 0.283)	0.999 [a]	0.113 [d]	0.847 [d]	0.921 [d]
5-HIAA	1.66 ± 0.41	1.54 ± 0.45	0.486 [b]	1.52 ± 0.42	0.294 [b]	1.69 ± 0.34	1.64 ± 0.38	0.886 [b]	1.60 ± 0.42	0.541 [b]	0.722 [c]	0.390 [c]	0.553 [c]
NEO	0.19 (0.13; 0.27)	0.19 (0.15; 0.25)	0.999 [a]	0.19 (0.13; 0.27)	0.995 [a]	0.19 (0.14; 0.30)	0.19 (0.16; 0.25)	0.999 [a]	0.19 (0.15; 0.29)	0.999 [a]	0.727 [d]	0.870 [d]	0.669 [d]
BIO	0.37 ± 0.12	0.41 ± 0.12	0.239 [b]	0.44 ± 0.17	**0.023** [b]	0.41 ± 0.10	0.42 ± 0.12	0.835 [b]	0.43 ± 0.12	0.687 [b]	0.236 [c]	0.758 [c]	0.742 [c]

Om3, omega-3 group; Om6, omega-6 group; CR, creatinine; TRP, tryptophan; KYN, kynurenine; 5-HTP, 5 -hydroxytryptophan; SER, serotonin; 5-HIAA, 5-hydroxyindole acetic acid; NEO, neopterin; BIO, biopterin; p, significance; a, Friedman test with Dunn's post hoc test; b, Repeated-measures one-way ANOVA with Tukey's post hoc test; c, unpaired t-test; d, Man-Whitney U test.
Bold values indicate significant p value.

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TABLE 3 Significant and marginally significant correlations between metabolites of TRP catabolism and markers of oxidative stress and selected parameters related to the pathophysiology of depressive disorder at baseline.

All Patients at baseline	n	r	*p*
5-HTP and LP	50	0.259	*0.069*
SER and LP	50	0.285	**0.045**
SER and AOPP	57	0.301	**0.023**
SER and NT	57	−0.393	**0.039**
5-HIAA and BDNF	50	−0.284	**0.045**
5-HIAA and GPx	57	−0.336	**0.011**
5-HIAA and Chol	57	0.335	**0.011**
5-HIAA and Cortisol	55	0.262	*0.051*
KYN/TRP and Cortisol	55	0.268	**0.048**
KYN/TRP and Om6/Om3	53	0.292	**0.034**
KYN and TEAC	57	0.352	**0.007**
NEO vs. GPx	57	-0.275	**0.038**
BIO vs. TXB	53	-0.311	**0.024**
5-HIAA and CDI	57	0.334	**0.011**

TRP, tryptophan; KYN, kynurenine; 5-HTP, 5 -hydroxytryptophan; SER, serotonin; 5-HIAA, 5-hydroxyindoleacetic acid; NEO, neopterin; BIO, biopterin; LP, lipoperoxides; AOPP, advanced oxidation protein products; NT, nitrotyrosine; GPx, glutathione peroxidase; TEAC, trolox equivalent antioxidant capacity; BDNF, brain derived neutrophic factor; Chol, total cholesterol; Om3, omega-3 fatty acids; Om6, omega-6 fatty acids; CDI, Children's Depression Inventory; n, group size; r, Spearman's rank correlation coefficient; p, significance.
Bold values indicate significant p value.

depressive patients and healthy controls in our study (Table 1) as well as in the study of Öztürk et al. (8). As we did not determine kynurenic acid (KA) (neuroprotective metabolite) for technical reasons, nor quinolinic acid (QUIN) (neurotoxic metabolite), we cannot further elaborate on the latter finding.

The second pathway of TRP catabolism is the serotonin pathway (Figure 1). In our patients, the levels of 5-HTP, SER, and 5-HIAA were significantly lower compared to healthy controls. Since baseline TRP levels in patients and healthy controls differed, we recalculated the ratios of individual metabolites of the serotonin pathway. The 5-HTP/TRP ratio was significantly lower in patients ($p = 0.017$) (Figure 3), supporting our previous findings of redirecting TRP catabolism to the kynurenine pathway. The SER/5-HTP ratio was not different between patients and controls, while the 5-HIAA/SER ratio was significantly higher in patients compared to controls ($p = 0.031$) (Figure 3). This suggests that monoamine oxidase (MAO) activity (represented by the 5-HIAA/SER ratio) was increased in patients, leading to the increased formation of 5-HIAA. Similarly, Jones and Raghanti (30) found increased activity and expression of MAO in both depressed patients and animal experiments. This finding is consistent with the study of Jayamohanan et al. (10), who found that the level of 5-HIAA increases with stress. In our pediatric patients, the level of 5-HIAA marginally significantly positively correlates with cortisol level (p=0.051), significantly with the severity of depression (CDI score) (p=0.011), and negatively with brain-derived neurotrophic factor (BDNF) (p=0.045). These findings point to the involvement of 5-HIAA in the pathophysiology of depressive disorder. The low levels of SER and 5-HIAA in CSF are associated with suicide attempts (16, 31). A low cholesterol level in adult patients is also correlated with suicide attempts (32). Similarly, we also found a positive correlation between total cholesterol (21) and 5-HIAA in the urine of our pediatric patients (Table 3). Patients with depressive disorder in our study did not report suicidal attempts, which are associated with low 5-HIAA and cholesterol levels (16, 32).

Omega-3 fatty acids, EPA, DHA, and their ratio play an important role in the pathophysiology of depressive disorders (7). In a recent review, Zhou et al. (33) discussed an antidepressant effect of omega-3 FA. Carabelli et al. (34) found that fish oil high in omega-3 fatty acids inhibited indoleamine 2,3-dioxygenase (IDO) and increased SER in the male Wistar rat model system after induction of depression with lipopolysaccharide. In another model system, omega-3 fatty acids positively influenced the reduction of neurogenesis caused by pro-inflammatory cytokines by increasing neurogenesis. Moreover, EPA and DHA inhibited the formation of KYN, QUIN, and mRNA expression of the enzyme kynurenine-3-monooxygenase (35). Fish oil supplementation has been reported to decrease the expression of IDO (represents KYN/TRP ratio) and increase the level of SER in the hippocampus (34).

We found that omega-3-FA supplementation increases the urinary KYN/TRP ratio (representing IDO activity) after 12 weeks of supplementation and increases KYN levels after 6 and 12 weeks of omega-3-FA supplementation. At the same time, omega-3 FAs increased the level of the first metabolite of the serotonin pathway, 5-HTP, after 6 and 12 weeks (Table 2).

Similarly, omega-6 FA increases the KYN/TRP ratio after 6 weeks of supplementation, but after 12 weeks the increase is borderline significant. The serotonin pathway is not affected by omega-6 FAs.

The stimulatory effect of omega-3 FA on the formation of KYN found in our work contradicts the findings of Carabelli et al. (34) and Borsini et al. (35). As we mentioned above, we did not

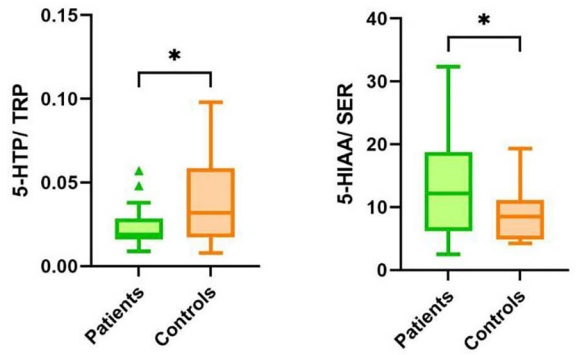

FIGURE 3
Ratios of metabolites in the serotonin pathway of TRP catabolism in patients and controls. TRP, tryptophan; 5-HTP, 5-hydroxytryptophan; SER, serotonin; 5-HIAA, 5-hydroxyindoleacetic acid, *$p < 0.05$.

determine either KA or QUIN and therefore cannot assess whether the transformation of KYN was more neuroprotective (through KA formation) or neurotoxic (through the formation of QUIN). This would help to explain the relationship between omega-3 FAs and their possible positive or negative effect on the kynurenine pathway of TRP catabolism. We do not assume that the increased level of KYN after omega-3 FA supplementation would have a fundamental effect on the severity of depression, as the correlations between the CDI score and KYN (r=−0.055, p=0.683), or the KYN/TRP ratio (r=−0.074, p=0.585) were not significant at baseline or after 6 or 12 weeks of omega-3 FA supplementation.

Omega-3-FA supplementation increased 5-HTP by 15% after 12 weeks. SER was increased non-significantly by 15.2% after 6 weeks. We can only speculate that omega-3 FA exerts their antidepressant effect, except for other mechanisms (7), through the weak stimulation of the serotonin pathway of TRP catabolism rather than through inhibition of the kynurenine pathway.

No correlation was found between the studied metabolites of TRP degradation and the concentrations of EPA and DHA FAs determined in the same cohort of patients (7). However, in the present study, it was found that the omega-6/omega-3 FA ratio positively correlates with KYN/TRP (r = 0.292, p = 0.034) in patients. These findings align with the conclusions of Oxenkrug (11), who discovered that omega-3 FAs transcriptionally inhibit IDO expression. Trebatická et al. (7) also found that the severity of depressive disorder in children and adolescents is more influenced by the ratio of omega-6 to omega-3 fatty acids than by the levels of EPA and DHA alone. It can be assumed that the current correlation between the omega-6 to omega-3 fatty acid ratio and the KYN/TRP ratio supports the importance of fatty acid composition in the pathophysiology of depressive disorder. The positive effect of omega-3 FA can also be attributed to their anti-inflammatory activity (22, 33) (Figure 1).

The metabolic pathways of tryptophan (TRP) breakdown are significantly affected by high levels of permanent stress. Stress activates the HPA axis, leading to excessive cortisol production. Cortisol, in turn, activates the IDO/TDO enzymes and the kynurenine pathway through the production of pro-inflammatory cytokines (Figure 1). In a study by Michels et al. (14), the relationship between TRP catabolism, psychological stress, and inflammation was evaluated. The authors concluded that psychological stress in adolescents correlated with kynurenine pathway metabolites in the presence of high inflammation. In our recent study (15), we measured the level of salivary cortisol in depressed patients. However, direct markers of the inflammatory response were not monitored, and high-sensitivity C-reactive protein (hsCRP) did not indicate strong inflammation. Midday cortisol showed a significant but weak correlation between cortisol and the KYN/TRP ratio (r = 0.268, p = 0.048) and a borderline significant correlation with the final metabolite of the serotonin pathway, 5-HIAA (r = 0.262, p = 0.051). Our results suggest that in children and adolescents with depressive disorder, stress represented by cortisol can initiate the kynurenine pathway and possibly activate monoamine oxidase (MAO), leading to the subsequent decomposition of serotonin (SER) into 5-HIAA and potentially contributing to the worsening of depression.

Metabolites of the kynurenine pathway, 3-HK, and QUIN, are known pro-oxidative metabolites, forming superoxide, hydroxyl radical, and hydrogen peroxide (36). The superoxide can react with NO to form the highly reactive peroxynitrite, ONOO–. The activation of the kynurenine pathway contributes to the formation of reactive oxygen and nitrogen species and thereby increases oxidative stress (11). The oxidation of SER to 5-HIAA in the serotonin pathway catalyzed by MAO also produces the pro-oxidant, H_2O_2 (37). The onset of oxidative stress goes hand in hand with the activation of inflammation, leading to the activation of IDO and thus kynurenine catabolism (38).

We presented the association of oxidative stress with depressive disorder in children and adolescents in a recent paper (22). We found an increased level of 8-isoprostanes in urine (later products of lipoperoxidation), AOPP, and NT, and reduced activity of GPx compared to healthy children. We also found a strong positive correlation of depression severity, CDI with NT at baseline, and a negative correlation with TEAC, SOD, and GPx. In this study, we correlated oxidative stress markers (22) with metabolites of the kynurenine and serotonin pathways. Surprisingly, neither KYN/TRP nor KYN correlated with markers of oxidative stress. However, SER positively correlated with LP and AOPP. This could be attributed to the fact that in depression, the activity of MAO (the enzyme that catalyzes the conversion of SER to 5-HIAA) (Figure 1) is increased and that H_2O_2 formed during the catalytical reaction can trigger lipoperoxidation and oxidative damage to proteins (39). Reduced GPx activity also contributes to the formation of LP (a marker of the earlier phase of lipoperoxidation) (22). These connections are also supported by our present finding of a negative correlation between 5-HIAA and GPx in depressive patients (Table 3).

In our recent work (22), we posited that the causal marker of oxidative stress in adolescents with depressive disorder is NT. Nobis et al. (40) found a decreased level of TRP and an increased level of NT in the urine of adult depressive patients by our results in children and adolescents. This supports our assertion that nitrosative stress also plays a role in the pathophysiology of depressive disorder (41). Notably, in the present work, NT negatively correlated with SER (r =−0.393, p=0.039) in patients with depressive disorder, supporting our previous observation.

The observed negative correlation between 5-HIAA and BDNF in our pediatric patients (Table 3) leads us to speculate that 5-HIAA may negatively affect the maintenance and survival of neurons and synaptic plasticity regulated by BDNF (41). The kynurenine and serotonin pathway metabolites did not correlate with CDI, except for the correlation between 5-HIAA and CDI in depressed patients (r = 0.334, p = 0.011). This result, along with the negative correlation between 5-HIAA and BDNF, hints at the importance of 5-HIAA in the pathophysiology of depressive disorder in children and adolescents.

Information on NEO and BIO levels in depressed children and adolescents is only sporadic and quite heterogeneous. In our pediatric and adolescent patients, we did not detect a difference in NEO and BIO from healthy controls. Deac et al. (2016) found in healthy non-inflamed young individuals (18-28 y.) a positive correlation of NEO with KYN and KYN/TRP ratio and a negative correlation with TRP

(42). In our work, we did not find a significant correlation between NEO, BIO, and metabolites of TRP catabolism neither in healthy children nor in depressed patients. However, we found in depressed patients a negative correlation between NEO and the antioxidant enzyme GPx (22), between BIO and the inflammatory marker TXB (23), and a positive correlation between BIO and total antioxidant capacity (TEAC) (22). These findings confirm the involvement of inflammation, oxidative stress, and imbalance in TRP catabolism pathways in the pathophysiology of depressive disorder in children and adolescents.

The level of NEO in the urine of depressed patients was not affected by either omega-3 or omega-6 FA during the 12-week supplementation period. However, BIO increased significantly after 12 weeks of omega-3 FA but not omega-6 FA supplementation. There are no known studies on the relationship between NEO, omega-3 FA, and depression. However, in adult patients with coronary artery disease, a weak negative correlation was found between fish intake and KYN/TRP ratio and omega-3 FA intake and plasma NEO (43). Since there is not enough information about the role of BIO and tetrahydrobiopterin in the pathophysiology of depressive disorder, this topic is currently a matter of discussion.

The presented study has certain limitations. Gender differences were not thoroughly explored due to the small number of boys included in the study. This is attributed to the higher prevalence of depressive disorder in girls and the general reluctance of boys to provide biological samples. Additionally, the patient group consisted of a maximum of 58 individuals (46 females and 12 males), while the healthy control group comprised from ethical reason only 20 individuals (12 females and 8 males). Nutritional habits of patients and controls were not monitored, preventing a complete explanation for the baseline difference in urinary TRP levels between patients and controls. However, participants were instructed to follow a standard diet with an obligation to inform the responsible doctor about any deviations in eating habits. Furthermore, the study did not measure the levels of quinolinic acid (QUIN) or kynurenic acid (KA), which would offer a more detailed understanding of the balance in TRP metabolism (neurotoxic versus neuroprotective pathways) and the involvement of TRP metabolites in the pathophysiology of depressive disorder.

5 Conclusion

The impact of both omega-3 fatty acids (FAs) and omega-6 FAs was evident in the increased activation of the KYN/TRP ratio. The lack of QUIN and KA measurements limits our ability to explain these findings and assess the potential influence of fatty acids on the degradation of TRP concerning the neurotoxic or neuroprotective functions of its metabolites. Interestingly, omega-3 FAs, but not omega-6 FAs, led to an increase in the production of the first metabolite of the serotonin pathway, 5-HTP. We established a connection between the kynurenine and serotonin pathways of TRP catabolism and depressive disorder in children and adolescents.

However, no association was observed between NEO and BIO and the metabolites of TRP degradation. While cortisol was found to stimulate the kynurenine pathway of TRP catabolism, it showed no correlation with the severity of depression. On the other hand, the terminal metabolite of the serotonin pathway, 5-HIAA, exhibited a significant positive correlation with CDI and a negative correlation with BDNF. This supports the idea that 5-HIAA plays a role in the pathophysiology of depressive disorder in children and adolescents.

We confirmed the link between oxidative stress and the catabolism of TRP in depressive children. NEO shows an association with oxidative stress through a negative correlation with glutathione peroxidase (GPx), and biopterin (BIO) shows a negative correlation with TXB.

Importantly, we were the first to underscore the significance of the precise omega-6/omega-3 fatty acid ratio and its correlation with the kynurenine pathway of TRP degradation (KYN/TRP ratio) in the pathophysiology of depressive disorders in children and adolescents.

It's crucial to note that depressive disorder is a highly multifactorial condition. Therefore, the generalization of our findings necessitates further studies with precise diagnoses and larger study cohorts.

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.

Ethics statement

The studies involving humans were approved by Ethics Committee of the National Institute of Children's diseases and the Faculty of Medicine, Comenius University Bratislava (20 March 2013). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Children provided verbal assent before participation in the study.

Author contributions

LI: Formal analysis, Visualization, Writing – original draft. MM: Formal analysis, Writing – review & editing. JM: Methodology, Writing – review & editing. ZP: Formal analysis, Writing – review & editing. IG: Methodology, Writing – review & editing. ZĎ: Conceptualization, Project administration, Supervision, Writing – review & editing, Funding acquisition. LŠ: Conceptualization, Supervision, Visualization, Writing – review & editing. JT: Conceptualization, Investigation, Supervision, Writing – review & editing.

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Conflict of interest

Oil emulsions were provided by Cultech Ltd., UK. IG is an employee of Cultech Ltd. and had no role in the recruitment, data collection, and analysis. ZP, JM, JT, and ZD are/have been involved in other collaborative projects with Cultech Ltd.

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1347178/full#supplementary-material

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Glow up: does a professional photoshoot intervention affect self-esteem and emotions among adolescent psychiatric patients?—A longitudinal intervention study

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Background: Today, online communication is shaped by a billion-dollar social media (SM) and social networking site (SNS) industry. Visual content consumed by children and adolescents has been shown to influence behavioral patterns, state emotions, and self-esteem (SE). In this study, we introduced a novel intervention creating visual content through a professional photoshoot and investigated its impact on state emotions and SE in child and adolescent psychiatric (CAP) patients.

Methods: Standardized and validated self-rating questionnaires were used to assess SE, state emotions, coping mechanisms, psychopathological symptoms, and internet use behavior at baseline. SE and state emotions were monitored at different time points around a professional photoshoot within 45 CAP patients (30 female patients; mean age, 15.1 years) using a longitudinal design.

Results: Within-subject repeated-measures ANOVA and bootstrapped paired-sample *t*-tests showed a significant fluctuation in state emotions and SE throughout the intervention. Spearman correlations and univariate logistic regressions revealed that internalizing symptomatology and maladaptive coping significantly worsened the outcome of the intervention on state emotions and SE in girls. Internet-related variables heightened the positive effect of the intervention in boys and lowered SE in girls during the intervention.

Conclusion: The photo intervention had various gender-specific effects. Boys did benefit from the intervention in terms of longitudinal outcome on positive

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state emotions (PE) and SE, even positively influenced by SNS and SM. Thus, it might be concluded that online social comparison was processed more beneficial in boys. In contrast, when working with visual content in girls, psychopathology and coping must be considered. Internet consumption in general, especially SM and SNS, was related to low SE in girls. Nevertheless, when therapeutically accompanied, the "glow up moment" during the shoot (high on PE and SE; low on negative state emotions) could be used as an index moment for therapeutic reflection.

KEYWORDS

children and adolescent psychiatry, self-esteem, state emotions, photo intervention, gender differences, social media, social networking sites

1 Introduction

With over five billion users worldwide, the internet plays a key role in the way we communicate today (1). Social media (SM) and social networking sites (SNS) have been found to promote pro-social functions, such as social support, friendship enhancement and maintenance, and to decrease loneliness (2).

In a parallel vein, SM and SNS are linked to a billion-dollar industry (3). The source of income for SM and SNS companies is product placement aiming to influence consumption behavior (4). Product presentation in SMS and SNS is characterized by behavior-relevant visual triggers, by communication through apparently like-minded peers (influencers), and by purchase recommendation with an ostensible non-commercial interest (5–9). The industry and its framework are accompanied by high-scale research on reachability of the main target group, which are young people in the phase of self-reflective identity seeking (10, 11). Products are presented by generally attractive, successful people of young age, leading to a continuous confrontation with perfect images of peers (12). Recently, an article in the *Wall Street Journal* leaked internal investigation results indicating that the use of Instagram increased body image dissatisfaction in adolescents, especially girls, leading to the development of eating disorders and depressions (13). Negative body image is associated with dissatisfied self-image and poses a high risk of developing low self-esteem (SE) (14), depression, and poor quality of life (14, 15). The irritation caused by idealized images on SM and SNS might be intentional, triggering the need to consume in order to adapt or to create an own desirable online personality (16).

SM and SNS aim at the basic human urge to communicate (17) and the human desire to be recognized by others (18). Needs such as visibility, acceptance, belonging, and at the same time recreational distraction are particularly present in adolescence (12, 19, 20), a phase characterized by various biological (21), psychological, and social changes (22) and affective regulation and identity formation processes (23). In particular, adolescents with low SE are more prone to instant messaging addiction (24) as well as problematic internet use (PIU) (25), while high SE may play a protective role in terms of PIU (26). PIU in adolescents can intensify maladjustment leading to altered self-concept and low self-satisfaction (27, 28), psychopathological symptoms, distinctive personality traits (29, 30), and problematic behavior among users (31, 32).

As psychopathological symptoms are often associated with poor SE and a negative self-perception (28, 33), creating a positive self-image is a major goal in psychotherapy with children and adolescents. Classic psychotherapeutic approaches are mainly language based and low SE is difficult to target, especially when it gets to personal appearance and body image. Being aware of the importance of visual content experiences online when it comes to social comparison and the impact on self-perception and identity development, an exclusively verbally conveyed approach seems insufficient when working with adolescent patients. Using photography as a therapeutic tool for psychiatric patients has been found to improve social skills, impulse control, and SE (34, 35). Different approaches such as the use of personal photographs as a representation for self-analysis (36, 37) or taking and posting a daily photo on SNS have been found to be related to positive therapeutic outcomes in terms of social interaction and emotion regulation (38–42).

Inspired by the project "Glow-up" created by Theresa Marka, in which she offered a professional photoshoot (PS) to her university fellows, we designed a study implementing a PS for child and adolescent psychiatric (CAP) patients (https://textmarka.com/category/project-glow-up/accessed on 05.10.2023). We chose a multiple time point assessment design in order to monitor the

Abbreviations: AICA, Scale for the Assessment of Internet and Computer Game Addiction; CAP, Child and adolescent psychiatric; CIUS, Compulsive Internet Use Scale; FEEL-KJ, Questionnaire for the evaluation of emotional regulation in children and adolescents; NE, Negative state emotions; PANAS, Positive and negative affect schedule; PE, Positive state emotions; PIU, Problematic internet use; PS, Photoshoot; SE, Self-esteem; SEKJ, Self-Esteem inventory for Children and Adolescents; SM, Social media; SNS, Social networking sites; YSR, Youth Self-Report.

whole process including the phase of expectation, the actual shooting process, the reaction to the photos, and a follow-up in terms of SE and state emotions. We then analyzed the impact of psychopathological symptoms, coping strategies, and internet behavior on the course of the interventional outcome in CAP patients.

2 Methods, materials, and statistics

2.1 Participants and procedure

The study took place at the University Clinics for Child and Adolescent Psychiatry and Psychotherapeutic Medicine, Salzburger Landeskliniken, Paracelsus Medical University between June 2021 and February 2022. The department offers inpatient, outpatient, and day-clinic treatment and is the major supply hospital in the state of Salzburg, Austria.

A total sample of 45 children and adolescents was enrolled in the study. Inclusion criteria were (1) a minimum age of 12 (2), a maximum age of 20 (3), being a patient at University Clinics for Child and Adolescent Psychiatry and Psychotherapeutic Medicine, and (4) a written declaration of consent signed by patients and caregivers. Exclusion criteria were (1) inability to fill out self-rating questionnaires due to intellectual disability or insufficient German language proficiency (2), acute suicidality, and (3) eating disorder or acute severe psychiatric disorders with thought disorder and loss of reality (such as psychotic disorders and complex posttraumatic stress disorders) present at the time of the study. Inclusion and exclusion criteria were clinically assessed by the clinician responsible for psychiatric treatment.

The same intervention procedure was chosen for each participant. After the invitation to participate in the study and consent, a baseline test was collected, further test points were immediately determined before the PS, during the PS, upon receipt of the pictures, and 3 months after receipt of the pictures. This made it possible to record emotions and SE in detail throughout the entire process (see Figure 1).

The PS took place in urban locations within walking distance from the clinics. Led by a professional photographer (Theresa Marka), the session spanned between 1.5 and 2 h, allowing participants ample time to feel at ease in front of the camera. The photography equipment utilized included a Canon 5D Mark II camera body with EF 24–70 mm f/2.8l and EF 70–200 mm f/2.8l lenses, set to program auto mode. Prior to the PS, the participants received a concise introduction to camera handling. The photographer conducted the PS individually with the participants, initiating the session with a stroll outside the clinic while engaging in light conversation to establish a sense of comfort and safety. The three designated photo locations were carefully selected to offer distinct settings. These included a serene nature spot, an urban locale adorned with vibrant graffiti capturing the essence of youth, and a backdrop featuring an architectural urban building. At the onset of the shoot, the photographer provided guidance on posing to help participants relax, subsequently minimizing interference to preserve authenticity. Employing professional techniques, diverse perspectives, including close-ups and long shots, wide-angle and portrait compositions, and full-body shots and shots from varying angles such as low and high, to capture a comprehensive view of the participants were incorporated during the PS. Post-PS, the pictures were imported to the photographer's laptop and underwent minimal alteration, limited to color correction using the Adobe Lightroom application to achieve a more accurate representation of the scene, focusing on white balance adjustment, exposure and contrast, saturation and vibrance, hue adjustment, and tonal curve adjustments. This process was used to maintain a natural and authentic representation of the participants while ensuring that the colors were balanced. After the color correction, the pictures were exported as JPEGs onto a USB flash drive.

Approximately 1 week after the PS, each participant received between 120 and 150 photos on a personal USB flash drive. This procedure of receiving the photos was accompanied by one of the authors of the study and the photographer. The photos were shown to each participant and they were given opportunities to talk about the photos and their perceptions. After their talk, they completed the questionnaires of T4 (see Figure 1). To ensure privacy, the

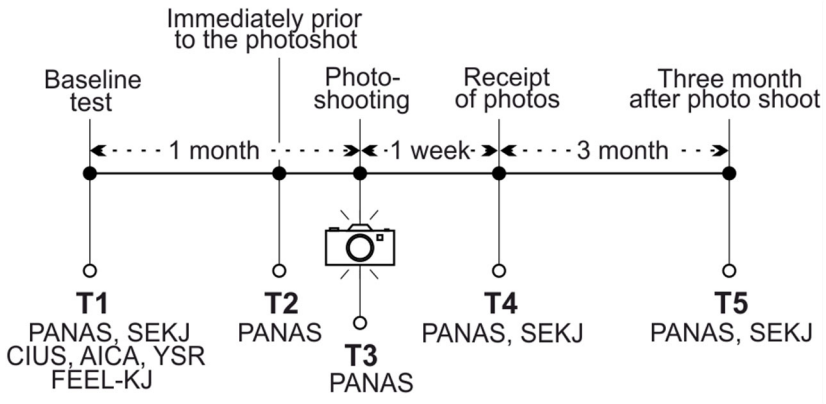

FIGURE 1
Test application in the longitudinal study design.

pictures were deleted from all data storage devices used during the procedure after handing out the USB flash drive. The participants were allowed to do whatever they want with the photos. There was no obligation to post the photos online.

2.2 Measures

2.2.1 Positive and negative affect schedule

The Positive and Negative Affect Schedule (PANAS) is widely used to assess emotions (43, 44). It consists of 20 adjectives, which correlate to certain sensations and feelings. Items are rated on a five-point Likert scale ranging from 1 (= not at all) to 5 (= extremely). Summary scales for positive state emotions (PE) and negative state emotions (NE) are summarized based on 10 items, respectively (44). Depending on instruction, it is possible to measure affect in different contexts such as (i) the present moment, (ii) any past moment (day, week, or year), or (iii) in general (on average). The scale provides information to measure emotional responses to events as well as emotional fluctuations throughout a specific time frame (44). It is reliable and valid and shows a high internal consistency with a stability at appropriate levels over a period of 2 months (44). The German version of the PANAS has been derived from the English version (43).

2.2.2 Self-esteem inventory for children and adolescents (German: Selbstwertinventar für Kinder und Jugendliche)

The Self-Esteem inventory for Children and Adolescents (SEKJ) contains three scales to assess important domains of SE, namely, height, stability over time, and academic contingency bound (45). All scales consist of 10 to 12 items/statements (32 items in total) scoring on a five-point rating scale to assess the extent of either agreement or disagreement. The internal consistency for all three scales scores between Cronbach α = 0.81 and 0.86 for 10- to 12-year-olds and between Cronbach α = 0.87 and 0.90 for 13- to 16-year-olds (46). The formulations of the specific scale items are based on systematic construct definitions and guarantee item validity of the inventory and were confirmed with two factor analyses (45). Expectation conform scale intercorrelations as well as associations with other factors such as depression, school phobia, rumination, and self-concept provide clear evidence for convergent/discriminant validity of the scales. The SEKJ was standardized in a sample of n = 3.121 pupils aged 10–16 years (45). The norm sample was representative for this age group in Germany in terms of geographical, gender, and school-type distribution (45).

2.2.3 Compulsive internet use scale and scale for the assessment of internet and computer game addiction

We used a combination of the Compulsive Internet Use Scale (CIUS) (47) and the Scale for the Assessment of Internet and Computer Game Addiction (AICA) (48) to assess internet consumption behavior. The CIUS is a widely used self-report questionnaire that contains 14 items to assess internet use and its compulsiveness (47). The items measure loss of control, preoccupation (mental and behavioral), conflict (intrapersonal and interpersonal), withdrawal symptoms, and coping or mood modification on a five-point Likert scale. The CIUS sum score ranges from 0 to 56 points (47). A cutoff score of 21 points identifies a subthreshold PIU, whereas 28 points confirm PIU (49). The items of the CIUS are based on the Diagnostic and Statistical Manual of Mental Disorders version 4 criteria for dependence, obsessive–compulsive disorder, and behavioral addictions (47). The CIUS shows good reliability (Cronbach α = 0.89–0.90), good internal consistency (Cronbach α = 0.87), and good validity (47). The AICA was developed to assess the use of online formats (gaming, streaming, SM, and SNS) and appears in different versions (48). The screening version is a self-questionnaire tool based on the Diagnostic and Statistical Manual of Mental Disorders version 5 criteria for internet gaming disorder (50), consisting of six items measuring specific internet use within the last 12 months (51). When compared to external ratings of psychotherapists, scores of the self-report version of the AICA obtained a good diagnostic accuracy (sensitivity = 80,5%; specificity = 82,4%) as well as sound psychometric properties (52).

2.2.4 Youth self-report

The Youth Self-Report (YSR) is a widely used self-report instrument, measuring behavioral and emotional problems among youth aged 11–18 years during the past 6 months (53). A total of 118 items can be rated on a three-point scale from 0 (= not true) to 2 (= very true). The scores lead to a total problem scale, two broadband scales (internalizing and externalizing problems) and eight empirically derived first-order syndrome scales (somatic complaints, social withdrawal, thought problems, social problems, anxiety/depression, aggressive behaviors, delinquent behaviors, and attention problems) (53). The YSR shows good validity, reliability, and internal consistency (54).

2.2.5 Questionnaire for the evaluation of emotional regulation in children and adolescents (German: Fragebogen zur Erhebung der Emotionsregulation bei Kindern und Jugendlichen)

The Questionnaire for the evaluation of emotional regulation in children and adolescents (FEEL-KJ) is a standardized self-report questionnaire to assess emotion regulation (55). It contains 15 different strategies of emotion regulation consisting of five maladaptive, seven adaptive, and three other strategies. They are rated on five-point Likert scales evaluating the emotions sadness, fear, and anger. The questionnaire shows an internal consistency between Cronbach α = 0.69 and 0.93 (55).

2.2.6 Narrative follow-up assessment

As part of the follow-up, the following questions were assessed based on written narrative. Question 1: How do you feel about the photos today? Question 2: Do you sometimes look at them? Question 3: Have you posted them on the Internet? For analyses, question 1 was coded into three categories: positive, ambivalent, and negative feelings toward the photos; question 2 was coded into two

categories: yes/no revising the photos; and question 3 was coded into two categories: yes/no posting the photos.

2.3 Statistical and data analysis

Differences in demographics, internalizing and externalizing problems (YSR), maladaptive and adaptive strategies (FEEL-KJ), height of SE (SEKJ), PE and NE (PANAS), general internet, and specific internet behaviors (CIUS and AICA) between girls and boys were analyzed using chi-square tests for categorial variables and Mann–Whitney *U*-tests for continuous variables. Effect sizes of significant findings in chi-square tests were calculated using Cramers *V* with values >0.10 interpreted as small effects, >0.30 interpreted as medium effects, and 0.50 interpreted as large effects (56). Effect sizes of significant Mann–Whitney *U*-test findings were calculated using Cohen's *d* with values >0.20 interpreted as small effects, >0.50 interpreted as medium effects, and 0.80 interpreted as large effects (56).

To test for the difference in mean scores of variables assessed in repeated observations, a within-subject repeated-measures ANOVA was performed using SPSS Version 28. Effect sizes were calculated using Cohen's *d* (56). To test potential differences between the levels of PE, NE (PANAS), and SE (SEKJ) over time, we used bootstrapped paired-sample *t*-tests. For those sections in the interventional course that showed a significant rise or decline, simple linear regressions were administered to test if individual variables [internalizing and externalizing problems (YSR), maladaptive and adaptive strategies (FEEL-KJ), and general and specific internet use (CIUS and AICA)] significantly influence the section history. To assess possible influences of internet use-related variables, internalizing and externalizing symptomatology, and adaptive and maladaptive strategies on PE, NE, and SE at the different time points of the intervention, we performed two-tailed Spearman correlations.

All analyses were conducted in SPSS version 28.

2.4 Ethics

This study was approved on the 25 June 2021 by the ethics committee (ethic committee vote number: 1,091/2,021) of the state of Salzburg and was performed according to the Declaration of Helsinki 1995 (as revised in Edinburgh in 2000). All participants and their legal custodians provided written informed consent prior to participating in the study.

3 Results

3.1 Descriptive measures

Our study population consisted of 45 patients with a mean age of 15.51 years, of which $n = 30$ (66.7%) were female and $n = 15$ (33.3%) were male. A total of 24 participants received in-patient treatment, 13 received outpatient treatment, and 8 received day-clinic treatment.

Mean average use of the internet was 5.35 h/day on weekdays and 7.08 h/day on weekends. There was no difference in gender regarding the internet use on weekdays ($U = 197.5$, $Z = -0.317$, $p = 0.751$) or weekends ($U = 174.5$, $Z = -0.899$, $p = 0.369$). Psychopathology was obtained from our internal medical records. In the study, patients with diagnoses from the following categories were included: substance use disorders ($n = 1$), affective disorders ($n = 3$), neurotic, stress-related, and somatoform disorders ($n = 23$), personality disorders ($n = 7$), and disruptive behavior disorders ($n = 11$). There were no significant gender differences obtained, except for disruptive behavior disorders (male individuals, $n = 7$) [χ^2 (1, 45) = 6.016, $p = 0.026$].

TABLE 1 Descriptives for age and outcome measures of instruments used: CIUS (generalized internet behavior), AICA (application-related internet behavior), YSR (internalizing and externalizing problems), FEEL-KJ (coping strategies), PANAS (positive and negative state emotions), and SEKJ (Self-esteem).

	Total sample ($n = 45$)	Girls ($n = 30$)	Boys ($n = 15$)	Test[1,2]	Effect size[3,4]
Demographics					
Age (m, SD)	15.51 (1.66)	15.33 (1.647)	15.87 (1.685)	$p = 0.249^1$	0.172^4
CIUS					
CIUS score (m, SD)	23.80 (10.05)	22.20 (9.77)	27.00 (10.17)	$p = 0.071^1$	0.269^4
CIUS no PIU (CIUS ≤ 20; *n*, %)	19 (42.2)	16 (53.3)	3 (20.0)	$p = 0.054^2$	0.318^3
CIUS subthreshold PIU (CIUS = 21–27; *n*, %)	14 (31.1)	8 (26.7)	6 (40.0)	$p = 0.497^2$	0.136^3
CIUS PIU (CIUS ≥ 28; *n*, %)	12 (26.7)	6 (20.0)	6 (40.0)	$p = 0.174^2$	0.213^3
AICA categories					
AICA CP score (m, SD)	5.22 (6.47)	3.97 (6.40)	7.73 (6.04)	$p = 0.015^1$	0.363^4
AICA stream score (m, SD)	5.93 (5.77)	5.07 (5.47)	7.67 (6.14)	$p = 0.150^1$	0.214^4

(Continued)

TABLE 1 Continued

	Total sample (n = 45)	Girls (n = 30)	Boys (n = 15)	Test[1,2]	Effect size[3,4]
AICA categories					
AICA SM score (m, SD)	7.16 (6.15)	7.17 (6.75)	7.13 (4.97)	$p = 0.506$[1]	0.099[4]
AICA SNS score (m, SD)	8.02 (6.40)	7.73 (6.33)	8.60 (6.72)	$p = 0.646$[1]	0.068[4]
YSR					
Internalizing score (m, SD)	26.82 (11.67)	28.40 (11.22)	23.67 (12.30)	$p = 0.242$[1]	0.174[4]
Externalizing score (m, SD)	19.96 (10.33)	21.07 (10.25)	17.73 (10.48)	$p = 0.462$[1]	0.109[4]
FEEL-KJ					
Adaptive strategies (m, SD)	113.16 (29.42)	117.57(30.09)	104.33 (26.83)	$p = 0.064$[1]	0.276[4]
Adaptive strategies below norm (n, %)	20 (44.4)	10 (33.3)	10 (66.7)	$p = 0.056$[2]	0.316[3]
Adaptive strategies within norm (n, %)	23 (51.1)	19 (63.3)	4 (26.7)	$p = 0.029$[2]	0.346[3]
Adaptive strategies above norm (n, %)	2 (4.4)	1 (3.3)	1 (6.7)	$p = 1.00$[2]	0.076[3]
Maladaptive strategies (m, SD)	100.62 (15.76)	102.53(16.88)	96.80 (12.93)	$p = 0.135$[1]	0.222[4]
Maladaptive strategies below norm (n, %)	1 (2.2)	1 (3.3)	0 (0.0)	$p = 1.00$[2]	0.107[3]
Maladaptive strategies within norm (n, %)	11 (24.4)	6 (20.0)	5 (33.3)	$p = 0.464$[2]	0.146[3]
Maladaptive strategies above norm (n, %)	33 (73.3)	23 (76.7)	10 (66.7)	$p = 0.496$[2]	0.107[3]
PANAS (1 month prior to intervention)					
Positive emotions (m, SD)	15.82 (7.41)	16.43 (7.97)	14.60 (6.19)	$p = 0.433$[1]	0.116[4]
Negative emotions (m, SD)	20.00 (8.68)	20.27 (9.82)	19.43 (5.80)	$p = 0.733$[1]	0.065[4]
SEKJ (before intervention)					
Self-esteem Score (m, SD)	25.02 (10.20)	24.48 (10.85)	26.07 (9.09)	$p = 0.519$[1]	0.097[4]
Self-esteem below norm (n, %)	29 (65.9)	21 (72.4)	8 (53.3)	$p = 0.315$[2]	0.191[3]
Self-esteem within norm (n, %)	13 (29.5)	6 (20.7)	7 (46.7)	$p = 0.092$[2]	0.270[3]
Self-esteem above norm (n, %)	2 (4.5)	2 (6.9)	0 (0.0)	$p = 0.540$[2]	0.157[3]
Narrative Questions (at follow-up)					
Revisiting of the photos (n, %)	23 (51.1)	16 (53.3)	7 (46.7)	$p = 0.303$[2]	0.196[3]
Posting of the photos (n, %)	11 (24.4)	7 (23.3)	4 (26.7)	$p = 1.000$[2]	0.003[3]
Positive feelings toward photos (n, %)	26 (57.8)	15 (50.0)	11 (73.3)	$p = 0.706$[2]	0.113[3]
Ambivalent feelings toward photos (n, %)	6 (13.3)	4 (13.3)	2 (13.3)	p=1.000[2]	0.051[3]

According to the data, tests for gender differences were performed.
[1] Mann–Whitney U-tests and [2] χ^2-tests for categorical measures; m, mean; SD, standard deviation; CIUS, Compulsive Internet Use Scale; AICA, Assessment of Internet and Computer Game Addiction; YSR, Youth self-report; FEEL-KJ, Questionnaire for the evaluation of emotional regulation in children and adolescents; PANAS, Positive and Negative Affect Schedule; SEKJ, Self-worth inventory for children and adolescents; [3] Cramers V, interpretation according to Cohen (1988) 0.10 (small effect), 0.30 (medium effect), and 0.50 (large effect), [4] Cohen's d, interpretation according to Cohen (1988) 0.20 (small effect), 0.50, (medium effect), and 0.80 (large effect).

Descriptive findings on sample characteristics and the results gained for internet behavior, psychopathological symptoms, adaptive/maladaptive strategies, PE, NE, and SE are shown in Table 1 for each gender separately. Noteworthy, 46.7% of the girls and 80% of the boys showed subthreshold or full PIU. There were no significant differences in internet application use between the genders, respectively; 44.4% of our sample reported adaptive strategies below norm, and 73.3% reported maladaptive strategies above norm; 65.9% of our sample presented with SE below norm at T1. Significant differences between adaptive strategies within norm between girls and boys were present ($p = 0.029$).

3.2 Course of state emotions and SE over points of measurement

To tests for the difference in mean scores of variables assessed in repeated observations, a within-subject repeated-measures ANOVA was performed.

In girls, Mauchly's test indicated that the assumption of sphericity had been violated for PANAS PE χ^2 (9) = 20.577, $p = 0.015$, and for PANAS NE χ^2 (9) = 18.586, $p = 0.029$, and therefore, a correction of degrees of freedom was done by using Greenhouse–Geisser estimates

of sphericity (ε = 0.691 and ε = 0.724, respectively). A repeated-measures ANOVA with Greenhouse–Geisser correction determined that mean PANAS PE differed statistically significantly between time points [$F(2.76, 66.30) = 17.83$, $p < 0.001$], ω2 = 0.228 as well as PANAS NE [$F(2.90, 69.54) = 34.15$, $p < 0.001$], ω2 = 0.391. Mauchly's test indicated that the assumption of sphericity had been met for SEKJ SE, $\chi^2(2) = 0.855$, $p = 0.652$. Multivariate tests showed a significant difference of SE means over all time points, $V = 0.28$, $F(2, 22) = 4.342$, $p = 0.026$, ω2 = 0.026.

In boys, Mauchly's test indicated that the assumption of sphericity had been violated for PANAS NE, $\chi^2(9) = 18.026$, $p = 0.037$, and therefore, a correction of degrees of freedom was done by using Greenhouse–Geisser estimates of sphericity (ε = 0.601). A repeated-measures ANOVA with Greenhouse–Geisser correction determined that mean PANAS NE differed statistically significantly between time points [$F(2.40, 26.43) = 10.31$, $p < 0.001$], ω2 = 0.318. Mauchly's test indicated that the assumption of sphericity had been met for PANAS PE, $\chi^2(9) = 7.809$, $p = 0.558$, and SEKJ SE, $\chi^2(2) = 3.669$, $p = 0.160$. Multivariate tests showed that PANAS PE and SEKJ SE means differed statistically significantly over all time points, $V = 0.678$, $F(4, 10) = 5.263$, $p = 0.015$, ω2 = 0.070 and $V = 0.469$, $F(2, 13) = 5.742$, $p = 0.016$, ω2 = 0.020.

After significance of the interventional course was detected in within-subject repeated-measures ANOVA, bootstrapped paired-sample *t*-tests were performed to test for significance of mean changes in PE and NE as well as SE in both genders over the different time points of the course of the intervention (see Figures 2–4).

Girls showed a significant rise in PE between T1 (m = 16.48, SD = 8.38) and T2 (m = 19.92, SD = 10.26); $t(24) = -2.171$, $p = 0.047$ and T2 (m = 19.92, SD = 10.26) and T3 (m = 29.32, SD = 7.77); $t(24) = -7.935$, $p < 0.001$; as well as a significant decline between T4 (m = 26.60, SD = 10.10) and T5 (m = 17.64, SD = 10.92); $t(24) = 4.837$, $p < 0.001$ (Figure 2).

When looking at NE in girls, they highly significantly declined between T1 (m = 22.28, SD = 9.26) and T2 (m = 12.64, SD = 7.55); $t(24) = 5.741$, $p < 0.001$; T2 (m = 12.64, SD = 7.55) and T3 (m = 4.28, SD = 4.34); $t(24) = 7.539$, $p < 0.001$ and rose between T3 (m = 4.28, SD = 4.34) and T4 (m = 7.80, SD = 7.08); $t(24) = -2.729$, $p = 0.013$; T4 (m = 7.80, SD = 7.08) and T5 (m = 18.00, SD = 10.61); $t(24) = -5.037$, $p < 0.001$ (Figure 3). Nevertheless, an overall significant decline in NE was detected between T1 (m = 22.28, SD = 9.26) and T5 (m = 18.00, SD = 10.61); $t(24) = 2.392$, $p = 0.028$ (Figure 3). A highly significant rise in SE in girls was found between T1 (m = 25.13, SD = 11.39) and T4 (m = 30.00, SD = 11.14); $t(23) = -2.939$, $p = 0.009$; as well as a significant decline between T4 (m = 30.00, SD = 11.14) and T5 (m = 25.88, SD = 9.99); $t(23) = 2.103$, $p = 0.042$. (Figure 4).

Boys showed a highly significant rise in PE between T1 (m = 14.50, SD = 6.41) and T5 (m = 22.64, SD = 8.04); $t(13) = -4.964$, $p = 0.005$ (Figure 2). Regarding NE, a highly significant decline was found between T1 (m = 19.00, SD = 5.80) and T2 (m = 9.92, SD = 7.33); $t(12) = 4.410$, $p = 0.004$ and between T2 (m = 9.92, SD = 7.33) and T3 (m = 5.15, SD = 6.16); $t(12) = 5.029$, $p = 0.001$ as well as a rise between T4 (m = 9.15, SD = 8.45) and T5 (m = 17.31, SD = 8.23); $t(12) = -3.105$, $p = 0.005$ (Figure 3).

Concerning SE in boys, a highly significant rise was shown between T1 (m = 26.07, SD = 9.09) and T4 (m = 30.07, SD = 9.36); $t(14) = -2.997$, $p = 0.010$ (Figure 4).

3.3 Correlations

To assess possible influences of internet use-related variables, internalizing and externalizing symptomatology, and adaptive and maladaptive strategies on perceived emotions and SE during the different time points of the intervention, we performed two-tailed Spearman correlations. Results are shown in Supplementary Table 1 and Table 2.

For YSR internalizing problems, girls showed significant negative correlations with PE at T1, T2, and T3 and significant positive correlations with NE at T1 and T2. In terms of FEEL-KJ

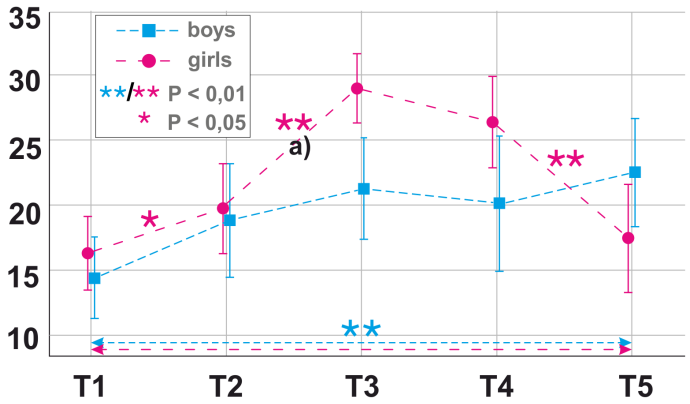

FIGURE 2
Longitudinal mean findings for positive state emotions (PE) as measured by Positive and Negative Affect Schedule (PANAS) over time by gender. T1 = 1 month prior to the photoshoot, T2 = immediately before the photoshoot, T3 = during the photoshoot, T4 = after the photoshoot/during receipt of photos, T5 = 3 months after the photoshoot/at follow-up. Significance [* < 0.5 level, ** < 0.01 level (two-tailed)] was calculated with paired-sample bootstrapped *t*-tests for difference in PE between consecutive time points. Alphabetic character **(A)** refers to significant linear regression model for adaptive strategies and internalizing problems in girls.

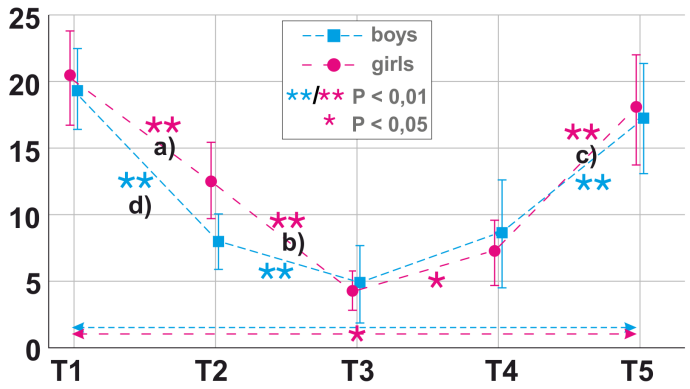

FIGURE 3
Longitudinal mean findings for negative state emotions (NE) as measured by Positive and Negative Affect Schedule (PANAS) over time by gender. T1 = 1 month prior to the photoshoot, T2 = immediately before the photoshoot, T3 = during the photoshoot, T4 = after the photoshoot/during receipt of photos, T5 = 3 months after the photoshoot/at follow-up. Significance [* < 0.5 level, ** < 0.1 level (two-tailed)] was calculated with paired-sample bootstrapped *t*-tests for difference in NE between consecutive time points. Alphabetic characters refer to significant linear regression models for **(A)** adaptive strategies; **(B)** internalizing problems, externalizing problems, Assessment of Internet and Computer Game Addiction (AICA) video streaming, and AICA online gaming; and **(C)** maladaptive strategies and externalizing problems in girls. Alphabetic characters refer to significant linear regression models for **(D)** maladaptive strategies in boys.

adaptive strategies, significant positive correlations could be found with PE at T4 and T5 and significant negative correlations could be found with NE at T1 and T5. For FEEL-KJ maladaptive strategies, significant negative correlations could be found with PE at T1, T2, T3, and T5 and significant positive correlations could be found with NE at T1 (see Supplementary Table 1). Concerning possible influences on SE (SEKJ), girls showed significant negative correlations with CIUS total score, AICA SM use, AICA SNS use, YSR internalizing problems, and FEEL-KJ maladaptive strategies at receipt of the photos (T4). At baseline (T1), negative correlations were found with CIUS total score. At baseline (T1) and at follow-up (T5), significant negative correlations with AICA SNS, YSR internalizing problems, and FEEL-KJ maladaptive strategies were detected (see Table 2).

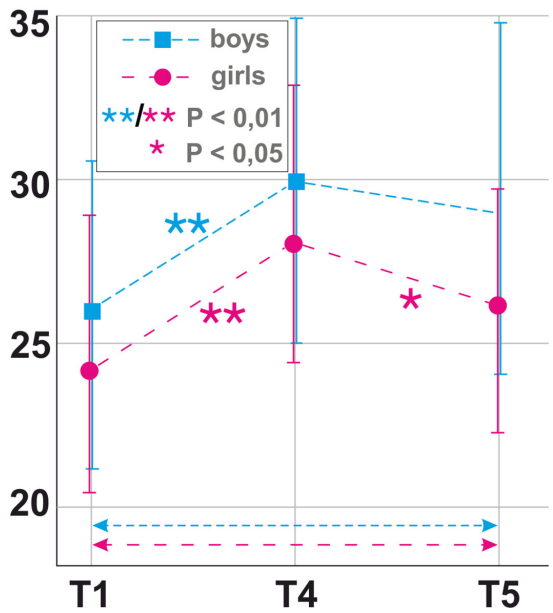

FIGURE 4
Longitudinal mean findings for self-esteem (SE) as measured by self-worth inventory for children and adolescents (SEKJ) over time by gender. T1 = 1 month prior to the photoshoot, T4 = after the photoshoot/during receipt of photos, T5 = 3 months after the photoshoot/at follow-up. Significance [* < 0.5 level, ** < 0.1 level (two-tailed)] was calculated with paired-sample bootstrapped *t*-tests for difference in SE between consecutive time points.

Boys showed significant positive correlations between PE at receipt of the photos (T4) with AICA video streaming, AICA SNS, and AICA SM. Furthermore, significant positive correlations between FEEL-KJ maladaptive strategies with NE at T1 and T5 could be found (see Supplementary Table 1). When assessing possible influences on SE (SEKJ) in boys, significant negative correlations with YSR internalizing problems at baseline (T1) and receipt of the photos (T4) were found. Furthermore, significant positive correlations were detected between AICA streaming and SEKJ T5 (see Table 2).

3.4 Simple linear regression

For those sections in the interventional course (Figures 2–4; PANAS, SEKJ) that showed a significant rise or decline, simple linear regressions were administered to test if individual variables significantly influence the section history. We used the following independent variables: internalizing problems (YSR), externalizing problems (YSR), adaptive strategies (FEEL-KJ), maladaptive strategies (FEEL-KJ), internet use (CIUS), and specific internet use (AICA).

In girls, several significant regression equations were found: Adaptive strategies significantly negatively predicted [R^2 of 0.26, F (1,28) = 9.69, p = 0.004, t(28) = −3.11, β = −0.10] and internalizing problems significantly positively predicted rise in PE from T2 to T3 [R^2 = 0.20, F(1,28) = 7.036, p = 0.013, t(28) = 2.653, β = 0.226] (see Figure 2A).

TABLE 2 Two-tailed Spearman correlations between self-esteem (SE) measured by SEKJ at the different time points with CIUS (general internet behavior), AICA (application-related behavior), YRS (internalizing and externalizing problems), and FEEL-KJ (coping strategies).

	m	SD	SEKJ		
			T1	T4	T5
Girls (n = 30)					
CIUS	22.2	9.8	−0.421*	−0.423*	−0.376
AICA CP	35.5	6.4	−0.290	−0.165	−0.261
AICA streaming	45.1	5.5	−0.048	−0.065	−0.168
AICA SM	42.9	6.7	−0.252	−0.399*	−0.291
AICA SNS	26.8	6.3	−0.449*	−0.537**	−0.431*
YSR internalizing	28.4	11.2	−0.694**	−0.407*	−0.406*
YSR externalizing	45.1	10.3	−0.256	−0.271	−0.419*
FEEL-KJ adaptive strategies	117.6	30.1	0.257	0.357	0.507**
FEEL-KJ maladaptive strategies	102.5	16.9	−0.662**	−0.507**	−0.622**
Boys (n = 15)					
CIUS	27.0	10.2	−0.022	−0.131	0.174
AICA CP	26.8	60.4	0.482	0.431	0.454
AICA streaming	24.7	6.1	0.346	0.178	0.559*
AICA SM	41.5	5.0	0.276	0.240	0.358
AICA SNS	22.1	6.7	0.301	0.214	0.458
YSR internalizing	23.7	12.3	−0.560*	−0.616*	−0.407
YSR externalizing	17.7	10.5	−0.032	−0.173	0.101
FEEL-KJ adaptive strategies	104.3	26.8	0.351	0.470	0.315
FEEL-KJ maladaptive strategies	96.8	12.9	−0.241	−0.247	−0.300

Correlation was performed for each gender separately.
** Correlation is significant at the 0.01 level (two-tailed), * Correlation is significant at the 0.05 level (two-tailed); m, mean; SD, standard deviation; CIUS, Compulsive Internet Use Scale; AICA, Assessment of Internet and Computer Game Addiction (CP, computer gaming; Stream, video streaming; SM, social media; SNS, social networking sites); YSR, Youth self-report (Int, internalizing problems; Ext, externalizing problems); FEEL-KJ, questionnaire for the evaluation of emotional regulation in children and adolescents; SEKJ, self-worth inventory for children and adolescents; T1 = 1 month prior to the photoshoot; T4, after the photoshoot/during receipt of photos; T5 = 3 months after the photoshoot/at follow-up.

Adaptive strategies positively predicted decline in NE from T1 to T2 [R^2 = 0.18, F(1,28) = 5.993, p = 0.021, t(28) = 2.448, β = 0.117] (see Figure 3A). Internalizing problems [R^2 = 0.16, F(1,28) = 5.379, p = 0.028, t(28) = −2.319, β = −0.205], externalizing problems [R^2 = 0.16, F(1,28) = 5.499, p = 0.026, t(28) = −2.345, β = −0.226], AICA-video streaming [R^2 = 0.14, F(1,28) = 4.372, p = 0.046, t(28) = −2.091, β = −0.385], and AICA-computer gaming [R^2 = 0.20, F(1,28) = 6.813, p = 0.014, t(28) = −2.610, β = −0.396] negatively predicted decline in NE from T2 to T3 (see Figure 3B). The rise in NE from T4 to T5 was positively predicted by FEEL-KJ maladaptive strategies [R^2 of 0.23, F(1,23) = 6.90, p = 0.015, t(23) = 2.63, β = 0.28] and externalizing problems [R^2 = 0.20, F(1, 23) = 5.638, p = 0.026, t(23) = 2.374, β = 0.429] (see Figure 3C).

For boys, only one regression equation was detected: Maladaptive strategies significantly negatively predicted the decline in NE from T1 to T2 [R^2 = 0.36, F(1,11) = 6.12, p = 0.031, t(11) = −2.47, p = 0.031. β = −0.34] (see Figure 3D).

3.5 Narrative follow-up on assessment

Seventy-three percent of boys and 50% of the girls reported positive feelings towards the photos. Fifty-one percent of the participants reported revising the photos, and 24% of the sample posted the photos online. For further details, see Table 1.

4 Discussion

Through the use of SM and SNS, social comparison with idealized young people, especially in terms of appearance, is omnipresent among adolescents (57, 58). Mediated by the use of photo editing, the perception of the average external appearance diverges from the actual reality of the norm (e.g., thin, toned, well-exercised, healthy eating, and weight loss-encouraging individuals) (59, 60). This perceptual shift can lead to negative influence on mental health, such as body (61) and face dissatisfaction (62). In the study presented, we developed a new approach to CAP patients by offering a professional PS in the treatment setting. We evaluated the outcome on SE and state emotions at different points of the intervention (in anticipation of the PS, during the PS, at receiving the photos, and long-term outcome).

Internet use in our population was problematic (PIU) in 50% of girls and 80% of boys. In girls, the results are consistent with clinical populations; in boys, they exceed the previously reported rates (63, 64). A possible explanation might be an increase in prevalence of PIU during the COVID pandemic (65, 66). Compared to the test norm, our subjects showed increased maladaptive defense strategies and reduced adaptive ones, as well as reduced SE, especially the girls.

During the photo intervention, substantial fluctuations in emotionality and SE could be detected. Girls reported a significant rise in PE and SE and a decline in NE from baseline to the PS, possibly caused by anticipation. Being invited to a PS was possibly associated with good expectations, receiving centered attention and the photo-shooting atmosphere might have enhanced wellbeing. In girls, the positive emotional effect and increase in SE, however, could not be sustained after receiving the pictures. In boys, overall, in terms of positive emotionality and SE, the intervention had a beneficial outcome. Reacting less enthusiastically in the expectation phase from baseline to PS, an overall outcome of heightened positive emotions at follow-up could be observed. SE significantly rose and remained at higher levels. Only NE over the course of the intervention were similar to those in the girls.

In general, adolescents tend to experience high-intensity emotions and higher emotional instability compared to children and adults (67, 68). The gender differences in affect converge with studies reporting elevated emotional reactivity in female when compared with male adolescents (69–74), especially in terms of negative affect (71–74). A possible explanation might be higher

probability of negative life events and increased cognitive vulnerability in girls (72). In addition, adolescent boys have been shown to have more efficient regulatory mechanisms for negative affect as well as greater hedonic balance levels (75).

4.1 The role of defense strategies in relation to the intervention

In girls, coping mechanisms were relevant for the emotional perception and experienced SE at different time points of the intervention. Maladaptive strategies diminished PE before and during the shooting and mediated a rise in NE after the intervention and were associated with low levels of SE throughout the intervention. Adaptive strategies lowered positive expectations before the intervention and, at the same time, relevantly diminished NE and allowed PE to remain higher after the intervention. High levels of adaptive strategies allowed SE to remain elevated after the intervention. No significant influence on the course of the intervention due to coping strategies was found in boys.

Hence, our results reflect a remarkable gender difference in emotion regulation and SE as a function of coping with an interventional offer. In adolescence, a decreased use of adaptive strategies and an increased use of maladaptive strategies have been described (76, 77). There is consensus that in stressful situations, different coping strategies are more likely to be used within the genders, respectively (78–80). Especially in girls, a stronger decrease in humor enhancement and cognitive problem solving ability has been reported (77). The higher vulnerability of girls to mental illness in adolescence can therefore also be interpreted as a function of limited defense strategies (81, 82).

4.2 The role of psychopathological symptoms in relation to the intervention

Girls with internalizing symptoms experienced a lower baseline but a significantly higher rise in positivity and decline in negativity during the intervention. This emotional uplift triggered by the intervention could be specifically therapeutically used in internalizing patients, for instance, as index moment in cognitive behavioral therapy. Furthermore, internalizing symptoms were associated with lower SE throughout the intervention in both genders. Internalizing problems are defined as being directed inwardly and express internal distress (83). They include symptoms related to depression and anxiety and lower SE (84–86). Female adolescents are more likely to experience depression compared to male adolescents and prevalence rates are constantly rising (72, 87). Externalizing symptoms were found to be associated with a rise in negative emotions after the intervention in girls. Externalizing problems include symptoms related to aggression, reduced reward dependence, hostile affect, and delinquency (86, 88). Prevalence rates of externalizing problems such as deviant behaviors and conduct behaviors are increasingly relevant in girls, while prevalence rates for this diagnostic category decreased in male adolescents over time (89, 90).

4.3 The role of internet-related variables in relation to the intervention

High levels of SNS use and internet use in girls were associated with low levels of SE during the intervention. SM use could be linked to low SE when being confronted with the pictures. Interestingly, this negative outcome in relation to SNS or SM could not be observed in boys. In contrast, the use of streaming, SM and SNS lead to elevated positive emotion at receipt of the photos.

In general, problematic mobile phone and SM/SNS use is more prevalent among female adolescents (91, 92), whereas among male adolescents, there are higher prevalence rates in gambling and online gaming disorders (92). Social comparison, social feedback, and self-reflection are the three key mechanisms contributing to a possible relation between SM/SNS and SE (93). Building up SE is an important developmental task during adolescence and a predictor of later psychological wellbeing (94, 95), healthy peer attachment (96), and success in life (94). SE in female adolescents was found to be more social-oriented and reward-oriented compared to their male counterparts (80, 97–99). In accordance, female adolescents reported more often to benefit from the use of SM/SNS in order to satisfy their social needs (100, 101). On the other hand, social expectations can promote problematic SM/SNS use (102, 103). When it comes to boys, researchers have found that they show a more robust SE (75). Male adolescents show less concern with feelings of others due to a higher sensitivity threshold to others' emotions (104). Male adolescents tend to be more involved in competitive internet activities as represented by online gaming (105, 106).

Adolescent girls are more exposed to stressors such as concerns about their body image (107). Tendency to self-objectification, to monitor attractive individuals (108), and to carry out social comparison on SM was found to be related to lower SE (109). The marketing-driven SM industry is geared towards upward social comparison (comparing oneself to others who are better off) (110, 111) and judgmental body image (112), leading to dissatisfaction, lower levels of SE, and emotional distress (113, 114). In particular, the algorithm-driven passive form of SM use is reported to be related to increased social comparison (115, 116), lower wellbeing (57), body dissatisfaction (115), and depression (117).

4.4 Limitations and strengths

The focus of our study was to assess the impact of a new intervention, namely, a PS, on adolescents undergoing psychiatric treatment. We were interested in examining the different time points of the intervention to determine how patients react at different stages of the intervention and whether certain factors such as internet use, coping mechanisms, or psychopathology had an impact on the course. However, our specific approach was associated with limitations: Firstly, our sample included significantly more girls, which, at the same time, reflects the reality of gender distribution of adolescents in psychiatric treatment (118). However, the unequal gender ratio and the smaller sample size of boys must be taken into account when interpreting the results. It is possible that detection of statistically relevant effects was more unlikely in the male sample. In general, the sample size was rather

small, but it should be borne in mind that the interventional study design was rather elaborate. Another limitation is that our study took place in CAP patients with an expected ceiling effect in psychopathology as well as negative coping and SE. Therefore, the results cannot be generalized to non-clinical adolescents and future studies including a non-clinical comparison group would be of relevance. In particular, the negative effects of internet and SNS/SM use on the outcome of the intervention in girls could be related to the specific vulnerability of our sample.

One of the strengths of the study is the new approach to working with young people with psychiatric disorder. The study was met with great interest and willingness on the part of the young people to participate. This is also reflected in the fact that all of the young people who took part stayed on for the entire intervention and the majority of the participants (n = 40) remained accessible for the follow-up study. Three months after receiving the photos, 73% of the boys rated their photos positively and 63.3% of the girls rated them positively or at least ambivalently. Professional camera equipment and instruction led to higher-quality portrait photography compared to (self-guided) mobile phone camera use. Using a professional camera instead of a mobile phone camera demarcated the intervention from the topic of SNS and SM. The results converge with the literature and substantially add to our knowledge on new treatment approaches in CAP patients.

4.5 Conclusion

The novel intervention using PS was well received by patients. Girls experienced a positive development in SE and an increase in positive emotion, particularly in anticipation of and during the PS. Perhaps the offer represents a contrast to other interventions because it provides centered attention and focus while maintaining intimacy. Increase in PE and SE experienced could be used and processed therapeutically. Furthermore, our results add to our understanding on the relevance of coping mechanisms in the processing of offers in CAP patients. Our results suggest that it is relevant to reflect on SM behavior with girls in terms of the impact on their SE. For boys, the intervention appears to be largely beneficial. The use of SM and SNS does not seem to have a negative influence on their perception of their individual photos. Although practitioners are generally less likely to consider that interventions relating to external attributes might be relevant for boys, this does appear to be the case.

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 humans were approved by Ethics committee of the state of Salzburg (ethic committee vote-number: 1091/2021). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

KW: Data curation, Formal Analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing – original draft, Writing – review & editing. TM: Conceptualization, Project administration, Writing – review & editing. BS: Visualization, Writing – review & editing, Formal Analysis, Supervision. NR: Data curation, Project administration, Writing – review & editing. CS: Formal Analysis, Writing – review & editing, Methodology. MH: Conceptualization, Project administration, Writing – review & editing. JT-S: Conceptualization, Writing – review & editing, Project administration. LR: Formal Analysis, Methodology, Writing – review & editing, Data curation. WH: Writing – review & editing, Formal Analysis, Methodology. CA: Supervision, Writing – review & editing, Validation. BP: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing.

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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

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1310252/full#supplementary-material

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The effect of systematic couple group therapy on families with depressed juveniles: a pilot trial

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Background: Depression is a primary cause of illness and disability among teenagers, and the incidence of depression and the number of untreated young people have increased in recent years. Effective intervention for those youths could decrease the disease burden and suicide or self-harm risk during preadolescence and adolescence.

Objective: To verify the short efficacy of the systemic couple group therapy (SCGT) on youths' depression changes and families with depressed adolescents.

Methods: The study was a self-control trial; only within-group changes were evaluated. Participants were couples with a depressed child who was resistant to psychotherapy; they were recruited non-randomly through convenient sampling. The paired-sample *t*-test and Wilcoxon signed-rank test were used to compare differences before and after interventions. The effect sizes were also estimated using Cohen's d. Spearman's correlation analysis was used to examine associations between changes.

Results: A downward trend was seen in depressive symptoms after treatment, and Cohen's d was 0.33 (p = 0.258). The adolescents perceived fewer interparental conflicts, and the effect sizes were medium for perceived conflict frequency (0.66, p = 0.043), conflict intensity (0.73, p = 0.028), conflict solutions (0.75, p = 0.025), coping efficacy (0.68, p = 0.038), and perceived threat (0.57, p = 0.072). For parents, global communication quality, constructive communication patterns, and subjective marital satisfaction significantly improved after interventions, with large effect sizes (1.11, 0.85, and 1.03, respectively; all p < 0.001). Other destructive communication patterns such as demand/withdraw (p = 0.003) and mutual avoidance (p = 0.018) and communication strategies like verbal aggression (p = 0.012), stonewalling (p = 0.002), avoidance–capitulation (p = 0.036), and child involvement (p = 0.001) also reduced, with medium effect sizes (0.69, 0.52, 0.55, 0.71, 0.46, and 0.79, respectively). Meanwhile, the associations between depression changes and changes in interparental conflicts (p < 0.001) and marital satisfaction (p = 0.001) were significant.

Conclusions and clinical relevance: The SCGT offers the possibility for the treatment of families with depressed children who are unwilling to seek treatment. Helping parents improve communication and marital quality may have benefits on children's depressive symptoms.

KEYWORDS

adolescent, communication, couples therapy, depression, family conflict

Introduction

Depression is a serious mental health problem during adolescence; the prevalence of the youth population experiencing depression at any one time is 2.6% (1, 2). Depression is a leading cause of youth illness and disability and also predicts a wide range of long-term negative effects, including mental disorders in adulthood, educational under-achievement, and increased risk of self-harm and suicidal behavior (3). The prevalence of depression and the number of young people with untreated depression have increased in recent years (4). Longer duration of untreated depression leads to greater severity, poorer prognosis, higher suicide and self-harm risk, and cognitive impairment (5). Effective intervention for those youths with depression could decrease the disease burden and suicide and self-harm risk during preadolescence and adolescence, a sensitive period of social and neural development (6).

The current National Institute for Health and Care Excellence (NICE) guidelines for the treatment of moderate/severe depression in youths recommend individual cognitive behavioral therapy (CBT), interpersonal therapy (IPT), family therapy, or psychodynamic psychotherapy for at least 3 months (7). However, there are also difficulties in engaging depressed youths in psychotherapy. Recent trials have demonstrated a significant level of drop-out from CBT and other therapies (8). Children are usually embedded in a family context and dependent on their parents for nurturance, support, and assistance; depression does, of course, run in families (9).

Findings point to the negative impacts of exposure to high interparental conflicts on youth's adjustment problems, aggression, conduct disorders, anxiety, and depression (10, 11). The interparental conflicts influence the family environment in which children learn and grow. Children are also likely exposed to indirect effects of interparental conflicts, which affect parenting behaviors—the effects "spilling over" from the interparental relationship to the parent–child relationship (12). Partners who are satisfied with and receive support from their spouse tend to be more available and responsive to their children's needs and vice versa (13). High marital conflicts, low marital satisfaction and fitness, and maladaptive communication and problem-solving are risk factors associated with depression in children (14, 15). For depressed youths with difficulties engaging in psychotherapy, parental involvement in the therapy may help reduce those risk factors, bringing direct or indirect benefits for depressed children.

In the present study, we employed systemic couple group therapy (SCGT) focusing on interparental conflicts to verify 1) the efficacy on marital quality and 2) the good impact on children. We included the listed variables for family, e.g., interparental communication satisfaction, marital satisfaction and fitness, and adolescents' perception of interparental conflicts and interparental communication, which have been proven to impact depressive symptoms of adolescents (6 10). We postulated that interparental communication, marital satisfaction, and fitness will be improved and that perceived interparental conflicts and depression in children will change along with the change in interparental relationships. This study could offer a potential approach to intervention in depressed youths unwilling to participate in therapy.

Methods

The design of the present study was a self-control trial. We focused on the within-group effects before and after the SCGT intervention for parents with depressed youths. The study was approved by the Biomedical Ethics Committee of Peking University Sixth Hospital. The findings of the study were reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist.

Participants

Couples were eligible for the study if 1) their current marital status ≥1 year; 2) their dyadic adjustment scale (DAS) ≤95 reported by at least one spouse; 3) they are Chinese; 4) one of their children is diagnosed with depressive disorders according to the International Classification of Diseases (ICD), 11th edition, without medication or not under stable medication during the treatment period; 5) their children <18 years; 6) their depressed adolescents exhibit resistance to participating in psychotherapy; and 7) their children stay in contact with one or both parents. Exclusion criteria were as follows:

1) other urgent issues, i.e., active suicidal intent, serious self-harm, and frequent non-attendance; 2) other comorbid disorders required exclusion such as schizophrenia and substance addiction.

Participants were recruited through convenient sampling in mainland China from October 2021 to January 2022. Written informed consent was obtained from all participants.

Measures

Demographic characteristics included age, education, family income, and marriage length. The dyadic adjustment scale (DAS), quality of marriage index (QMI), conflicts and problem-solving scale (CPS), communication patterns questionnaire (CPQ), and primary communication inventory (PCI) were used in the present study.

The DAS is a 32-item inventory scored on a Likert scale, which can reflect marriage adjustment and satisfaction among couples (16). It contains four dimensions: affection expression, dyadic consensus, dyadic cohesion, and marital satisfaction. Higher scale scores represent greater marital satisfaction. The cutoff score of the DAS is 107, which is considered an indicator of serious distress in married couples (17). In the present study, Cronbach's α values were 0.95 and 0.96 for husband and wife, respectively.

The perceived quality of marital relationship (marital satisfaction) was assessed using the QMI. The QMI is a six-item scale that asks spouses to rate on a 9-point scale (18). The higher the score (ranging from 6 to 45), the better the marital quality. In the present study, Cronbach's α values were 0.98 and 0.98 for husband and wife, respectively.

The CPS was utilized to measure specific marital conflict strategies. The CPS is a 44-item questionnaire that comprises four conflict dimensions (i.e., frequency, severity, resolution, and efficacy) and six conflict strategy subscales (i.e., cooperation, avoidance–capitulation, stonewalling, verbal aggression, physical aggression, and child involvement) (19). In the present study, Cronbach's α values were 0.76–0.95 and 0.69–0.95 for husband and wife, respectively, on each dimension.

The CPQ is designed to gauge the extent to which couples employ conflict patterns when dealing with relationship problems. Each partner indicates what typically occurs in their relationship on a 9-point scale. The CPQ measures mutual discussion, understanding, and problem-solving (mutual constructive communication), and demand/withdraw (demand/withdraw communication) (20).

The PCI adopted here is a 19-item 5-point Likert scale that assesses verbal and non-verbal communication between partners (21). Higher scores reflect greater satisfaction with a couple's communication level (22). In the present study, Cronbach's α values were 0.94 and 0.92 for husband and wife, respectively. Communication frequency in the last month was assessed using a 5-point scale adapted from the communication scale of the partnership questionnaire. A higher score means more communication frequencies.

The children's perception of interparental conflict scale (CPIC) was used to examine the relationship between interparental conflict, and child behavioral and emotional problems (23, 24). The CPIC has four subscales: conflict properties (i.e., conflict frequency and intensity), triangulation/stability (i.e., enduring aspects of conflict as well as the degree to which children feel caught between parents), self-blame (i.e., the extent to which children blame themselves for interparental conflict), and perceived threat regarding potential negative consequences of interparental conflict, such as divorce.

Children's depression was assessed using the children's depression inventory (CDI). The CDI has five subscales: anhedonia, negative affect, low self-esteem, low efficacy, and interpersonal problems. Responses are scored on a 0–2 scale with "2" representing the severe form of a depressive symptom and "0" representing the absence of that symptom. The cutoff value is 19. Cronbach's α was 0.86–0.95 (25).

Outcomes

The primary outcomes were remission of depression in youths and the association between remission of depressive symptoms and perceived interparental conflicts in youths and interparental communication. Depressive symptoms were assessed before and after treatment according to CDI. The perceived interparental conflicts were examined using CPIC before and after treatment. Interparental communication satisfaction was assessed through indicators of constructive communication, such as constructive communication patterns and cooperating communication strategies, and indicators of destructive communication including demand/withdraw communication patterns, mutual avoidance communication patterns, and communication strategies, such as verbal aggression, physical aggression, child involvement, stonewalling, and avoidance–capitulation, before and after treatment according to the CPS and CPQ.

The secondary outcomes were the improvement of interparental communication satisfaction, reduction of perceived interparental conflicts in youths, and enhancement of marital satisfaction and fitness before and after treatment according to the CPS, CPQ, CPIC, CPI, QMI, and DAS. The raters were both psychiatrists (GBL and QY) and blinded to the participants' treatment conditions.

Intervention

The present study adopted a 5-week online SCGT for parents with depressed youths. The treatment protocol was based on family systems theory with the characteristics of short duration and intensive interventions. It contained one preparation session (approximately 2 hours), five intervention sessions (2 hours each session), and four discussion sessions (approximately 1 hour each session). Each participant underwent 16 treatment hours in total. Intervention and discussion session was conducted once a week; moreover, there was no discussion session in the fifth week. The experimental material was presented through word sheets. The detailed interview outlines are presented in the Supplementary Material. Two instances of non-attendance were considered

dropping out of the study. In the current study, one participant dropped out of the study due to COVID-19 infection. The remaining subjects participated in all the sessions.

Interventions were provided by a qualified clinical psychologist (WYL) and a graduate student in clinical psychology (MTJ) who were trained in systemic family therapy and systemic couple therapy. They noted treatment records after each treatment and scored whether key treatment points were followed. A senior psychiatrist and psychologist (TDH) supervised the interventions.

Statistical analyses

In the present study, the Shapiro–Wilk test was employed to verify the normality of data because our study was a small sample trial. A paired-sample *t*-test was used for data of normal distribution, while the Wilcoxon signed-rank test was applied to data of non-normal distribution to compare differences in depressive symptoms, perceived interparental conflicts, perceived interparental communication in youths, and the interparental communication satisfaction, marital satisfaction, and fitness in parents before and after interventions. The effect sizes were estimated using Cohen's d; in the current study, the effect sizes of 0.2–0.3 were small, 0.5 medium, and ≥0.8 large (26). Subgroup analyses for gender and stress levels were performed.

The associations between depression, adolescents' perceived changes, and interparental changes were further examined to show whether adolescents' perceived changes and interparental changes affected the change in depression level. Spearman's correlation analysis was used because some data had a non-normal distribution. LJJ and YJL performed the data analysis. All analyses were performed in SPSS 22.0, and $p < 0.05$ (two-sided) was considered significant.

Findings

The flowchart of the present study is presented in Figure 1. We included data from 12 couples and 12 depressed youths ultimately. The mean age of parents was 45.13 years. The education of 19 (79.2%) participants was bachelor or above. The mean marriage year was 17.7, and 70.8% (17) of adult participants had severe marital stress (DAS ≤ 80).

The mean age of adolescents was 13 years. The youths were an even mix of genders, and the mean age of male youths was 12 years, while the mean age of female youths was 14 years (Table 1).

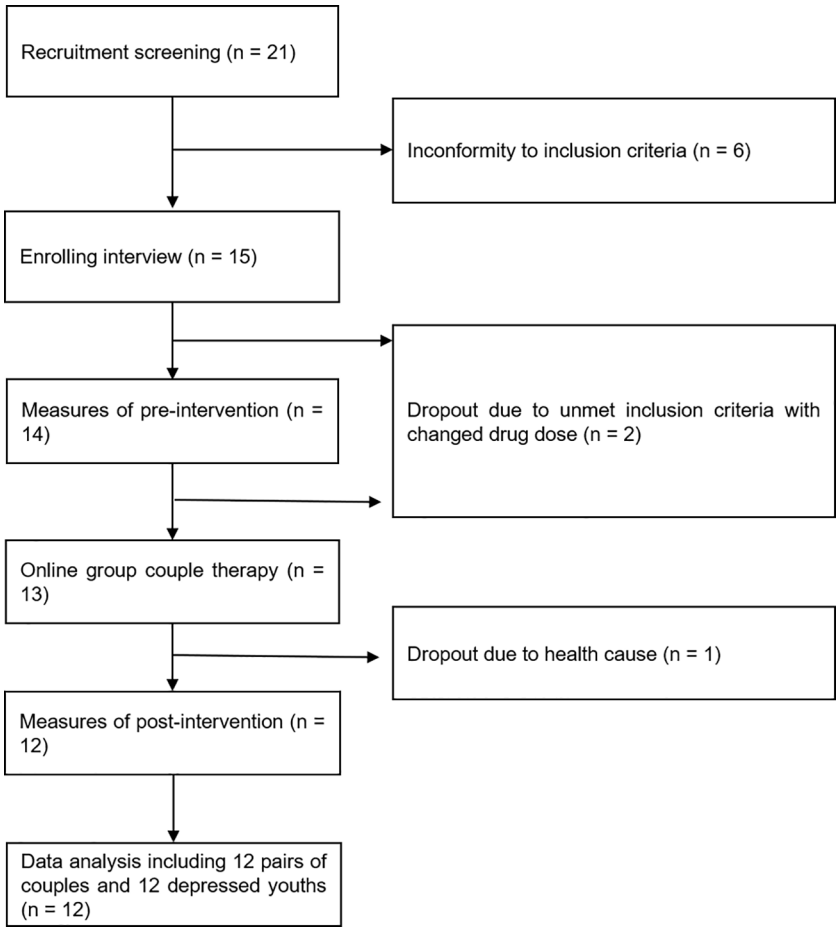

FIGURE 1
The flowchart of the systemic couple group therapy for families with depressed youths.

TABLE 1 Demographic characteristics of enrolled participants.

Parental data	
Sample sizes (n)	24
Age (years)	
30–39	4 (16.7%)
40–49	17 (70.8%)
50–59	3 (12.5%)
Years of marriage	11–25.2
Education	
Bachelor or above	19 (79.2%)
Below bachelor	5 (20.8%)
Family income (yuan/month)	5,000–50,000
10,000–30,000	16 (66.7%)
Number of children	
Only one	11 (91.7%)
Two	1 (8.3%)
DAS score (M ± SD)	62.7 ± 25.5
Adolescent data	
Age (years)	7–17
Gender	
Male	6 (50%)
Female	6 (50%)

DAS, dyadic adjustment scale.

Children's depression did not improve significantly post-intervention

The Wilcoxon signed-rank test was used to assess CDI differences before and after the intervention and found that there was a downward trend; however, no significant differences were seen in the depression level of children in the present study. Furthermore, Cohen's d was 0.33, a small effect size ($p = 0.258$).

Parental communication quality markedly improved post-intervention

The paired-sample *t*-test indicated that the global communication quality and satisfaction significantly improved, with a large effect size (Cohen's d = 1.11, $p < 0.001$). Constructive communication patterns significantly improved after intervention as well, and the effect size was large (Cohen's d = 0.85, $p < 0.001$). Other communication patterns, such as demand/withdraw (Cohen's d = 0.69, $p = 0.003$) and mutual avoidance (Cohen's d = 0.52, $p = 0.018$), and communication strategies, like verbal aggression (Cohen's d = 0.55, $p = 0.012$), stonewalling (Cohen's d = 0.71, $p = 0.002$), avoidance–capitulation (Cohen's d = 0.46, $p = 0.036$), and child involvement (Cohen's d = 0.79, $p = 0.001$), also reduced (Table 2).

The Wilcoxon signed-rank test indicated that communication frequency (Z = 3.14, $p = 0.002$) and cooperation strategy (Z = 2.18, $p = 0.029$) increased and physical aggression reduced (Z = −2.58, $p = 0.010$) (Table 2).

We further evaluated whether gender and DAS level impact the communication improvements, indicating that no significant differences were seen in gender and DAS level (DAS < 80 vs. DAS < 95 and DAS ≥ 80).

Parental marital quality markedly improved post-intervention

The findings of the paired-sample *t*-test demonstrated that significant improvements in subjective marital satisfaction occurred, with a large effect size (Cohen's d = 1.03, $p < 0.001$). The findings of the Wilcoxon signed-rank test for DAS indicated that marriage adjustment significantly improved (Z = 3.49, p < 0.001) (Table 2). The average marital stress decreased from a severe level (62.67 ± 25.51) to a moderate or mild level (86.08 ± 26.20) through a 5-week intervention. The proportion of severe marital stress declined from 70.8% before intervention to 29.2% after intervention.

In addition, there were no significant differences for gender in both subjective and objective marital quality. However, compared with the mild/moderate stress level, better improvement was seen in the severe stress level for subjective marital satisfaction (13.00 ± 12.22 vs. 7.00 ± 5.07) and the DAS (29.76 ± 31.81 vs. 8.00 ± 9.78).

Children's perceived parental conflicts decreased post-intervention

The findings of the paired-sample *t*-test demonstrated that marital conflict frequencies ($p = 0.043$) and intensity ($p = 0.028$) decreased, while marital conflict solutions ($p = 0.025$) and coping efficacy ($p = 0.038$) enhanced. The effect sizes were medium with 0.66 for conflict frequency, 0.73 for conflict intensity, 0.75 for conflict solutions, and 0.68 for coping efficacy. Also, the effect size was medium for perceived threat (Cohen's d = 0.57), although it was not significant ($p = 0.072$) (Table 3). There were no significant gender differences in terms of the perceived conflict measures.

Correlations between interparental and children's perceived changes

Parent values were averaged when considering correlations with adolescent data because we found that there were no gender differences in terms of measured variables.

For interparental relationships, subjective marital satisfaction had positive correlations with communication satisfaction (r = 0.70, $p < 0.001$) and constructive communication patterns (r = 0.58, $p = 0.003$) but negative correlations with demand/withdraw patterns (r = −0.62, $p = 0.001$), mutual avoidance patterns (r = −0.47, $p = 0.022$), verbal and physical aggression (r = −0.52,

TABLE 2 Comparisons of communication and marriage quality pre- and post-intervention.

Paired-samples *t*-test		Pre-intervention (M ± SD)	Post-intervention (M ± SD)	t	Cohen's d
Communication satisfaction	Communication satisfaction	50.13 ± 11.24	61.46 ± 11.19	4.97***	1.11
Communication patterns	Constructive	−4.38 ± 9.97	6.42 ± 10.66	4.17***	0.85
	Demand/withdraw	36.67 ± 10.02	27.83 ± 8.57	−3.37**	0.69
	Mutual avoidance	15.17 ± 5.79	11.58 ± 4.67	−2.56*	0.52
Communication strategies	Verbal aggression	22.71 ± 5.79	18.17 ± 6.54	−2.72*	0.55
	Stonewalling	18.04 ± 3.38	14.58 ± 4.40	−3.47**	0.71
	Avoidance–capitulation	23.63 ± 4.44	21.83 ± 3.31	−2.23*	0.46
	Child involvement	14.50 ± 3.49	10.25 ± 4.13	−3.85**	0.79
Marriage quality	Subjective satisfaction	20.88 ± 11.16	32.13 ± 10.44	5.07***	1.03
Wilcoxon signed-rank test		**Pre-intervention (M ± SD)**	**Post-intervention (M ± SD)**	**Z**	
Communication strategies	Physical aggression	10.50 ± 3.40	8.71 ± 2.66	−2.58*	
	Cooperation	23.88 ± 5.02	26.42 ± 4.12	−2.18*	
Communication frequency	Communication frequency	3.00 ± 0.72	3.75 ± 0.79	−3.14**	
Marriage quality	Marital fitness	62.67 ± 25.51	86.08 ± 26.20	−3.49***	

*p < 0.05; **p < 0.01; ***p < 0.001.

p = 0.009, and r = −0.47, p = 0.021, respectively), stonewalling (r = −0.55, p = 0.006), and child involvement (r = −0.48, p = 0.019). The DAS (marital fitness) positively correlated with communication satisfaction (r = 0.74, p < 0.001) and constructive communication patterns (r = 0.51, p = 0.012) but negatively correlated with mutual avoidance patterns (r = −0.41, p = 0.049).

For adolescents, depression level was significantly negatively correlated with interparental communication satisfaction (r = −0.52, p = 0.009) and interparental constructive communication patterns (r = −0.41, p = 0.044) and positively correlated with interparental mutual avoidance (r = 0.49, p = 0.016), marital satisfaction (r = 0.62, p = 0.001), and marital fitness (r = 0.70, p < 0.001). Perceived interparental conflict level positively correlated to interparental mutual avoidance (r = 0.46, p = 0.025), marital satisfaction (r = 0.43, p = 0.036), marital fitness (r = 0.67, p < 0.001), and depression level (r = 0.66, p < 0.001) (Table 4).

Discussion

We designed the couple group therapy based on family systems theory to test the short efficacy of the intervention on families with depressed children and its effect on child depression changes. We found that SCGT could effectively improve interparental relationships and enhance marital satisfaction and fitness. It had a small effect size in improving the depressive symptoms of youths. There were positive relationships between interparental communication, marital satisfaction, and perceived interparental conflict and depression. Our study offers a potential way for families with depressed children who are unwilling to seek help.

There was a downtrend in depression scores after intervention without significance. One reason is limited to the small sample, and another is due to the short treatment duration. It could also be not enough to improve depression in children only through

TABLE 3 Perceived interparental conflicts of children pre- and post-intervention (paired-samples *t*-test).

	Pre-intervention (M ± SD)	Post-intervention (M ± SD)	t	Cohen's d
Conflict frequency	16.83 ± 2.44	13.83 ± 4.63	−2.29*	0.66
Conflict intensity	17.08 ± 3.06	14.33 ± 4.46	−2.53*	0.73
Conflict resolution	15.33 ± 3.42	12.25 ± 4.45	−2.59*	0.75
Coping efficacy	18.67 ± 3.75	15.67 ± 4.25	2.36*	0.68
Perceived threat	17.00 ± 5.12	14.50 ± 4.56	1.99	0.57
Self-attribution	11.92 ± 3.92	11.83 ± 3.22	0.14	0.04
Conflict content	10.67 ± 2.87	10.67 ± 3.14	0.00	0.00

*p < 0.05.

TABLE 4 Correlations between interparental and children's perceived changes.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Communication satisfaction	–														
2. Constructive communication	0.45*	–													
3. Demand/ withdraw communication	−0.50*	−0.48*	–												
4. Mutual avoidance communication	−0.34	−0.64**	0.42*	–											
5. Verbal aggression	−0.30	−0.66**	0.59**	0.39	–										
6. Physical aggression	−0.42*	−0.46*	0.40	0.05	0.74**	–									
7. Cooperation	0.51*	0.35	−0.34	−0.28	−0.42*	−0.31	–								
8. Stonewalling	−0.31	−0.58**	0.31	0.31	0.75**	0.74**	−0.16	–							
9. Avoidance capitulation	−0.14	−0.11	0.17	0.12	0.35	0.12	−0.01	0.25	–						
10. Child involvement	−0.27	−0.52**	0.57**	0.30	0.89**	0.66**	−0.39	0.62**	0.47*	–					
11. Communication frequency	0.44*	0.21	−0.39	−0.40	−0.06	−0.11	0.24	−0.08	−0.09	−0.13	–				
12. Marital satisfaction	0.70**	0.58**	−0.62**	−0.47*	−0.52**	−0.47**	0.37	−0.55**	−0.01	−0.48*	0.19	–			
13. Marital fitness	0.74**	0.51*	−0.37	−0.41*	−0.33	−0.40	0.36	−0.37	−0.05	−0.32	0.11	0.73**	–		
14. Depression of children	−0.52**	−0.41*	0.66	0.49*	0.24	0.33	−0.18	0.34	0.29	0.10	−0.06	0.62**	0.70**	–	
15. Children's perceived interparental conflict	−0.29	−0.27	0.21	0.46*	0.27	0.28	0.05	0.32	0.05	0.26	−0.07	0.43*	0.67**	0.66**	–

*$p < 0.05$; **$p < 0.01$.

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interparental intervention, and further studies are needed. However, the decrease in children's depression scores was positively correlated with the increase in parents' communication satisfaction, constructive communication patterns, the decrease in parents' mutual avoidance patterns, and the reduction of perceived interparental conflicts. This provides an important direction for future clinical work; that is, parents need interventions to help them improve communication, which is likely to have a benefit on depressive symptoms for their children, especially for those unwilling to seek treatment. Children's awareness of parental conflicts may be a mediating factor between parental conflict and childhood depression. In addition, a measure for suicidal ideation and the association between suicidal ideation and marital conflicts is needed in the future. Since suicidal ideation or suicide and self-harm risk among adolescents is a big step above depression, it is vital to reveal the role of marital conflicts in youths' suicidal ideation and suicide and self-harm risk.

Rathgeber et al. found that the majority of participants in couple therapy were under mild/moderate marital stress; however, participants of the present study at baseline were under severe marital stress, indicating that SCGT could be an effective approach even for those couples with severe marital difficulties (27). Compared to couples with mild/moderate difficulties, greater improvements were seen in participants with severe marital difficulties. It indicated that in terms of marital quality, the current intervention was particularly effective for the severely affected population, which may be due to the unique therapeutic factor of group therapy, which is universality, which can lead group members to feel less alone or unique in their problems or level of misery (28). The spillover hypothesis from family systems theory suggests that the positivity or negativity experienced in the interparental relationship may transfer to the parent–child relationship (29). Emphasizing the importance of positive changes experienced in the interparental relationship on children would increase parents' sense of efficacy, further transferring high stress to intensive hope and power.

Consistent with previous data, we also found that the more constructive the communication, the better the marital quality, and the more destructive the communication, the worse the marital quality (30). There were large effect sizes of communication satisfaction and constructive communication patterns. Medium effect sizes were seen in the demand/withdraw communication patterns, mutual avoidance patterns, verbal aggression, stonewalling, and child involvement, while there was a small effect size in the avoidance–capitulation strategy. It suggests that SCGT could enhance interparental communications. Both subjective marital satisfaction and fitness were positively correlated with communication satisfaction and constructive communication patterns and negatively correlated with mutual avoidance communication patterns in the present study. However, multiple destructive patterns and strategies affected subjective marital satisfaction, such as demand/withdraw patterns, verbal and physical aggression, stonewalling, and child involvement, which is in accordance with previous findings that 90.4% of the variance in marital satisfaction can be accounted for by couples' communication (21). This is because destructive marital conflict involves more negative conflict resolution tactics, including aggressive and threatening behavior, arguing frequently, and leaving issues unresolved (11).

Perceived interparental conflict intensity and frequency declined, which is consistent with the decrease in interparental verbal and physical aggression and child involvement. In addition, the perceived increase in solving ability for marital conflict is consistent with the improvement of interparental constructive communication patterns and cooperative strategy, and the decline of demand/withdraw patterns, mutual avoidance patterns, and stonewalling strategy. Significant improvement in coping efficacy when facing interparental conflicts may be directly related to a decrease in the intensity and frequency of interparental conflicts and destructive communication patterns or an indirect benign internalization process. When parents are able to resolve conflicts that arise, the distress of children significantly reduces, and even if the conflict is not completely resolved, the distress reduces as well, which is positively correlated with the degree of resolution (31). It indicated that even if conflicts between parents persist, as long as it can help parents better handle conflicts, it can have a positive impact on the family and children. This highlights the importance of incorporating parent–child relationships when attempting to understand the underlying pathways between marital conflict and child functioning. However, for children, self-attribution and conflict contents related to themselves did not significantly change. A possible explanation is the limited efficacy of the intervention on children's spontaneous emotional response and attribution style in a short time. Changes (aggressive behavior) in subsystems take a longer time to occur (29).

Limitations

There were several limitations in our study. First, the study was a single group, and only within-group changes were evaluated. This greatly affected the accuracy of the results and increased the possibility of biased results caused by factors that threaten internal and external validity. Second, a small sample size in the present study may result in inflation of Type 1 errors, and we interpreted findings with caution. A larger sample size (such as more than 400) trial should be conducted in the future using a structural equation modeling to multi-level modeling for the adolescent/parent structure of data to further offer a reliable conclusion. Third, the present study is not a randomized controlled trial (RCT), and the non-random selection of samples rendered further causal inferences of results. RCTs with large samples are needed to validate the efficacy of SCGT further in the future. Fourth, it would be better if there were qualitative data in the present study. Fifth, the treatment duration was limited, which may have hindered significant changes in some indicators requiring a longer time to occur, such as changes in children's depressive symptoms, automated emotions, and attribution styles. Sixth, it is unclear how the impact of SCGT on participating families changes over time, as well as whether it will continue and for how long. Future research should extend the treatment cycle appropriately to

bring about more significant therapeutic effects and be conducted with multiple follow-ups like 4 weeks, 6 months, or 1 year after the end of the intervention.

Conclusion and clinical relevance

The SCGT could significantly enhance interparental communication satisfaction, constructive communication patterns and strategies, communication frequencies, marital satisfaction, and fitness while reducing destructive communication patterns and strategies. Depressed youths also perceived less interparental conflict intensity, frequency and difficulty in conflict resolution, and a higher sense of self-efficacy. Helping parents improve communication and marital quality may affect depression symptoms for children in their families. The SCGT offers a possibility for the treatment of families with depressed children who are unwilling to seek treatment: spillover positive changes in the parental subsystem into the children subsystem through family systems dynamics and processes.

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 humans were approved by ethics committee/institutional review board of Peking University Sixth Hospital. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. All data collected were anonymous, and the study was conducted following the ethical principles of the World Medical Association Declaration of Helsinki of 1975, as revised in 2008.

Author contributions

T-JM: Investigation, Writing – original draft. YQ: Supervision, Writing – review & editing. Y-LW: Investigation, Writing – review & editing. B-LG: Methodology, Writing – review & editing. J-JL: Writing – review & editing. J-LY: Funding acquisition, Writing – review & editing. D-HT: Supervision, Writing – review & editing.

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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

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1283519/full#supplementary-material

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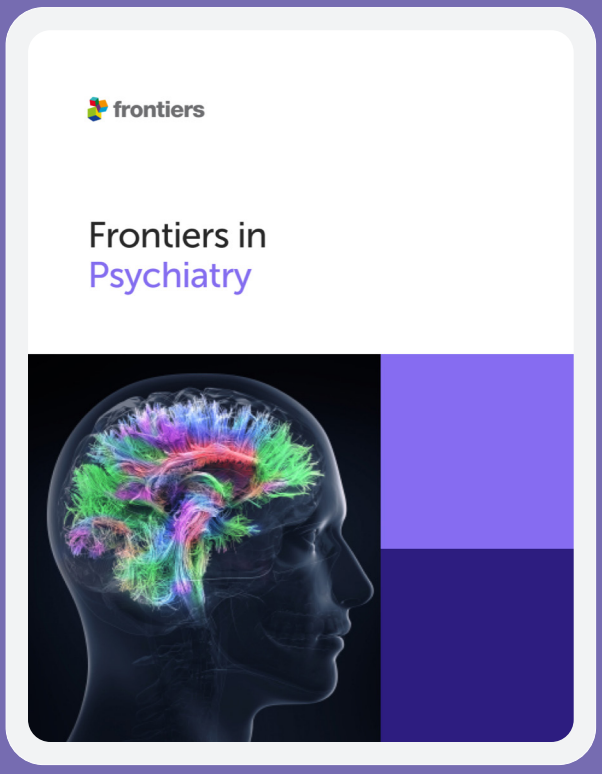

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