

# The Relationship between Internet Addiction and Internalizing Problems in Overweight/Obese Adolescents: A Moderated Mediation Model

Zhen Wei, MS;<sup>1^</sup> Zhongyan Zheng, MS;<sup>2^</sup> Ying Zhang, PhD;<sup>3</sup>  
Rui Song, MD;<sup>4</sup> Junli Zhu, BS;<sup>5</sup> Guobin Wan, MD;<sup>1</sup> Ziwen Peng, PhD<sup>2\*</sup>

<sup>1</sup> Shenzhen Maternity & Child Healthcare Hospital, Shenzhen, Guangdong, China

<sup>2</sup> School of Psychology, South China Normal University, Guangzhou, Guangdong, China

<sup>3</sup> Boston Children's Hospital, Boston, MA

<sup>4</sup> To Cure Autism Institute, Burlington, MA

<sup>5</sup> Fisher College, Boston, MA

To explore the relationship of Internet addiction, coping styles, stressful life events and internalizing problems in overweight/obese adolescents, this research surveyed 1438 middle school students among which 245 overweight and obesity (non-clinical cases) were screened based on the body mass index (BMI) percentile criteria of Working Group on Obesity in China (WGOC) by a series of questionnaires and anthropometric indices. The results indicated as follows: (1) Negative coping styles played a partial mediating role in the relationship between Internet addiction and internalizing problems among overweight/obese adolescents, which means Internet addiction had a direct effect on internalizing problems and also indirectly affected internalizing problems through negative coping styles. (2) The mediating effect of negative coping styles was moderated by stressful life events. The effect of negative coping styles on internalizing problems was in positive proportion to internalizing problems. Internet addiction, coping styles, stressful life events and internalizing problems among overweight/obese adolescents constructed a moderated mediating model.

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**Key Words:** internet addiction, coping styles, stressful life events, internalizing problems, overweight/obese adolescents

## INTRODUCTION

Overweight and obesity, which are defined as excessive or abnormal fat accumulation, are chronic metabolic disorders caused by the excessive calorie intake over the amount of energy consumption under the influence of genetic and environmental factors.<sup>1</sup> Ever since the 1980s, the incidences of overweight and obesity disorders grow exponentially. Obesity and its related symptoms have been developed into a major public health concern in developed and some developing countries.<sup>2</sup> The average BMI index increases from 28.8% to 36.9% among adult men from 1980 to 2013 worldwide. During the same period this number increases from 29.8% to 38% in women. In 2013, the overweight/obesity rate among 2-19 years old boys and girls in developed countries are 23.8% and 22.6% respectively. In developing countries these numbers also increase from 8.1%, 8.4% to 12.9%, 13.4% for boys and girls, respectively.<sup>3,4</sup> Similarly, the detection rate of

overweight and obesity also increase rapidly in China. From 1985 to 2014, the detection rate of overweight/obesity among students aged 7 to 18 continuously increase, with the annual growth rates of 0.27%-0.63% for overweight cases and 0.1%-0.58% for obesity cases. Moreover, the obesity detection annual growth rate from 1985-2014 reaches its peak from 2010-2014.<sup>5</sup> Overweight and obesity bring significant harms to children and adolescence, and they increase the risk of developing chronic diseases later in life. Studies show that around 80% of adolescence with obesity will develop adult obesity.<sup>6</sup> At the same time, there are close relationships between adolescent obesity with multiple types of cardiovascular and metabolic disorders, including hypertension, hyperlipidemia, fatty liver and type II diabetes. The risks of developing these disorders increase with the early onset of obesity and the prolonged course of the disease.<sup>7</sup> Therefore, the long-term harmful effects of obesity on the health status of adolescents could not be overlooked.

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\*Corresponding Author: School of Psychology, South China Normal University, 55 Zhongshan Avenue, Guangzhou, Guangdong, China 510631. (Email: pengzw@m.scnu.edu.cn)

<sup>^</sup> Co-first authors

Except from the health concerns, overweight and obesity also have adverse effects on the psychological and behavioral development of adolescents. Internalizing problem behavior is

defined as the negative and unhappy feelings experienced by individuals, which is mainly manifested as anxiety and depression. Compared to externalizing problem behaviors such as aggressiveness and delinquency, internalizing problem behavior are hard to notice and would not cause direct threat to others. However, it will cause long-lasting hidden problem to the mental health of the individuals.<sup>8</sup> Most of the overweight/obese children will not feel confident with their own body weight and shape. Since obesity causes many inconveniences during their daily activities, these kids easily become the subjects of ridicule among their peers. Moreover, obese students have much less opportunities to go on stage to perform during school activities, which will further reduce their self-confidence.<sup>9</sup> Consequently, their social communication and adaption abilities are usually compromised compared to kids with normal body weight. The dual effects of prejudice from outside world and their self-consciousness often make obese children feel low self-esteem, isolated, depressed and anxious, causing their mental illness.<sup>10-12</sup> Compared to the adolescents with normal weight, the depression and anxiety are common mental health issues associated with overweight/obese adolescents. For example, through the meta-analysis of longitudinal studies, Manna found that obesity and depression influence each other; the rates of obesity among depressed adolescents increase by 70%. Vice versa, the risk of depression also increases by 40% among obese adolescents.<sup>13</sup> Recent studies have already confirmed the increased frequencies of depressing and anxious mood among overweight/obese adolescents compared to those with normal body weight.<sup>14</sup> Due to the adverse impact of obesity on the mental health of those affected, research on the mechanism of internalizing problem development among overweight/obese adolescents are crucial to further prevent and intervene these issues.

With the vigorous development and widespread of Internet, it has gradually become a necessary tool during the daily activities for adolescents. However, the issue of Internet addiction has also inevitably developed. Internet Addiction (IA) or Internet Addiction Disorder (IAD), also named pathological Internet use (PIU) or Internet overuse (IO), indicates the loss of control over one's Internet tolerance, withdrawal response and desire to use Internet that are caused by the inappropriate use of Internet in a long time period, which impairs one's physiological, mental and social functions.<sup>15</sup> Due to the Internet addiction, some adolescents show a series of problems including indifferent social relationships, narrow social interactions, poor social adaption, disorganized time management, as well as academic and personal developmental hardship.<sup>16</sup> Studies have shown that pathological Internet usage will cause a number of social relationship and mental problems and will cause mental illness in adolescents, especially introvert boys.<sup>17</sup> Adolescents have become the susceptible group to Internet addiction.<sup>18</sup> Past studies have reached similar conclusions that overuse of Internet has close relations with adolescent mental disorders, social anxiety, depression and suicide.<sup>19</sup> For example, the prospective study conducted by Ko et al<sup>20</sup> has confirmed that the pathological usage of Internet could predict the occurrence

of depression and social interaction disorders during the follow-up studies within the next two years. A 9-month follow-up study conducted by Lawrence<sup>21</sup> showed that the risk of developing depression among mentally healthy adolescents with pathological Internet usage at the start of the study is 2.5 times higher compared to those with normal Internet usage. At the same time, other studies show that overuse of Internet among adolescents will exacerbate their existing overweight problems.<sup>22</sup> Moreover, as Internet addiction leads to a more sedentary lifestyle, it may become an independent risk factor to predict the occurrence of adolescent obesity.<sup>23</sup> Therefore, the first task of our work is to study the impact of Internet addiction on the internalizing problems (depression, anxiety) of adolescents.

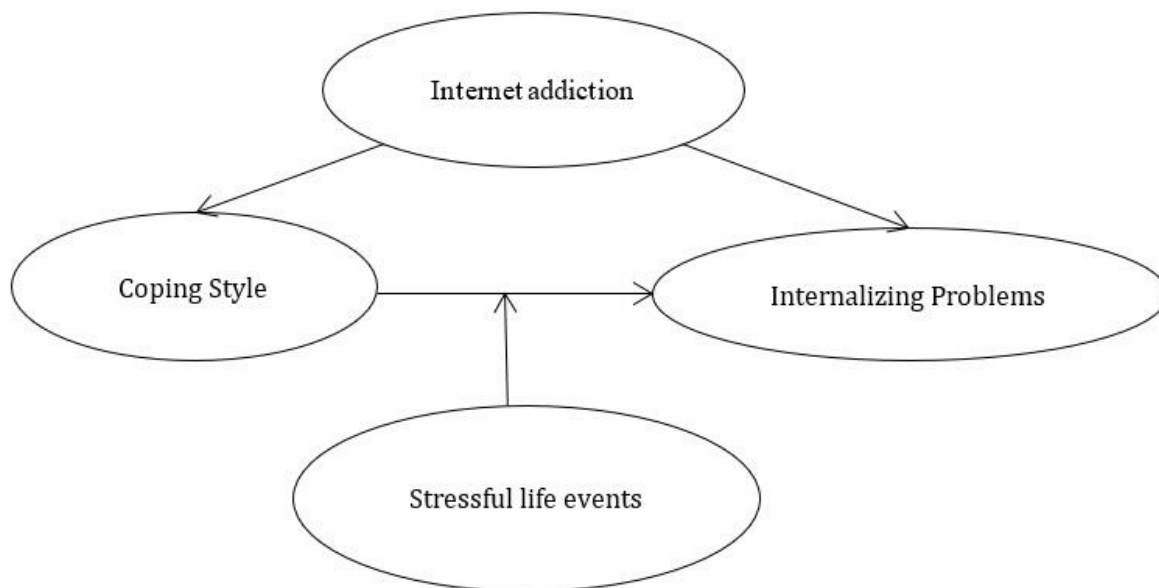
In this study, another important question to ask is how Internet addiction actually influences the development of internalizing problems among overweight/obese adolescents, and whether Internet addiction is an indirect influence that requires mediators. Coping style, also known as coping strategy or coping mechanism, indicates the cognitive and behavioral approaches individuals take when facing stress and challenges. It is an important factor when evaluating the mental healthiness of adolescents.<sup>24</sup> As a factor of internal self-regulation, coping style also has important effects on the development of Internet addiction.<sup>25,26</sup> Basing on the existing literature, we hypothesize that coping style may be an important mediator between Internet addiction and internalizing problems in overweight/obese adolescents. Previous studies show that coping style is related to negative emotions, positive coping style is in negative relation with depression and anxiety, while negative coping style is positively related to these negative emotions.<sup>27</sup> The social cognitive theory indicates that the use of Internet is a social cognitive process, and how individuals use the Internet may reflect their self-regulation capacities. On the other hand, Davis proposed a cognition-behavior model, which indicates the non-adaptive cognition as the proximal and sufficient reason for Internet addiction.<sup>28</sup> Both of these theories emphasized that Internet addiction is related to the cognitive characteristics of the Internet users.<sup>29</sup> Empirical research also supports this point, which shows that individuals who are addicted to Internet exhibit significant differences in terms of self-blame, hallucination, evacuation, rationalization and total negative coping scores. In addition, when facing challenges and stressful events, adolescents who are addicted to Internet randomly try to change the stressful environment through directly solving the problems and asking for help. Most of them negatively cope with stressful events through evacuation, self-blame and hallucination.<sup>30</sup> However, whether coping style could mediate the effects of Internet addiction on overweight/obese adolescents remains unclear. Thus, basing on related theory and research evidence, the second aim of our study is to investigate whether the coping style is a mediator in the process of Internet addiction affecting the internalizing problems of obese/overweight adolescents.

Stressful life events indicate the major events encountered by individuals during their daily life that could acutely and

strongly affect their mental states. They are prone to induce negative psychological responses, which through changing the functions of neurological and endocrine systems, result in physiological and psychological disorders and negatively affect mental health of individuals.<sup>31</sup> Additionally, stressful life events are the inducing factors of depression and anxiety, functioning as 'trigger' during the generation of internalizing problems.<sup>32</sup> The Stress-coping model proposed by Wagner<sup>33</sup> is the most popular explanation for the cognition-behavior theory during the addictive process. Wagner indicates that addictive behavior can be viewed as a coping strategy used by the addicting people in response to stressful events. It could either help relieve the stress brought by the negative emotions, or increase the positive emotions of the addicting people. Accordingly, we predict that different levels of stressful life events will affect the corresponding coping styles. Stressful events could therefore be the moderator of adolescent internalizing problems, and directly exert its effect through affecting the individual's coping style. How do stressful life events moderate the mediating effects of coping styles? Under what kind of circumstances, and how would stressful life events exert their moderating effect? Notably, a pulling force (temptation felt by the Internet users) and a pushing force (stressful life events) coexist during the process of Internet addiction. One needs two independent mental strategies to cope this dual effect. With the stressful life events, 'stress-coping system' is required to eliminate or reduce the negative

impacts; while 'temptation-coping system' is needed to prevent one from Internet addiction.<sup>26</sup> It is likely that stressful life events would lead individual to cope through immature behaviors (i.e. hallucination, evacuation, self-blame etc.), in order to reduce the negative emotion and impacts from real-life. When there are a number of stressful life events at the same time, it is more likely that an individual will take the negative coping style, which facilitates the generation of internalizing problems. When the number of stressful events decreases, the predicting effects of negative coping behaviors on internalizing problems decrease. This shows that stressful life events may play a moderating role in the second half of the mediating chain of coping style, i.e. positive moderating effect between the indirect relation of Internet addiction and internalizing problems.

In summary, the major goal of this study is to discuss the effects of Internet addiction, coping style and stressful life events on the internalizing problems in overweight/obese adolescents, and to study the interaction mechanisms of these factors. Basing on the previous studies, we hypothesize that coping style plays a mediating role between Internet addiction and the internalizing problems in overweight/obese adolescents. This mediating effect is positively regulated by stressful life events. Internet addiction has moderated mediating effect on the internalizing problems in overweight/obese adolescents (**Figure 1**).



**Figure 1.** The hypothetical model for coping style, Internet addiction, stressful life events and internalizing problems.

## METHODS

### Subjects

Using convenient sampling method, 1639 students (average age  $15.34 \pm 1.81$ ) were chosen from grade 7, 8, 10 and 11 of three junior high and high schools in Guangdong province, China. The questionnaire and anthropometric indices data

were collected in the same week. The questionnaire has the self-evaluation format. After taking out the invalid questionnaires due to missing data or formatted answers, we collected 1601 valid questionnaires, with the effective collection rate of 97.68%. The same students were subjected

to anthropometric indices measurement, and we collected 1518 valid data points of the 1618 subjects tested, with an effective collection rate of 93.82%. After combining the questionnaire and anthropometric data, 1438 data points were eventually collected for data analysis. Among the subjects 627 were male while 811 were female; with 351 grade 7 students (24.41%), 341 grade 8 students (23.71%), 372 grade 10 students (25.87%) and 374 grade 11 students (26.01%). Among all subjects 57.16% were only child while the rest 42.84% have siblings. Basing on the education level of the subjects' parents, 4.2% fathers and 2.8% mothers do not have formal education or not graduated elementary school; 4.2% fathers and 7.8% mothers only graduated elementary school; 28.7% fathers and 34.8% mothers have senior high school level education; 47.9% fathers and 43.9% mothers have high school or equal level education; while 15% fathers and 11.4% of mothers have college or above level education.

### Study Tools

#### *Anthropometric indices and the selection of overweight/obese adolescents*

Anthropometric indices include: Body Mass Index (BMI), Waist Circumference (WC), Waist-Hip Ratio (WHR), Waist-Height Ratio (WHTR), Systolic Blood Pressure, Diastolic Blood Pressure, Fasting Blood Glucose (FBG), Triglyceride (TG), Total Cholesterol (TC), High Density Lipoprotein Cholesterol, HDL-C, Low Density Lipoprotein Cholesterol (LDL-C) etc. All physiological and biochemical data collection was all performed by measurers that have undergone standard training. The height, weight, waist circumference and hip circumference were all measured in air-conditioned rooms at appropriate temperature. Students wore light underwear and were bare-foot for the measurements. Height and Weight were measured by automatic meters (Henggang SG, Shanghai, China). Systolic and diastolic blood pressure were measured by blood pressure monitor (Yutu, Shanghai, China). Students were fasted for at least 8 hours before blood collection. Blood biochemical data including blood lipids were measured by automatic biochemical analyzer (RiLi 7150, Tokyo, Japan). The criteria for overweight/obese adolescent selection were based on the Chinese children and adolescents BMI overweight, obesity screening classification criteria (WGOC).<sup>34</sup> The formula for BMI index is: weight (kg)/height (m<sup>2</sup>).

#### *Young Internet Addiction scale (Internet Addiction Test, IAT)*

Young Internet addiction scale is also called the 'Internet Addiction Test', which is designed by Kimberly S. Young from University of Pittsburgh. The Chinese version of this form use DSM-IV as criteria, which is modified according to the diagnosis of pathological gambling addiction. This scale could be used for both adults and children, the questions were formatted like 'Do you think the time you spend online are longer than you expected?' There are 20 questions in total. All questions were scored 1-5 basing on the answers 'Never, Randomly, Sometimes, Usually, Always'. The higher score indicates more severe case of Internet addiction. This test has accumulated steady reliability and efficiency, and it has shown high reliability and efficiency under different language

environments.<sup>19,21</sup> This test has shown internal consistency coefficient of 0.91 in this study.

#### *Trait Coping Style Questionnaire (TCSQ)*

The trait coping style questionnaire used in this study is designed by Qianjin Jiang.<sup>35</sup> It is to reflect the coping strategies related to the relatively stable characteristics of individuals, and are associated with the individual's personality traits. This questionnaire includes 20 questions, which are scored 1-5 basing on the answers 'Never, Randomly, Sometimes, Usually, Always'. Two factors were extracted basing on the factor analysis, including negative coping styles (NC) and positive coping styles (PC). Individual that scored higher on one factor indicates that the individual has characters that are more prone to that corresponding coping style. NC and PC have internal consistence coefficient of 0.69 and 0.7. In this study NC and PC have internal consistence coefficient of 0.88 and 0.87, respectively.

#### *Stressful life events scale*

This stressful life events scale contains 82 subsets, which asks the possible life events experienced during the past half a year. These events are mainly categorized into family-related events, school-related events, social relationship-related events and personal events. All events were categorized as never experienced (score 0) or experienced, in the latter case the impact of this event will be asked and scored from 1-5 basing on the answers 'Severely affected, heavily affected, moderately affected, slightly affected, not affected'. The scores from each subset will be added up, the score higher than 1 indicated related events have been experienced. The higher the score obtained for an adolescent that has experienced stressful life events, the more moderate effect these events have on its mood. The sum-up value indicates the stress intensity level for each category. In this study, the internal consistence coefficient is between 0.92-0.94 for each category in this scale.

#### *Self-rating depression scale, SDS*

Self-rating depression scale is designed by Zung in 1965.<sup>36</sup> It is a scale used for counseling, depression symptoms screening and severity evaluation, as wells as for psychopharmacology research. The scale contains 20 subsets, 10 of them are designed for reverse scoring. It is scored 1-4 basing on the answers 'seldom or never, sometimes, often, most of the time or always'. Higher score indicates more severe depression symptoms. This scale has an internal consistence coefficient of 0.86. In this study, this coefficient value is 0.77.

#### *Self-rating anxiety scale, SAS*

Self-rating anxiety scale is designed by Zung in 1971.<sup>37</sup> It is quite similar to SDS, and is mainly used for evaluating the degree of severity. The scale contains 20 subsets, 5 of them are designed for reverse scoring. It is scored 1-4 basing on the answers 'seldom or never, sometimes, often, most of the time or always'. Higher score indicates more severe anxiety levels. This scale has an internal consistence coefficient of 0.78. In this study, this coefficient value is 0.74.

## Data Analysis

Data were analyzed by SPSS 19.0 software. Since the number of missing data for major variables were limited, we estimated the missing values using the maximum likelihood estimation method. With the premise to protect the original data as much as possible, this approach would allow us to get better-unbiased parameter estimation and more accurate standard errors. First, all main variables were statistically described; Secondly, the relations between the main variables were

analyzed through Pearson correlation; Finally, the moderated mediation model was analyzed by regression model. In addition, to efficiently reduce type I and type II errors if the premise of null hypothesis is not met in classic parameter tests (i.e. homogeneity of variance), we used the bootstrapping approach<sup>38</sup> for significant test of regression coefficient, in order to get the robust standard error and confidence intervals of parameter estimation. If the confidence interval does not include 0, it indicates there is statistical significant difference.

**Table 1.** Comparison of internalizing problems and anthropometric indices among adolescents with different body weight.

Variables	Normal weight group (n = 1193)	Overweight/Obesity group (n = 245)	P
<b>Internalizing problem</b>			
Depression (SDS)	2.16±0.41	1.84±0.42	0.001
Anxiety (SAS)	1.63±0.34	1.67±0.33	0.11
<b>Obesity parameters</b>			
BMI	18.48±2.04	25.12±2.76	0.001
Waist circumference (WC)	66.52±6.87	78.25±8.15	0.001
Waist-to-hip ratio (WHR)	0.81±0.07	0.86±0.06	0.001
Waist-to-height ratio (WHtR)	0.41±0.04	0.49±0.05	0.001
<b>Biochemical parameters</b>			
Triglycerides (TG)	0.96±0.397	1.44±0.741	0.001
Fasting blood-glucose (FBG)	4.61±0.41	4.65±0.45	0.53
Total cholesterol (TC)	4.05±0.693	4.46±0.846	0.001
HDL-cholesterol	1.38±0.274	1.28±0.222	0.002
LDL-cholesterol	2.48±0.614	2.89±0.843	0.001
<b>Blood pressure</b>			
SBP	106.86±8.536	112.04±7.327	0.001
DBP	65.92±6.515	69.49±6.608	0.001

## RESULTS

### Examining the Common Method Biases

Due to the fact that self-report was the only way of collecting data in this research, its results could be affected by common method biases. In order to eliminate these biases as much as possible, we strictly controlled the process of data collection and used Harman's single-factor test to limit the common method biases. Initially, during the data collection, we collected data anonymously, separated the questionnaires with similar contents, and subtly changed the description of questionnaires among different subjects. After data collection, we examined the common method biases with Harman's single-factor test. It turned out that rotated or not, the characteristic root of the eleven factors was always greater than 1. Meanwhile, the variance retrieved from the unrotated first factor was 21.01%, while it became 13.76% after rotation. Both of them were lower than the standard of 40%, which indicated that there are no severe common method biases in this research.

### The Prevalence of Overweight and Obesity in Adolescents

According to WGOE BMI standard, all subjects were divided into two groups: 82.96% into the normal weight group (BMI 18.48±2.04 kg/m<sup>2</sup>, n = 1193) and 17.04% into the overweight/obesity group (BMI 25.12 ± 2.76 kg/m<sup>2</sup>, n = 245). The difference between these two groups was significant in BMI (t = 35.26, P < 0.001) as well as many other indicators of obesity waist circumference, waist-to-hip ratio, waist-to-

height ratio and biochemical parameters (including TG, TC, HDL-C, LDL-C, Ps < 0.001) (See **Table 1**). We compared the normal weight group to the overweight/obesity group to determine whether the difference in internalizing problems (e.g. depression, anxiety) was significant. The results showed that these two groups have a significant difference in depression scores (t = 2.95, P < 0.01), while the difference in anxiety scores is not significant.

### Descriptive and Correlational Analyses

The means, standard deviations and correlation matrix of variants are shown in **Table 2**, in which the mean values indicate the average scores of overweight/obese adolescents in different questionnaires. We found that there is a significant positive correlation between the internalizing problems in overweight/obese adolescents and three factors, which include Internet addiction, negative coping styles (NC), and stressful life events. This suggests that these three factors are risk factors for the internalizing problems in overweight/obese adolescents. Though positive coping style (PC) is significantly and negatively correlated with depression and anxiety, it doesn't have any significant correlation with Internet addiction and stressful life events. According to Wen, Hou, and Zhang,<sup>39</sup> a certain variant can't be a mediator when its correlation with the dependent/independent factor is not strong enough. Therefore, in our following mediation analysis, we only examined the mediation effect of negative coping style.

**Table 2.** Descriptive analysis and correlation matrix.

Variables	M	SD	1	2	3	4	5	6
1. Internet addiction	1.63	0.61	1.00					
2. stressful life events	9.63	2.70	0.36***	1.00				
3. positive coping style	3.11	0.97	0.12	0.09	1.00			
4. negative coping style	2.19	0.84	0.48***	0.35***	0.27***	1.00		
5. depression	1.96	0.41	0.23***	0.15*	-0.49***	0.18**	1.00	
6. anxiety	1.63	0.34	0.36***	0.21**	-0.19**	0.38***	0.60***	1.00

\*:  $P < 0.05$ ; \*\*:  $P < 0.01$ ; \*\*\*:  $P < 0.001$ .

### The Relationship Between Internet Addiction and Internalizing Problems in Overweight/Obese Adolescents

We used hierarchical regression to examine the mediating model of Internet addiction and internalizing problems in overweight/obese adolescents, which is moderated by negative coping styles and stressful life events. According to Hayes;<sup>40</sup> Muller, Judd and Yzerbyt;<sup>41</sup> Wen and Ye,<sup>42</sup> in order to test for a moderated mediating model, we need to examine the first stage, second stage and direct effect of the moderation model to investigate whether they are influenced by the moderator variables. Determined by our hypothesis, this research only needs to examine the moderating effect of moderator variables in the second stage. Parameter estimates for three regression equations are necessary to test the moderated mediating model (See **Table 3**). Equation 1 estimates the effect of stressful life events (moderator variable) on the relationship between Internet addiction (independent variable) and depression/anxiety (dependent variable); equation 2 estimates the effect of stressful life events (moderator variable) on the relationship between Internet addiction (independent variable) and negative coping style (mediator); equation 3 estimates the effect of stressful life events (moderator variable) on the relationship between negative coping style (mediator) and depression/anxiety (dependent variable). If the regression test

validates the effect of mediators as well as the moderating effect of moderator variable, the existence of a moderated mediation is proved. This study centers all predictors in every equation and controls factors including sex, age, and parent's education level to avoid multi-collinearity.

As shown in **Table 3**, in equation 1, the main effect of Internet addiction (IA) on internalizing problems in overweight/obese adolescents is significant ( $\beta_{\text{depression}} = 0.22$ ,  $\beta_{\text{anxiety}} = 0.24$ ,  $P_s < 0.01$ ), whereas the main effect of stressful life events (SLEs,  $\beta_{\text{depression}} = 0.02$ ,  $\beta_{\text{anxiety}} = 0.61$ ,  $P_s > 0.05$ ) and the interaction effect of these two ( $\beta_{\text{depression}} = 0.07$ ,  $\beta_{\text{anxiety}} = 0.003$ ,  $P_s > 0.05$ ) are insignificant. In equation 2, both IA and SLEs significantly and positively predict negative coping style (NC,  $\beta_1 = 0.84$ ,  $\beta_2 = 0.08$ ,  $P_s < 0.01$ ), and the interaction effect is significant as well ( $\beta = 0.03$ ,  $P_s < 0.05$ ). In equation 3, NC has a significant main effect on internalizing problems in overweight/obese adolescents ( $\beta_{\text{depression}} = 0.19$ ,  $\beta_{\text{anxiety}} = 0.05$ ,  $P_s < 0.05$ ), and the moderator of NC and SLEs can also significantly predict internalizing problems ( $\beta_{\text{depression}} = 0.02$ ,  $\beta_{\text{anxiety}} = 0.01$ ,  $P_s < 0.001$ ). Comparing equation 3 to equation 1, we found that  $\Delta R^2_{\text{depression}} = 0.02$ ,  $\Delta R^2_{\text{anxiety}} = 0.03$ , which explain 2% and 3% of the deviation respectively.

**Table 3.** Testing of the moderated mediating model for the effect of Internet addiction on internalizing problems in overweight/obese adolescents.

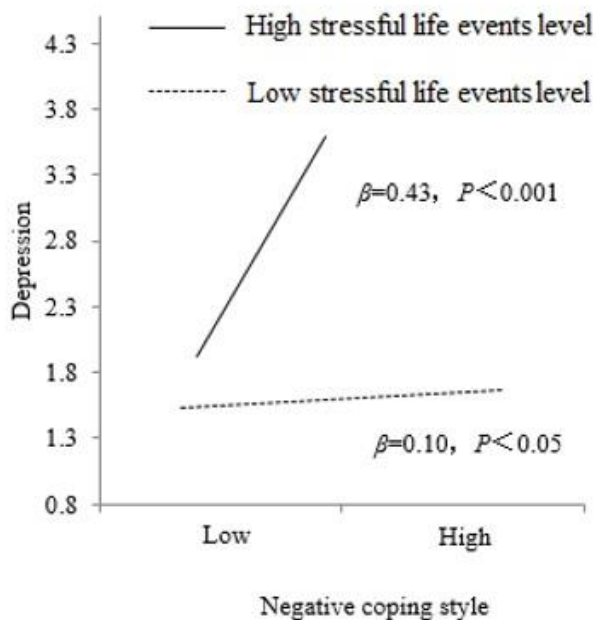
	Depression						Anxiety					
	Equation 1 Depression		Equation 2 Negative coping style		Equation 3 Depression		Equation 1 Anxiety		Equation 2 Negative coping style		Equation 3 Anxiety	
	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$	$\beta$	$t$
Sex	-0.02	-0.29	0.41	4.81**	-0.05	-0.94	0.01	0.19	0.41	4.81**	-0.03	-0.70
Age	-0.03	-0.22	0.11	4.67**	-0.52	-1.28	0.02	1.26	0.11	4.67**	0.004	0.32
Father's education level	-0.01	-0.43	-0.03	-0.75	-0.01	-2.06	0.002	0.11	-0.03	-0.75	0.01	0.28
Mother's education level	-0.04	-0.14	0.06	1.27	-0.05	-1.47	-0.06	-2.32	0.06	1.27	-0.07	-2.58
Internet addiction (IA)	0.22	1.94**	0.84	4.64***	0.18	1.37	0.24	2.75**	0.84	4.64***	0.18	1.78*
Stressful life events (SLEs)	0.02	1.19	0.08	2.83**	0.01	0.36	0.61	1.33	0.08	2.83**	0.07	0.49
IA×SLEs	-0.07	-0.70	-0.03	-1.99*	-0.01	-0.62	0.003	0.88	-0.03	-1.99*	-0.01	0.52
Negative coping style (NC)					0.19	3.65**					0.05	1.71*
NC×SLEs					0.02	3.76***					0.01	3.77***
$R^2$	0.06		0.39		0.08		0.14		0.39		0.17	
$F$	3.19**		23.48***		3.14***		6.68***		23.48***		6.41***	

Our data suggests that NC is a partial mediator between IA and internalizing problems, and SLEs have a moderating effect on the relation between NC and internalizing problems. Subsequently, we used the simple slope test<sup>43</sup> to further

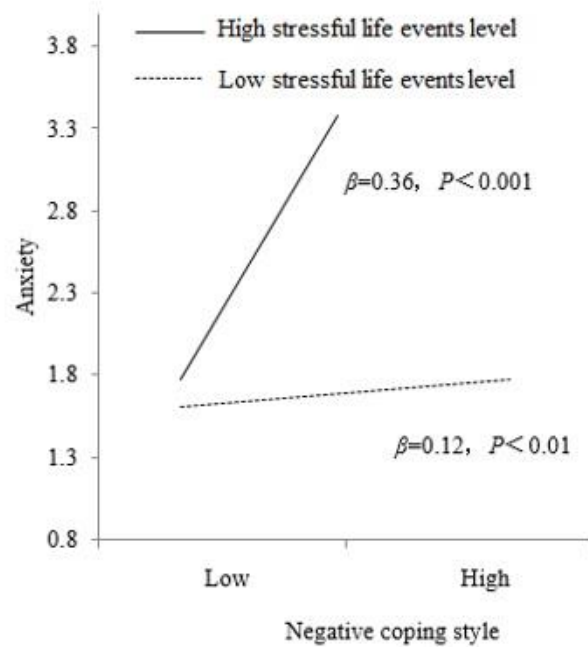
analyze the moderating effect. We analyzed the effect of NC on internalizing problems in overweight/obese adolescents at two conditions, i.e. SLEs = M + SD and SLEs = M - SD respectively (See **Figure 2** and **Figure 3**). Results show that

for those with a high level of stressful life events, NC has a significant positive predictive value on depression/anxiety in overweight/obese adolescents ( $b_{\text{depression}} = 0.43$ ,  $t_{\text{depression}} = 7.34$ ,  $b_{\text{anxiety}} = 0.36$ ,  $t_{\text{anxiety}} = 5.57$ ,  $P_s < 0.001$ ); for those with a low level of SLEs, NC has a weaker (simple slope<sub>depression</sub> = 0.43 decreases to simple slope<sub>depression</sub> = 0.10; simple slope<sub>anxiety</sub> = 0.36 decreases to simple slope<sub>anxiety</sub> = 0.12) yet positive effect on depression/anxiety in overweight/obese adolescents

( $b_{\text{depression}} = 0.10$ ,  $t_{\text{depression}} = 2.35$ ,  $b_{\text{anxiety}} = 0.12$ ,  $t_{\text{anxiety}} = 2.82$ ,  $P_s < 0.05$ ). This indicates that with the increase in stressful life events, the effect of NC on depression/anxiety in overweight/obese adolescent increases as well. In other words, the indirect impact of Internet addiction on internalizing problems in overweight/obese adolescents increases with the level of stressful life events (with a mediator of negative coping style).



**Figure 2.** The moderating effect of stressful life events on negative coping style and depression.



**Figure 3.** The moderating effect of stressful life events on negative coping style and anxiety.

## DISCUSSION

### The Mediating Effect of Negative Coping Style

Based on the existing research, this study includes coping styles to explore the mechanism of Internet addiction regarding its influence on the internalizing problems in overweight/obese adolescents. The result showed that the negative coping style partially mediated the impact of Internet addiction on internalizing problems in overweight/obese adolescents, which preliminarily verified the hypothesis of this research - the mediating effect of coping style. Davis<sup>28</sup> and social-cognitive theory suggest that the impact of Internet addiction on individual problem behavior is mainly through intrinsic characteristics of individuals, coping styles and other internal factors. The results of this study not only support this theory, but also prove that negative coping style is an important mediator in the relationship between Internet addiction and internalizing problems among overweight/obese adolescents.

This study found that Internet addiction was significantly positively correlated with internalizing problems in overweight/obese adolescents, indicating that Internet

addiction is a risk factor for depression and anxiety. Individuals with a strong Internet addiction are more likely to suffer from depression or anxiety problems, which is in line with the previous studies.<sup>11,14,21</sup> At the same time, negative coping style also has a significant direct predictive value on depression and anxiety, which is consistent with Beck's Cognitive Susceptibility Model for Depression and Development. That is, stress can activate individual susceptibility (mainly due to attribution style, personality, self-cognition assessment and coping style, etc.), which leads to the internalizing problems such as depression.<sup>44</sup> As for overweight/obese adolescents, they are more prone to emotional problems such as depression and anxiety, because they hope to alleviate negative emotions in this way. Therefore, individuals who are more inclined to adopt passive coping strategies such as avoidance and withdrawal are more likely to form such a problem handling mechanism. This study further examines the indirect effect of Internet addiction on the internalizing problems in overweight/obese adolescents through passive coping style and finds that individuals with severe Internet dependence lack effective coping strategies

when facing stress problems such as frustration or stress. They are less likely to change the stress environment by solving problems and asking for help. Instead, most of them adopt negative coping styles such as withdraw, self-blame and fantasy, causing negative behavioral and emotional problems such as hyperphagia, loneliness, depression, and anxiety.<sup>45,46</sup> Therefore, when facing the society in real life, they feel more and more isolated and tend to escape the reality through Internet, which eventually becomes a vicious cycle.

### **The Moderator Effect of Stressful Life Events**

In this study, regression analysis found that stressful life events can regulate the indirect effects of Internet addiction on internalizing problems in overweight/obesity adolescent. The specific regulatory role is located in the second half of the intermediary chain. That is, the relationship between the negative coping style and the internalizing problems in overweight/obese adolescents is conditioned by the stressful life events they experience. The indirect effects of Internet addiction on the internalizing problem in overweight/obese adolescents by negative coping patterns increase with the growing level of stress life events. This result validates our assumptions. In the meantime, Wagner's<sup>33</sup> stress-coping model is further verified and expanded. That is, addiction behavior is a coping reaction of addicts to cope with stressful events. At the same time, in the process of Internet addiction, in view of the dual effects of pulling force (temptation felt by the Internet users) and pushing force (life event stress), overweight/obese adolescents need two sets of independent psychological mechanisms to cope with the synergistic effect of the two: the need of "stress coping system" to deal with life events stress in order to solve or reduce the negative influence; the need of "temptation coping system" in face of the perceived Internet temptation to prevent the Internet addiction. These two coping systems are independent of each other, even though individuals resist the temptation from the Internet to ease the stress of life events, they may still indulge in the network to escape the negative emotions and adverse effects in real life because of the immature coping styles (such as fantasy, withdraw, self-blame can also include the rationalization etc.) they use.<sup>26</sup> Therefore, the coping style cannot independently restrain Internet addiction and internalizing problem. It needs to work together with stressful life events. When the amount of stressful life events accumulates, overweight/obese teenagers are more inclined to adopt a negative coping style, and more likely to rely on the Internet to relieve their own stress, resulting in depression, anxiety, and other internalized behavior. Thus, stressful life event is a positive moderator in the indirect effect of Internet addiction on internalizing problems in overweight/obese adolescents.

### **Research Value and Prospects**

This study reveals the intrinsic mechanism of Internet addiction on the internalizing problems in overweight/obese adolescents, which is of both theoretical and practical value. First of all, in theory, this study not only helps to understand how Internet addiction acts directly and indirectly on the internalizing problems in overweight/obese adolescents, but

also further reveals the strength differences on individuals who experience different levels of life events and being influenced by mediation effects.<sup>47</sup> Secondly, this study provides empirical evidence on the mechanism of internalizing problem formation of overweight/obese adolescents. In fact, the discussion on the mechanism of internalizing problems in overweight/obese adolescents has important implications for the prevention and intervention of adolescent overweight/obesity, depression and anxiety. Although individuals with high levels of Internet dependence are more likely to develop depression, anxiety, and other negative emotions, the possibility of internalization can be reduced through intervention in predisposition such as self-awareness assessment and coping style. By increasing the awareness of overweight/obese adolescents, admitting themselves and making themselves believe that they can handle the stressful life events, they should take more active measures to actively seek support and help. In addition, the living and learning environments of adolescents should also be optimized to minimize the frequency of negative life events. More importantly, schools should make use of various channels to conduct extensive mental health education and psychological counseling among adolescents to improve their ability to cope with negative life events, regulate the role of Internet addiction on the issue of internalization and reduce the possibility of internalizing problem formation of overweight/obese adolescents.

This study also has some limitations. First of all, the self-report method was used to collect the data. Although the results of Harman's single-factor test showed that there were no significant common method biases, there may still be some social appraisal effect. Due to smaller sample sized survey, the interpretation is limited because there are much bias and confounding factors in this cross-sectional study. It is necessary for the future research to collect the data through various means, such as teacher's report, parent's report and peer nomination, in order to further improve the validity of the research. Secondly, due to the cross-sectional study design, the relationship between variables could not be clarified by causal inference. In the future, it is necessary to use the method of longitudinal follow-up research to further verify the research results. Finally, in this study, overweight and obesity subjects were screened only with anthropometric parameters, and the clinical symptoms of obesity were not diagnosed. Therefore, in the future, it is necessary to study the clinically diagnosed obesity adolescents so as to make the research results more clinically significant.

### **CONCLUSION**

(1) Internet addiction has a direct impact on the internalizing problems in overweight/ obese adolescents, and indirectly affects them through coping styles. The negative coping style plays a partial mediating role in the problem of internalization of overweight/obese adolescents by Internet addiction.

(2) The mediating effect of negative coping styles was moderated by stressful life events.



**CONFLICT OF INTEREST**

None.

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