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Excessive weight and academic performance among Chinese children and adolescents: Assessing the mediating effects of bullying victimization and self-rated health and life satisfaction☆

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ABSTRACT

Using a nationally representative survey of urban areas from China, the present study examines the association between excessive weight and academic performance, with a specific focus on the potential mediating effects of bullying victimization and self-rated health and life satisfaction. Our findings indicate that overweight and obese girls are more likely to report poorer academic performance than their normal weight counterparts. However, these detrimental effects are fully explained by their overweight perceptions. In addition, obese girls are more likely to report cyberbullying victimization, contributing to lower life satisfaction and poorer academic performance. Surprisingly, girls who perceive themselves as slightly underweight are also more likely to report poorer academic performance. Finally, neither weight nor weight perceptions are linked to poorer academic performance among boys. Given the implications of academic performance on future employment and health outcomes, our study highlights the importance of documenting factors contributing to children's and adolescents' poorer academic performance.

1. Introduction

Excessive weight is an important public health concern among children and adolescents (Lobstein et al., 2015; Peckins, Negriff, Schneiderman, Gordis, & Susman, 2019). From 2002 to 2015, the percentage of overweight children had increased from 4.5 to 9.6% in China; likewise, the percentage of obese children had also increased from 2.1 to 6.4% (Li et al., 2016). In addition to well-established adverse effects of overweight and obesity on health consequences (Halfon, Larson, & Slusser, 2013; Swallen, Reither, Haas, & Meier, 2005), scholars have examined the potential developmental outcomes of excessive weight. Previous research has primarily focused on academic performance (Judge & Jahns, 2007) since academic performance during childhood and adolescence has implications for adults' employment (Laitinen, Power, Ek, Sovio, & Järvelin, 2002) and health (Mayer, Šimon, Heidrich, Cokkinos, & De Bacquer, 2004) outcomes. Overall, studies have found that excessive weight is linked to poorer academic performance (Judge & Jahns, 2007).

Overweight perceptions are an important, but often overlooked aspect of weight status. It remains unclear how overweight perceptions might shape children's and adolescents' academic performance. Moreover, little is known about the ways in which excessive weight and overweight perceptions affect children's and adolescents' academic performance. In this study, we seek to (1) examine the simultaneous effect of excessive weight and overweight perceptions on academic performance and (2) explore how bullying victimization and self-rated health and life satisfaction might play important mediating roles in those relationships. Fig. 1 illustrates the conceptual framework that guides our hypotheses.

1.1. Excessive weight and poorer academic performance

A growing body of research has documented the association between excessive weight and academic performance. According to reflected self-appraisal, individuals view themselves based on the judgment of others, suggesting that the functioning of individuals is largely

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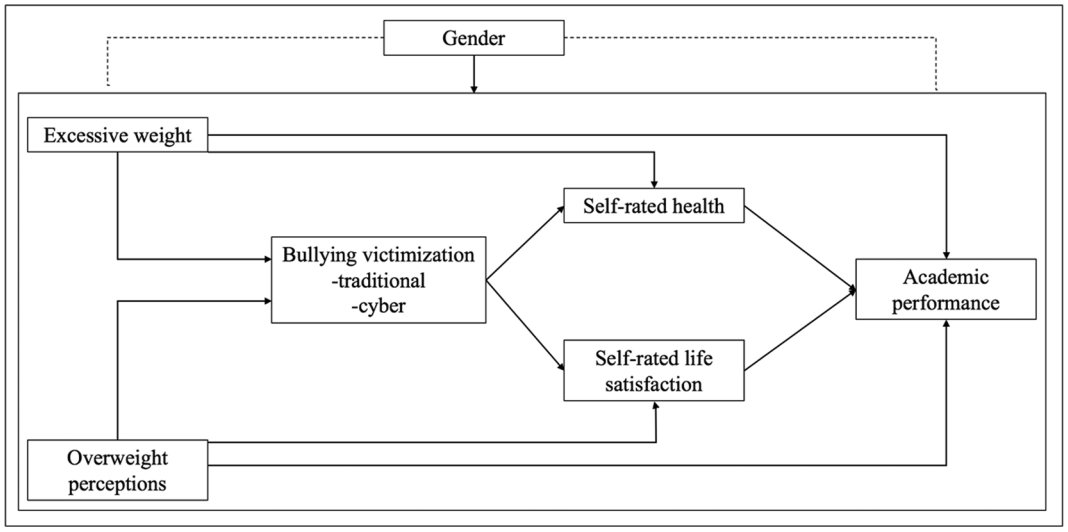

Fig. 1. Conceptual framework of excessive weight and overweight perceptions, bullying victimization, self-rated health and life satisfaction, and academic performance. *Note*: The solid lines represent the direct effects between variables. The dashed lines indicate moderating effects of gender on the association between excessive weight/overweight perceptions, bullying victimization, self-rated health and life satisfaction, and academic performance.

shaped by how their characteristics align with socially constructed collective norms and cultural values (Cooley, 1983; Markus, 1977). Given the prejudicial attitudes toward overweight and obese individuals (Crandall & Schiffhauer, 1998; Greenberg, Eastin, Hofschire, Lachlan, & Brownell, 2003), excessive weight has been conceptualized as a heavily stigmatized identity (Allon, 1981). Research demonstrates that individuals with excessive weight are often perceived as physically unattractive and undesirable (Puhl & Brownell, 2001). In addition, they are often viewed as responsible for their weight, which is attributed to their laziness or a lack of self-control (Hoyt, Burnette, Auster-Gussman, Blodorn, & Major, 2017). Although some individuals can nullify negative judgments, it is more common for people to absorb those judgments into their self-concept (Crosnoe & Muller, 2004). As Crosnoe and Muller (2004) suggest, "the lack of fit between the individuals' characteristics and larger normative structures typically hampers adjustment and functioning" (p.394), which might explain why overweight and obese individuals are more likely to experience adverse developmental outcomes. In other words, due to social stigma associated with excessive weight, overweight and obese individuals might negatively evaluate their abilities and might be evaluated by others in the same way, which, in turn, creates additional obstacles toward successful functioning (Quinn & Crocker, 1999). Applying to one of the primary markers of individual functioning, most studies find that being overweight in childhood and adolescence is linked to poorer academic performance (Judge & Jahns, 2007; Kark, Hjern, & Rasmussen, 2014; Lu, Chou, & Lin, 2014; Shore et al., 2008). However, there is also evidence that the association is statistically insignificant (Abdelalim et al., 2012; Baxter, Guinn, Tebbs, & Royer, 2013). These inconsistent findings might be attributable to the use of different study samples or/and measures of academic performance. Based on the aforementioned theoretical perspective, we hypothesize that overweight and obese children and adolescents are more likely to report poorer academic performance than their normal weight counterparts (**Hypothesis 1**).

1.2. Overweight perceptions and poorer academic performance

Scholars have recently recognized the importance of incorporating overweight perceptions while documenting the academic performance of children and adolescents (Florin, Shults, & Stettler, 2011). Despite a lack of consistent theoretical explanations, previous research finds that overweight perceptions are associated with elevated levels of health problems net of actual excessive weight, suggesting that overweight perceptions are more important than medically defined excessive weight in predicting mental health and behavioral problems (Atlantis & Ball, 2008; ter Bogt et al., 2006). Nevertheless, to predict academic performance by perceived weight status, some scholars have highlighted the effect of social context, which essentially aligns with the ideas of reflected self-appraisal (Florin et al., 2011). As Frisco and colleagues (2010) further stress, "consequences of sociocultural ideals about weight and weight stigma operate through weight perceptions, not actual weight" (p. 216). Based on previous empirical evidence and theoretical ideas, overweight perceptions might also be a more important factor contributing to children's and adolescents' poorer academic performance. Very few studies have documented a simultaneous effect of excessive weight and overweight perceptions on children's and adolescents' academic performance. Using the 2003 Youth Risk Behavior Survey, Florin and colleagues (2011) observed that overweight adolescents were associated with poorer academic performance than those who were normal weight, but its deleterious effect was fully explained by their overweight perceptions. These patterns suggest that overweight perceptions might account for the positive association between excessive weight and poorer academic performance. Thus, we hypothesize that children and adolescents who perceive themselves as overweight are more likely to report poorer academic performance than those who perceive themselves as normal weight (**Hypothesis 2**) and that overweight perceptions might fully mediate the positive association between excessive weight and poorer academic performance (**Hypothesis 3**).

1.3. The mediating effects of bullying victimization and self-rated health and life satisfaction

To establish the mediating mechanisms, we employ two theoretical models. First, we use concepts of primary stressors, secondary stressors, and stress proliferation embedded in the stress process model to develop a conceptual framework for the mediating processes in the associations between excessive weight and poorer self-rated health and life satisfaction (Pearlin & Bierman, 2013). The stress process model indicates the association between primary and secondary stressors as "stress proliferation," emphasizing that one stressor could create additional stressors. We integrate these concepts to posit that excessive weight (i.e., a primary stressor) is linked to bullying victimization (i.e., a secondary stressor), and part of the associations between excessive weight and poorer self-rated health and life satisfaction might therefore

be attributable to bullying victimization. Research has shown that (1) excessive weight is detrimental to individuals' health and well-being (Forste & Moore, 2012; Lee et al., 2016; Reilly & Kelly, 2011); (2) excessive weight is positively associated with bullying victimization (Juvonen, Lessard, Schacter, & Suchilt, 2017; Puhl, Luedicke, & Heuer, 2011; Van Geel, Vedder, & Tanilon, 2014); and (3) bullying victimization is associated with elevated levels of health and well-being problems (Chai, Xue, & Han, 2020; Hertz, Everett Jones, Barrios, David-Ferdon, & Holt, 2015). Therefore, bullying victimization might mediate the detrimental associations between excessive weight and self-rated health and life satisfaction.

Second, a large body of research has applied the interpersonal risk model to examine the consequences of bullying victimization (Nakamoto & Schwartz, 2010). Prior studies have established a positive association between bullying victimization and poorer academic performance (Nakamoto & Schwartz, 2010; Schwartz, Gorman, Nakamoto, & Toblin, 2005). Some scholars have proposed the potential mediating mechanisms embedded in that relationship, suggesting that children's and adolescents' health and well-being are essential to perform academic tasks (Ryan & Deci, 2000). Experiencing bullying victimization might undermine children's and adolescents' health and well-being, which puts them at a higher risk of poor academic performance (Thijs & Verkuyten, 2008). Based on these theoretical ideas, it is reasonable to assume that part of the association between bullying victimization and poorer academic performance might be attributable to worse self-rated health and life satisfaction. Together, by drawing on ideas of the stress process model (Pearlin & Bierman, 2013) and the interpersonal risk model (Nakamoto & Schwartz, 2010), we hypothesize that excessive weight is associated with greater exposure to bullying victimization, which contributes to worse self-rated health and life satisfaction and poorer academic performance (**Hypothesis 4a**).

Likewise, bullying victimization and poorer self-rated health and life satisfaction might at least partially mediate the positive association between overweight perceptions and poorer academic performance. Research has shown that children and adolescents who perceive themselves as overweight tend to have low self-esteem, which might shape how they respond to certain social situations, making them potential targets among bullies (Egan & Perry, 1998) and experiencing deleterious health and well-being consequences (Chai et al., 2020). Along with the associations discussed above—bullying victimization might be indirectly linked to poorer academic performance through worse self-rated health and life satisfaction (Thijs & Verkuyten, 2008), we hypothesize that overweight perceptions are associated with greater exposure to bullying victimization, which contributes to worse self-rated health and life satisfaction and poorer academic performance (**Hypothesis 4b**).

1.4. Gender differences

The focal associations outlined previously might differ for boys and girls. Body image concern among adolescents is deeply embedded in sociocultural expectations regarding what ideal female and male body shapes should look like (Brodie, Bagley, & Slade, 1994). Due to global media influences, thinness has been increasingly portrayed as the ideal female body image, while muscularity has been considered the ideal male body image (Demarest & Langer, 1996). Therefore, the adverse consequences of excessive weight might be more detrimental to girls than boys due to the greater stigmatized identity attached to overweight and obesity among girls. Likewise, similar patterns might also apply to overweight perceptions. There is evidence that girls are more likely than boys to perceive themselves as overweight; importantly, even among normal weight or underweight females, many of them still perceive themselves as overweight (Demarest & Langer, 1996). Thus, it is likely that the adverse effect of overweight perceptions on poorer academic performance is stronger for girls than boys. Surprisingly, very few studies have empirically tested the potential gender differences in the effects of excessive weight and overweight perceptions on poorer academic performance. With one exception: using the baseline data from the China Seven City Study (CSCS), Xie et al. (2006) revealed that perceived overweight was associated with poorer academic performance among adolescent girls only. These empirical and theoretical ideas might suggest that girls might be more sensitive to excessive weight and overweight perceptions, resulting in comparatively greater exposure to bullying victimization, worse self-rated health and life satisfaction, and ultimately poorer academic performance. Thus, we hypothesize that the associations of excessive weight and overweight perceptions with bullying victimization, worse self-rated health and life satisfaction, and poorer academic performance would differ for girls than boys, reflecting greater differences among girls (**Hypothesis 5**).

2. Method

2.1. Participants

To examine our research questions, we use a nationally representative survey of urban areas from China collected in 2016. We purposively selected seven provinces to cover the geographical variations, including the northeast, north, east, south, southwest, and central part of China. Then we selected each province's capital city—Shenyang, Beijing, Lanzhou, Guiyang, Nanjing, Guangzhou, and Changsha. Next, we selected one of each type of pre-college school (i.e., primary school, middle school, high school, and vocational school) based on the available connections with local schools. Within each school, one class of each grade was randomly selected. We did not sample students from Grade one to Grade three because of a lack of reading and understanding the survey questions. All the students from each selected class were asked to complete the questionnaire voluntarily with the help of one research assistant from the research team. These aforementioned sampling strategies allowed us to best balance the "representativeness," the scientific rationale, as well as the available reality (Lohr, 2009). In total, 3,777 questionnaires were distributed to 28 schools (4 schools per province multiply by 7 provinces). The response rate was 100%. However, 152 (4.0%) students were excluded from the analyses due to missing values. The final sample is 3,625 (1,877 girls and 1,748 boys).

2.2. Measures

Academic performance. We examine academic performance based on the question: "How would you evaluate your academic performance last year?" Responses are coded as: "very poor (1)," "poor (2)," "average (3)," "good (4)," and "very good (5)." We further recode the variable into a dummy variable (1 = "very poor/poor," 0 = "average/good/very good").

Weight status. We include two measures of weight status. *Actual weight* is assessed based on BMI. BMI is calculated based on the following formula: BMI = weight(kg)/height^2(m^2) (Kaltiala-Heino, Lankinen, Marttunen, Lindberg, & Fröjd, 2016). According to grade and gender-specified BMI cut-off points suggested by the National Student Physical Health Standard (revised in 2014) from the Ministry of Education of the People's Republic of China (Ministry of Education of the People's Republic of China, 2014), we recode BMI into four categories, including "underweight (1)," "normal weight (2)," "overweight (3)," and "obese (4)." *Perceived weight* is assessed based on the question: "How do you feel about your body weight?" Responses include "too thin (1)," "slightly thin (2)," "normal (3)," "slightly overweight (4)," and "overweight (5)."

School bullying victimization. We measure school bullying victimization based on the question: "In the last academic year, had your classmates or peers done any of the following behaviors to you?" By relying on the existing literature (Ba et al., 2019; Chai et al., 2020), we include two bullying victimization forms. Traditional bullying victimization includes six items (α = 0.88): two items of verbal bullying (e.g.,

"called nickname, made fun of, or insulted in a hurtful way" and "threat you with harm"), two items of physical bullying (e.g., "kick, hit, push, or spit at you" and "deliberately destroy your things"), two items of relational bullying (e.g., "spread rumors about you and encourage others to dislike you" and "exclude you from group activities on purpose"), and cyberbullying victimization includes four items ($\alpha = 0.86$) (e.g., "spread bad news or rumors about you on the internet or social media," "purposively post your private information/photos/videos on the internet or social media," "threat or insult you by sending message from phone/WeChat/QQ," and "deliberately exclude you from online communication or game"). Responses of each question include "never (1)," "rarely (2)," "sometimes (3)," and "frequently (4)." By following recent literature (Chai et al., 2020), we first recode each item as a dummy variable (1 = "rarely/sometimes/frequently" and 0 = "never"). We then create traditional bullying and cyberbullying as "1" when at least one item is reported as "rarely/sometimes/frequently" and "0" when all items are reported as "never."

Self-rated health. We measure self-rated health based on the question: "In general, how would you evaluate you overall health status?" Responses are coded as: "very poor (1)," "poor (2)," "average (3)," "good (4)," and "very good (5)." We then recode the variable into a dummy variable (1 = "very poor/poor" and 0 = "average/good/very good") (Mewes & Giordano, 2017). Previous research has shown the validity of the single item of self-rated health (Chai et al., 2020; Zhang, De Luca, Oh, Liu, & Song, 2019).

Self-rated life satisfaction. We measure self-rated life satisfaction based on the question: "In general, how would you evaluate your life satisfaction?" The responses are coded as: "very dissatisfied (1)," "dissatisfied (2)," "average (3)," "satisfied (4)," and "very satisfied (5)." We then recode the variable into a dummy variable (1 = "very dissatisfied/dissatisfied" and 0 = "average/satisfied/very satisfied") (Chai et al., 2020; Lacruz et al., 2016). Prior studies have documented a good validity of the single item of self-rated life satisfaction (Jovanović & Lazić, 2018).

We include the following control variables based on the existing literature (Abdelalim et al., 2012; Datar, Sturm, & Magnabosco, 2004; Florin et al., 2011; Judge & Jahns, 2007; Luo et al., 2009; Xie et al., 2003). *Ethnicity* is recoded as a dummy variable (1 = ethnic majority (i.e., Han), 0 = other). *School type* is recoded as: "primary school (1)," "middle school (2)," "high school (3)," and "vocational school (4)." *Boarding school* is measured as a dummy variable, indicating whether a student was living on campus (1 = boarding, 0 = not boarding). *Living arrangement* is recoded as the following categories: "living with parents (1)," "living with one parent (i.e., father or mother) (2)," and "living with grandparents/other relative(s)/alone/other (3)." *Father's education* and *mother's education* are measured as: "primary school or illiterate (1)," "middle school (2)," "high school or equivalent (3)," "college (4)," "bachelor (5)," and "post-graduate (6)." *Perceived family's socioeconomic status* is recoded as the following: "very low (1)," "low (2)," "average (3)," "high (4)," and "very high (5)." *Geographic locations* are measured as the following: "Beijing (1)," "Lanzhou (2)," "Guangzhou (3)," "Guiyang (4)," "Changsha (5)," "Nanjing (6)," and "Shenyang (7)." Table 1 presents the descriptive statistics of selected variables in the analyses.

2.3. Analytical strategy

We use a series of logistic regression models to fit our dichotomous measures of bullying victimization, self-rated health and life satisfaction, and academic performance. For these models, in addition to odds ratios, we also report average marginal effects (AME), suggesting a discrete change in the outcome (i.e., the predicted probability) with other covariate values averaged across the population (Chai & Maroto, 2020).

To test gender differences across our focal associations, we create and test an interaction term between gender and excessive weight/

Table 1
Descriptive statistics of selected variables in the analyses.

	Full sample %	Girls %	Boys %
Academic performance			
Very poor/poor	19.94	17.58	22.48
Average/good/very good (REF)	80.06	82.42	77.52
Actual weight			
Underweight	9.02	8.42	9.67
Normal (REF)	75.86	78.58	72.94
Overweight	7.61	6.61	8.70
Obese	7.50	6.39	8.70
Perceived weight			
Too thin	7.42	4.85	10.18
Slightly thin	15.50	12.84	18.36
Normal (REF)	40.47	39.69	41.3
Slightly overweight	28.63	34.26	22.60
Overweight	7.97	8.36	7.55
Traditional bullying victimization			
Rarely/sometimes/frequently	41.24	35.96	46.91
Never (REF)	58.76	64.04	53.09
Cyberbullying victimization			
Rarely/sometimes/frequently	17.88	14.38	21.62
Never (REF)	82.12	85.62	78.38
Self-rated health			
Very poor/poor	3.20	2.72	3.72
Average/good/very good (REF)	96.80	97.28	96.28
Self-rated life satisfaction			
Very dissatisfied/dissatisfied	3.06	2.40	3.78
Average/satisfied/very satisfied (REF)	96.94	97.60	96.22
Ethnicity			
Han	91.81	91.26	92.39
Other (REF)	8.19	8.74	7.61
School type			
Primary school (REF)	37.77	36.28	39.36
Middle school	27.59	27.33	27.86
High school	27.06	27.7	26.37
Vocational school	7.59	8.68	6.41
Boarding school			
Boarding	18.12	19.61	16.53
Not boarding (REF)	81.88	80.39	83.47
Living arrangement			
With parents (REF)	73.35	74.32	72.31
With one parent	9.90	9.38	10.47
With grandparents/other relative(s)/alone/other	16.74	16.30	17.22
Father's education			
Primary school or illiterate	9.85	8.79	10.98
Middle school (REF)	31.42	32.77	29.98
High school or equivalent	24.30	24.24	24.37
College	11.50	11.56	11.44
Bachelor	14.12	14.06	14.19
Post-graduate	8.80	8.58	9.04
Mother's education			
Primary school or illiterate	14.23	15.45	12.93
Middle school (REF)	30.04	29.57	30.55
High school or equivalent	22.32	22.16	22.48
College	11.50	11.88	11.10
Bachelor	13.66	13.80	13.50
Post-graduate	8.25	7.14	9.44
Perceived family's socioeconomic status			
Very low	3.70	2.88	4.58
Low	11.03	10.39	11.73
Average (REF)	54.32	57.01	51.43
High	26.43	26.43	26.43
Very high	4.52	3.30	5.84
Geographic location			
Beijing	15.94	15.98	15.90
Lanzhou	12.50	11.99	13.04
Guangzhou	12.83	12.57	13.10
Guiyang	13.71	14.01	13.39
Changsha (REF)	21.49	20.72	22.31

(*continued on next page*)

Table 1 (*continued*)

	Full sample %	Girls %	Boys %
Nanjing	10.59	10.02	11.21
Shenyang	12.94	14.70	11.04
N	3,625	1,877	1,748

overweight perceptions (e.g., gender X excessive weight) on bullying victimization, self-rated health and life satisfaction, and academic performance. Given that the current *American Sociological Review (ASR)* editors have recently stressed that: "Don't use the coefficient on the interaction term to draw conclusions about significance of statistical interaction in categorical models such as logit, probit, Poisson, and so on" (Mustillo, Lizardo, & McVeigh, 1282, 2018). Thus, we test the moderating effects of gender using the predicted probability metric (Mize, 2019).

3. Results

3.1. The mediating effects of bullying victimization and self-rated health and life satisfaction

In the top panel of Table 2, Model 2 shows that obese girls are more likely to report cyberbullying victimization than their normal weight counterparts (AME = 0.094, p < .01). As shown in Model 4, obese girls are more likely to report poorer self-rated life satisfaction (AME = 0.037, p < .01). Model 6 shows that cyberbullying victimization is linked to poorer self-rated life satisfaction (AME = 0.022, p < .10). Together, these findings suggest that cyberbullying victimization might mediate the effect of obesity on poorer self-rated life satisfaction among girls. A Sobel z-test confirms the proposed mediating effect ($Z_{cyberbullying}$=2.05, p < . 05).

Model 1 in Table 3 shows that overweight (AME = 0.069, p < .05) and obese (AME = 0.071, p < .05) girls are more likely to report poorer academic performance than their normal weight counterparts. Likewise, Model 2 shows that girls who perceive themselves as slightly overweight (AME = 0.046, p < .05) and overweight (AME = 0.122, p < .001) are more likely to report poorer academic performance than those who perceive themselves as normal weight. Model 3 shows that the same patterns remain (AME = 0.040, p < .05 for perceived slightly overweight and AME = 0.096, p < .01 for perceived overweight) after accounting for actual weight.

In Table 3, Model 4 shows that girls who experience cyberbullying victimization are more likely to report poorer academic performance (AME = 0.047, p < . 10). Model 5 shows that poor self-rated life satisfaction is associated with poorer academic performance (AME = 0.193, p < .001). These findings suggest that poor self-rated life satisfaction might mediate the positive association between cyberbullying victimization and poorer academic performance. A Sobel test confirms this proposed mediating effect ($Z_{poorlifesatisfaction}$=1.85, p < . 10). In combination with the previous findings from top panel of Table 2, cyberbullying victimization and poor self-rated life satisfaction might mediate the association between obesity and poorer academic performance among girls. Sobel tests confirm the proposed meditating effects of cyberbullying victimization ($Z_{cyberbullying}$ = 3.22, p < . 01)) and poor self-rated life satisfaction ($Z_{poorlifesatisfaction}$ = 1.74, p < . 10).

In the bottom panel of Table 2, Model 1 shows that girls who perceive themselves as overweight are more likely to experience traditional bullying victimization (AME = 0.129, p < .01). Model 3 shows that those who perceive themselves as overweight are associated with poorer self-rated health (AME = 0.034, p < .10). However, given that traditional bullying victimization is not linked to poorer self-rated health, as shown in Model 5, traditional bullying victimization could not mediate the association between overweight perception and poorer self-rated health. Consequently, it is not possible that overweight perceptions are linked to traditional bullying victimization, contributing to poorer self-rated health and poorer academic performance.

In terms of boys, given that neither weight nor weight perception are linked to poorer academic performance as shown in Models 1 and 2 in Table 5, respectively, it is not possible that bullying victimization and self-rated health and life satisfaction would mediate those associations (confirmed in Table 4).

3.2. Gender differences

By following Mize (2019) statistical approach, we do not find gender differences in the association between weight and poorer self-rated life satisfaction and weight and poorer academic performance (results not shown). However, there is evidence that gender moderates the association between weight and cyberbullying victimization. Table 6 shows the probability of reporting cyberbullying victimization by gender and weight—marginal effects of gender and differences in effects of gender across weight categories: Normal weight and overweight boys are more likely to experience cyberbullying victimization than girls. The gender gap in the probability of reporting cyberbullying victimization is significantly larger for children and adolescents who are normal weight compared to those who are obese (p < .10). A similar pattern has also been observed for overweight children and adolescents than those who are obese (p < .10). Together, although gender does moderate the association between weight and cyberbullying victimization, the findings do not support the specific gendered patterns as we proposed.

In sum, our findings suggest that only overweight and obese girls are more likely to report poorer academic performance compared to their normal weight counterparts, which partially supports **Hypothesis 1**. In addition, we find that only girls who perceive themselves as slightly overweight and overweight are more likely to report poorer academic performance than those who perceive themselves as normal weight; overweight perceptions fully mediate the positive association between excessive weight and poorer academic performance. Together, these findings partially support for **Hypotheses 2** and **3**. Furthermore, we find that cyberbullying victimization and poorer self-rated life satisfaction mediate the association between obesity and poorer academic performance among girls, which partially supports **Hypothesis 4a** and fails to support **Hypothesis 4b**. Finally, our findings do not support the proposed gender differences, failing to support **Hypothesis 5**.

4. Discussion

Using a nationally representative survey from urban areas in China, this study focuses on the simultaneous effect of excessive weight and overweight perceptions on academic performance among Chinese children and adolescents. More specifically, we seek to understand the extent to which bullying victimization and poorer self-rated health and life satisfaction mediate those associations, as well as the potential gender differences in these dynamics.

First, prior studies have primarily focused on the effect of excessive weight when documenting the association between body weight and children's and adolescents' academic performance (Judge & Jahns, 2007; Kark et al., 2014; Shore et al., 2008). Our findings support scholars' recent claims, highlighting the importance of overweight perceptions (Florin et al., 2011). Among girls, our findings suggest that the adverse effects of overweight and obesity become statistically insignificant in predicting poorer academic performance after accounting for overweight perceptions. Nevertheless, the detrimental effect of overweight perceptions on academic performance remains. This pattern aligns with Florin and colleagues' (2011) claim that overweight perceptions are an important but often overlooked determinant contributing to children's and adolescents' poorer academic performance. Together, in addition to excessive weight, future studies should include

Table 2
Logistic regression models predicting bullying victimization and poor self-rated health and life satisfaction for girls.

Top panel	Model 1 Traditional bullying			Model 2 Cyberbullying			Model 3 Poor SR health			Model 4 Poor SR life satisfaction			Model 5 Poor SR health			Model 6 Poor SR life satisfaction		
Actual weight	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Underweight	.797	.154	−.042	.753	.196	−.030	1.322	.683	.008	.851	.537	−.003	1.388	.725	.009	.876	.556	−.002
Normal weight (REF)																		
Overweight	1.060	.242	.011	.718	.233	−.035	1.062	.669	.002	3.246*	1.585	.040	1.003	.639	.000	3.246*	1.584	.039
Obese	1.435	.321	.071	1.930**	.472	.094	.840	.540	−.004	3.053*	1.422	.037	.739	.483	−.007	2.692*	1.269	.030
Traditional bullying (=1)													1.570	.607	.011	1.301	.527	.006
Cyberbullying (=1)													2.233*	.868	.025	2.215+	.937	.022
Intercept	2.285			.345			.013				.010		.007			.006		
Pseudo R^2	.137			.057			.119				.091		.142			.107		
Bottom panel	Model 1 Traditional bullying			Model 2 Cyberbullying			Model 3 Poor SR health			Model 4 Poor SR life satisfaction			Model 5 Poor SR health			Model 6 Poor SR life satisfaction		
Actual weight	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Underweight	.785	.161	−.045	.756	.206	−.030	1.463	.823	.012	.668	.438	−.007	1.543	.868	.013	.706	.464	−.006
Normal weight (REF)																		
Overweight	.869	.204	−.026	.641	.212	−.045	.725	.487	−.007	3.068*	1.597	.038	.685	.469	−.008	3.136*	1.643	.038
Obese	1.194	.278	.034	1.710*	.442	.075	.549	.382	−.012	2.594+	1.323	.030	.511	.353	−.013	2.395+	1.218	.026
Perceived weight																		
Thin	1.772*	.464	.107	1.251	.406	.026	1.059	.743	.001	1.983	1.259	.020	.970	.675	−.001	1.817	1.149	.017
Slightly thin	1.241	.212	.039	1.055	.234	.006	.431	.275	−.014	1.406	.673	.008	.417	.268	−.015	1.411	.678	.009
Normal (REF)																		
Slightly overweight	1.565***	.206	.083	1.194	.198	.020	1.119	.395	.003	.837	.349	−.003	1.063	.379	.002	.800	.337	−.004
Overweight	1.973**	.438	.129	1.522	.412	.052	2.523+	1.372	.034	1.496	.842	.010	2.330	1.263	.030	1.381	.780	.008
Traditional bullying (=1)													1.559	.606	.011	1.280	.524	.006
Cyberbullying (=1)													2.214*	.865	.024	2.226+	.946	.022
Intercept	1.930			.324			.014			.010			.007			.006		
Pseudo R^2	.145			.059			.131			.097			.154			.113		
N	1,877			1,877			1,877			1,877			1,877			1,877		

Note: All models include full control variables.
***p < .001; **p < .01; *p < .05; +p < .10.

Table 3
Logistic regression models predicting poorer academic performance, mediation by bullying victimization and poor self-rated health and life satisfaction for girls.

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7		
	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Actual weight																					
Underweight	.811	.210	−.025				.748	.204	−.035	.848	.222	−.020	.843	.221	−.020	.785	.216	−.029	.785	.216	−.028
Normal weight (REF)																					
Overweight	1.603*	.380	.069				1.367	.339	.044	1.618*	.389	.069	1.531 +	.374	.059	1.420	.357	.049	1.358	.346	.041
Obese	1.622*	.396	.071				1.324	.349	.039	1.528 +	.376	.060	1.476	.370	.054	1.284	.339	.034	1.259	.337	.031
Perceived weight																					
Thin				1.359	.427	.037	1.464	.479	.047							1.350	.445	.036	1.326	.438	.033
Slightly thin				1.864**	.379	.082	1.909**	.391	.087							1.895**	.392	.085	1.942**	.405	.087
Normal (REF)																					
Slightly overweight				1.457*	.230	.046	1.387*	.222	.040							1.313 +	.213	.033	1.328 +	.218	.034
Overweight				2.372***	.543	.122	2.024**	.507	.096							1.881*	.475	.084	1.830*	.466	.078
Traditional bullying (=1)										1.885***	.310	.086	1.859***	.309	.082	1.845***	.306	.082	1.826***	.306	.079
Cyberbullying (=1)										1.404 +	.269	.047	1.313	.255	.036	1.414 +	.272	.047	1.319	.258	.037
Poor SR health (=1)													2.423**	.775	.137				2.499**	.804	.141
Poor SR life satisfaction (=1)													1.095	.193					3.198***	1.086	.188
Intercept	.157			.126			.128			.087			.087			.074			.073		
Pseudo R^2	.092			.098			.100			.111			.123			.118			.131		
N	1,877			1,877			1,877			1,877			1,877			1,877			1,877		

Note: All models include full control variables.
***p < .001; **p < .01; *p < .05; +p < .10.

overweight perceptions while documenting children's and adolescents' academic performance.

Second, our study contributes to prior literature by exploring the potential mediating mechanisms that might explain the adverse effects of excessive weight and overweight perceptions on poorer academic performance. Drawing on ideas of the stress process model (Pearlin & Bierman, 2013) and the interpersonal risk model (Nakamoto & Schwartz, 2010), we discover that obese girls are more likely to experience cyberbullying victimization, which contributes to worse self-rated life satisfaction and poorer academic performance. However, we do not find the same mediating pattern for the effect of overweight perceptions. Given that overweight perceptions are not even associated with cyberbullying victimization, the mediating mechanisms might differ compared to the effect of obesity. Future studies should explore other theoretical frameworks to guide testing the mediating mechanisms of the relationship between overweight perceptions and poorer academic performance.

Third, we contribute to the literature by examining the potential gender differences among the focal variables. Contrast to our hypothesis, we find that overweight boys are more likely to experience cyberbullying victimization compared to girls. This pattern aligns with a recent Chinese study (Ba et al., 2019). Our findings might suggest that body image concerns among girls and boys might not be sufficient to theorize the gendered patterns of the association between excessive weight and cyberbullying victimization. Further exploration of alternative theoretical perspectives is needed.

Fourth, prior studies have primarily focused on the effects of excessive weight and overweight perceptions while documenting academic performance (Judge & Jahns, 2007; Kark et al., 2014; Shore et al., 2008). Little is known how underweight and underweight perceptions might affect children's and adolescents' academic performance. We find that although underweight does not affect academic performance among girls, those who perceive themselves as slightly underweight are more likely to report poorer academic performance compared to their counterparts who perceive themselves as normal weight. Surprisingly, their performance is even worse than those who perceive themselves as slightly overweight. Our findings align with prior research on the adverse effect of underweight perceptions on mental health outcomes (Daniels, 2005; Pesa, Syre, & Jones, 2000). We encourage scholars to further assess the association between underweight perceptions and academic performance, especially the potential mediating mechanisms embedded in that relationship.

Several limitations of this study should be noted. First, the dataset employed in the present study is cross-sectional, which limits any potential causality. Second, due to a lack of measures of mental health, we are unable to examine how it might explain the effects of excessive weight and overweight perceptions on poorer academic performance (Quek, Tam, Zhang, & Ho, 2017). Third, academic performance is a self-reported measure, which might bias our results. However, self-reported academic performance has been commonly used in the literature (Florin et al., 2011). One study has shown a moderate to good correlation (r = 0.63) between self-reported academic performance and actual GPA (Huang, Goran, & Spruijt-Metz, 2006).

5. Conclusion

Academic performance in childhood and adolescence might influence their adult employment (Laitinen et al., 2002) and health (Mayer et al., 2004) outcomes. Therefore, understanding the contributing factors to academic performance is crucial for children's and adolescents' future success. Given previous evidence on the negative association between excessive weight and academic performance (Judge & Jahns, 2007; Kark et al., 2014; Shore et al., 2008), physical education and nutrition have been considered to be contributing factors to improve academic performance (Rampersaud, Pereira, Girard, Adams, & Metzl, 2005). However, our findings indicate that, instead of excessive weight,

Table 4
Logistic regression models predicting bullying victimization and poor self-rated health and life satisfaction for boys.

Top panel	Model 1 Traditional bullying			Model 2 Cyberbullying			Model 3 Poor SR health			Model 4 Poor SR life satisfaction			Model 5 Poor SR health			Model 6 Poor SR life satisfaction		
Actual weight	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Underweight	.959	.173	−.009	.680+	.149	−.057	2.178*	.810	.031	.966	.409	−.001	2.565*	.971	.038	1.224	.530	.007
Normal weight (REF)																		
Overweight	1.103	.210	.021	.971	.215	−.005	1.978	.833	.026	1.071	.507	.002	1.996	.851	.025	1.149	.558	.005
Obese	1.048	.207	.010	1.026	.228	.004	2.039+	.866	.027	1.247	.585	.008	1.969	.856	.024	1.187	.576	.006
Traditional bullying (=1)													3.337**	1.278	.035	3.425**	1.466	.033
Cyberbullying (=1)													2.170*	.659	.028	3.288***	1.032	.043
Intercept	2.039			.289			.029			.037			.008			.010		
Pseudo R^2	.122			.052			.098			.144			.153			.224		
Bottom panel	Model 1 Traditional bullying			Model 2 Cyberbullying			Model 3 Poor SR health			Model 4 Poor SR life satisfaction			Model 5 Poor SR health			Model 6 Poor SR life satisfaction		
Actual weight	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Underweight	.817	.156	−.042	.586*	.135	−.076	1.618	.652	.018	.728	.325	−.010	2.026+	.843	.027	.959	.443	−.001
Normal weight (REF)																		
Overweight	1.131	.227	.025	.997	.231	−.000	1.351	.609	.010	.879	.436	−.004	1.345	.608	.010	.940	.480	−.002
Obese	1.128	.248	.025	1.027	.250	.004	1.304	.614	.009	.997	.503	−.000	1.231	.588	.007	.941	.488	−.002
Perceived weight																		
Thin	1.788**	.351	.122	1.614*	.340	.081	3.549***	1.389	.052	3.066**	1.218	.047	3.077**	1.228	.043	2.440*	1.008	.034
Slightly thin	1.432*	.213	.075	1.320+	.220	.045	.798	.389	−.005	1.046	.444	.001	.698	.346	−.007	.868	.377	−.004
Normal (REF)																		
Slightly overweight	1.178	.170	.034	1.029	.172	.004	2.019+	.744	.022	1.366	.513	.009	2.074+	.777	.023	1.209	.470	.006
Overweight	.984	.238	−.003	1.169	.320	.024	3.252*	1.704	.047	2.278	1.220	.030	3.441*	1.851	.049	2.095	1.200	.027
Traditional bullying (=1)													3.276**	1.260	.034	3.363**	1.446	.032
Cyberbullying (=1)													2.216*	.684	.029	3.200***	1.012	.041
Intercept	1.783			.260			.023			.032			.007			.009		
Pseudo R^2	.127			.056			.126			.160			.181			.236		
N	1,748			1,748			1,748			1,748			1,748			1,748		

Note: All models include full control variables.
***p < .001; **p < .01; *p < .05; +p < .10.

Table 5
Logistic regression models predicting poorer academic performance, mediation by bullying victimization and poor self-rated health and life satisfaction for boys.

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7		
	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME	OR	SE	AME
Actual weight																					
Underweight	1.145	.234	.022				1.057	.229	.009	1.165	.239	.025	1.119	.232	.018	1.093	.238	.014	1.073	.235	.011
Normal weight (REF)																					
Overweight	1.166	.256	.025				1.078	.249	.012	1.153	.255	.023	1.118	.250	.018	1.059	.246	.009	1.046	.245	.007
Obese	1.377	.291	.054				1.238	.297	.036	1.377	.292	.054	1.333	.286	.047	1.222	.293	.033	1.212	.293	.031
Perceived weight																					
Thin				1.406+	.284	.057	1.383	.293	.055							1.309	.279	.045	1.210	.262	.031
Slightly thin				.920	.160	−.013	.923	.161	−.012							.890	.156	−.018	.896	.158	−.017
Normal (REF)																					
Slightly overweight				1.156	.183	.023	1.129	.185	.019							1.115	.184	.017	1.083	.180	.013
Overweight				1.408	.330	.057	1.265	.336	.039							1.284	.342	.041	1.215	.326	.032
Traditional bullying (=1)										1.430*	.211	.057	1.370*	.204	.050	1.431*	.212	.057	1.374*	.205	.050
Cyberbullying (=1)										1.235	.197	.035	1.140	.186	.021	1.230	.196	.034	1.141	.186	.021
Poor SR health (=1)													2.681***	.775	.186				2.588***	.749	.178
Poor SR life satisfaction (=1)												1.700+	.503	.093				1.660+	.492	.088	
Intercept	.223			.224			.219			.166			.160			.165			.161		
Pseudo R^2	.071			.072			.073			.078			.087			.080			.089		
N	1,748			1,748			1,748			1,748			1,748			1,748			1,748		

Note: All models include full control variables.
***p < .001; **p < .01; *p < .05; +p < .10.

Table 6
Probability of reporting cyberbullying victimization by gender and actual weight status: marginal effects of gender and differences in effects of gender across levels of weight status.

	Girls	Boys	Gender Gap (AME of Gender)	Contrasts
a. Normal weight	0.142	0.223	0.081***	d
b. Underweight	0.117	0.159	0.042	
c. Overweight	0.109	0.221	0.112*	d
d. Obese	0.237	0.222	−0.016	a, c

Note: The "contrast" column reports which gender gaps are significantly different across actual weight status.
***p < .001; **p < .01; *p < .05; +p < .10, two-tailed test.

overweight perceptions might be a more important factor determining children's and adolescents' academic performance, especially among girls. Moreover, our findings also indicate that cyberbullying and poor self-rated life satisfaction mediate the effect of obesity on poorer academic performance among girls. Together, education policymakers should allocate more attention and resources, thereby helping children and adolescents avoid exposure to bullying victimization and improve their well-being.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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