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Original Research

Gender Differences in the Association Between Peer Victimization and Depressive Symptoms Among Chinese Adolescents: A Moderated Mediation Analysis

Qingliang Bu[1,2,†], Susu Tian[1,†], Xinyi Hu[1], Yuxuan Liu[1], Jiayi Tian[1], Yingxue Wang[1], Yihan Wang[1], Hao Hou[3,*], Wei Wang[1,4,5,*]

[1]School of Public Health, Xuzhou Medical University, 221004 Xuzhou, Jiangsu, China
[2]Discipline Inspection Commission, Xuzhou Medical University, 221004 Xuzhou, Jiangsu, China
[3]School of Public Health, Wuhan University, 430072 Wuhan, Hubei, China
[4]Department of Public Health, The Affiliated Xuzhou Oriental Hospital of Xuzhou Medical University, 221004 Xuzhou, Jiangsu, China
[5]Research Center for Psychological Crisis Prevention and Intervention of College Students in Jiangsu Province, Xuzhou Medical University, 221004 Xuzhou, Jiangsu, China
*Correspondence: houhao1996@foxmail.com (Hao Hou); weiwang90@163.com (Wei Wang)
[†]These authors contributed equally.
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Abstract

Background: Peer victimization (PV), internet addiction (IA), and shorter sleep duration are established risk factors for depressive symptoms in adolescents; however, the mechanisms underlying these associations and the extent to which they differ by gender remain poorly understood. **Methods:** A cross-sectional survey was conducted in Xuzhou, China, from March to July 2023. Data on sociodemographic characteristics, PV, IA, depressive symptoms, and sleep duration were collected via anonymous self-report questionnaires. Mediation and moderated mediation models were tested using the Hayes PROCESS macro in SPSS. **Results:** A total of 4190 adolescents participated, with 48% male and 52% female. The mediation model showed a positive association between PV and depressive symptoms, partially mediated by IA in both genders (male: indirect effect = 0.313, 95% confidence interval [CI]: 0.206–0.453; female: indirect effect = 0.523, 95% CI: 0.343–0.734). The moderated mediation analysis revealed that sleep duration moderated the direct effect of PV on depressive symptoms in females ($\beta = 0.216$, $p < 0.01$), and the effects of PV on IA ($\beta = 0.014$, $p < 0.05$) and IA on depressive symptoms ($\beta = 0.073$, $p < 0.05$) were also moderated by sleep duration in males. **Conclusions:** IA partially mediates the relationship between PV and depressive symptoms in both genders. Sleep duration moderated the effect of PV on depressive symptoms, with this effect varying by sex. These findings may inform the development of targeted protective interventions for adolescents at risk of depressive symptoms.

Keywords: adolescents; peer victimization; depressive symptoms; internet addiction; sleep duration

1. Introduction

1.1 The Association Between Peer Victimization (PV) and Depressive Symptoms

Depression is a severe global public mental health challenge, with its high prevalence, elevated disability rates, and substantial disease burden constituting a critical social concern (Zhang et al., 2025). Depression is also a leading cause of illness and disability among adolescents worldwide (World Health Organization, 2017). Studies have reported that 36.2–55.8% of adolescents experience depressive symptoms (Tirfeneh and Srahbzu, 2020; Tsehay et al., 2020). Previous research has demonstrated that PV is associated with depression (Crockett et al., 2020).

A growing body of evidence suggests that depression in adolescents is partly explained by experiences of PV (Perret et al., 2021), which represents a significant environmental stressor that can trigger depressive symptoms by activating underlying vulnerabilities inherent in adolescent development, as posited by the diathesis-stress model (Monroe and Simons, 1991; Morita et al., 2022). PV is prevalent in the school setting, with approximately 33% of adolescents reported to have bullied at least once (Chen et al., 2018; González-Cabrera et al., 2020), and over 15% of PV victims receiving a diagnosis of depression (Lucas-Molina et al., 2022). Notably, prior research has indicated significant gender differences in these relationships (Song et al., 2024). Males are more susceptible to being perpetrators and victims of PV, whereas female adolescents are more susceptible to relational victimization (Wang et al., 2015). A recent systematic review and meta-analysis revealed that PV has a stronger association with the risk of depression in females (odds ratio [OR] = 2.84, 95% confidence interval [CI] [2.49, 3.26], $p < 0.01$) (Song et al., 2024).

1.2 The Mediating Role of Internet Addiction (IA)

IA is positively associated with depressive symptoms among adolescents (Kojima et al., 2021; Stevens et al., 2020). The prevalence of IA is higher in males than fe-

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males (Karacic and Oreskovic, 2017), and male adolescents with IA are more likely to experience depressive symptoms (Yen et al., 2007). Male adolescents typically exhibit stronger associations between IA and depressive symptoms. In males with Internet Gaming Disorder (IGD) connectivity strength within the anticipatory network has been positively correlated with subjective craving (Dong and Potenza, 2022; Wang et al., 2022). These gender-specific patterns may be attributed to differences in coping strategies, social support utilization, and emotional regulation between male and female adolescents (Doménech et al., 2025; Rose and Rudolph, 2006). Although existing research has indicated that adolescents who experienced PV (Chen et al., 2021; Huang et al., 2021) or IA (Liang et al., 2021) are more vulnerable to depressive symptoms, one study have explored the mediating pathways linkins these factors (Li et al., 2019). Building on stress-coping theory, IA may function as a maladaptive coping mechanism through which adolescents attempt to escape or regulate the negative emotions elicited by PV (Mu et al., 2022). Prior studies have found that PV can lead to depression through several pathways, such as impaired sleep quality (Cao et al., 2021), reduced psychological security (Niu et al., 2020), and increased social anxiety (Mei et al., 2021). Furthermoe, IA has been considered as a psychological escape mechanism to avoid real-world problems (Mihajlov and Vejmelka, 2017) and has been shown to mediate the relationship between PV and adverse mental health outcomes (Lu et al., 2020).

1.3 The Moderating Role of Shorter Sleep Duration

While sleep disturbances (e.g., reduced sleep duration) may function as a mediator linking PV to depression, emerging evidence suggests that sleep duration may also act as a moderator by influencing the strength of this association (Yang et al., 2022). For instance, individuals with normative sleep duration may exhibit greater resilience, whereas sleep deprivation may amplify vulnerability to depressive symptoms by impairing prefrontal cortex function (Van Someren, 2021). This study therefore examines sleep duration as a moderator, as its potential buffering or exacerbating effects align with the stress-vulnerability paradigm and complement the existing mediation framework. Adolescents exhibit a high incidence of sleep deprivation and mood disorders, and sufficient sleep has been shown to mitigate mental health problems (Booth et al., 2021). Sleep loss has been proposed to exert a modulatory influence on mental health, such as anxiety and major depression (Difrancesco et al., 2019; Etxaburu et al., 2024; Walker and Harvey, 2010). Furthermore, greater vulnerability of PV has been associated with increase sleep deprivation (Ding et al., 2023). Additionally, insufficient sleep is commonly observed among students with IA, who are more likely to experience anxiety and depression (Shen et al., 2020).

1.4 Gender Differences

Gender differences are also prominent in IA patterns and sleep behaviors. Male adolescents typically show higher rates of IA, particularly in gaming-related activities (Andreassen et al., 2017; Chen et al., 2020), whereas female adolescents are more likely to experience IA through social media use (Sánchez-Fernández and Borda-Mas, 2023). These gender-specific patterns of IA contribute differently to sleep outcomes, with male adolescents with IA reporting later bedtimes and shorter sleep duration compared to females (Wang et al., 2019). Insufficient sleep is commonly observed among students with IA, who are more likely to experience anxiety and depression (Wong et al., 2020). The relationship between IA and sleep patterns shows distinct gender variations, with females exhibiting stronger associations between social media use and sleep disruption (Twenge et al., 2019). Although sleep duration has been linked to the risk of PV, IA, and depressive symptoms, no study has explored its moderating effect while accounting for gender differences in these associations. Understanding these gender-specific patterns is crucial, as it may inform targeted interventions that address the differential vulnerabilities and risk factors between male and female adolescents.

1.5 The Present Study

Overall, few studies have simultaneously examined IA as a mediator in the PV-depression pathway while investigating the gender-specific moderating role of sleep duration within this mechanism. To address these knowledge gaps, this study aims to examine the relationships between PV, IA, sleep duration, and depressive symptoms among adolescents. We hypothesized that (1) IA mediates the association between PV and depressive symptoms, and (2) sleep duration moderates all paths in the proposed mediation model (Fig. 1). In addition, several covariates known to influence depressive symptoms in adolescents were controlled for in all analyses. Physical exercise was included as a covariate given it has been consistently demonstrated to have protective effects against depression through multiple pathways, including enhanced mood regulation and stress reduction (Casanova et al., 2023). Similarly, body mass index (BMI) was controlled for given its established bidirectional relationship with depressive symptoms, as both obesity and underweight status can adversely affect psychological well-being among adolescents (Malmir et al., 2019). These covariates were selected to ensure a more precise examination of the hypothesized relationships.

2. Materials and Methods

2.1 Study Design and Data Collection

From March 2023 to July 2023, a cross-sectional study was conducted in Xuzhou, China, as part of the Chinese Adolescent Health Related Behavior Survey, involving middle school, high school, and college adolescents.

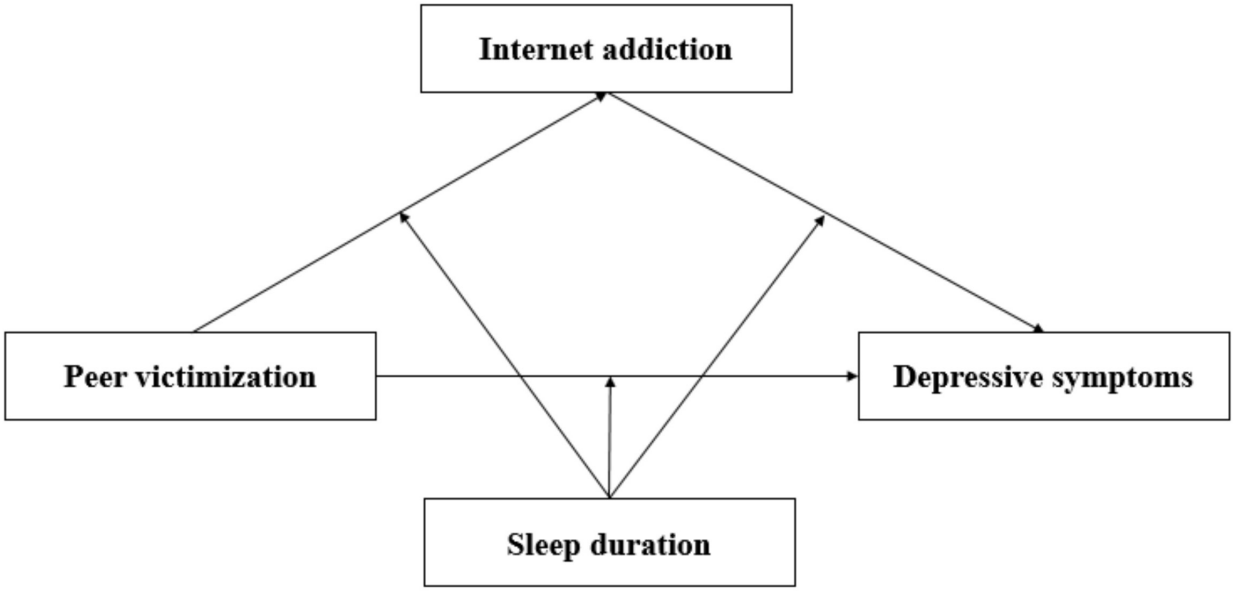


Fig. 1. Hypothesized model of the relationships between PV, IA, sleep duration, and depressive symptoms. PV, peer victimization; IA, internet addiction.

A stratified cluster sampling method was used to recruit the participants. Within each stratum, 6 middle schools, 6 high schools, and 4 universities were randomly selected. Within each selected school, 8–10 classes were randomly selected, and all students in those classes were invited to participate. All students were informed of their rights to participate and were advised that they could withdraw at any time. A total of 4521 adolescents were recruited. Of these, 331 were excluded due to missing responses or implausible answers. Inclusion criteria required participants to: (1) be currently enrolled in grades 7–12 (middle or high school) or in undergraduate programs; (2) be aged 12–24 years; (3) provide informed consent (with parental consent required for minors); and (4) be present in class on the day of survey administration. Exclusion criteria comprised: (1) age outside the 12–24 year range; (2) non-student status; (3) >20% missing data in responses; or (4) clearly invalid responses (e.g., straight-line response patterns, contradictory answers). Based on these criteria, 331 participants were excluded due to incomplete or invalid responses and protocol violations, resulting in a final analytical sample of 4190 participants (2011 males and 2179 females). The effective response rate was 92.68%. This study protocol was approved by the Ethics Committee of the Xuzhou Medical University and Xuzhou Center for Disease Control and Prevention.

2.2 Assessment

2.2.1 Sociodemographic Characteristics

Sociodemographic characteristics included age (years), gender (male/female), education level (junior high school/senior high school/college), campus residency (yes/no), school suspension (yes/no), physical exercise, and BMI.

2.2.2 Peer Victimization (PV)

PV was assessed using the Chinese version of the Bully/Victim Questionnaire (Solberg and Olweus, 2003; Zhang et al., 1999), adapted from Zhang et al.'s (1999) validated translation of the Olweus instrument. The scale consists of six items and three subscales: physical bullying (e.g., hitting, kicking, and extortion), verbal bullying (e.g., name-calling, teasing, or mockery) and relational bullying (e.g., social exclusion, rumor spreading). Each item was rated on a 3-point Likert scale (1 = never, 2 = sometimes, 3 = always), with higher scores indicating greater victimization. In the present study, the Cronbach's alpha (α) for the total scale was 0.823, with subscale reliabilities as follows: physical bullying: α = 0.782 (2 items); verbal bullying: α = 0.758 (2 items); and relational bullying: α = 0.725 (2 items). All values exceeded the psychometric threshold of 0.70, confirming acceptable internal consistency for both the total scale and its subscales in our sample.

2.2.3 Internet Addiction (IA)

IA was assessed by using Chinese version of Young Diagnostic Questionnaire for Internet Addiction (YDQ) (Yang et al., 2014). The scale consists of 8 items and each item was rated by a Likert scale (1 = no, 2 = yes), with the total score as the cumulative score of all items; higher scores indicate greater IA. The reliability and validity of the YDQ in adolescent samples have been previously established (Otsuka et al., 2020). Herein, the YDQ demonstrated a Cronbach's α of 0.811.

2.2.4 Sleep Duration

Sleep duration was assessed using a self-reported single-item question: "How long did you sleep on average every day in the last month?" Participants were instructed to estimate their typical sleep duration in hours and minutes. Responses were recorded as continuous variables in hours (e.g., 7.5 hours for 7 hours and 30 minutes) (Short et al., 2012). Although this single-item measure precludes traditional internal consistency reliability assessment, prior research supports its psychometric adequacy. Short et al. (2012) reported moderate convergence between self-reported sleep duration and actigraphy in adolescents, and comparable single-item measures have demonstrated adequate test-retest reliability (r = 0.70–0.78) in youth populations (Chung and Cheung, 2008; Wolfson et al., 2003).

2.2.5 Depressive Symptoms

We used the 20-item scale Center for Epidemiologic Studies Depression (CES-D) to measure depressive symptoms in adolescents (Radloff, 1991; Santor et al., 1995). Items are rated on a 4-point Likert scale (ranging from 0 = rarely or none of the time to 3 = almost or all the time). The positively phrased items (item 4, 8, 12, and 16) were reverse-coded. The total score of CES-D (range 0–60) was calculated as the sum of responses to the 20 items. The higher score for the CES-D indicates more severe depressive symptoms. The good reliability and validity of CES-D in Chinese adolescents has been validated in previous studie (Zhu et al., 2021). The Cronbach's α for the of CES-D in the present study was 0.849.

2.3 Statistical Analysis

All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive analyses were first computed for all variables. Continuous variables were first tested for normality using the Shapiro-Wilk test. Normally distributed variables were described as mean (standard deviation, SD), while non-normally distributed variables were described as median (interquartile range, IQR). Categorical variables were described as n (%) and were compared between groups using the chi-square test or Fisher's exact test (when expected cell count <5). Spearman correlation analysis was used to assess the relationships between PV, IA, depressive symptoms, and sleep duration of adolescents. Mediation analyses (Model 4, SPSS 25.0 PROCESS v3.5 macro) were conducted to explore the mediation role of IA in the association between PV and depressive symptoms of adolescents. Moderated mediation analysis (Model 59, SPSS 25.0 PROCESS v3.5 macro) was used to explore the effect of sleep duration on the proposed mediation model. All variables were centralized to reduce collinearity when conducting mediation analysis and moderated mediation analysis. The significant *p*-value of R^2 was used to assess the goodness of model fit. Bias-corrected bootstrap CIs for indirect effect were estimated based on 5000 bootstrap samples. Mediation and moderated analyses were controlled for the covariates education, campus residency, school suspension, age, BMI, and physical exercise. A probability of $p < 0.05$ was considered statistically significant in all statistical analyses.

3. Results

3.1 Sociodemographic Characteristics

A total of 4190 participants were included in this study. As shown in Table 1, 48% of respondents were male and 52% were female. The mean age of all the samples was 15.33 ± 2.24 years. Participants were drawn from junior high school (43.41%), senior high school (45.11%), college and 11.48%. Approximately two-thirds of participants (67.35%) reside on campus and nearly all (97.78%) had not applied for a school suspension. The mean BMI was 21.63 and the mean sleep duration was 7.16 hours. Furthermore, the mean number of self-reported physical exercise days per week was 3.49. Chi-square and F-test analysis revealed statitically significant differences across all variables by gender ($p < 0.05$).

3.2 Correlations Between PV, IA, Sleep Duration, and Depressive Symptoms

Table 2 depicts the Spearman's correlations between PV, IA, sleep duration, and depressive symptoms among male and female adolescents, respectively. Results show that PV was positively associated with IA (r = 0.27, $p < 0.01$; r = 0.23, $p < 0.01$, respectively) and depressive symptoms (r = 0.28, $p < 0.01$; r = 0.30, $p < 0.01$, respectively) in both of genders, but was negatively associated with sleep duration (r = –0.05, $p < 0.05$) only in females. In addition, IA was positively and significantly associated with depressive symptoms (r = 0.34, $p < 0.01$; r = 0.33, $p < 0.01$, respectively) and negatively associated with sleep duration (r = –0.10, $p < 0.01$; r = –0.08, $p < 0.01$, respectively) in both genders. Similarly, depressive symptoms were negatively associated with sleep duration (r = –0.20, $p < 0.01$; r = –0.17, $p < 0.01$, respectively) in both of genders.

3.3 Mediation Modeling Analysis

Fig. 2 and Fig 3 show that IA partially mediated the relationship between PV and depressive symptoms in both male and female adolescents (male: indirect effect = 0.313, accounting for 19.80% of the total effect; female: indirect effect = 0.523, accounting for 21.48% of the total effect).

3.4 Moderated Mediation Analysis

Results in Table 3 and Fig. 4 demonstrate that all interaction effects in the model were statistically significant (β = 0.014, 0.073, all $p < 0.05$), with the exception of the interaction between PV and sleep duration on depressive symptoms among male adolescents (β = 0.024, $p = 0.37$). Results of moderated mediation analysis among female adolescents are depicted in Table 3 and Fig. 5, which demonstrate that

Table 1. Sociodemographic characteristics of adolescents (n = 4190).

Characteristics	Male		Female		Total		*p*-value[a]
	n = 2011		n = 2179		n = 4190		
Education[b]							
Junior high school	980	(48.73)	839	(38.50)	1819	(43.41)	<0.01
Senior high school	905	(45.00)	985	(45.20)	1890	(45.11)	
College	126	(6.27)	355	(16.30)	481	(11.48)	
Campus residency							
Yes	1281	(63.70)	1541	(70.72)	2822	(67.35)	<0.01
No	730	(36.30)	638	(29.28)	1368	(32.65)	
School Suspension							
Yes	65	(3.23)	28	(1.28)	93	(2.22)	<0.01
No	1946	(96.77)	2151	(98.72)	4097	(97.78)	
Age[c]	14.99	(2.02)	15.64	(2.39)	15.33	(2.24)	<0.01
BMI	22.06	(4.54)	21.23	(3.44)	21.63	(4.03)	<0.01
Sleep duration	7.31	(1.80)	7.03	(1.28)	7.16	(1.56)	<0.01
Physical exercise	3.92	(2.28)	3.09	(1.95)	3.49	(2.15)	<0.01
PV	6.52	(1.44)	6.35	(1.09)	6.43	(1.27)	<0.01
IA	10.36	(2.15)	10.00	(1.72)	10.17	(1.95)	<0.01
Depressive symptoms	12.52	(8.38)	13.13	(8.74)	12.83	(8.57)	0.02

Note: [a] *p*-values from chi-square test for difference between genders. [b] Below data were shown as n (%). [c] Below data were shown as mean (SD).
BMI, body mass index; SD, standard deviation.

Table 2. Correlations between PV, IA, sleep duration, and depressive symptoms among adolescents.

Variables	PV	IA	Depressive symptoms	Sleep duration
Male (n = 2011)				
PV	1.000			
IA	0.274**	1.000		
Depressive symptoms	0.281**	0.338**	1.000	
Sleep duration	–0.042	–0.097**	–0.195**	1.000
Female (n = 2179)				
PV	1.000			
IA	0.225**	1.000		
Depressive symptoms	0.296**	0.332**	1.000	
Sleep duration	–0.050*	–0.078**	–0.168**	1.000

Note: r indicates the correlation coefficient. * $p < 0.05$, ** $p < 0.01$.

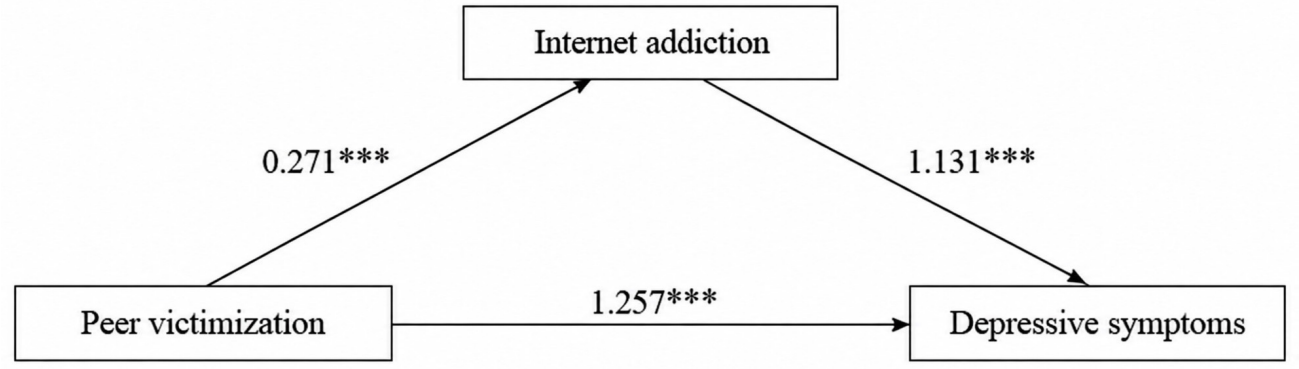


Fig. 2. Mediation model of the relationship among PV, IA, and depressive symptoms among male adolescents. Notes: (1) Covariates controlled in the modeling analysis were education, campus residency, school suspension, age, BMI, and physical exercise. (2) *** $p < 0.001$.

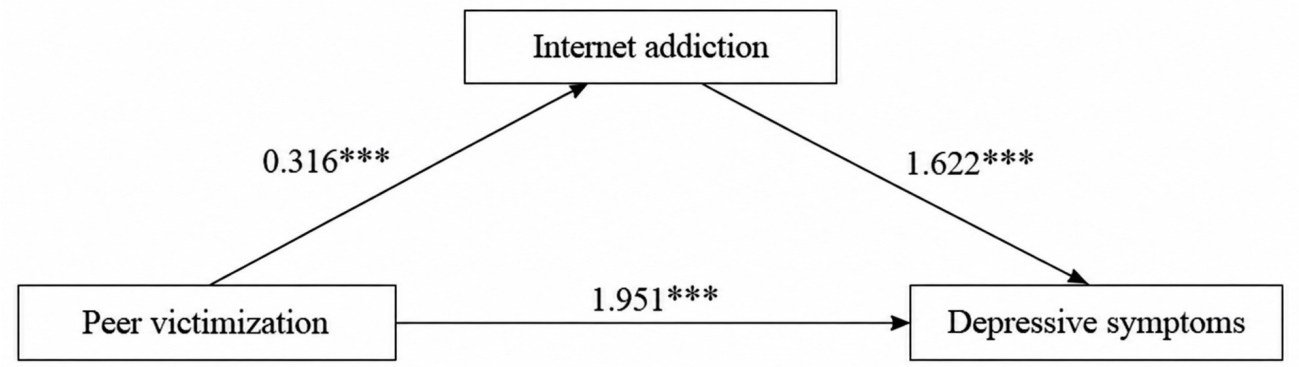


Fig. 3. Mediation model of the relationship among PV, IA, and depressive symptoms among female adolescents. Notes: (1) Covariates controlled in the modeling analysis were education, campus residency, school suspension, age, BMI, and physical exercise. (2) *** $p < 0.001$.

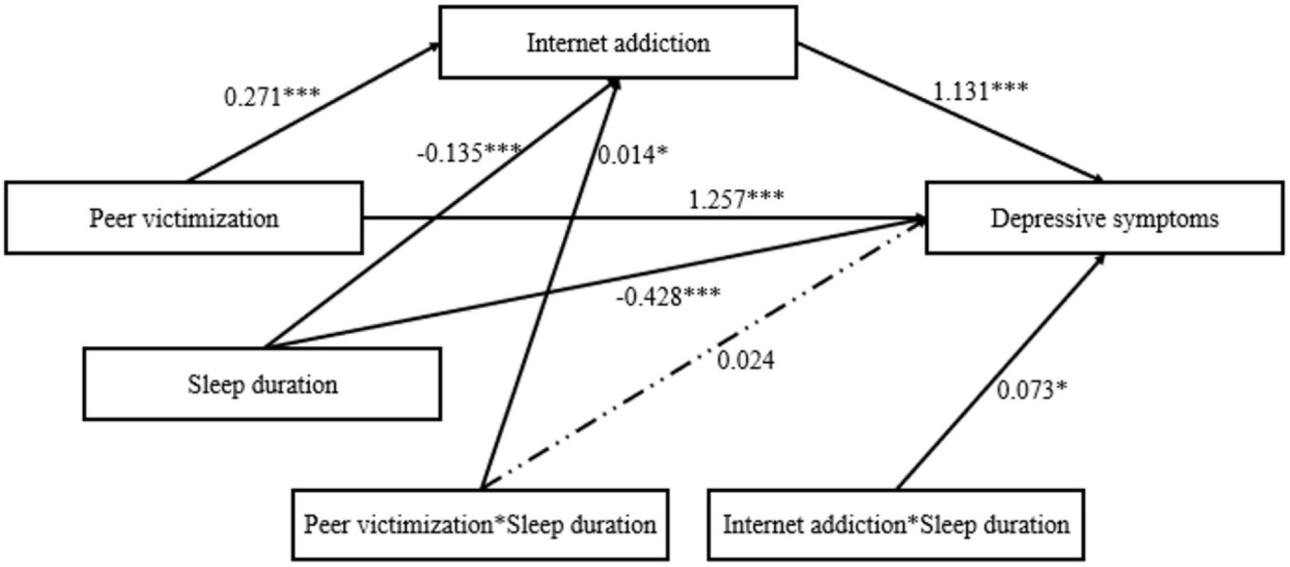


Fig. 4. Moderated mediation model of the complex relationship among PV, IA, sleep duration, and depressive symptoms in male adolescents. Notes: (1) Covariates controlled in the modeling analysis were education, campus residency, school suspension, age, BMI, and physical exercise. (2) Solid lines indicate statistically significant paths, whereas the dash-dotted line indicates the non-significant interaction effect of PV × sleep duration on depressive symptoms. (3) * $p < 0.05$, *** $p < 0.001$.

only the interaction effect of PV and sleep duration (β = 0.216, $p < 0.01$) on depressive symptoms were statistically significant. In other words, sleep duration significantly and positively moderated the association between PV and IA, as well as the association between IA and depressive symptoms among male adolescents. Similarly, the results also suggest that sleep duration was significantly and positively moderated by the association between PV and depressive symptoms among female adolescents.

3.5 Conditional Effect of Moderated Mediation Analysis

Table 4 presents the moderated effects stratified by gender. For male adolescents, it shows the conditional indirect effects of PV on depressive symptoms through IA at different levels of sleep duration. For female adolescents, the table displays the conditional direct effects of PV on depressive symptoms across sleep duration levels. The results demonstrate significant effects across all sleep duration levels for both genders. Among males, the indirect effects (PV → IA → depressive symptoms) were significantly low (β = 0.245, 95% CI: 0.147–0.391), moderate (β = 0.306, 95% CI: 0.203–0.443), and high (β = 0.374, 95% CI: 0.223–0.553) for sleep duration levels. Among females, the direct effects were similarly significant at low (β = 1.675, 95% CI: 1.329–2.021), moderate (β = 1.951, 95% CI: 1.641–2.261), and high (β = 2.227, 95% CI: 1.854–2.600) sleep duration levels.

4. Discussion

This study explored the predictive effects of PV and IA on depressive symptoms among Chinese adolescents

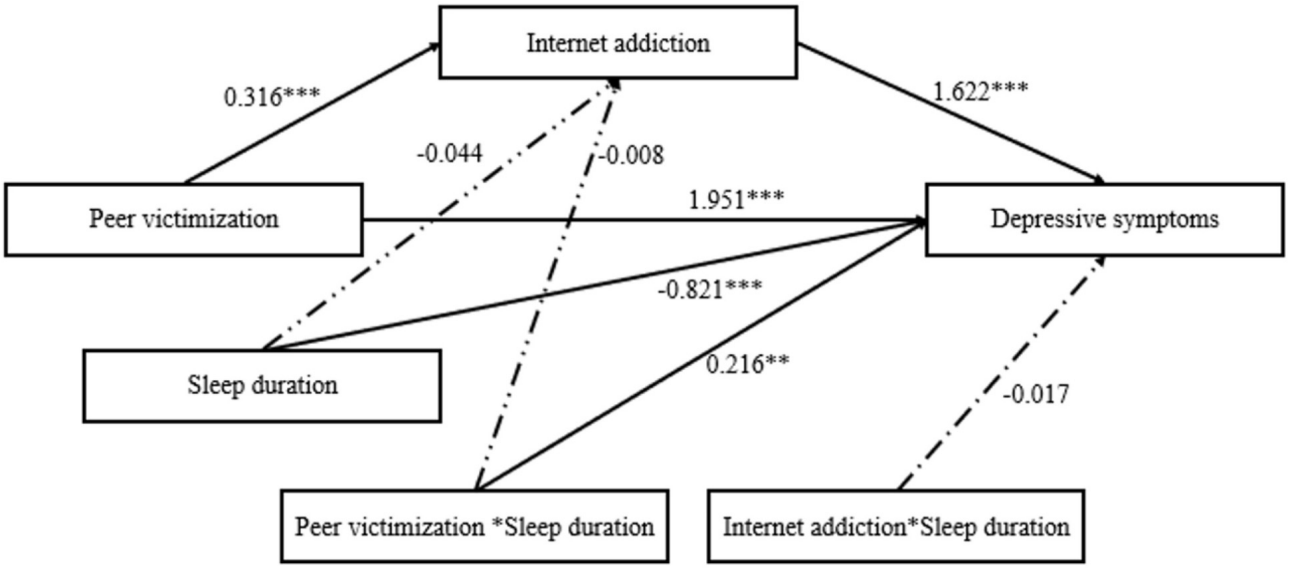


Fig. 5. Moderated mediation model of the complex relationship among PV, IA, sleep duration, and depressive symptoms in female adolescents. Notes: (1) Covariates controlled in the modeling analysis were education, campus residency, school suspension, age, BMI, and physical exercise. (2) Solid lines indicate statistically significant paths, whereas the dash-dotted line indicates the significant interaction effect of PV × sleep duration on depressive symptoms (β = 0.216, $p < 0.01$). (3) ** $p < 0.01$, *** $p < 0.001$.

Table 3. Regression coefficients for the prediction of depressive symptoms with sleep duration as a moderator.

Explanatory variables	IA				Depressive symptoms			
	β	SE	t	*p*-value	β	SE	t	*p*-value
Male								
Constant	0.203	0.772	0.263	0.79	12.286	2.830	4.342	<0.01
PV	0.271	0.033	8.305	<0.01	1.257	0.121	10.349	<0.01
Sleep duration	–0.135	0.028	–4.800	<0.01	–0.428	0.104	–4.116	<0.01
PV *Sleep duration	0.014	0.007	2.026	0.04	0.024	0.027	0.889	0.37
IA					1.131	0.083	13.687	<0.01
IA *Sleep duration					0.073	0.035	2.089	0.04
Model summary	$R^2 = 0.070$; F = 16.644; $p < 0.001$				$R^2 = 0.183$; F = 40.732; $p < 0.001$			
Female								
Constant	1.266	0.799	1.585	0.11	9.556	3.693	2.587	0.01
PV	0.316	0.034	9.411	<0.01	1.951	0.158	12.349	<0.01
Sleep duration	–0.044	0.029	–1.503	0.13	–0.821	0.135	–6.079	<0.01
PV *Sleep duration	–0.008	0.013	–0.606	0.54	0.216	0.073	2.960	<0.01
IA					1.622	0.099	16.330	<0.01
IA *Sleep duration					–0.017	0.076	–0.224	0.82
Model summary	$R^2 = 0.064$; F = 16.462; $p < 0.001$				$R^2 = 0.224$; F = 56.837; $p < 0.001$			

SE, Standard Error.

and initially examined the moderating role of sleep duration. Our research findings indicate that PV was positively associated with IA, which in turn predicted depressive symptoms, suggesting that IA is an important mediator of the indirect effect of PV on depressive symptoms. In addition, sleep duration moderated the indirect relationship from PV to depressive symptoms (through IA) among male adolescents. Similarly, sleep duration significantly moderated the direct relationship between PV and depressive symptoms among female adolescents. Understanding the underlying mechanism of PV on depressive symptoms is important for developing tailored interventions to protect adolescents from depressive symptoms.

4.1 IA Mediates the Link Between PV and Depressive Symptoms

Considering the well-established association between PV and depressive symptoms observed in the present study, and consistent with diathesis-stress models, IA was found to

Table 4. Conditional effect of PV on depressive symptoms at special levels of sleep duration in adolescents.

Sleep duration	Effect β	Boot SE	Boot LLCI	Boot ULCI
Male				
–1.804[a]	0.245	0.062	0.147	0.391
0[b]	0.306	0.061	0.203	0.443
1.804[c]	0.374	0.084	0.223	0.553
Female				
–1.28[a]	1.675	0.176	1.329	2.021
0[b]	1.951	0.158	1.641	2.261
1.28[c]	2.227	0.190	1.854	2.600

Notes: (1) Values for males represent the conditional indirect effect of moderated mediation analysis; values for females represent the conditional direct effect of moderated mediation analysis. (2) [a] Low was 1 SD below the mean; [b] Moderate was the mean; [c] High was 1 SD above the mean. (3) Covariates controlled in the modeling analysis were education, campus residency, school suspension, age, BMI, and physical exercise. (4) Data were mean-centered. LLCI, lower limit of the bootstrap confidence interval; ULCI, upper limit of the bootstrap confidence interval.

partially mediate this relationship in both genders. It can be explained by psychological defense mechanism. It is important to acknowledge that the relationship between PV and IA can be complex. Although IA could theoretically moderate the impact of PV—for instance, if pre-existing addiction exposes youth to negative social comparisons that amplify victimization-related distress—we conceptualized IA as a mediator based on the Psychological Escape Mechanism (She and Li, 2025). In the present sample of Chinese adolescents, internet use is frequently adopted as a coping strategy to alleviate the negative emotions and social isolation resulting from PV (Lu et al., 2025). Therefore, we aimed to examine how PV leads to maladaptive behavior, which subsequently contributes to depressive symptoms, rather than to evaluate IA as a pre-existing vulnerability factor. Adolescents who experience PV often struggle to establish intimate relationships with their peers, and their ability to develop autonomy and exert control over their lives may be impaired, leading to unmet psychological needs (Allen and Anderson, 2018; Mills and Allen, 2020; Mills et al., 2018). The development of IA may be predicted by the frustration arising from unmet basic psychological needs, such as the loss of friendship caused by PV. Adolescents tend to cope with psychological distress by relying on the virtual environment of the internet, which is considered a means of alleviating negative emotions experienced in the real world (Zhang et al., 2023). In addition when adolescents experience a reduction in basic psychological need satisfaction, they tend to seek fulfillment from internet use, as the internet provides a readily accessible means of obtaining psychological satisfaction (Allen and Anderson, 2018; Mills and Allen, 2020; Mills et al., 2018). Moreover, IA in adolescents is associated with disconnection from real life and isolation from the social environment (Soulioti et al., 2018), which may contribute to mental health problems and social difficulties (Paulus et al., 2018; Wang et al., 2019; Zajac et al., 2017).

4.2 Gender Differences in Moderated Mediation

One of the most notable findings in the present study is the presence of a complete gender difference in the moderating role of sleep duration within the mediation model. Importantly, our data also reveal subtle but meaningful gender differences in the strength of the foundational association between PV and depression, which may reflect females' greater interpersonal orientation and emotional attunement, rendering them more sensitive to peer-related stressors, as posited by gender socialization theory. This may be attributable to gender-related differences in sleep duration and IA onset. Our study suggests that the relation between sleep duration and IA may be stronger in males than in females. Three possible mechanisms have been proposed to explain this relationship: IA may contribute to reduced sleep duration, whereas shorter sleep duration may contribute to the development of IA, or both conditions may mutually reinforce each other (Tokiya et al., 2020). Contrary to most studies reporting a stronger association between sleep duration and IA in females than in males (Durkee et al., 2016; Tokiya et al., 2020), the present findings suggest the opposite pattern. To further interpret these distinct gender patterns, insights from gender socialization theory may be informative (Mousavi et al., 2019). Females are often socialized to be more interpersonally oriented and emotionally attuned, which may render them more vulnerable to the direct emotional impact of interpersonal stressors like PV. For them, sleep—which is critical for emotional regulation and processing—may therefore directly moderate the PV-depression link. In contrast, males are frequently socialized towards more instrumental and behavioral coping styles. Their sleep patterns might influence their propensity to engage in excessive online activity as a coping strategy, as well as to modulate its subsequent emotional impact, creating a more indirect moderating pathway (Wartberg et al., 2022). Females may show better executive control than males (Williams et al., 2023), while males are hard to control their gaming cravings and more vulnerable to be IA when they facing gaming cues (Niskier et al., 2024). Combined with evidence that parents may be stricter on bedtimes for females than males (Endendijk et al., 2016), the combination of these two factors contribute to the closer association between IA and sleep duration observed among male adolescents. It is worth noting that we conceptualized sleep duration as a moderator rather than a mediator between PV, IA, and depressive symptoms. While previous literature suggests that victimization can impair sleep quality, our data indicate a relatively weak correlation between

PV and sleep duration. This suggests that in our sample, sleep duration may be more heavily influenced by external constraints than by victimization experiences alone. Therefore, testing sleep duration as a moderator is theoretically more appropriate for this study. This approach aligns with the Diathesis-Stress Model, in which sleep deprivation is viewed as a physiological vulnerability (Drake et al., 2014).

4.3 Implications and Future Research

Contrary to our hypothesis, sleep duration predicted the direct effect of PV on depressive symptoms among females and predicted the indirect effect of PV on depressive symptoms among males. The robust association between PV and depression observed in both genders underscores the clinical significance of bullying as a public mental health concern and highlights the need for targeted interventions. Notably, longer sleep duration was associated with a higher likelihood to depression in both genders. Rather than being protective, extended sleep duration in adolescents may reflect underlying psychopathology, including lethargy, social withdrawal, or circadian rhythm dysregulation, all of which are symptomatic features of depression itself. This interpretation aligns with our findings that longer sleep duration amplified rather than buffered the depressogenic effects of PV. Prior epidemiological research has found that longer sleep duration can increase the risk of depression (Liu et al., 2024), potentially through mechanisms such as impaired arousal quality and sleep inertia that adversely impact mental health (Lopez et al., 2017). Importantly, evidence from population-based studies examining natural sleep duration reveals a U-shaped relationship with depression, whereby both short and excessively long sleep are associated with increased symptom severity (Gillin et al., 2001; Tang et al., 2015).

Nevertheless, several important conceptual complexities must be acknowledged in interpreting sleep duration as a moderator. First, the cross-sectional design of the present study precludes definitive disentanglement of moderation from potential mediation pathways. Although sleep duration was conceptualized as a moderator based on the relatively weak correlation between PV and sleep and its theoretical alignment with the stress-vulnerability paradigm, it remains plausible that sleep disruption partially mediates the PV–depression link (PV → sleep → depression). In the absence of temporal sequencing, the observed interaction may reflect a hybrid process in which sleep functions simultaneously as an outcome of PV and a modifier of its impact. Future longitudinal studies should formally compare competing models to clarify whether sleep operates as a mediator, a moderator, or both.

Second, the moderating effect observed in the present study may be partially attributable to unmeasured common causes influencing both victimization risk and sleep patterns. Despite adjustment for education, campus residence, BMI, age, and physical activity, factors such as family conflict, parental mental health, socioeconomic disadvantage, academic pressure, evening technology use, or recent disruptive life events (e.g., school transitions) could simultaneously increase vulnerability to PV and disrupt sleep. If such variables cluster within specific sleep duration strata, the observed estimates may reflect differential exposure to broader adversity rather than a pure sleep-specific vulnerability mechanism. Although established confounders were controlled for in the present analyses, residual confounding likely remains. Future research should incorporate family-level measures, objective sleep assessments (e.g., actigraphy), and school- community-level contextual variables to isolate the unique contribution of sleep duration.

Although sleep duration did not moderate the direct association between PV and depressive symptoms in male adolescent, a significant association between sleep duration and depressive symptoms was nonetheless observed. This highlights the importance of adequate sleep duration for adolescent mental health. While individuals suffering from PV with shorter sleep duration exhibited low-level depressive symptoms, this finding should not be interpreted as indicating that sleep duration reduction is without limit or consequence. Insufficient sleep may independently contribute to poor academic performance (Hysing et al., 2021), circadian rhythm disruption (Cain and Gradisar, 2010), and depression (Fredrick and Demaray, 2018). Crucially, our gender-specific findings call for tailored interventions. Among male adolescents, in whom sleep duration exacerbated the indirect effect of PV through IA, interventions should simultaneously target internet and gaming use management and sleep hygiene, with the dual aim of reducing online escapism while establishing consistent sleep schedules. For female adolescents, in whom sleep duration moderated the direct impact of PV, promoting healthy sleep patterns should be framed as a protective emotional buffer, supporting more effective processing of peer-related psychological distress. In summary, maintaining moderate sleep duration alongside adequate quality of sleep is best for preventing depression in adolescents. Positive family environment, physical activity, parent-regulated bedtimes and wake times are recommended strategies for maintaining moderate sleep duration in adolescents (Maratia et al., 2023). Future research should further explore gender-specific patterns in the relationship between sleep duration and depressive symptoms. Particularly, longitudinal studies are needed to examine how gender differences in sleep habits, IA, and responses to PV evolve over time and influence depressive symptoms. Additionally, intervention studies targeting gender-specific risk factors could inform the development of more effective prevention strategies for both male and female adolescents.

4.4 Limitations

Several limitations of the present study should be acknowledge. Firstly, the cross-sectional design precludes es-

tablishing temporal precedence and causal inference; this also prevents definitive distinction between moderation and mediation for sleep duration, as the observed interaction may reflect a hybrid process in which sleep functions as both an outcome of PV and as a modifier of its impact. Consequently, reverse causality cannot be excluded—for instance, depressive symptoms may lead to increased IA rather than the converse, or a bidirectional relationship may exist. Since establishing causality requires evidence that the cause precedes the effect, the relationships observed in this study should be interpreted as correlational associations rather than causal effects (Qin, 2024). Second, despite adjustment for several covariates, unmeasured common causes (e.g., family conflict, socioeconomic disadvantage, and recent life disruptions) may influence both PV and sleep duration, potentially confounding the estimates of sleep's moderating role. Thirdly, the reliance on self-report questionnaires may have reduced the accuracy for detecting PV and sleep duration, as some participants may have underreported victimization experiences. Specifically, sleep duration was assessed via a single self-report item, which may be subject to recall bias and lacks the comprehensive psychometric properties of multi-item scales. Fourthly, the sample drawn exclusively from Xuzhou limits the generalizability of the findings to the broader Chinese adolescent population. Lastly, although covariates were included in the moderated mediation analyses, their differential effects were not examined; future work should examine whether BMI and physical exercise moderate the associations between PV and depressive symptoms, and should address the aforementioned conceptual limitations through longitudinal designs and comprehensive family- and environmental-level measures. Additionally, future studies should employ multi-group analysis to formally test measurement and structural invariance.

5. Conclusions

The findings of the present study not only demonstrate that IA partially mediates the relationship between PV and depressive symptoms but also elucidate the mechanism by which sleep duration amplifies the impact of PV on depressive symptoms among adolescents in both genders. These findings suggest that promoting a positive family environment, encouraging physical activity, and establishing parent-set bedtimes and wake up times are important strategies for maintaining adequate sleep duration in adolescents and, consequently, protecting them from depressive symptoms.

Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available but are available from the corresponding authors on reasonable request.

Author Contributions

QLB & SST: Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. JYT & YXW: Formal analysis, Investigation, Methodology, Validation, Writing – review & editing, Funding acquisition. XYH and YXL: Validation, Writing – review & editing. YHW, WW and HH: Conceptualization, Funding acquisition, Supervision, Writing – review & editing. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study has been performed in accordance with the Declaration of Helsinki and received ethical approval from the Ethics Committee of the Xuzhou Medical University and Xuzhou Center for Disease Control and Prevention (Approval No.: XYFY2020-KL219-01), and all participants/their legal guardians provided written informed consent before participating in the study. The purpose, procedures, and voluntary nature of the study were explained to all participants. They were informed of their right to withdraw at any time without consequences.

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Conflicts of Interest

The authors declare no conflicts of interest.

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