



The Role of Self-Esteem in Protecting Against Cyber-Victimization and Gaming Disorder Symptoms Among Adolescents: A Temporal Dynamics Analysis

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Abstract

Previous literature has suggested that victimization is linked to low self-esteem and increases the symptoms of gaming disorder. However, little is known about the intra-individual processes, and the temporal dynamics of cyber-victimization, self-esteem, and gaming disorder symptoms. To address this gap, a three-year longitudinal study was performed using data collected at six different time points from 4206 Chinese adolescents (aged 12–17 years; 50.4% boys). Results of random intercept cross-lagged panel models (RI-CLPMs) indicated that at the within-person level, the fluctuation in self-esteem weakly predicted late cyber-victimization, and the fluctuation of cyber-victimization also weakly predicted late self-esteem. Additionally, the current study identified an interactive effect between self-esteem and gaming disorder symptoms at the within-person level. Fluctuations in self-esteem negatively predicted late gaming disorder symptoms, and vice versa. However, when combining the three variables (i.e., cyber-victimization, self-esteem, and gaming disorder symptoms) into one RI-CLPM, the results did not support the mediation of self-esteem in the relationship between cyber-victimization and gaming disorder symptoms at the within-person level. Moreover, fluctuations in self-esteem negatively predicted late gaming disorder symptoms and cyber-victimization at the within-person level in the RI-CLPM. These findings emphasize the protective role of self-esteem developed against cyber-victimization and gaming disorder symptoms among adolescents.

Keywords Cyber-victimization · Self-esteem · Gaming disorder symptoms · Temporal dynamics · Intra-individual process
Random intercept cross-lagged panel model

Introduction

The digital age has brought new challenges for adolescents, particularly regarding cyber-victimization and gaming disorder symptoms. Given the negative effect of cyber-victimization (e.g., Tran et al., 2023) and gaming disorder symptoms (e.g., Reed et al., 2022) on mental health and well-being, it is important to examine the protective factors associated with these behaviors and their dynamic relationships over time to develop effective interventions and preventive strategies. Previous empirical studies suggested close relationships between cyber-victimization, self-esteem, and gaming disorder symptoms (e.g., Gan et al., 2023; Kavanagh et al., 2023; Richard et al., 2021; Xiang et al., 2022). However, only a few longitudinal studies (e.g., Teng et al., 2020; Wartberg et al., 2019) have examined these relationships and they have reported mixed results. It still remains unclear whether self-esteem significantly mediates the longitudinal relationship between cyber-victimization and symptoms of gaming disorder.

Therefore, the current study examined the longitudinal relationship between cyber-victimization and gaming disorder symptoms and explored the mediating processes involving self-esteem, using random intercept cross-lagged panel models (RI-CLPMs) from both between-person and within-person perspectives.

Cyber-victimization and Gaming Disorder Symptoms

Cyber-victimization refers to targeted harassment or victim experienced through the use of mobile phones and the internet (Smith et al., 2008). According to social cognitive theory (Bandura, 2001), adolescents experiencing cyber-victimization may resort to excessive or problematic gaming as a coping mechanism to deal with negative cognitions and emotions caused by cyber-victimization. Several cross-sectional studies (e.g., Gan et al., 2023; Li & Zhu, 2022) demonstrated a positive association between cyber-victimization and symptoms of gaming disorder. For example, experiences of cyber-victimization could potentially trigger the onset of problematic gaming and increase symptoms of gaming disorder (Gan et al., 2023).

Moreover, there is evidence that gaming disorder symptoms increase the risk of cyber-victimization. First, the online environment provides opportunity and anonymity, making it easier to access internet videogames and potentially fall victim to cyberbullying (Kowalski et al., 2014; Teng et al., 2020a). Second, excessive gaming can lead to social isolation, causing adolescents to depend heavily on online communities (Sublette & Mullan, 2012). Cyber-victimization can occur in online gaming environments (e.g., Ballard & Welch, 2017; Przybylski, 2019), emphasizing the interconnected nature of the mixture between cyber-victimization and gaming disorder symptoms. Therefore, the direction of the relationship between cyber-victimization and symptoms of gaming disorder is complex and needs to be further examined in longitudinal studies.

While previous cross-sectional studies have contributed to the understanding of cyber-victimization and gaming disorder symptoms, they have not delineated longitudinal

relationships and distinguished *within-person and between-person effects* (e.g., Curran & Bauer, 2011; Hoffman & Stawski, 2009). RI-CLPMs (Hamaker et al., 2015; Orth et al., 2021) present a comprehensive solution that simultaneously explores trait-like and state-like components, examining between-person and within-person effects. The *between-person effect* examines the inherent differences among groups of adolescents based on victimization frequency, providing trait-level insights on symptoms of gaming disorder. Conversely, the within-person effect captures individual variations in symptoms of gaming disorder relative to changes in victimization experiences, and offers state-level perspectives. By implementing the RI-CLPMs augmented methodological rigor, it facilitates a nuanced exploration of the temporal dynamics between cyber-victimization and gaming disorder symptoms.

Cyber-victimization and Self-esteem

Traditional bullying victimization experiences can profoundly harm self-esteem (Tsaousis, 2016; van Geel et al., 2018), an individual's subjective evaluation of their self-worth and value (Rosenberg et al., 1995), leading to a range of emotional and psychological difficulties (Rose & Tynes, 2015). Like traditional bullying victimization, studies have shown that cyber-victimization is stressful and can result in negative self-evaluation and produce negative emotions and feelings, thereby obstructing the development of self-esteem (e.g., Cénat et al., 2014; Extremera et al., 2018; Zhong et al., 2021). Moreover, victimized adolescents typically show low self-esteem (e.g., Álvarez-García et al., 2015; Yang et al., 2013; Zhong et al., 2021), or those who have low self-esteem are more likely to be targeted as victims in cyberspace (Patchin & Hinduja, 2010).

Moreover, individuals with low self-esteem may use the internet and videogames more frequently to seek social interaction or escape real-life problems (Kardefelt-Winther, 2014). This makes it more likely that they will be exposed to potential cyberbullying behaviors and become the targets of cyber-victims. Self-esteem serves as an internal barometer for social

acceptance and rejection, acting as a psychological measure that monitors the extent that an individual feels included or excluded by others (Patchin & Hinduja, 2010). Moreover, low self-esteem leads individuals to expect negative interactions or believe they deserve mistreatment, which can inadvertently draw them into situations in which they become victims of cyberbullying. Low self-esteem is often associated with heightened emotional sensitivity and reactivity (e.g., Richter & Ridout, 2011; Wang et al., 2021). Cyberbullies may intentionally provoke emotional responses from their victims, and individuals with low self-esteem might react strongly, reinforcing their behavior and encouraging further victimization. This negative self-perception and low self-esteem would make it more possible for online victimization to occur. By using the RI-CLPMs, the current study examined the temporal dynamics between cyber-victimization and self-esteem.

Self-esteem and Gaming Disorder Symptoms

A negative association between self-esteem and gaming disorder symptoms has been empirically established in a meta-analysis ($r = -0.27$, Kavanagh et al., 2023). However, the intricacies of this relationship, specifically the direction of causality, remain a subject of ongoing investigation. Theoretically, the *compensatory hypothesis* (Kardefelt-Winther, 2014) posits that the inception of low self-esteem could lead to increase symptoms of gaming disorder. This hypothesis suggests that individuals experiencing mental health adversities, such as low self-esteem, may find solace in videogame playing because of its mood-modifying capacity, which often induces positive emotions, leading to a sense of accomplishment (Griffiths, 2005). Although initially beneficial, these compensatory mechanisms can paradoxically exacerbate the symptoms of gaming disorder by intensifying the desire to evade real-world psychological distress (Brewer & Kerslake, 2015). Empirical studies have corroborated this assertion, demonstrating that gamers with low self-esteem whose main motive in playing is escape, exhibit an elevated propensity for gaming disorder symptoms (e.g., de Hesselde et al., 2021;

Montag et al., 2022; Teng et al., 2021). However, the *maladaptive hypothesis* suggests that symptoms of gaming disorder might lead to the development of a range of mental health problems, including low self-esteem. This hypothesis is derived from the interpersonal impairment hypothesis but emphasizes the negative impacts of gaming disorder symptoms on personal, family, social, educational, and other aspects (e.g., self-esteem; Teng et al., 2020b). By using the RI-CLPMs, the current study also examined the temporal dynamics between self-esteem and gaming disorder symptoms.

Theoretically, SDT (Ryan & Deci, 2000; Ryan et al., 2006) emphasizes individuals' inclination to engage in activities that cater to their intrinsic psychological needs for relatedness and competency, resulting in a bolstering of self-esteem (Allen & Anderson, 2018; Ryan & Deci, 2017). When these needs are unmet in the real world, gaming may present an alternative space for their fulfillment (Scerri et al., 2019), albeit with an increased symptoms of gaming disorder. According to SDT, cyber-victimization can be perceived as a stressor leading to a decrease in self-esteem, which may increase symptoms of gaming disorder as individuals seek to fulfill their psychological needs within online environments. Therefore, the current study further examined the mediation role of self-esteem in the longitudinal relationships between cyber-victimization and gaming disorder symptoms.

Current Study

Previous findings suggested close relationships between cyber-victimization, self-esteem, and gaming disorder symptoms. However, longitudinal studies are scarce and the dynamic relationships between them remain unknown. Employing a three-year longitudinal design across six waves, the current study examined the dynamic relationships between cyber-victimization, gaming disorder symptoms, and self-esteem using the RI-CLPMs. The current study addressed the following key research questions (RQs): (i) Does a bidirectional relationship exist between cyber-victimization and gaming disorder symptoms at the within-

person level in the RI-CLPMs? (RQ1); (ii) Within the RI-CLPMs, does cyber-victimization decrease self-esteem at the within-person level, or *vice versa*? (RQ2); (iii) Does a decrease in self-esteem lead to an increase in symptoms of gaming disorder at the within-person level in the RI-CLPMs, or *vice versa*? (RQ3); and (iv) Does a decrease in self-esteem mediate the link between cyber-victimization and gaming disorder symptoms at the within-person level in the RI-CLPMs? (RQ4).

Methods

Participants

The study included participants from the School Mental Health Development project, an ongoing longitudinal study conducted Southwest China across the provinces of Chongqing, Sichuan, and Yunnan. Participants were selectively clustered from 12 schools, encompassing six middle and five high schools. The current study used data from Waves 1 to 6 (2018–2021 period, with each wave assessed six months apart). All schools provided authorization for data collection. Students in 7th and 10th grades were invited to participate in the current study and provided written informed consent. Student consent rates averaged 98%, and parental consent rates averaged 95%. Only students who provided both personal and parental informed consent participated in the current study.

The sample comprised 4,206 adolescents (aged 12–17 years; 51.2% boys). Over half the participants resided in rural areas in Southwest China (57.8%). Moreover, 26.4% of the children were left behind in rural regions while their parents left to work in urban areas. Almost one-fifth of fathers and mothers had undergraduate degrees (nearly 20%), with more than 50% having a monthly family income of less than 5,000 yuan.

Procedure

The project was approved by the appropriate ethics review board of Faculty of Psychology, Southwest University. All participants were informed of the study purpose, and

the datasets were made available only for academic research. All the school officials and teachers agreed to participate in the current study, which took approximately 30 minutes to complete. In Waves 1–4, and 6, participants completed the study survey in their classroom setting, whereas, in Wave 5, students completed an online survey from home owing to COVID-19 restrictions. After completing the survey, participants were given a feedback report on the survey results from their schools and gifted a notebook or pen (valued at 10 yuan).

Measures

Cyber-victimization. Cyber-victimization was assessed using the Chinese version of the five-item E-Victimization Scale (E-VS; Lam & Li, 2013). The original version is based on the Aggression and Victimization Scale (Orpinas & Horne, 2006). The E-VS is divided into two distinct categories of victimization: (1) mild victimization comprising two items, which encapsulate behaviors such as the deployment of derogatory language, teasing, or slanderous remarks toward an individual through digital channels such as emails, text messages, or social media platforms such as *Weibo* or *WeChat* (e.g., “How many times did someone tease you using emails, texting, short messages, on a social media platforms such as Weibo, WeChat, etc.”); and (2) serious victimization comprising three items, which encompasses more severe actions, such as issuing threats, encouraging physical harm, or strategically spreading disinformation with the intent to disrupt interpersonal relationships, also conducted via similar online platforms (e.g., “How many times did someone say he/she was going to hit/hurt you using emails, texting, short messages, on a social media platforms such as Weibo, WeChat, etc.”). Participants were guided to reflect on their involvement in such behaviors over the past month. Their frequency of cyber-victimization was then quantified using a seven-point scale where: 0 = “never,” 1 = “once,” 2 = “twice,” 3 = “three times,” 4 = “four times,” 5 = “five times,” and 6 = “at least six times.” The five items are averaged to provide a mean score, in which higher scores indicate a higher frequency of cyber-victimization. In the current study, the E-VS

demonstrated good internal consistency, as indicated by McDonald's ω coefficients of 0.876–0.933 across the six waves.

Gaming disorder symptoms. Internet gaming disorder symptoms severity was assessed using the nine-item Internet Gaming Disorder Scale-Short Form (IGDS9-SF: Pontes & Griffiths, 2015; Chinese version: Teng et al., 2020). The nine items are based on DSM-5 IGD symptoms criteria (e.g., “Do you feel compelled to increase your gaming engagement to achieve satisfaction or pleasure incrementally?”) and rated on a five-point scale ranging from 1 (“never”) to 5 (“very often”). Individual items scores were averaged, and the scores ranged from 1 to 5. Higher scores indicate greater severity of symptoms. The IGDS9-SF was only administered four times because data on gaming disorder symptoms was not collected in the first year of the study. In the current study, the scale of IGDS9-SF demonstrated good internal consistency, as indicated by McDonald's ω coefficients of 0.868–0.943 across the four waves.

Self-esteem. Self-esteem was assessed using the 10-item Rosenberg Self-Esteem Scale (RSES: Rosenberg et al., 1995; Chinese version: Tian, 2006). One item (i.e., “I wish I could have more respect for myself”) was excluded owing to its incongruity with the Chinese culture, as suggested by Tian (2006). The items (e.g., “I hold a positive attitude toward myself”) are rated on a four-point scale ranging from 1 (“strongly disagree”) to 4 (“strongly agree”). In the current study, the RSES demonstrated good internal consistency, as indicated by McDonald's ω coefficients of 0.877–0.914 across the six waves.

Data Analysis

Missing data. Missing data are unavoidable in longitudinal studies. Two missing mechanisms can be examined in the longitudinal studies: data missing completely at random (MCAR) and data missing at random (MAR; Graham, 2009). Two primary schools and one secondary school did not have participants in Wave 1 but participated in Waves 2–6. Therefore, both waves had missing data in the sample. The attrition rates were 9.3% (Wave 1), 8.2% (Wave 2), 5.6% (Wave

3), 5.6% (Wave 4), 11.2% (Wave 5), and 26.5% (Wave 6). Attrition was mainly owing to students being transferred and drop out to other schools or absent on the assessment date.

Missing data mechanisms were examined using MCAR or MAR and a series of chi-square and *t*-tests to ascertain mean differences between completed and missing data (Little & Rubin, 2019). The results suggested that sex ($\chi^2_{(1)} = 21.17, p < .001$), age, ($t_{(4,204)} = 10.35, p < .001$), cyber-victimization ($t_{(3,649)} = 5.66, p < .001$), gaming disorder symptoms ($t_{(3,648)} = 6.22, p < .001$), and self-esteem ($t_{(3,846)} = 3.96, p < .001$) all contained data MAR (but not MCAR), which is common in longitudinal studies (Ibrahim & Molenberghs, 2009). These missing data were not deleted but employed full information maximum likelihood (FIML) to model estimations using Mplus 8.40, which estimates model parameters using all available information (Graham, 2009). Multiple imputations (MIs) were used for the sensitivity analyses.

Measurement invariance. Confirmatory factor analysis (CFA) was used to examine the longitudinal measurement invariance of the study variables. The indicators assessed the study variables, which included five items for cyber-victimization and nine items each for self-esteem and gaming disorder symptoms. To reduce measurement errors caused by multiple items, inter-item correlations in a cross-sectional framework were adjusted (Little & Rubin, 2019). First, configural invariance models were constructed that freed the estimated CFA. Second, weak invariance models were used that constrained the factor-loading paths equally across times. Third, strong invariance models that constrained the factor intercept equally across time were employed. Model comparison was used for the change in the comparative fit index (CFI), and a $\Delta CFI > 0.01$ suggested significant model differences (Cheung & Rensvold, 2002; for measurement invariance results, see **Table S1**).

Descriptive Analyses

Descriptive statistics (**Table 1**) and correlations (**Table 2**) were calculated using the software SPSS Statistics for Windows, version 24.0. Intra-class correlation coefficients (ICCs)

were calculated for study variables using Mplus 8.4. A high ICC implies a relatively greater variance between individuals, whereas a low ICC implies a relatively greater within-individual variance. The ICCs for cyber-victimization, self-esteem, and gaming disorder symptoms were 0.314, 0.582, and 0.551, respectively, which suggests that separate between-person and within-person variance was needed.

Random Intercept Cross-lagged Panel Models

Before conducting RI-CLPMs, a latent curve model with structured residuals (LCM-SR, see Curran et al., 2014) was performed, but the model could not be identified. Therefore, RI-CLPMs (Hamaker et al., 2015; Orth et al., 2021) were conducted. The observed variables (cyber-victimization, self-esteem, and gaming disorder symptoms) were separated into between-person and within-person variance components. Through the implementation of the RI-CLPMs, wherein stable individual differences are bifurcated at the trait level, the lagged coefficients signify within-person tendencies of transformation at the state level. The associations among the unobserved individual-specific intercepts represent between-person effects. Potential confounding factors, such as age and sex were utilized as time-invariant covariates in all RI-CLPMs (Mulder & Hamaker, 2021) and were subsequently regressed on the random intercepts.

Four RI-CLPMs were established, and the model was examined by including within-wave associations, stability paths, and cross-lagged effects. The first RI-CLPM was used to examine the longitudinal relationship between cyber-victimization and gaming disorder symptoms (**Fig 1**); the second assessed cyber-victimization and self-esteem (**Fig 2**); the third assessed self-esteem and gaming disorder symptoms (**Fig 3**), and the fourth combined the three variables to examine the mediation model of self-esteem in the within-person effect of cyber-victimization on gaming disorder symptoms (**Fig 4**). A series-constrained RI-CLPMs were used to model comparison (**Table 3**). First, an unconstrained model (i.e., the free model, Model 1)

was presented. Second, the within-wave autoregression analysis path was constrained to be equal over time (Model 2). Third, the within-wave cross-lagged effect was constrained to be equal across time (Model 3). Fourth, the within-person variance was constrained to be equal across time (Model 4). All Mplus Syntaxs were in the online supplementary material.

Results

Description and Correlations

Table 1 shows the descriptive statistics for cyber-victimization, self-esteem, and gaming disorder symptoms by age and sex (i.e., numbers, means, standard deviations). Early adolescents showed a high average level of cyber-victimization and gaming disorder symptoms. Boys also showed a high average level of cyber-victimization and gaming disorder symptoms. **Table 2** shows the correlations among all variables across all waves. Cyber-victimization was positively associated with gaming disorder symptoms across all waves ($r = 0.080$ to 0.225 , all p -values $< .001$) and negatively associated with self-esteem across all waves ($r = -0.157$ to -0.066 , all p -values $< .001$). Self-esteem was negatively associated with gaming disorder symptoms across all waves ($r = -0.256$ to -0.087 , all p -values $< .001$).

Table 1 Descriptive statistics of adolescents' age for the total sample and gender

	Sample size			Total		Male		Female		Early		Late	
	n_{total}	n_{boys}	n_{early}	M	SD	M	SD	M	SD	M	SD	M	SD
CV													
T1	3651	1809	1422	0.42	0.99	0.55	1.18	0.28	0.74	0.43	1.00	0.41	0.99
T2	3695	1806	1608	0.36	0.97	0.49	1.19	0.23	0.67	0.41	0.99	0.32	0.95
T3	3856	1926	1633	0.21	0.74	0.30	0.92	0.12	0.49	0.26	0.80	0.18	0.70
T4	3808	1901	1621	0.23	0.71	0.32	0.86	0.15	0.52	0.30	0.77	0.18	0.66
T5	3583	1787	1597	0.20	0.67	0.28	0.82	0.12	0.45	0.27	0.76	0.14	0.57
T6	2985	1427	1414	0.21	0.57	0.23	0.62	0.19	0.51	0.18	0.60	0.23	0.53
SE													
T1	3650	1808	1421	2.88	0.59	2.95	0.59	2.82	0.59	3.01	0.58	2.80	0.59
T2	3694	1806	1608	2.87	0.59	2.94	0.58	2.81	0.59	2.95	0.60	2.82	0.57
T3	3856	1926	1633	2.91	0.59	2.96	0.60	2.86	0.59	2.94	0.60	2.89	0.59
T4	3822	1912	1620	2.91	0.58	2.95	0.58	2.88	0.58	2.93	0.60	2.90	0.56
T5	3575	1781	1592	2.90	0.58	2.96	0.58	2.85	0.58	2.92	0.61	2.89	0.56
T6	2978	1423	1408	2.91	0.58	2.96	0.57	2.87	0.58	2.92	0.58	2.91	0.57
GDS													
T3	3848	1922	1628	1.71	0.81	2.00	0.89	1.42	0.60	1.77	0.84	1.67	0.79
T4	3802	1899	1614	1.72	0.77	2.02	0.81	1.42	0.59	1.80	0.81	1.65	0.74
T5	3583	1787	1597	1.63	0.71	1.89	0.76	1.36	0.53	1.71	0.74	1.56	0.67

T6	2959	1422	1408	1.60	0.74	1.86	0.81	1.36	0.56	1.69	0.77	1.52	0.69
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Note. CV = cyber-victimization; SE = self-esteem; GDS = gaming disorder symptoms; T1-T6 = time 1 to time 6.

Table 2 Correlations between main study variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.T1 CV	–														
2.T2 CV	0.393	–													
3.T3 CV	0.340	0.397	–												
4.T4 CV	0.332	0.380	0.395	–											
5.T5 CV	0.317	0.337	0.462	0.454	–										
6.T6 CV	0.205	0.170	0.163	0.272	0.335	–									
7.T1 SE	–0.157	–0.107	–0.084	–0.066	–0.051	–0.099	–								
8.T2 SE	–0.118	–0.171	–0.101	–0.095	–0.065	–0.112	0.648	–							
9.T3 SE	–0.126	–0.154	–0.179	–0.135	–0.111	–0.092	0.545	0.629	–						
10.T4 SE	–0.125	–0.156	–0.139	–0.146	–0.142	–0.134	0.512	0.573	0.676	–					
11.T5 SE	–0.100	–0.101	–0.116	–0.111	–0.146	–0.099	0.494	0.554	0.614	0.695	–				
12.T6 SE	–0.098	–0.083	–0.088	–0.085	–0.105	–0.131	0.475	0.526	0.598	0.642	0.680	–			
13.T3 GDS	0.193	0.225	0.276	0.207	0.196	0.080	–0.126	–0.162	–0.256	–0.199	–0.182	–0.162	–		
14.T4 GDS	0.196	0.190	0.197	0.217	0.221	0.131	–0.087	–0.107	–0.154	–0.227	–0.203	–0.177	0.547	–	
15.T5 GDS	0.187	0.169	0.207	0.186	0.227	0.109	–0.102	–0.111	–0.160	–0.208	–0.251	–0.204	0.540	0.632	–
16.T6 GDS	0.199	0.192	0.203	0.200	0.220	0.183	–0.111	–0.114	–0.186	–0.192	–0.194	–0.238	0.492	0.557	0.651

Note. CV = cyber-victimization; SE = self-esteem; GDS = gaming disorder symptoms; T1-T6 = Time 1 to Time 6. All p -values < .01.

Results of Random Intercept Cross-Lagged Panel Models

Cyber-victimization and gaming disorder symptoms. Table 3 shows the model comparison process for the RI-CLPM of cyber-victimization and gaming disorder symptoms with the FIML. The final constraint model (i.e., Model 4) exhibited a good model fit and nonsignificant difference from Models 1–3. The results of Model 4 are reported in Fig. 1. First, no significant cross-lagged dynamic within-person effect (all p -values $> .05$) was found between cyber-victimization and gaming disorder symptoms. However, there was significant stability within-person effects for cyber-victimization ($\beta = 0.127$ to 0.168 , all p -values $< .001$) and gaming disorder symptoms ($\beta = 0.101$ to 0.133 , all p -values $< .001$). There were also significant within-person relationships ($r = 0.057$ to 0.090 , all p -values $< .001$) and between-person relationships (i.e., random intercepts) between cyber-victimization and gaming disorder symptoms ($r = 0.406$, $p < .001$). More details about the model results are shown in Table S2.

Table 3 Model comparison test for the random intercept cross-lagged panel models

Models	χ^2 (df)	ΔCFI	ΔTLI	RMSEA [90% CI]	CFI	TLI	SRMR
RI-CLPM of cyber-victimization and gaming disorder symptoms							
Model 1	260.34 (40)	-	-	0.036 [0.032, 0.040]	0.949	0.917	0.058
Model 2	253.82 (46)	0.003	0.015	0.033 [0.029, 0.037]	0.952	0.932	0.064
Model 3	261.15 (50)	0.001	0.004	0.032 [0.028, 0.036]	0.951	0.936	0.065
Model 4	273.35 (53)	0.002	0.001	0.031 [0.028, 0.035]	0.949	0.937	0.065
RI-CLPM of cyber-victimization and self-esteem							
Model 1	426.15 (57)	-	-	0.039 [0.036, 0.043]	0.955	0.929	0.051
Model 2	411.08 (65)	0.003	0.013	0.036 [0.032, 0.039]	0.958	0.942	0.057
Model 3	434.04 (73)	0.002	0.004	0.034 [0.031, 0.037]	0.956	0.946	0.058
Model 4	459.16 (78)	0.002	0.001	0.034 [0.031, 0.037]	0.954	0.947	0.059
RI-CLPM of self-esteem and gaming disorder symptoms							
Model 1	242.15 (40)	-	-	0.035 [0.031, 0.039]	0.985	0.975	0.036
Model 2	277.49 (46)	0.002	0.001	0.034 [0.030, 0.038]	0.983	0.976	0.036
Model 3	286.20 (50)	0.001	0.001	0.034 [0.030, 0.037]	0.982	0.977	0.036
Model 4	290.22 (53)	0.000	0.001	0.033 [0.029, 0.036]	0.982	0.978	0.036
RI-CLPM of cyber-victimization, self-esteem, and gaming disorder symptoms							
Model 1	523.73 (91)	-	-	0.034 [0.031, 0.036]	0.966	0.944	0.047
Model 2	531.06 (101)	0.001	0.006	0.032 [0.029, 0.035]	0.967	0.950	0.050
Model 3	568.07 (117)	0.002	0.004	0.030 [0.028, 0.033]	0.965	0.954	0.052
Model 4	603.20 (128)	0.002	0.002	0.030 [0.027, 0.032]	0.963	0.956	0.052

Note. Model 1: the base model with no constraints; Model 2: the model constraints autoregressive coefficient equal across time; Model 3: the model constrains cross-lagged effect equal across time; Model 4: the model constrains the covariance of error invariance. df , degrees of freedom; RMSEA, root mean square error of approximation; CFI, comparative fit index; TLI, Tucker-Lewis Index; CI, confidence interval.

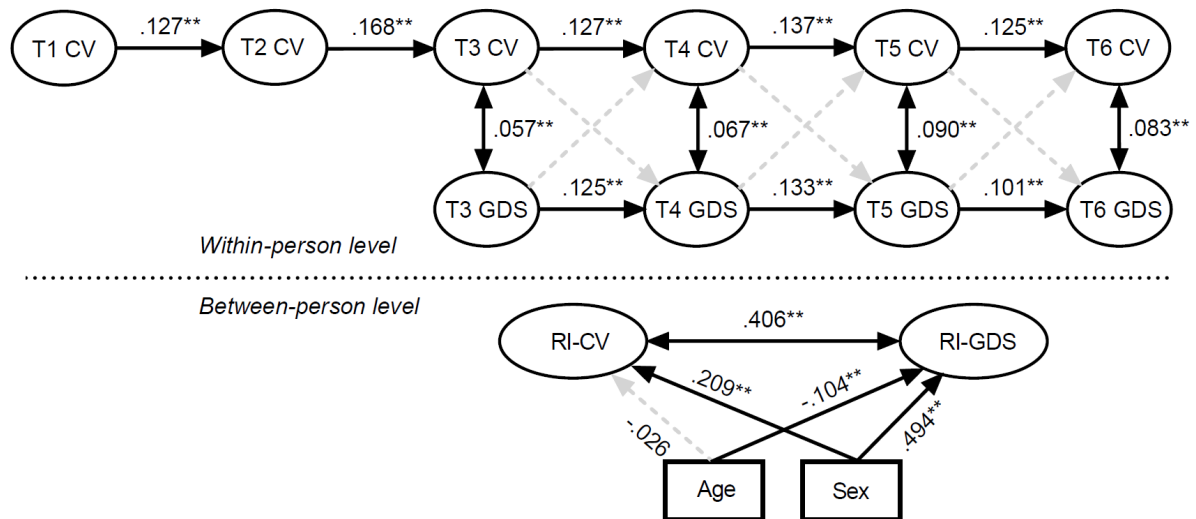


Fig. 1 RI-CLPM of cyber-victimization and gaming disorders symptoms.

Note. T1–T6 = Times 1–6. CV = cyber-victimization; GDS = gaming disorder symptoms; RI-CV = random intercept of cyber-victimization; RI-GDS = random intercept of gaming disorder symptoms. * $p < 0.05$, ** $p < 0.01$.

Cyber-victimization and self-esteem. As shown in **Table 3**, Model 4 showed a good model fit in the RI-CLPM of cyber-victimization and self-esteem and suggested a nonsignificant difference from Models 1–3. As can be seen in **Fig. 2**, there were small (but significant) cross-lagged dynamic within-person effects between self-esteem and cyber-victimization, whereby fluctuations in self-esteem (at the trait level of self-esteem) predicted fluctuations in cyber-victimization (at the trait level of victimization; β from -0.022 to -0.031, all p -values $< .05$); fluctuations in cyber-victimization also predicted fluctuations in self-esteem (β from -0.019 to -0.030, all p -values $< .05$). Moreover, there were significant stability within-person effects for cyber-victimization ($\beta = 0.127$ to 0.170 , all p -values $< .001$) and self-esteem ($\beta = 0.262$ to 0.282 , all p -values $< .001$). Moreover, there were also significant within-person relationships ($r = -0.053$ to -0.107 , all p -values $< .001$) and between-person relationship between cyber-victimization and self-esteem ($r = -0.283$, $p < .001$). More details about the model results are shown in **Table S3**.

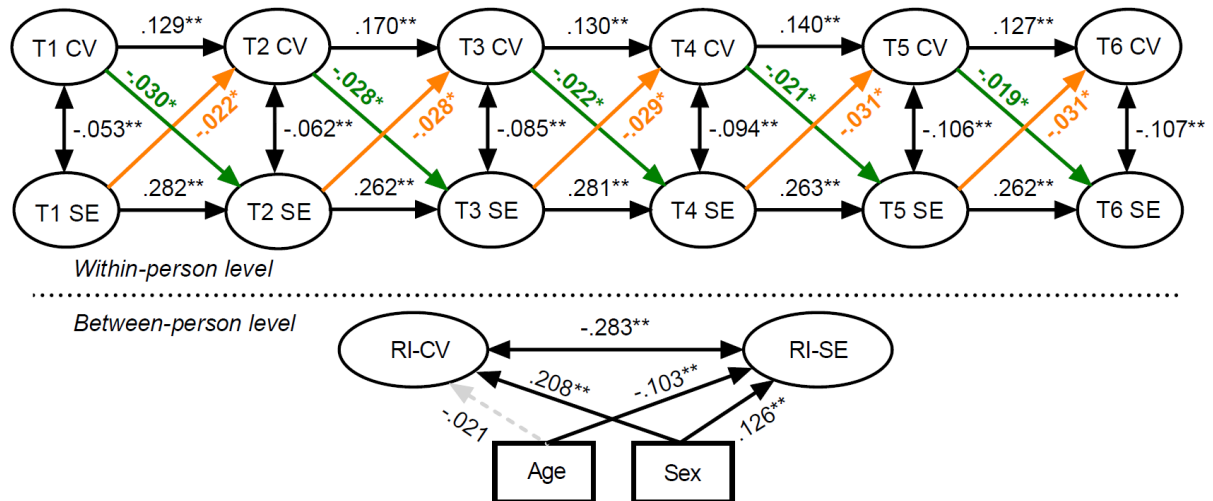


Fig. 2 RI-CLPM of cyber-victimization and self-esteem.

Note. CV = cyber-victimization; SE = self-esteem; RI-CV = random intercepts of cyber-victimization; RI-SE = random intercept of self-esteem. * $p < 0.05$, ** $p < 0.01$.

Self-esteem and gaming disorder symptoms. Model 4 (Table 3) showed a good model fit in the RI-CLPM of self-esteem and gaming disorder symptoms and a nonsignificant difference relative to Models 1–3. **Fig. 3** shows the interactions between self-esteem and gaming disorder symptoms in the cross-lagged dynamic within-person effects. There were significant cross-lagged dynamic within-person effects between self-esteem and gaming disorder symptoms. Specific, the fluctuations of self-esteem negatively predicted fluctuations in gaming disorder symptoms ($\beta = -0.039$ to -0.044 , all p -values < 0.05), and the fluctuations of gaming disorder symptoms also negatively predicted fluctuations in self-esteem ($\beta = -0.042$ to -0.051 , all p -values < 0.01). Moreover, there were significant stability within-person effects for self-esteem ($\beta = 0.254$ to 0.274 , all p -values $< .001$) and gaming disorder symptoms ($\beta = 0.107$ to 0.143 , all p -values $< .01$). Moreover, there were significant within-person relationships ($r = -0.144$ to -0.207 , all p -values $< .001$) and between-person associations between self-esteem and gaming disorder symptoms ($r = -0.392$, $p < .001$). More details about the model results are shown in Table S4.

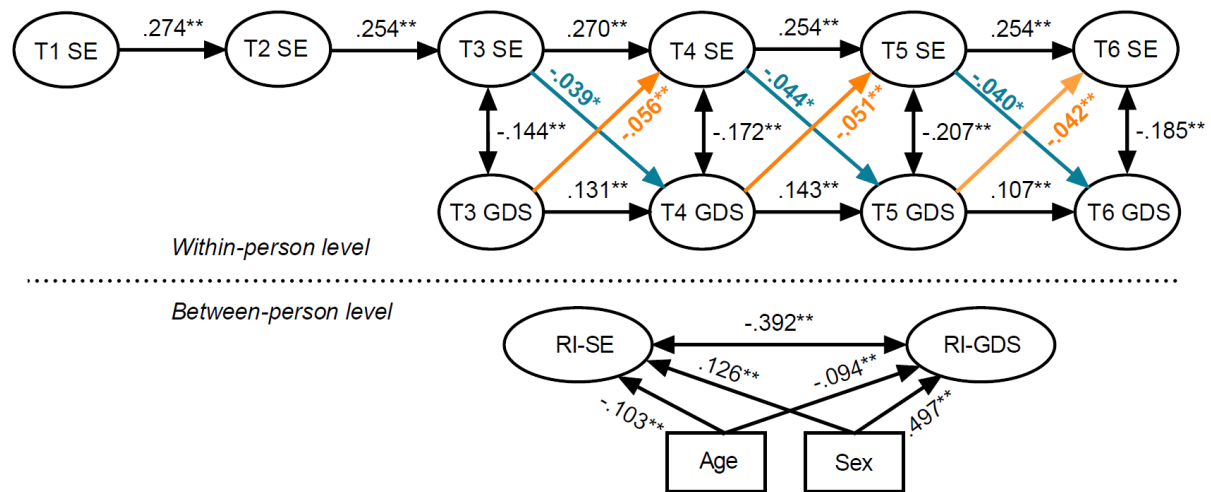


Fig. 3 RI-CLPM of self-esteem and gaming disorder symptoms.

Note. GDS = gaming disorder symptoms; SE = self-esteem; RI-SE = random intercept of self-esteem; RI-GDS = random intercept of gaming disorder symptoms. * $p < 0.05$, ** $p < 0.01$.

The longitudinal mediation of self-esteem. To examine whether there was longitudinal mediation of self-esteem in the dynamic within-person effect of cyber-victimization on gaming disorder symptoms, they were combined into one RI-CLPM that included the three variables of cyber-victimization, self-esteem, and gaming disorder symptoms. The model showed a good fit (**Table 3**). The results for Model 4 (constrained model) are reported in **Fig. 4**. There was a weak within-person effect of self-esteem on cyber-victimization but no significant effect of cyber-victimization on self-esteem. Moreover, as same with the separate model, there was an interplay relationship between self-esteem and gaming disorder symptoms at the within-person level. Therefore, longitudinal mediation of self-esteem in the within-person effects of cyber-victimization on symptoms of gaming disorder was not supported.

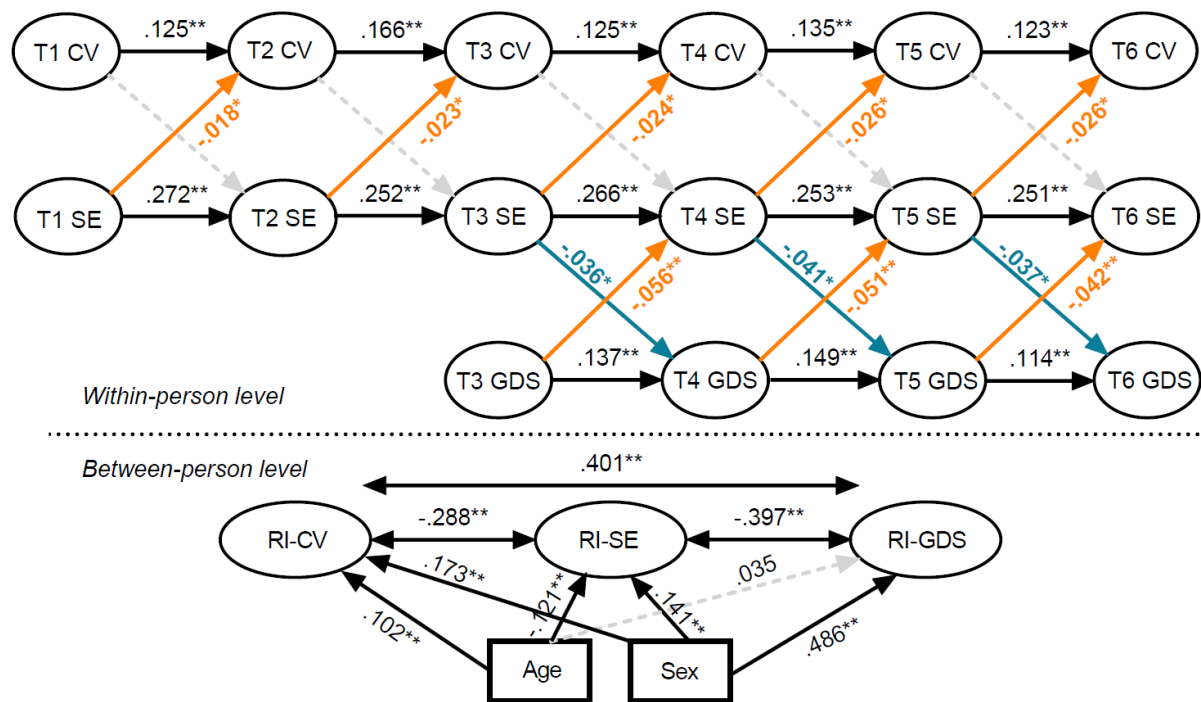


Fig. 4 RI-CLPM of cyber-victimization, self-esteem, and gaming disorder symptoms.

Note. CV = cyber-victimization; GDS = gaming disorder symptoms; SE = self-esteem; RI-CV = random intercept of cyber-victimization; RI-SE = random intercept of self-esteem; RI-GDS = random intercept of gaming disorder symptoms. Within-person correlations are not presented. * $p < .05$, ** $p < .01$.

Additional Analyses

As cyber-victimization and gaming disorder symptoms typically show sex differences, multigroup RI-CLPM was conducted across boys and girls, and the results showed no differences in model comparison (**Table S5**). Moreover, sensitivity analyses evaluated the robustness of the results when the model method changed and, consequently, assumptions also changed (e.g., a different method for estimating missing data). All RI-CLPMs were run based on FIML estimation, including MIs for the missing data. RI-CLPMs were then run which could be used for sensitivity analyses (Blozis et al., 2013). MIs were used to impute 200 times for the variables that had missing values. RI-CLPMs were then run based on the FIML estimation (i.e., Model 4). The model results were similar to FIML estimates. Therefore, there was no bias in reporting the results based on the FIML estimates.

Discussion

Although previous cross-sectional studies have suggested a close relationship between cyber-victimization, self-esteem, and gaming disorder symptoms, longitudinal studies are scarce, and the within-person relationship among these variables has been much less examined. Using a large sample of Chinese adolescents, the temporal dynamic relationships between cyber-victimization, self-esteem, and gaming disorder symptoms were examined. Although the effect size was small (Orth et al., 2022), the results of RI-CLPMs indicated that at the within-person level, (1) a significant bidirectional relationship existed between cyber-victimization and self-esteem, and (2) a significant bidirectional relationship existed between self-esteem and gaming disorder symptoms. However, at the within-person level, (3) there was neither significant direct effect of cyber-victimization on gaming disorder symptoms, (4) nor significant mediation of self-esteem in the relationship between cyber-victimization and gaming disorder symptoms. In addition, strong between-person relationships among cyber-victimization, self-esteem, and gaming disorder symptoms were found.

Consistent with previous findings (e.g., Gan et al., 2023; Kavanagh et al., 2023; Richard et al., 2021; Xiang et al., 2022), a strong between-person relationship between cyber-victimization and gaming disorder symptoms was found. Adolescents who have experienced victimization may seek ways to cope with and escape stress. Online gaming can serve as a means of temporarily escaping stress and negative emotions in reality (Blasi et al., 2019), enabling individuals to forget the pain and distress caused by victimization. Moreover, cyber-victimization was significantly negatively associated with self-esteem, feelings of inadequacy, worthlessness, and diminished self-worth (Kavanagh et al., 2023).

However, the results did not support a within-person dynamic effect between cyber-victimization and gaming disorder symptoms. Although studies have shown that victimization can adversely affect psychological well-being (e.g., Elgar et al., 2014; Kim et al., 2018; King

& Delfabbro, 2014; Reed et al., 2022; Rose & Tynes, 2015; Tran et al., 2023), it does not automatically lead to gaming disorder symptoms. Individuals who have experienced victimization may be more inclined to seek solace and comfort in online activities to escape and find support through; for example, social interactions. This makes it possible for them to construct new identities, thereby increasing their internet use and dependence. However, not all individuals who have experienced cyber-victimization would display increase symptoms of gaming disorder.

Although the strong association between self-esteem and peer victimization—such as a reciprocal relationship between them—has garnered extensive support (e.g., Choi & Park, 2018, 2021; van Geel et al., 2018), the current findings indicated that changes in self-esteem negatively predicted changes in cyber-victimization, and changes in cyber-victimization also negatively predicted self-esteem. Studies have shown that adolescents with low self-esteem are more likely to become targets of cyber-victimization owing to their vulnerability and perceived weakness (e.g., Patchin & Hinduja, 2010; Rose & Tynes, 2015) and are quickly victimized in cyberspace. Adolescents with low self-esteem may lack a stable sense of social identity and support systems in their offline lives (Rubin & Hewstone, 1998), leading to feelings of social exclusion and isolation. This makes them more prone to victimization on online platforms. The online environment also provides a relatively anonymous and discreet space (Kowalski et al., 2014; Smith et al., 2008), making it easier for bullies to engage in harmful behaviors. Therefore, adolescents with low self-esteem may be more likely to be targeted in cyber-victimization because they spend more time in the virtual world interacting and engaging with others.

The RI-CLPM also showed an interactive within-person relationship between gaming disorder symptoms and self-esteem. According to previous studies (e.g., Cheng et al., 2018; Kardefelt-Winther, 2014), individuals with low self-esteem may engage in addictive behaviors to escape negative emotions and self-doubt. Moreover, addictive behaviors can enhance mood

and self-perception among individuals with low self-esteem through neurochemical effects. For example, specific addictive behaviors, such as gambling, shopping, or food consumption, may trigger reward pathways in the brain, releasing neurotransmitters such as dopamine and generating pleasure and positive emotional responses (Brand, 2022). These positive emotional responses temporarily elevate the emotional state of individuals with low self-esteem, compensating for negative emotions caused by self-esteem deficits (Cheng et al., 2018; Kardefelt-Winther, 2014).

Moreover, adolescents with gaming disorder symptoms in the current study experienced decreased self-esteem, consistent with previous studies (Teng et al., 2020b) and the DSM-5 criteria for gaming disorder symptoms as maladaptive behavior (Gentile et al., 2017). Problematic gaming can reduce social interactions and interpersonal relationships in the real world, causing individuals to feel lonely, isolated, and socially disconnected. This social isolation further lowers their self-esteem. Further, videogames often involve competition and challenges that expose individuals to failure and frustration (Lobel et al., 2019). Prolonged symptoms of gaming disorder result in a continuous experience of failure and setbacks, wherein individuals struggle to achieve goals or obtain rewards and a sense of achievement within the game. This extended experience of failure and frustration undermines confidence and self-esteem. Moreover, the competitive environment and social networks in gaming encourage individuals to engage in negative self-evaluations and comparisons. They may compare themselves with other players, experience feelings of inadequacy and failure, and have lower self-esteem.

The RI-CLPM in the current study did not suggest a significant mediation of self-esteem in the relationship between cyber-victimization and gaming disorder symptoms, at the within-person level. Theoretically, according to STD (Ryan & Deci, 2000; Ryan et al., 2006), being victimized online may decrease an individual's self-esteem, leading to a failure in

meeting basic psychological needs. This could potentially result in online addictive behaviors, including increase symptoms of gaming disorder. In the current study, this theoretical viewpoint was validated in between-individual relationships, but it was not significant in within-individual relationships. There are two possible reasons. Owing to the RI-CLPM, controlling for static information makes it difficult for dynamic information to reach a significant effect. However, this does not imply that there is no mediation effect between them—it is just that the causal relationship remains to be further examined.

Conversely, since both problematic gaming and cyber-victimization occur online, being bullied online might lower self-esteem, but it may also lead teenagers to develop other problematic behaviors, such as depression and anxiety (internalizing issues). The causal relationship between these problems and gaming disorder symptoms is unclear. Therefore, after experiencing cyber-victimization, the amount of time spent on online gaming might not increase but could potentially decrease. However, these speculations require further investigation, especially in the longitudinal within-individual relationships between cyberbullying, depression, anxiety, other internalizing issues, and gaming disorder symptoms. Although the current study did not find a significant within-person mediation of self-esteem in the link between cyber-victimization and gaming disorder symptoms, the strong association between individuals suggests that cyber-victimization could concurrently lead to decreased self-esteem and increased symptoms of gaming disorder.

The current study has several limitations. First, as in other studies, all variables were self-reported measures, which may have been subject to common method bias (Kock et al., 2021). Future studies should employ multiple data sources, such as parental and teacher reports, to comprehensively assess students' experiences of cyber-victimization, self-esteem, and gaming disorder symptoms. Second, the sample comprised school adolescents from Southwest China, ensuring regional diversity by including students from different ethnic groups (e.g.,

Miao, Tujia). However, caution should be exercised when generalizing the findings to other populations. Third, the longitudinal study only collected data over three years. Future studies could extend the observation period to examine dynamic changes in cyber-victimization and the impact of self-esteem on cyber behavior. Finally, the data may be imbalanced because symptoms of gaming disorder was only assessed in four waves (others were measured in six waves). However, no evidence or data simulation studies have suggested that imbalanced data affect the results. Future studies could compare imbalanced with balanced panel data to further examine the RI-CLPM. Further, because the current study was not including such transition data, the longitudinal data concerning the transition from elementary to middle school were not analyzed, which could have provided insight concerning the longitudinal relationships between these variables. Given that the data for the current study came from an ongoing longitudinal study, in the future researchers could extend to examine the developmental effect of these variables from childhood to adolescence (e.g., used growth trajectories of cyber-victimization, self-esteem, and gaming disorder symptoms).

Conclusion

The complex temporal dynamics between cyber-victimization, self-esteem, and gaming disorder symptoms among children and adolescents remain largely understudied. To address this research gap, the current study employed several RI-CLPMs to examine the longitudinal dynamic relationships between these variables. By distinguishing between between-person variances and within-person changes, the current study produced several important findings. First, at the within-person level, the study found that fluctuations in self-esteem (at the trait level) heighten susceptibility to cyber-victimization and exacerbate the symptoms of gaming disorder. The study showed a weak bidirectional relationship between self-esteem and gaming disorder symptoms at the within-person level, indicating that high self-esteem can potentially reduce symptoms of gaming disorder, while changes in gaming disorder symptoms may further

precipitate a decline in self-esteem. However, at the within-person level, the findings did not support the mediation of self-esteem in the dynamic of cyber-victimization and gaming disorder symptoms. Second, at the between-person level, self-esteem was negatively related to both cyber-victimization and gaming disorder symptoms, and cyber-victimization had a positive association with gaming disorder symptoms. This finding provides valuable insights into the trait-level interrelations between these factors. Finally, the findings contribute significantly to the existing literature by highlighting the important role that the development of self-esteem plays in protecting adolescents against cyber-victimization and gaming disorder symptoms, which provides significant implications for interventions to enhancing self-esteem in adolescence.

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Authors' Contributions

QN conceived the study, collected the data, interpreted the results, drafted and edited the manuscript. MDG interpreted the results, helped to draft the manuscript, and revised and edited the manuscript. ZT conceived the study, performed the statistical analysis, interpreted the results, drafted and edited the manuscript. All authors reviewed and approved the final manuscript.

Data Sharing Declaration

The data supporting the current study's findings are available from the corresponding author upon reasonable request.

Compliance with Ethical Standards

Conflicts of Interest

The authors declare no conflict of interest except MDG. MDG has received research funding from *Norsk Tipping* (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from *Gamble Aware* (formerly the *Responsibility in Gambling Trust*), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the Declaration of Helsinki. The study was approved by the Research Project Ethical Review

Application Form, Faculty of Psychology, Southwest University (IRB protocol number: H19008).

Informed Consent

Parental consent and adolescent assent were obtained from all participants included in the study.
