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Regular Article

Developmental interactions between peer victimization and depressive symptoms in adolescents: A latent change score analysis

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Abstract

Peer victimization and depressive symptoms are highly relevant risks during adolescence. Understanding the dynamic patterns of interactions between peer victimization and depressive symptoms as well as gender differences in these variables can improve intervention strategies for adolescents navigating this critical transition period. In the present study, a large sample of Chinese adolescents reported peer victimization and depressive symptoms in four survey waves at six-month intervals. A total of 2534 adolescents (51.9% boys, $M = 12.98 \pm 0.60$ years) were included in the latent change score (LCS) analysis. The results supported the reciprocal effects model obtained in the full sample. Changes in peer victimization were influenced by prior changes in depressive symptoms over time, and changes in depressive symptoms were influenced by prior levels of peer victimization. There were also gender differences, with boys exhibiting depressive symptom-driven effects on peer victimization, while girls exhibiting peer victimization-induced depressive symptoms. The dynamic relationships between peer victimization and depressive symptoms that promote and constrain each other in adolescents are elucidated in this study. Differentiating effects on boys and girls is crucial for enhancing the effectiveness of practical interventions.

Keywords: adolescents; peer victimization; depressive symptoms; gender difference; latent change score model

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Introduction

The middle school stage is a critical transition period for adolescents and a time in which various adaptation challenges frequently occur. Peer victimization and depressive symptoms are major threats to the healthy development of adolescents worldwide. Twenty-three percent of 15-year-olds across the countries in the Organization for Economic Cooperation and Development (OECD) had been victimized by their peers (OECD, 2019), and 36.7% of adolescents aged 12–17 experienced persistent depressive symptoms (Bitsko et al., 2022). Peer victimization refers to being the target of peer aggression either directly (e.g., physical or verbal attacks) or indirectly (e.g., rumor spreading or social exclusion), which broadly encompasses repeated, intentional aggression characterized by power imbalances (i.e., bullying) and other forms of peer harm (Schacter, 2021). Peer victimization has shown a stable high correlation with depressive symptoms compared to many other adjustment problems (Christina et al., 2021). Given their prevalence, insight into the developmental associations between peer victimization and depressive symptoms during critical transitions may help promote healthy development and well-being in adolescents.

Although peer victimization and depressive symptoms are intertwined during adolescence, there is no consensus on the directionality of their interaction. From interpersonal risk perspectives, several longitudinal studies have found that peer victimization increases the risk of later depressive symptoms (Geoffroy et al., 2018), exhibiting dose-response effects (Zwierzynska et al., 2013). Adolescents who experience peer victimization tend to adopt withdrawal behaviors in peer interactions to avoid potentially hurtful social situations (Guedes et al., 2018; Pouwels et al., 2016). Meanwhile, peer victimization undermines positive self-perception, thus paving the way for the development of depressive symptoms in behavioral and cognitive aspects (Pan et al., 2020). However, other studies have found that the effects of depressive symptoms on peer victimization are symptom-driven (Krygsman & Vaillancourt, 2017; Marsh et al., 2016). Low activity in adolescents with depressive symptoms impedes the formation of favorable peer relationships (Kochel et al., 2012), and a negative ego-state that signals resignation is more likely to attract the attention of bullies, thus increasing the risk of peer victimization (Saint-Georges & Vaillancourt, 2019).

Inspired by these debates, researchers have increasingly examined the relationship between peer victimization and depressive symptoms from the perspective of developmental psychopathology. Focusing on different aspects of developmental change, this integrative framework elaborates on how competence and psychopathology unfold (Masten, 2006). As the systemic developmental principle emphasizes, different periods of development are sequentially and coherently changing processes. The system is capable of adapting to transitions and changes in the environment, and individuals and the environment have bidirectional influences as well. Moreover, the longitudinal principle emphasizes the importance of capturing changes in the rate of

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development and turning points in understanding the association between peer victimization and depressive symptoms. These principles indicate that there may be a developmental pattern of interaction between changes in peer victimization and depressive symptoms during adolescents' school transition (Troop-Gordon, 2017). In the context of school transition, the social hierarchy of peers is disrupted, which results in a reorganization of peer relationships (Rambaran et al., 2020). Some adolescents may bully others to maintain their status among peers (Vaillancourt et al., 2023), with fluctuations in the incidence of peer victimization (Evans & Smokowski, 2016; Garandeau et al., 2014). Increases in depressive symptoms make adolescents less energetic and socially impaired (Neal & Veenstra, 2021), thus making them easy targets for bullying and increasing the likelihood of peer victimization (Saint-Georges & Vaillancourt, 2019). Moreover, the need for favorable peer relationships becomes more pronounced during the school transition (Bukowski et al., 2011). Adolescents have difficulty coping with peer victimization due to sudden changes in interpersonal relationships and are more likely to develop depressive symptoms (Ames et al., 2019; Nelson et al., 2005). Based on this integrative framework, Cho et al. (2022) found a nonlinear development of peer victimization and depressive symptoms in adolescents. Peer victimization was associated with slower reductions in depressive symptoms, and depressive symptoms were associated with slower reductions in peer victimization.

However, the aforementioned work in this field did not capture the dynamic interactions of these variables over time, although peer victimization and depressive symptoms in adolescence are dynamic (i.e., changeable) in nature. Thus, understanding of intraindividual changes in peer victimization and depressive symptoms, as well as the drivers of change, is limited. To gain further insight into this issue, latent change score (LCS) analysis is an approach that is increasingly used because it emphasizes the concept of "change" (Grimm et al., 2012). LCS analysis examines temporal changes and models the changes along with "raw" scores as a predictor or outcome in the analysis; that is, it examines whether peer victimization/depressive symptoms at one point in time and prior changes in peer victimization/depressive symptoms predict subsequent changes in peer victimization/depressive symptoms (Klopack & Wickrama, 2020; Matusik et al., 2021). Accordingly, the overarching aim of this study was to explore changes in and temporal coupling between adolescents' peer victimization and depressive symptoms using LCS analysis.

Furthermore, despite the possible bidirectional influences between peer victimization and depressive symptoms, adolescent boys and girls differ in interpersonal and emotional interactions (Cyranowski et al., 2000). Thus, there may be subtle gender differences in the relationship between peer victimization and depressive symptoms (Girgus & Yang, 2015). On the one hand, interpersonal stress affects girls more prominently than boys, and girls exhibit more profound patterns of response to interpersonal stress (Flook, 2011). Girls prefer close confidant-like friendships in peer relationships to fulfill their social needs and sense of self-worth, with these friendships providing them with social feedback that reinforces positive or negative self-awareness (Baumeister, 2005; Rankin et al., 2004). In this way, girls' exposure to negative interpersonal events (e.g., peer victimization) may threaten critical self-perceptions and needs for interpersonal satisfaction, with attendant negative emotions that are difficult to cope with, thereby increasing the likelihood of depressive symptoms (Johnson & Whisman, 2013). On the other hand, boys appear to value peer relationships as a means to improve their status within the group at large (Kwang et al., 2013). The negative effects of low activity and social withdrawal associated with depressive symptoms are greater in boys. These symptoms put boys at greater risk of passive peer reactions, including peer rejection and lower popularity among peers (Doey et al., 2014). Thus, boys with depressive symptoms may be at an increased risk of relationship challenges and peer victimization. The current findings on gender differences in the relationship between peer victimization and depressive symptoms are mixed. Several studies have confirmed that girls have greater interpersonal vulnerability, leading to more severe negative impacts of peer victimization on depressive symptoms than boys (Pontes et al., 2018). Other studies have found no gender difference in the effect of peer victimization on depressive symptoms, with depressive symptoms predicting subsequent peer victimization in both boys and girls (Sentse et al., 2017; Stapinski et al., 2015). The understanding of gender differences may be limited by considering these variables as static rather than dynamic. Distinguishing the effects of state and time-varying components could further enhance understanding of gender differences in the association between peer victimization and depressive symptoms. Given the above theoretical and empirical findings of gender differences, the second aim of this study was to investigate gender differences in the coupling of adolescents' peer victimization and depressive symptoms over time.

In summary, the present study was designed to address the above gaps in understanding changes in adolescents' peer victimization and depressive symptoms over time using LCS analysis and to identify how these variables may act as dynamic determinants of one another (i.e., how changes in each variable predict subsequent changes in each variable). The two research topics were as follows: (1) the directionality of predictive relationships between peer victimization and depressive symptoms in terms of state and change components and (2) the presence of gender differences in the directionality of predictions. Moreover, subjective socioeconomic status (subjective SES) is an important demographic factor that influences adolescents' victimization and depressive symptoms; namely, low subjective SES was found to increase the risk of peer victimization and depressive symptoms. Subjective SES was included as a control variable in the current study (Pernille et al., 2009; Quon & McGrath, 2014).

Methods

Participants

Four waves of data collection were conducted in seven randomly selected middle schools in Central China at six-month intervals, starting in January 2015, which marked end of the first semester of 7th grade (the first semester in which adolescents enter middle school). The study included 13 classes in two urban schools, 15 classes in one suburban school, and 19 classes in four rural schools. A total of 2,613, 2,608, 2,600, and 2,536 adolescents completed the survey at T1, T2, T3, and T4, respectively. A total of 2,534 adolescents (51.9% boys, $M_{age} = 12.98 \pm 0.60$ years at T1) who completed at least three waves of data collection on peer victimization and depressive symptoms were included in the statistical analysis. Of these students, 95.5% were of Han Chinese ethnicity, 17.4% came from one-child families, 94% had paternal education of high school or less, and 98% had maternal education of high school or less. The missing rates for the four waves of peer victimization were 2.1%, 0.5%, 1.6%, and 4.2%, respectively, and those for depressive symptoms were 1.6%, 0.5%, 1.4%, and 4.1%.

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Procedure

All procedures were approved by the institutional review board of the authors' institution. At each assessment wave, data were collected through a paper-and-pencil survey in the classroom by trained graduate students. Parents or legal caregivers provided written informed consent for their children to participate in the study. Adolescents were told that all results would be treated with respect, including confidentiality, independence, and integrity, and that the data would be used only for scientific research purposes without revealing their personal information. Adolescents had the right to withdraw from the survey at any time and for any reason. The teacher was present during the survey to maintain classroom discipline.

Measures

Peer victimization

At each wave, adolescents completed the Campus Aggression and Bullying Scale (the National Children's Study of China, NCSC; Dong & Lin, 2011) to report the frequency of peer victimization in the past semester. This scale has seven items on physical victimization, verbal victimization, and relationship victimization. Each item is scored on a scale from 0 (did not occur) to four (more than five times). The score of peer victimization was computed as the average of scores on the seven items. The questionnaire showed good reliability (Cronbach's α values ranged from 0.794 to 0.864, and retest reliability ranged from 0.495 to 0.618 across the four waves) and construct validity (RMSEA ranged from 0.065 to 0.078, CFI values ranged from 0.928 to 0.937 across the four waves). Additional psychometric properties of the questionnaire were provided in the Supplementary Material (Section 1).

Depressive symptoms

Adolescents indicated the degree to which they experienced depressive symptoms in five dimensions over the past two weeks (i.e., anhedonia, negative mood, negative self-esteem, ineffectiveness, and interpersonal problems) using the Chinese version of the Child Depression Inventory (CDI; Kovacs, 1992; Liu et al., 2019). The 27 items were rated on a scale of 0–2 based on severity, ranging from mild to severe. The total score of depressive symptoms was computed as the average of scores on the five subscales. The Chinese version of the CDI has shown good reliability (Cronbach's α values ranged from 0.872 to 0.898, and retest reliability ranged from 0.506 to 0.698 across the four waves) and construct validity (RMSEA values ranged from 0.034 to 0.040, CFI values ranged from 0.910 to 0.914 across the four waves). Additional psychometric properties of the questionnaire were provided in the Supplementary Material (Section 1).

Demographic variables

Gender was coded as 0 = boys and 1 = girls. Subjective socioeconomic status (subjective SES) was measured at T1 using the following question: "How would you rank your family's financial situation?." Responses were rated from one to five, representing low, middle-low, middle, middle-high, and high SES.

Statistical analyses

A latent change scores model (LCSM) was established to examine the temporal dynamics of the relationship between peer victimization and depressive symptoms (Grimm et al., 2012). Changes in a variable of the univariate LCSM were considered a function of (1) a participant's individual linear trajectory over time that encompassed the additive sum of changes (i.e., slope) and (2) a quantity that was proportional to the lagged effect of the previous status or level of itself (β) (see Fig. 1). Thus, the changes in a variable of the bivariate LCSM could be predicted by the previous level or status (coupling effect) and the change in an alternative variable (change-to-change effect). To estimate the true latent change between each assessment, various parameters were equally constrained to ascertain if the same dynamics were at play across all assessments (e.g., the path shown in Fig. 1 was constrained to 1) (Grimm et al., 2016; 2017).

Analyses were conducted using M*plus* 8.3 (Muthén & Muthén, 1998–2017). First, longitudinal measurement invariance of peer victimization and depressive symptoms across time and gender was examined. Measurement homogeneity at different times and among different groups is a prerequisite for LCSM analysis (Widaman et al., 2010). Longitudinal measurement invariance was assessed using the following steps: (1) a baseline model was established (i.e., the loading and intercept of the observed variables were allowed to be estimated freely, and the mean value of each factor was fixed at 0), (2) the loading of the observed variables was restricted to be equal (i.e., weak factorial invariance model), and (3) the intercept of the entries was restricted to be equal (i.e., strong factorial invariance model). Considering that the chi-square index was sensitive to changes in sample size and that the sample size of this study was large, the criteria for comparing model differences in this study were as follows: $\Delta CFI \geq 0.02$ indicated a significant difference between models (Putnick & Bornstein, 2016; Rutkowski & Svetina, 2017).

Then, descriptive statistics were performed, and a series of competition models were constructed (see Fig. 2). Model 1 was the baseline model, assuming that there was no association between peer victimization and depressive symptoms. Model 2 was the unidirectional coupling model that peer victimization influences depressive symptoms, assuming that the level and change in peer victimization affected subsequent changes in depressive symptoms. Model 3 was the unidirectional coupling model that depressive symptoms influence peer victimization, assuming that the level and change in depressive symptoms affected the subsequent changes in peer victimization. Model 4 was the full coupling model of reciprocal effects, assuming that the level of and change in peer victimization and depressive symptoms influence subsequent changes in each other. Proportional change effects were constrained to be the same across time in all four models. The fit of each model was evaluated as follows: a better fitting model was indicated by smaller values of the χ^2 goodness-of-fit index, Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample size adjusted BIC (*adj.* BIC) (Vrieze, 2012). Likewise, adequate fit was indicated by a comparative fit index (CFI) and Tucker-Lewis index (TLI) greater than 0.90, as well as a standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA) less than 0.08 (Marsh et al., 2005; Mcdonald & Ho, 2002). All models were analyzed using a robust maximum likelihood estimator, and missing values were processed using full information maximum likelihood (Lee & Shi, 2021). The nested models were examined using the Satorra-Bentler chi-square difference test (Satorra & Bentler, 2001).

Next, multi-group structural equation modeling was conducted to identify the best-fit model (from Model 1 to Model 4 above) to determine gender differences in the interaction between peer victimization and depressive symptoms. Specifically, a free

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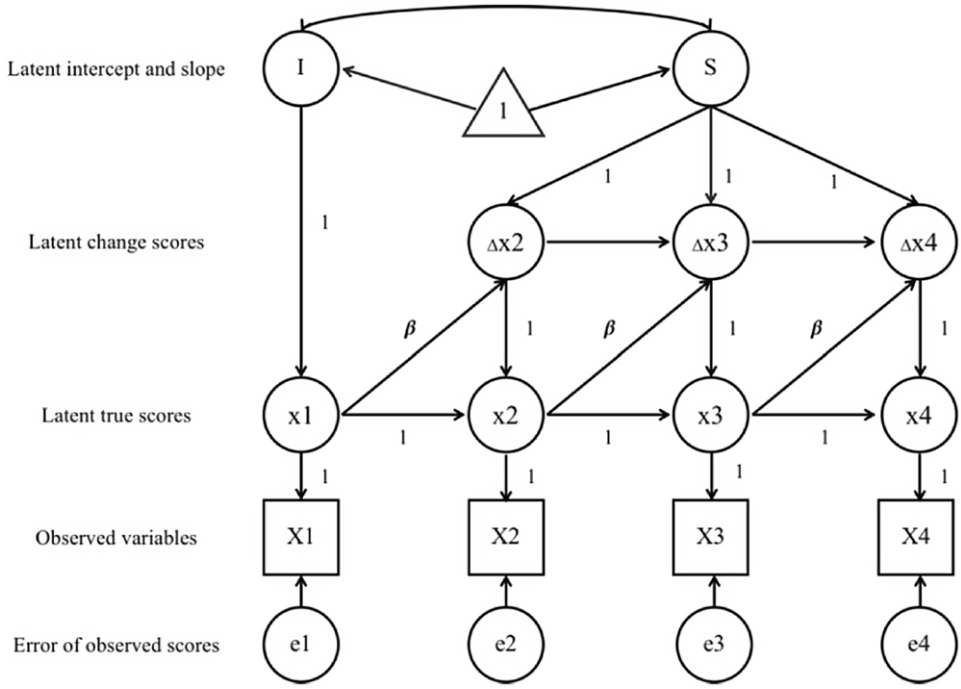


Figure 1. Univariate latent change score model.

estimation model (freely estimating proportional effects, coupling effects, and change-to-change effects for boys and girls) and a constraint model (restricting proportional effects, coupling effects, and change-to-change effects to be equal for boys and girls) were established to investigate whether there were gender differences in the best-fit model (Gelman & Stern, 2006). If the free estimation model had better fitting indices than the constraint model, it indicated that there were gender differences. Finally, the actual data trajectories and simulated trajectories of peer victimization and depressive symptoms were constructed using the package *ggplot2* in the *R* program (Wickham, 2016).

Power analysis

A Monte Carlo power analysis was conducted to determine the statistical power of the sample size for this study on LCSMs parameters (Zhang & Liu, 2018). According to the practice guidelines by Zhang et al. (2015), the *R* package, *RAMpath* was applied for analysis (Zainal & Newman, 2022). The results showed that for small effect sizes ($d < 0.2$), the sample size of this study had 100% power for LCSM parameters of the proportional effects, coupling effects, and change-to-change effects between peer victimization and depressive symptoms.

Results

Longitudinal measurement invariance

Analysis of longitudinal measurement invariance showed that peer victimization exhibited weak factorial invariance and strong factorial invariance, and depression symptoms exhibited weak factorial invariance in terms of cross-time measurement invariance. Further analysis showed that after enabling free estimates of the first wave of intercepts, depressive symptoms exhibited strong factorial invariance ($\Delta CFI = 0.006$). In terms of cross-gender invariance, depressive symptoms were consistent with weak factorial invariance and strong factorial invariance. Peer victimization was only consistent with weak factorial invariance, which may be related to the higher peer victimization of boys than girls in the four waves (see Table 1 for correlations between gender and peer victimization). Overall, the measurement of peer victimization and depressive symptoms had acceptable equivalence across time and gender. Additional information on longitudinal measurement invariance was provided in the Supplementary Material (Section 2, Table S4).

Descriptive analysis

Descriptive statistics and correlations of variables at each wave are shown in Table 1. The mean scores of peer victimization and depressive symptoms across the four waves ranged from 0.482 to 0.677 and from 0.487 to 0.528, respectively. The four-wave assessments showed a moderate positive association between peer victimization and depressive symptoms (*rs* varied from 0.230 to 0.369, $p < 0.001$). The peer victimization of girls was lower than that of boys in all four measurement waves (*rs* varied from −0.144 to −0.206, $p < 0.001$). Depressive symptoms were greater in girls than in boys at the third and fourth measurement waves ($rs = 0.048$, $p < 0.01$; $rs = 0.043$, $p < 0.05$, respectively).

LCSMs and model comparisons

The fitting indices of the four competing models are shown in Table 2. Compared with Models 1 to 3, Model 4 (reciprocal effects) was the optimal model with the best-fit index and the lowest AIC, BIC, and *adj.* BIC values. The unstandardized parameter estimates of the reciprocal effects model were summarized in the Supplementary Material (Section 3, Table S5). The slope mean represents constant linear changes for individuals, indicating that peer victimization ($B = 0.855$, $p < 0.001$) and depressive symptoms ($B = 0.199$, $p = 0.002$) increased across the four measurement waves. The correlation between the intercept and slope suggested that peer victimization changed more rapidly in individuals with higher peer victimization at the start ($B = 0.394$, $p < 0.001$), and depressive

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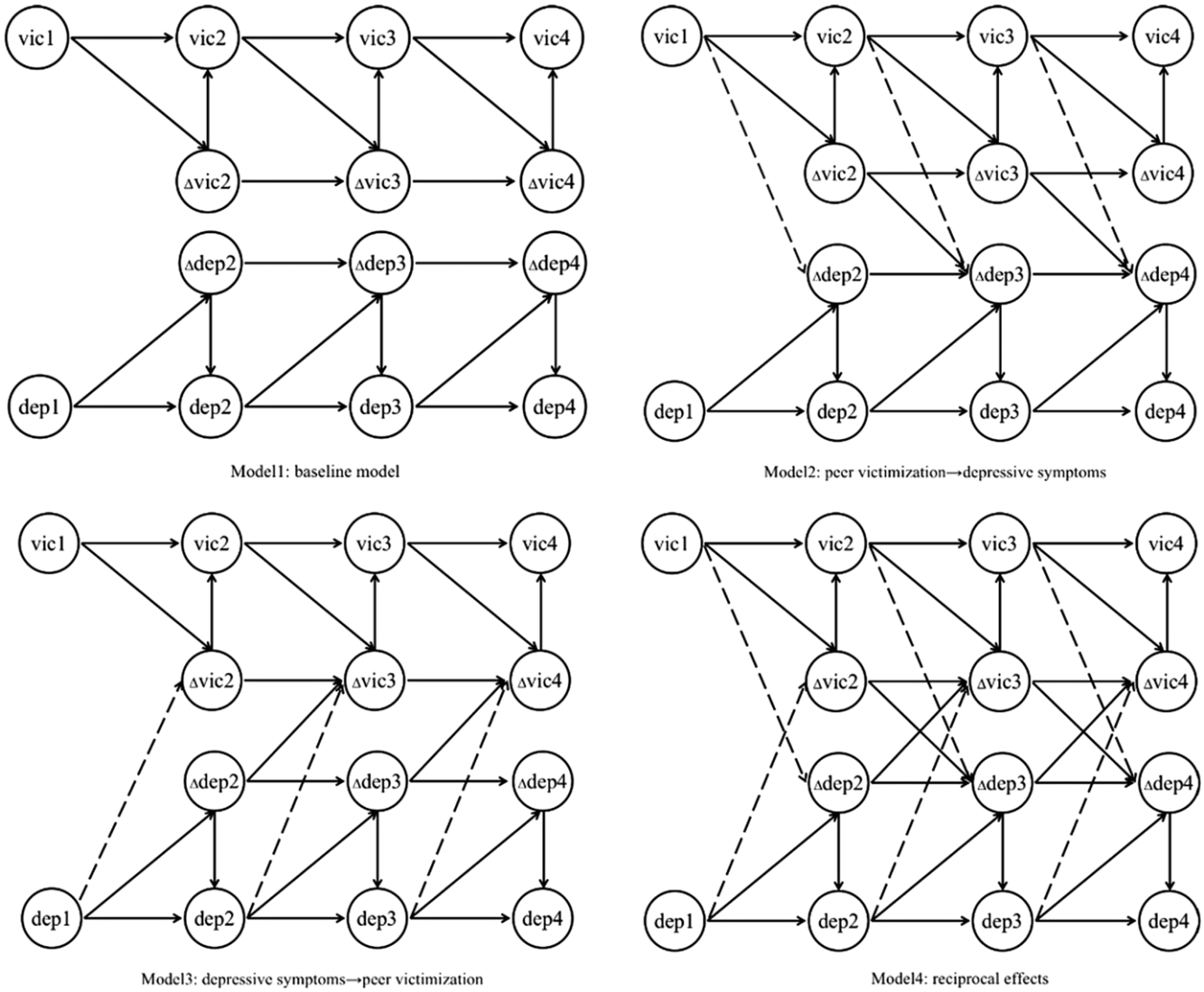


Figure 2. Competition model diagram of bivariate dual latent change score model. For clarity of presentation, latent slope and intercept factors, observed variables, residual variances were excluded. vic, peer victimization; dep, depressive symptoms.

symptoms changed more rapidly in individuals with higher depressive symptoms at the start ($B = 0.014$, $p = 0.013$). The intercept correlation indicated that individuals with higher levels of peer victimization at the initial measurement had higher depressive symptoms ($B = 0.073$, $p < 0.001$), and vice versa.

As shown in Figure 3, the proportional effects indicated that higher levels of peer victimization ($B = -1.978$, $p < 0.001$) and depressive symptoms ($B = -0.476$, $p < 0.001$) in the previous wave were associated with lower increases in these variables in subsequent waves, suggesting a ceiling effect. The coupling effects showed that higher levels of depressive symptoms in the previous wave were associated with a higher increase in peer victimization in the subsequent wave ($B = 1.599$, $p < 0.001$); similar effects were observed in prior peer victimization levels on subsequent changes in depressive symptoms ($B = 0.091$, $p = 0.034$). Changes in previous peer victimization ($B = 0.699$, $p < 0.001$) and depressive symptoms ($B = -1.421$, $p<0.001$) predicted future peer victimization changes. Upward changes in peer victimization exacerbated future peer victimization changes, and upward changes in depressive symptoms downregulated future peer victimization. However, changes in depressive symptoms were not affected by changes in prior depressive symptoms and peer victimization.

Gender differences in LCSMs

As shown in Table 2, the fitting indices of the gender difference model (free estimation model) were better than those of the constrained model (Satorra-Bentler Scaled $\chi^2 = 583.700$, $\Delta df = 14$, $p < 0.001$), indicating that there were gender differences in the reciprocal effects. The unstandardized parameter estimates of the LCSMs for boys and girls were summarized in the Supplementary Material (Section 3, Table S5). The mean slope of peer victimization for girls ($B = 1.035$, $p = 0.008$) was significant, but it was not significant in boys. The correlation between the intercept and slope of depressive symptoms was significant in girls ($B = 0.037$, $p < 0.001$). Girls showed a correlation between the intercept of depressive symptoms and the slope of peer victimization ($B = 0.106$, $p = 0.043$), while boys did not. The coupling effects of the prior levels of depressive symptoms on subsequent changes in peer victimization were significant in boys

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Table 1. Descriptive statistics for study variables at each wave

	1	2	3	4	5	6	7	8	9	10
1. gender (0 = boy, 1 = girl)	1									
2. subjective SES	− 0.022	1								
3. vic at wave 1	− 0.206***	− 0.067**	1							
4. vic at wave 2	− 0.144***	− 0.066**	0.542***	1						
5. vic at wave 3	− 0.152***	− 0.066**	0.496***	0.546***	1					
6. vic at wave 4	− 0.166***	− 0.090***	0.495***	0.518***	0.618***	1				
7. dep at wave 1	0.005	− 0.067**	0.369***	0.293***	0.260***	0.242***	1			
8. dep at wave 2	0.021	− 0.068**	0.274***	0.339***	0.256***	0.237***	0.645***	1		
9. dep at wave 3	0.048**	− 0.043*	0.244***	0.275***	0.302***	0.278***	0.557***	0.678***	1	
10. dep at wave 4	0.043*	− 0.045*	0.230***	0.262***	0.237***	0.307***	0.506***	0.620***	0.698***	1
11. M (SD)	—	2.726 (0.531)	0.658 (0.721)	0.482 (0.654)	0.531 (0.740)	0.677 (0.749)	0.487 (0.283)	0.528 (0.305)	0.520 (0.307)	0.518 (0.319)
12. Min (%)	—	1.000 (6.16%)	0.000 (22.03%)	0.000 (31.67%)	0.000 (35.37%)	0.000 (22.00%)	0.000 (0.89%)	0.000 (0.97%)	0.000 (0.94%)	0.000 (1.13%)
13. Max (%)	—	5.000 (0.73%)	4.000 (0.12%)	4.000 (0.32%)	4.000 (0.57%)	4.000 (0.21%)	1.960 (0.04%)	1.700 (0.04%)	1.670 (0.08%)	2.000 (0.04%)
14. Skewness	—	− 0.372	1.523	2.186	2.108	1.594	0.791	0.663	0.652	0.749
15. Kurtosis	—	0.660	2.245	5.640	4.923	2.541	0.590	0.196	0.095	0.365

vic, peer victimization; dep, depressive symptoms. *two-tailed $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 2. Fitting indexes and Satorra-Bentler chi-square difference test for latent change scores models

	baseline (1)	vic→dep (2)	dep→vic (3)	reciprocal (4)	reciprocal (gen-diff)	reciprocal (gen-diff-cons)
χ^2 (*df*)	623.526 (32)	195.642 (26)	80.432 (26)	55.151 (24)	73.562 (40)	591.715 (54)
p	< 0.001	< 0.001	< 0.001	<0.001	0.001	<0.001
RMSEA (90% CI)	0.086 (0.080, 0.092)	0.051 (0.045, 0.058)	0.029 (0.022, 0.036)	0.023 (0.015, 0.031)	0.026 (0.016, 0.035)	0.090 (0.083, 0.096)
SRMR	0.145	0.022	0.015	0.015	0.021	0.170
CFI	0.907	0.973	0.991	0.995	0.994	0.909
TLI	0.872	0.955	0.986	0.991	0.990	0.879
AIC	17,447.870	16,939.197	16,794.825	16,770.070	16,322.548	16,931.005
BIC	17,610.741	17,136.969	16,992.597	16,979.476	16,694.825	17,221.846
*Adj.*BIC	17,521.778	17,028.943	16,884.570	16,865.095	16,491.481	17,062.984
Model 2 vs 1	469.782 (6), $p < 0.001$					
Model 3 vs 1	615.929 (6), $p < 0.001$					
Model 4 vs 2	360.595 (2), $p < 0.001$					
Model 4 vs 3	50.809 (2), $p < 0.001$					
Model (gen-diff) vs (gen-diff-cons)					583.700 (14), $p < 0.001$	

vic, peer victimization; dep, depressive symptoms; gen-diff, model of gender difference; gen-diff-cons, constraint model of gender difference.

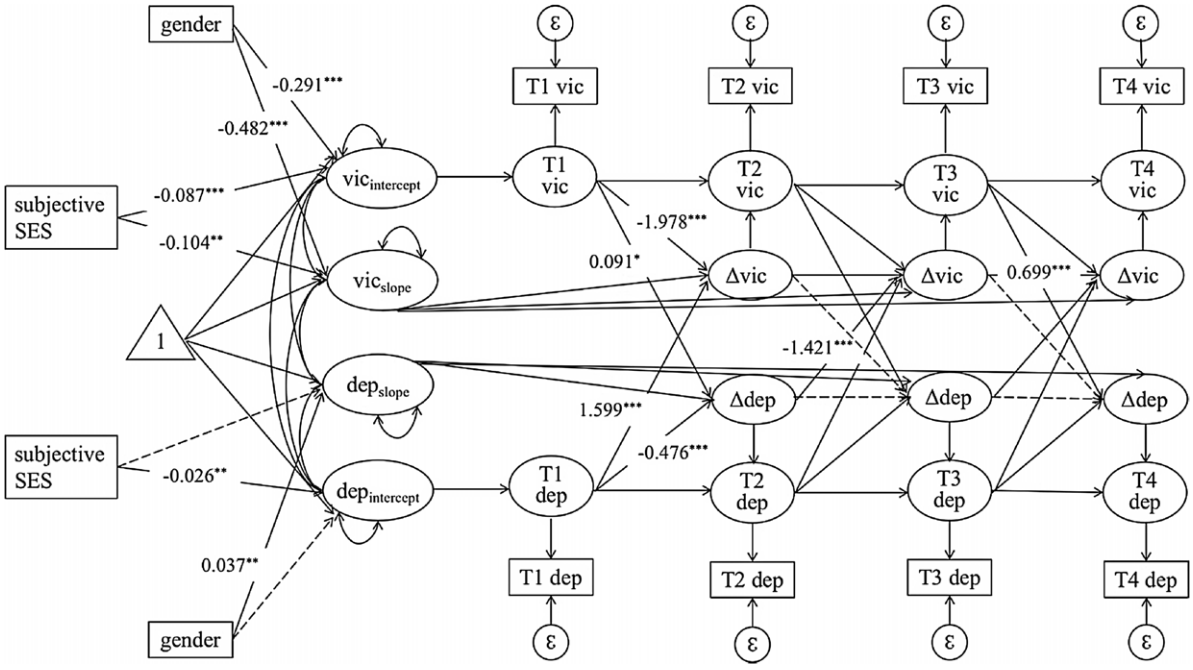


Figure 3. Latent change scores model of peer victimization and depressive symptoms for the full sample. For clarity of presentation, the path coefficients were displayed only once in paths that were constrained to be equal, and only significant path coefficients were displayed. Dashed lines indicate non-significant paths. vic, peer victimization; dep, depressive symptoms. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

($B = 2.243$, $p < 0.001$) but not in girls (see Fig. 4 for boys and Fig. 5 for girls). The coupling effects of peer victimization levels on changes in depressive symptoms were not significant in boys or girls. Regarding the change-to-change effects, increased depressive symptoms in boys decreased the change in later peer victimization ($B = -2.320$, $p = 0.001$), and increased peer victimization in girls increased the change in later depressive symptoms ($B = 0.166$, $p = 0.012$).

In addition, the difference test of three pathways with similar effects in boys and girls (peer victimization status → peer victimization change, depressive symptoms status → depressive symptoms change, and peer victimization change → peer victimization change) showed that the relationship between prior levels of depressive symptoms and subsequent changes in depressive symptoms was significantly stronger in girls than in boys ($\chi^2 = 10.460$, $df = 1$, $p = 0.001$). The remaining two pathways

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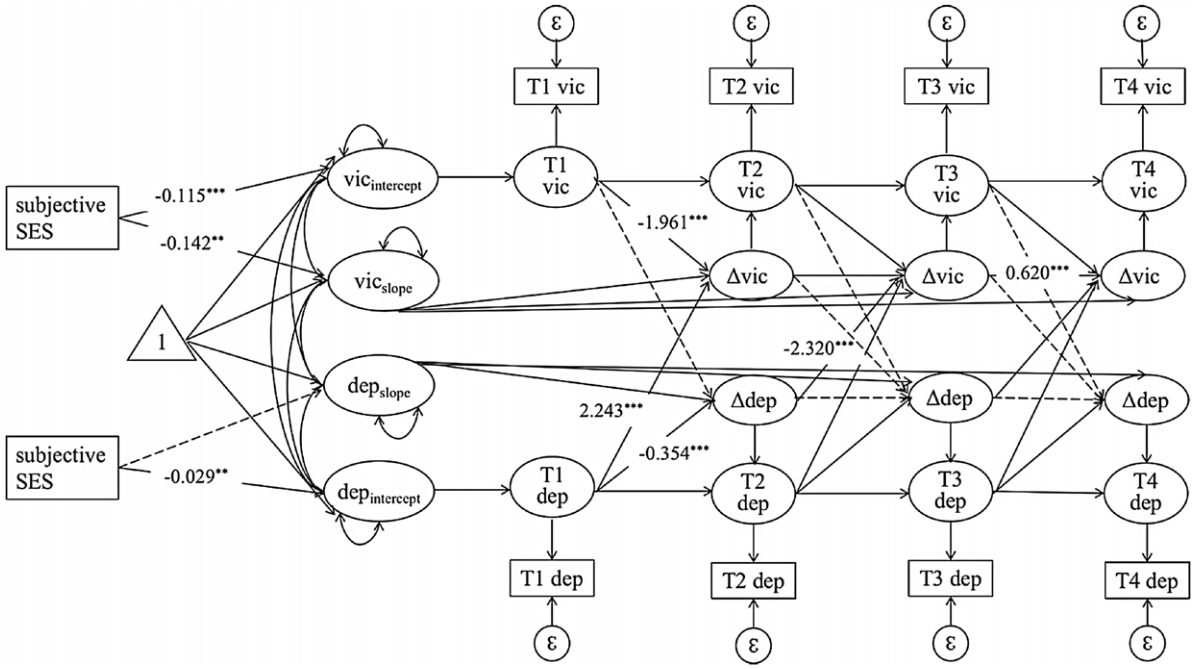


Figure 4. Latent change scores model of peer victimization and depressive symptoms for boys. For clarity of presentation, the path coefficients were displayed only once in paths that were constrained to be equal, and only significant path coefficients were displayed. Dashed lines indicate non-significant paths. vic, peer victimization; dep, depressive symptoms. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

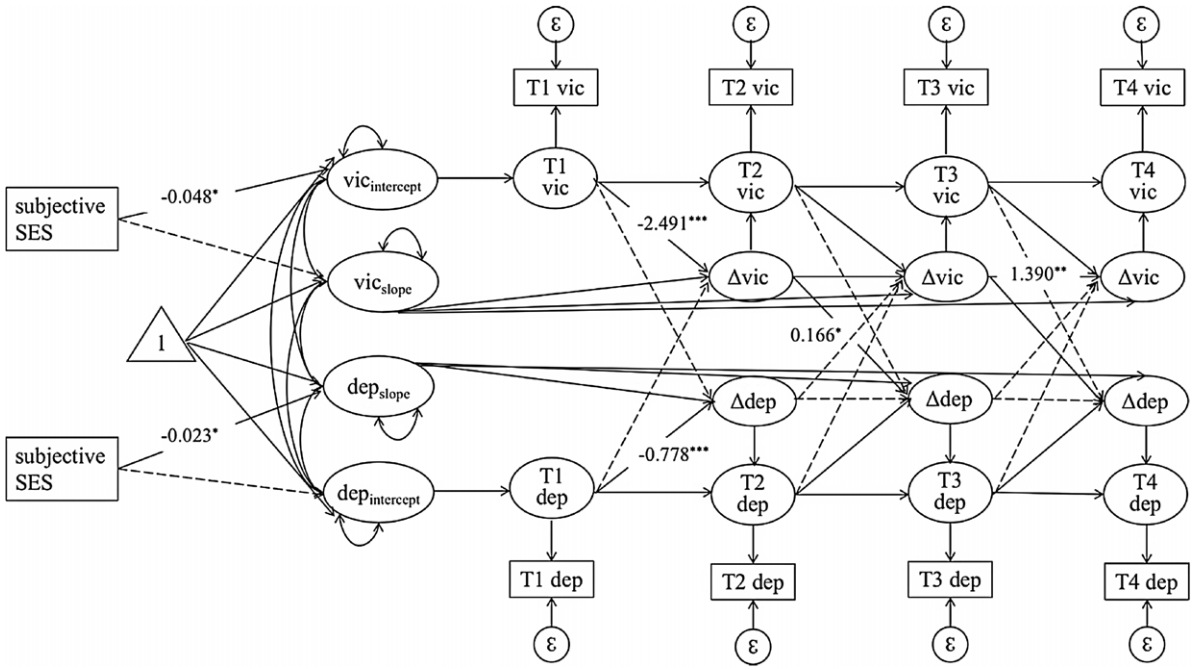


Figure 5. Latent change scores model of peer victimization and depressive symptoms for girls. For clarity of presentation, the path coefficients were displayed only once in paths that were constrained to be equal, and only significant path coefficients were displayed. Dashed lines indicate non-significant paths. vic, peer victimization; dep, depressive symptoms. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

showed no gender differences (peer victimization status → peer victimization change: $\chi^2 = 1.874$, $df = 1$, $p = 0.171$; peer victimization change → peer victimization change: $\chi^2 = 3.165$, $df = 1$, $p = 0.075$). Trajectories of the actual data in the four measurement waves of boys and girls are shown in Figures 6 and 7 (Kievit et al., 2018; Zainal & Newman, 2021).

Robustness analysis of the results

The following additional analyses were conducted to verify the robustness of the results. First, the developmental trajectories of LCSMs were simulated for boys and girls, with 0, 2, and 4 set as the starting values of peer victimization (which was measured on a scale of 0–4); 0, 1, and 2 set as the starting values for depressive

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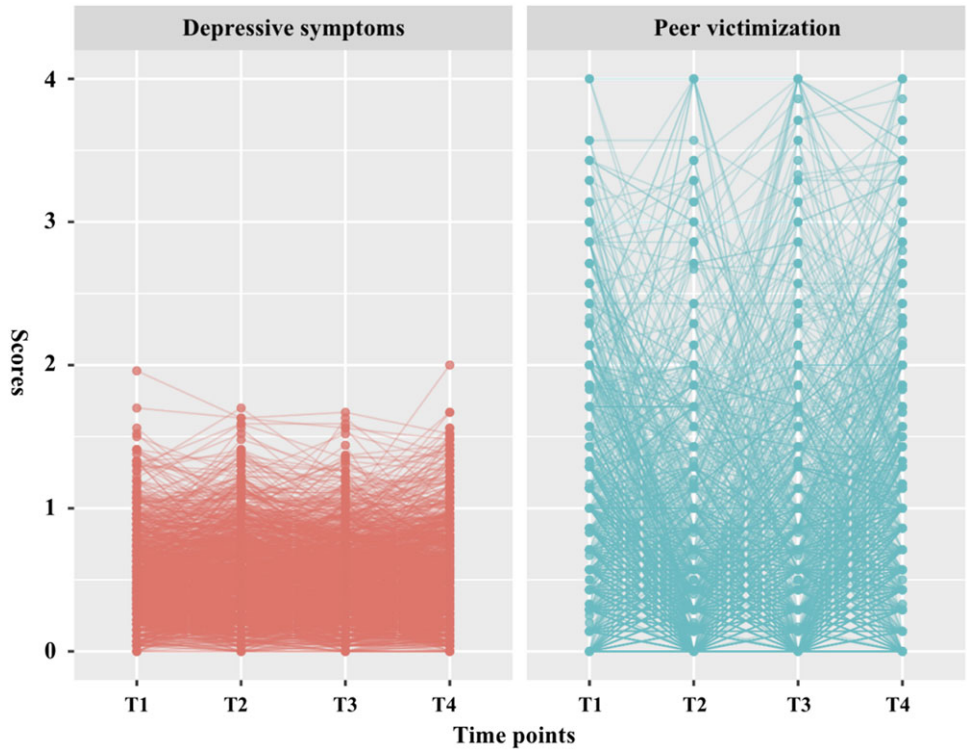


Figure 6. Trajectories of the actual data for boys.

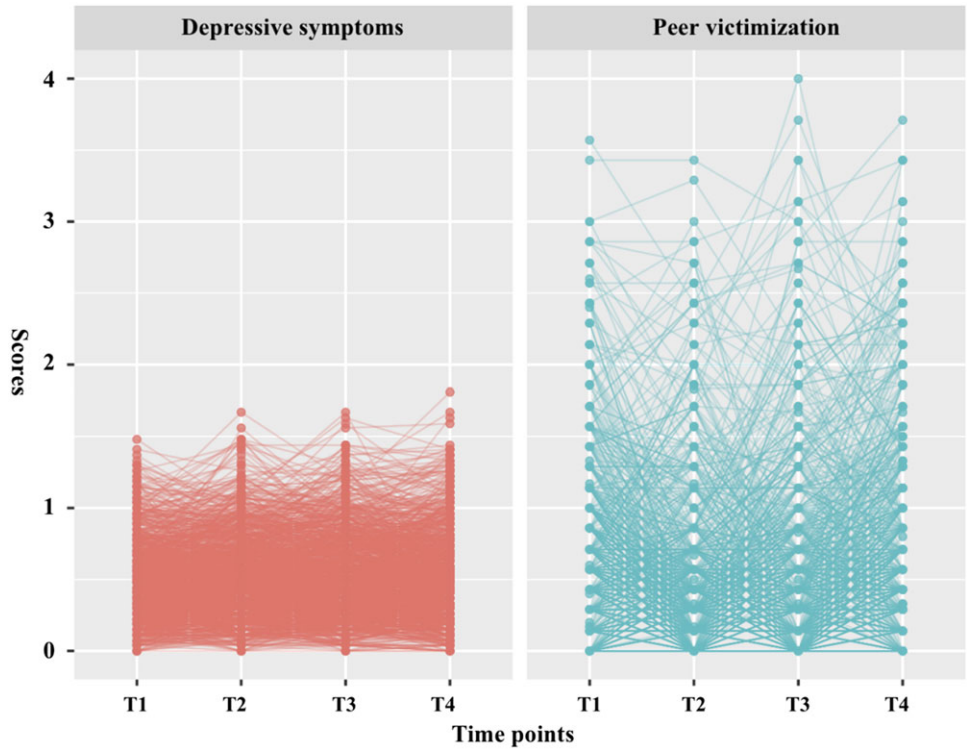


Figure 7. Trajectories of the actual data for girls.

symptoms (which was measured on a scale of 0-2); and a starting value of 0 for the change values of the two. Figure 8 shows that the peer victimization of boys increased with initial values of depressive symptoms and subsequently declined with decreasing depressive symptoms, demonstrating a stable symptom-driven effect of depressive symptoms. Changes in boys' peer victimization barely affected changes in depressive symptoms. Figure 9 shows that girls' depressive symptoms changed as the initial value of peer victimization increased, showing that depressive symptoms rose and fell with the fluctuations in peer victimization. Changes in initial values of depressive symptoms barely affect trends in peer victimization.

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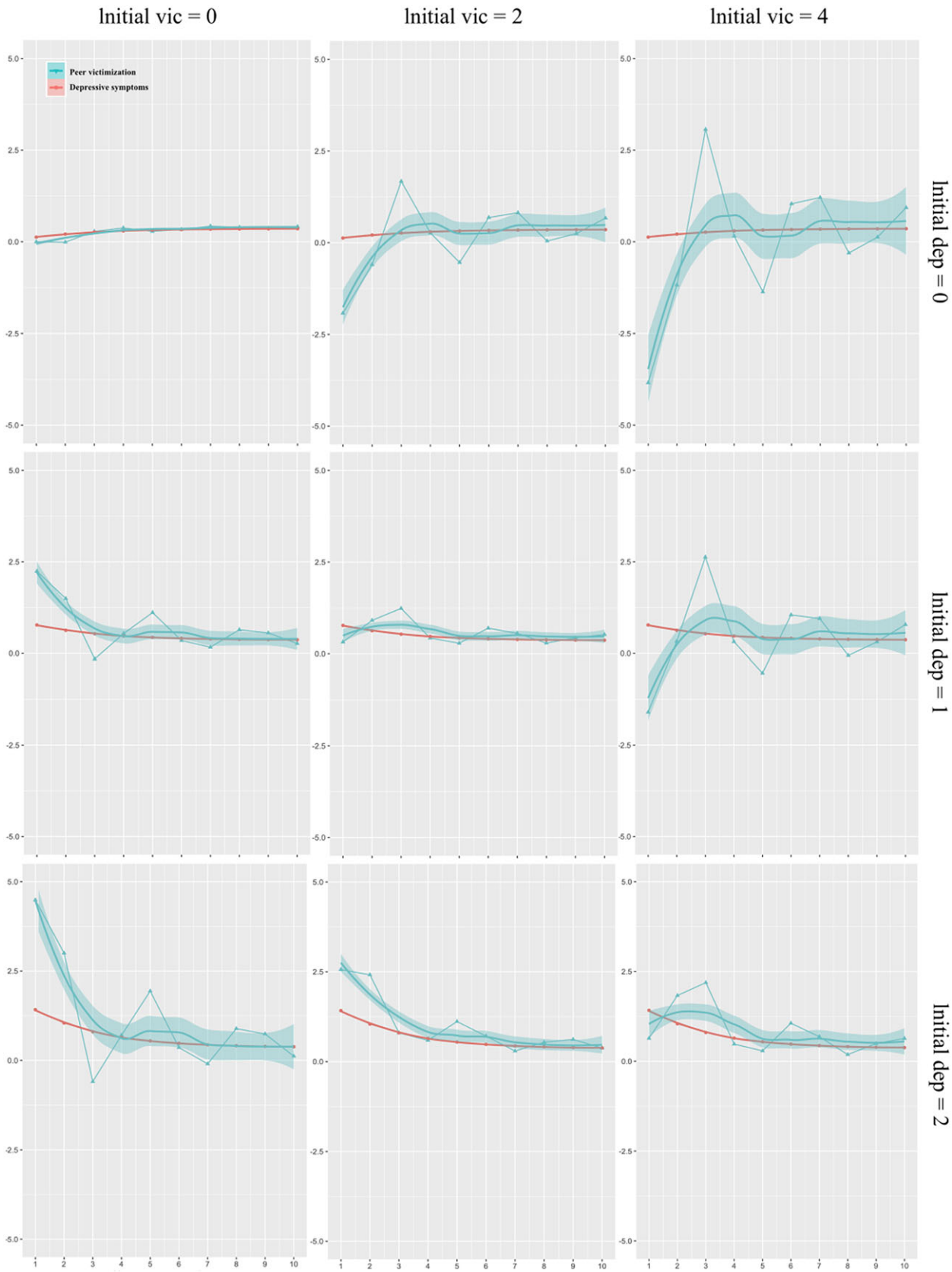


Figure 8. Simulated developmental trajectories of peer victimization and depressive symptoms for boys. vic, peer victimization; dep, depressive symptoms.

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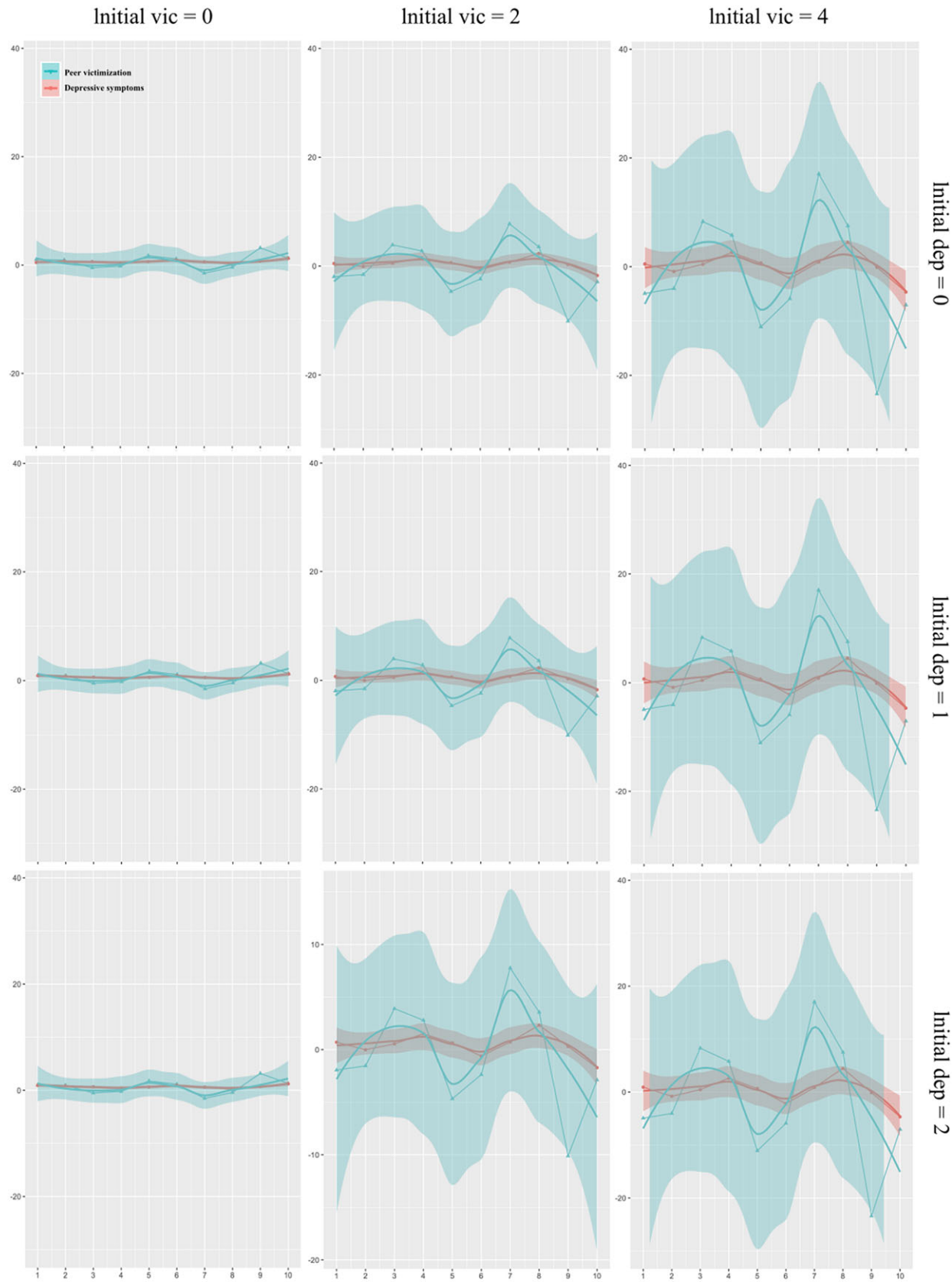


Figure 9. Simulated developmental trajectories of peer victimization and depressive symptoms for girls. vic, peer victimization; dep, depressive symptoms.

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Second, a random-intercept cross-lagged panel model (RI-CLPM; Hamaker et al., 2015) of peer victimization and depressive symptoms was conducted to validate the robustness of the LCSM results. Similar to the LCSM results, with a restricted autoregressive pathway of 1, peer victimization and depressive symptoms in boys interacted with each other (peer victimization → depressive symptoms, $B = 0.878$, $p < 0.001$; depressive symptoms → peer victimization, $B = 2.751$, $p < 0.001$). The stability of the depressive symptom-driven effects in boys was verified, whereas the effects of peer victimization on depressive symptoms may not have occurred through changes in depressive symptoms. Peer victimization affected depressive symptoms in girls ($B = 0.946$, $p < 0.001$), consistent with the results of LCSMs. RI-CLPM pathways for boys and girls were shown in the Supplementary Material (Section 4, Figures S1 and S2).

In addition, a sensitivity analysis was conducted by constraining the proportional effects to zero to reduce the possibility of overestimating the coupling effects (Zainal & Newman, 2022; 2023), as explained in the Supplementary Material (Section 5).

Discussion

The findings of this study support a reciprocal effects model in which changes in peer victimization and the occurrence of depressive symptoms was a function of prior levels and changes in each variable. Consistent with previous studies showing a strong association between the two (Christina et al., 2021; Wu et al., 2015), the positive correlation between intercepts in the full sample suggested that higher levels of peer victimization were associated with higher levels of depressive symptoms (and vice versa). Within-individual changes in the four measurement waves showed that the constant linear change components of adolescents' peer victimization and depressive symptoms increased over time. Levels and changes in peer victimization and depressive symptoms interacted, while changes in depressive symptoms unilaterally influenced changes in peer victimization. This pattern differed between boys and girls.

The ceiling effects of peer victimization and depressive symptoms over time were observed in both boys and girls, as well as the catalytic effect of changes in prior peer victimization on the stabilization of subsequent peer victimization. Gender differences were exhibited in the more subtle impact components. In boys, peer victimization (either level or change) did not affect changes in depressive symptoms; instead, levels and changes in depressive symptoms affected changes in peer victimization. Elevated levels of depressive symptoms reduced the subsequent increase in these levels, which in turn contributed to an increase in peer victimization. Thus, peer victimization and depressive symptoms showed depressive symptom-driven effects in boys, both as a direct effect of depressive symptom level on changes in peer victimization and through changes in depressive symptoms. In girls, increased prior peer victimization promoted subsequent increases in depressive symptoms. Elevated levels of peer victimization decreased the subsequent increase in peer victimization, which further reduced the magnitude of the increase in depressive symptoms. However, this does not imply a decline in depressive symptoms because depressive symptoms in girls showed a constant rate of increase (the slope of depressive symptoms was 0.484, $p < 0.001$). Thus, depressive symptoms in girls varied with peer victimization.

Gender stereotypes may be a potential explanation for the gender differences in the dynamic relationships between peer victimization and depressive symptoms. Specifically, gender stereotypes emphasize toughness and grit in boys. The outward manifestation of depressive symptoms, such as withdrawal and sadness, violates the social norms of boys; thus, depressive symptoms are more likely to elicit peer victimization (Card & Hodges, 2008; Rogers et al., 2017; Salk et al., 2017). In contrast to boys, girls experienced more negative consequences of peer victimization and suffered depressive symptoms as a result. Girls are more susceptible to interpersonal stress than boys (Stroud et al., 2017). Moreover, their strong sense of interpersonal dependence and group evaluation makes it difficult for them to cope with adverse events such as peer victimization that disrupt interpersonal relationships (Pontes et al., 2018). This further contributes to the exacerbation of depressive symptoms (Rudolph & Flynn, 2007).

Strengths and limitations

Adolescents in the transition from elementary to middle school experience dramatic emotional and behavioral fluctuations (Bailen et al., 2019). Focusing on the changes in adolescent development, this study identified the factors that influence changes in peer victimization and depressive symptoms from the perspective of the fluctuating nature of this period. These findings provide an empirical basis for understanding the developmental patterns in the dynamic changes in both variables. Gender differences in the dynamic relationships between peer victimization and depressive symptoms also have practical importance. Efforts to alleviate depressive symptoms in boys may be effective in encouraging their integration into peer groups and thus reducing subsequent changes in peer victimization. In girls, it is critical to monitor and identify the onset of peer victimization and intervene early to mitigate the subsequent depressive symptoms that may occur.

In addition to the above strengths, there are some limitations of this study. First, participants were not provided with a definition of peer victimization in the measurement, and there may be potential biases in participants' understanding of this construct (Sawyer et al., 2008). Second, self-reported peer victimization by adolescents may be underestimated due to the influence of social desirability (Ivarsson et al., 2005). Moreover, adolescents with depressive symptoms may be influenced by a bias in self-perception and exaggerate reports of peer victimization, increasing the correlation between these two variables (Casper & Card, 2017). Using a definition-based measure of peer victimization and combining self-reports with peer nominations to more accurately reflect peer victimization is worth considering. Third, emotion regulation and coping skills are not fully developed in adolescence, and depressive symptoms are affected by physiological development and environmental changes (DePasquale et al., 2021). Future research should further control for multiple possible influencing factors (e.g., puberty, life events) to obtain more comprehensive results. Fourth, data were collected over a limited time span in early adolescence. Extending the time frame examined to the high school years would be beneficial in providing comprehensive developmental patterns of the interaction between peer victimization and depressive symptoms. Moreover, the increased prevalence of cyber victimization makes it an issue of concern in the study of adolescent peer victimization (Tran et al., 2023). Future research should focus on the interrelationships between cyber victimization and the development of depressive symptoms to increase empirical evidence in the field of adolescent victimization and health development. Finally, the diversity of the sample of this study was limited (in terms of cultural context, sexual orientation, and gender

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identity). For generalization, the findings need to be replicated and validated in multi-regional, multi-cultural, and gender-diverse samples.

Conclusion

The relationships between peer victimization and depressive symptoms in adolescents are developmentally dynamic, especially during the school transition period. Depressive symptoms in boys drove peer victimization. Depressive symptoms in girls varied according to peer victimization. Taken together, these findings provide empirical evidence that enhances understanding of how adolescents' peer victimization and depressive symptoms interact with each other during development. This study also emphasizes the importance of distinguishing the effects in boys and girls for developing practical interventions.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579423001529.

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