**Appendix**

Section 1. Convergent validity and discriminant validity of the Campus Aggression and Bullying Scale and the Chinese version of the CDI

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References

**Section 1.** **Convergent validity and discriminant validity of the Campus Aggression and Bullying Scale and the Chinese version of the CDI**

The convergent validity of the Campus Aggression and Bullying Scale was shown in Table S1. Although the scale have the AVE slightly less than 0.5 across the four-wave measurements, it have the excellent composite reliability (all greater than 0.7). Taken together, the scale is widely used and have psychometric properties that reflect Chinese adolescent peer victimization (Chen et al., 2018; Guo et al., 2022).

The convergent validity and discriminant validity of the Chinese version of the CDI were shown in Table S2 and Table S3, respectively. Although the scale have less desirable convergent and discriminant validity across the four-wave measurements (AVE less than 0.5, CR less than 0.7, and the square root of AVE greater than the inter-factor correlation), the Chinese version of the CDI reflects the status of depressive symptoms in adolescents. Firstly, the construct of the CDI scale is unstable, which may be the cause of poor convergent validity and discriminant validity (Ozono et al., 2019). Secondly, the CDI scale focuses on individuals’ subjective experiences of their own depressive symptoms. The experience of depressive symptoms is inherently diverse for different individuals, and they may have inconsistent understandings of the items, which may result in the construct of the CDI scale that is not easily distinguishable. Nevertheless, the present study adopted the average of scores on the five subscales as a quantitative indicator of depressive symptoms in adolescents, which is widely used and well reflects the overall status of depressive symptoms (Gao et al., 2022; Sun et al., 2021). Therefore, unsatisfactory convergent and discriminant validity of the sub-dimensions do not affect the quantification of depressive symptoms in this study (Carle et al., 2008).

Table S1. Convergent validity of the Campus Aggression and Bullying Scale

|  |  |  |  |
| --- | --- | --- | --- |
|  | factor | average variance extracted (AVE) | composite reliability (CR) |
| T1 | peer victimization | 0.370 | 0.799 |
| T2 | peer victimization | 0.420 | 0.833 |
| T3 | peer victimization | 0.496 | 0.872 |
| T4 | peer victimization | 0.433 | 0.839 |

Table S2. Convergent validity of the Chinese version of the CDI

|  |  |  |  |
| --- | --- | --- | --- |
| factor | | average variance extracted (AVE) | composite reliability (CR) |
| T1 | anhedonia | 0.232 | 0.703 |
| negative mood | 0.270 | 0.676 |
| negative self-esteem | 0.247 | 0.591 |
| ineffectiveness | 0.243 | 0.558 |
| interpersonal problem | 0.139 | 0.380 |
| T2 | anhedonia | 0.249 | 0.721 |
| negative mood | 0.282 | 0.689 |
| negative self-esteem | 0.346 | 0.719 |
| ineffectiveness | 0.276 | 0.601 |
| interpersonal problem | 0.126 | 0.360 |
| T3 | anhedonia | 0.245 | 0.717 |
| negative mood | 0.307 | 0.716 |
| negative self-esteem | 0.346 | 0.720 |
| ineffectiveness | 0.262 | 0.582 |
| interpersonal problem | 0.195 | 0.471 |
| T4 | anhedonia | 0.269 | 0.743 |
| negative mood | 0.320 | 0.732 |
| negative self-esteem | 0.376 | 0.746 |
| ineffectiveness | 0.284 | 0.608 |
| interpersonal problem | 0.148 | 0.406 |

Table S3. Discriminant validity of the Chinese version of the CDI

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | anhedonia | negative mood | negative self-esteem | ineffectiveness | interpersonal problem |
| T1 | anhedonia | sqrt(AVE)=0.481 |  |  |  |  |
| negative mood | 0.911 | sqrt(AVE)=0.519 |  |  |  |
| negative self-esteem | 0.976 | 0.929 | sqrt(AVE)=0.496 |  |  |
| ineffectiveness | 0.829 | 0.745 | 0.872 | sqrt(AVE)=0.493 |  |
| interpersonal problem | 0.890 | 0.807 | 0.924 | 0.809 | sqrt(AVE)=0.373 |
| T2 | anhedonia | sqrt(AVE)=0.500 |  |  |  |  |
| negative mood | 0.887 | sqrt(AVE)=0.531 |  |  |  |
| negative self-esteem | 0.897 | 0.909 | sqrt(AVE)=0.588 |  |  |
| ineffectiveness | 0.786 | 0.788 | 0.877 | sqrt(AVE)=0.525 |  |
| interpersonal problem | 0.799 | 0.750 | 0.844 | 0.622 | sqrt(AVE)=0.354 |
| T3 | anhedonia | sqrt(AVE)=0.495 |  |  |  |  |
| negative mood | 0.890 | sqrt(AVE)=0.554 |  |  |  |
| negative self-esteem | 0.938 | 0.889 | sqrt(AVE)=0.588 |  |  |
| ineffectiveness | 0.825 | 0.775 | 0.886 | sqrt(AVE)=0.512 |  |
| interpersonal problem | 0.710 | 0.611 | 0.711 | 0.540 | sqrt(AVE)=0.442 |
| T4 | anhedonia | sqrt(AVE)=0.519 |  |  |  |  |
| negative mood | 0.899 | sqrt(AVE)=0.566 |  |  |  |
| negative self-esteem | 0.905 | 0.913 | sqrt(AVE)=0.614 |  |  |
| ineffectiveness | 0.864 | 0.840 | 0.874 | sqrt(AVE)=0.533 |  |
| interpersonal problem | 0.824 | 0.828 | 0.820 | 0.719 | sqrt(AVE)=0.385 |

**Section 2. Longitudinal measurement invariance test for peer victimization and depressive symptoms**

Table S4. Test of longitudinal measurement invariance

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | *χ*2 (*df*) | *p* | RSMEA (90% CI) | SRMR | TLI | CFI | ΔCFI |
| **Peer victimization** |  |  |  |  |  |  |  |
| **Time** |  |  |  |  |  |  |  |
| Model 1: baseline model | 1170.754 (302) | < 0.001 | 0.034 (0.032, 0.036) | 0.036 | 0.930 | 0.944 |  |
| Model 2: weak factorial invariance | 1288.962 (320) | < 0.001 | 0.035 (0.033, 0.037) | 0.044 | 0.926 | 0.937 | 0.007 |
| Model 3: strong factorial invariance | 1462.844 (338) | < 0.001 | 0.036 (0.034, 0.038) | 0.045 | 0.919 | 0.927 | 0.004 |
| **Gender** |  |  |  |  |  |  |  |
| Model 1: baseline model | 1336.446 (600) | < 0.001 | 0.031 (0.029, 0.033) | 0.046 | 0.938 | 0.951 |  |
| Model 2: weak factorial invariance | 1586.088 (624) | < 0.001 | 0.035 (0.033, 0.037) | 0.062 | 0.922 | 0.936 | 0.015 |
| Model 3: strong factorial invariance | 1814.633 (648) | < 0.001 | 0.038 (0.036, 0.040) | 0.069 | 0.909 | 0.922 | 0.029 |
| **Depressive symptoms** |  |  |  |  |  |  |  |
| **Time** |  |  |  |  |  |  |  |
| Model 1: baseline model | 237.872 (134) | < 0.001 | 0.017 (0.014, 0.021) | 0.016 | 0.994 | 0.996 |  |
| Model 2: weak factorial invariance | 313.062 (146) | < 0.001 | 0.021 (0.018, 0.024) | 0.023 | 0.992 | 0.993 | 0.003 |
| Model 3: strong factorial invariance | 1908.384 (158) | < 0.001 | 0.066 (0.063, 0.069) | 0.048 | 0.918 | 0.932 | 0.064 |
| **Gender** |  |  |  |  |  |  |  |
| Model 1: baseline model | 347.83 (272) | 0.001 | 0.015 (0.010, 0.019) | 0.020 | 0.996 | 0.997 |  |
| Model 2: weak factorial invariance | 396.227 (288) | < 0.001 | 0.017 (0.013, 0.021) | 0.025 | 0.994 | 0.996 | 0.001 |
| Model 3: strong factorial invariance | 461.327 (304) | < 0.001 | 0.020 (0.016, 0.024) | 0.024 | 0.992 | 0.994 | 0.003 |

**Section 3. Unstandardized parameter estimation of the reciprocal effects model**

Table S5. Unstandardized parameter estimation of reciprocal LCSMs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **B (all / boys / girls)** | **SE (all / boys / girls)** | ***p* (all / boys / girls)** | **95% CI (all / boys / girls)** |
| vic intercept (*μ*) | 1.035 / 1.113 / 0.623 | 0.058 / 0.082 / 0.068 | < 0.001 / < 0.001 / < 0.001 | (0.939, 1.130) / (0.978, 1.248) / (0.511, 0.734) |
| vic slope (*μ*) | 0.855 / 0.626 / 1.035 | 0.228 / 0.363 / 0.393 | < 0.001 / 0.085 / 0.008 | (0.479, 1.231) / (0.029, 1.223) / (0.388, 1.682) |
| dep intercept (*μ*) | 0.558 / 0.567 / 0.549 | 0.023 / 0.031 / 0.032 | < 0.001 / < 0.001 / < 0.001 | (0.520, 0.596) / (0.516, 0.618) / (0.497, 0.601) |
| dep slope (*μ*) | 0.199 / 0.128 / 0.484 | 0.064 / 0.058 / 0.091 | 0.002 / 0.027 / < 0.001 | (0.094, 0.304) / (0.033, 0.224) / (0.336, 0.633) |
| vic intercept (*σ2*) | 0.262 / 0.331 / 0.194 | 0.016 / 0.026 / 0.018 | < 0.001 / < 0.001 / < 0.001 | (0.236, 0.289) / (0.288, 0.375) / (0.165, 0.223) |
| vic slope (*σ2*) | 0.821 / 0.970 / 1.090 | 0.118 / 0.170 / 0.363 | < 0.001 / < 0.001 / 0.003 | (0.627, 1.015) / (0.690, 1.250) / (0.493, 1.687) |
| dep intercept (*σ2*) | 0.088 / 0.088 / 0.099 | 0.008 / 0.010 / 0.017 | < 0.001 / < 0.001 / < 0.001 | (0.075, 0.101) / (0.072, 0.104) / (0.071, 0.127) |
| dep slope (*σ2*) | 0.016 / 0.011 / 0.039 | 0.004 / 0.004 / 0.012 | < 0.001 / 0.007 / 0.002 | (0.010, 0.022) / (0.004, 0.018) / (0.018, 0.059) |
| ***Correlations*** |  |  |  |  |
| vic intercept ↔ vic slope | 0.394 / 0.437 / 0.443 | 0.049 / 0.075 / 0.088 | < 0.001 / < 0.001 / < 0.001 | (0.314, 0.475) / (0.313, 0.561) / (0.298, 0.588) |
| dep intercept ↔ dep slope | 0.014 / 0.008 / 0.037 | 0.006 / 0.005 / 0.010 | 0.013 / 0.116 / < 0.001 | (0.005, 0.023) / (0.000, 0.016) / (0.020, 0.054) |
| vic intercept ↔ dep intercept | 0.073 / 0.086 / 0.060 | 0.005 / 0.008 / 0.006 | < 0.001 / < 0.001 / < 0.001 | (0.064, 0.081) / (0.073, 0.100) / (0.050, 0.070) |
| vic slope ↔ dep slope | -0.021 / -0.024 / 0.067 | 0.020 / 0.022 / 0.064 | 0.297 / 0.265 / 0.293 | (-0.053, 0.012) / (-0.060, 0.012) / (-0.038, 0.173) |
| vic intercept ↔ dep slope | 0.001 / -0.004 / 0.037 | 0.013 / 0.015 / 0.020 | 0.937 / 0.803 / 0.059 | (-0.021, 0.023) / (-0.029, 0.021) / (0.005, 0.070) |
| dep intercept ↔ vic slope | 0.013 / -0.019 / 0.106 | 0.023 / 0.039 / 0.052 | 0.583 / 0.622 / 0.043 | (-0.025, 0.051) / (-0.083, 0.045) / (0.020, 0.191) |
| ***Proportional Effects*** |  |  |  |  |
| vic status → vic change | -1.978 / -1.961 / -2.491 | 0.130 / 0.154 / 0.355 | < 0.001 / < 0.001 / < 0.001 | (-2.191, -1.765) / (-2.215, -1.708) / (-3.075, -1.907) |
| dep status → dep change | -0.476 / -0.354 / -0.778 | 0.077 / 0.093 / 0.092 | < 0.001 / < 0.001 / < 0.001 | (-0.603, -0.350) / (-0.508, -0.201) / (-0.930, -0.627) |
| ***Coupling Effects*** |  |  |  |  |
| dep status → vic change | 1.599 / 2.243 / 0.590 | 0.262 / 0.543 / 0.332 | < 0.001 / < 0.001 / 0.075 | (1.168, 2.030) / (1.350, 3.137) / (0.045, 1.135) |
| vic status → dep change | 0.091 / 0.071 / -0.001 | 0.043 / 0.048 / 0.083 | 0.034 / 0.144 / 0.995 | (0.020, 0.161) / (-0.009, 0.151) / (-0.138, 0.137) |
| ***Change to Change Effects*** |  |  |  |  |
| vic change → vic change | 0.699 / 0.620 / 1.390 | 0.131 / 0.140 / 0.410 | < 0.001 / < 0.001 / 0.001 | (0.483, 0.914) / (0.390, 0.851) / (0.717, 2.064) |
| dep change → vic change | -1.421 / -2.320 / 0.039 | 0.356 / 0.693 / 0.505 | < 0.001 / 0.001 / 0.939 | (-2.007, -0.836) / (-3.460, -1.180) / ( -0.791, 0.869) |
| dep change → dep change | -0.079 / -0.049 / 0.137 | 0.103 / 0.186 / 0.118 | 0.442 / 0.791 / 0.247 | (-0.247, 0.090) / (-0.356 , 0.257) / (-0.058, 0.331) |
| vic change → dep change | 0.045 / 0.031 / 0.166 | 0.036 / 0.038 / 0.066 | 0.201 / 0.416 / 0.012 | (-0.013, 0.104) / (-0.032 , 0.094) / (0.057, 0.275) |
| ***Covariates*** |  |  |  |  |
| subjective SES → vic intercept | -0.087 / -0.115 / -0.048 | 0.019 / 0.028 / 0.023 | < 0.001 / < 0.001 / 0.038 | (-0.118, -0.057) / (-0.161, -0.069) / (-0.086, -0.010) |
| subjective SES → vic slope | -0.104 / -0.142 / -0.076 | 0.032 / 0.048 / 0.055 | 0.001 / 0.003 / 0.171 | (-0.157, -0.051) / (-0.220, -0.063) / (-0.166, 0.015) |
| subjective SES → dep intercept | -0.026 / -0.029 / -0.022 | 0.008 / 0.011 / 0.011 | 0.001 / 0.008 / 0.051 | (-0.039, -0.013) / (-0.047, -0.011) / (-0.041, -0.004) |
| subjective SES → dep slope | -0.003 / 0.004 / -0.023 | 0.006 / 0.007 / 0.010 | 0.545 / 0.522 / 0.020 | (-0.013, 0.006) / (-0.007, 0.015) / (-0.039, -0.007) |
| gender → vic intercept | -0.291 / — / — | 0.026 / — / — | < 0.001 / — / — | (-0.333, -0.249) / — / — |
| gender → vic slope | -0.482 / — / — | 0.052 / — / — | < 0.001 / — / — | (-0.567, -0.396) / — / — |
| gender → dep intercept | 0.002 / — / — | 0.011 / — / — | 0.873 / — / — | (-0.017, 0.020) / — / — |
| gender → dep slope | 0.037 / — / — | 0.013 / — / — | 0.004 / — / — | (0.016, 0.058) / — / — |

Note: B = unstandardized effect; SE = standard error; *μ* = mean; *σ*2 = variance. vic, peer victimization; dep, depressive symptoms.

**Section 4. RI-CLPM pathways for boys and girls**

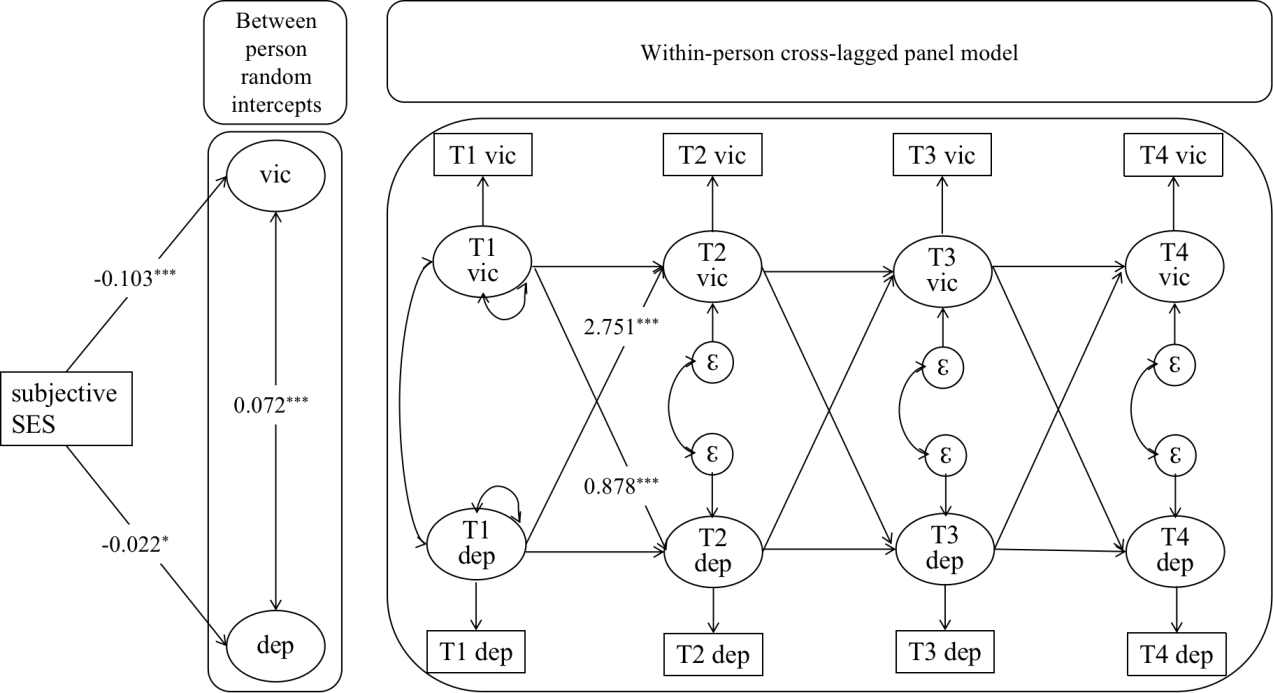


Figure S1. Random-intercepts cross-lagged panel model of peer victimization and depressive symptoms for boys

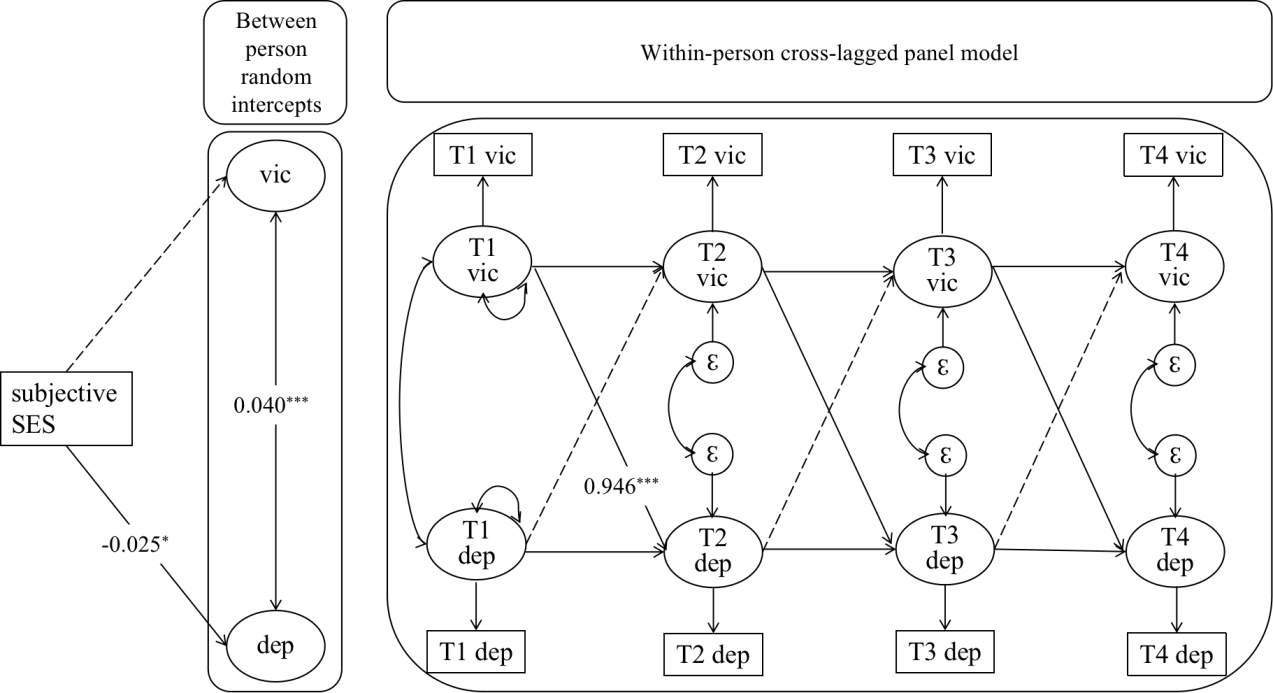


Figure S2. Random-intercepts cross-lagged panel model of peer victimization and depressive symptoms for girls

**Section 5. Explanation of sensitivity analysis**

Given that the results were adjusted at the initial point in time, there may be substantial bias due to regression to the mean when predicting changes in the results (Sorjonen et al., 2022). We attempted a sensitivity analysis, which constrained the proportional effect to 0. Unfortunately, the sensitivity analysis model could not converge. It may be that the distribution of peer victimization in this study is skewed, and some extreme values make it difficult for the model to converge. Some adolescents in this study authentically suffer from a high frequency of peer victimization, and these extreme values are not appropriate to exclude from the analysis. Therefore, we maintain the original statistical models from the manuscript and demonstrate the robustness of the models in the “Robustness analysis of the results” subsection. Nevertheless, sensitivity analysis is necessary for the accuracy of LCSM results and should be actively attempted by researchers (Zainal & Newman, 2022; 2023).

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