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EMPIRICAL RESEARCH

Self-harm and Aggression in Chinese Early Adolescents: Their Co-occurrence and the Role of Bullying Victimization

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Abstract

Self-harm and aggression increase markedly during early adolescence. However, few studies considered these harmful behaviors simultaneously. This study employed a person-centered approach to identify profiles of adolescents who differed in their patterns of self-harm, reactive aggression, and proactive aggression, examined the stability of these patterns, and explored the effect of bullying victimization on latent profile membership and transition. A total of 2463 early adolescents (48.8% girls, $M_{age} = 13.93 \pm 0.59$) participated in two waves of the study over six months. The results indicated that low symptoms profile (80.4%), moderate aggression profile (14.2%), high aggression profile (3.0%), and high self-harm profile (2.4%) were identified at time 1, and low symptoms profile (82.1%), dual-harm profile (7.6%), high aggression profile (7.7%), and high self-harm profile (2.6%) were identified at time 2. Adolescents assigned to at-risk profiles showed moderate to high transition, suggesting the developmental heterogeneity of self-harm and aggression. Moreover, adolescents high in bullying victimization were more likely to belong or transition to at-risk profiles. The findings revealed the co-occurring and transitional nature of self-harm and aggression and the transdiagnostic role of bullying victimization, which can be used to guide prevention and intervention strategies.

Keywords Self-harm · Reactive aggression · Proactive aggression · Bullying victimization · Person-centered approach

Introduction

Self-harm and aggression during adolescence are important public health issues. According to a representative survey conducted in China (Wan et al., 2011), 17.0% of adolescents and young adults reported that they had harmed themselves deliberately in the past 12 months. Similarly, about 9.0% to 24.3% of Chinese children and adolescents exhibited aggressive behaviors (Han et al., 2017; Huang et al., 2017). Self-harm and aggression can have detrimental effects on adolescents' development and mental health outcomes (Hawton et al., 2012; Hubbard et al., 2010). Most existing studies have typically focused on either self-harm or aggression, far fewer studies explored the combination of these two harmful behaviors. Indeed, relevant research has suggested that self-harm and aggression are linked (O'Donnell et al., 2015; Shafti et al., 2021). The coexistence of aggressive and self-harming behavior within the same individual has been recently termed "dual harm" (Slade, 2019). Individuals who engage in dual-harm may represent a high-risk group with unique characteristics and patterns of harmful behaviors (Shafti et al., 2021). To better understand the co-occurrent nature of self-harm and aggression, the current study employed a person-centered approach to determine profiles of co-occurring self-harm, reactive aggression, and proactive aggression, their short-term stability and change, and the role of bullying victimization on behavioral profiles and their transitions among Chinese early adolescents.

The Co-occurrence of Self-harm and Aggression

Self-harm is commonly used to describe a wide range of behaviors and intentions in response to intolerable tension (Skegg, 2005). Aggression referred to any behavior directed toward another individual that is carried out with the proximate intent to cause harm (Anderson & Bushman,

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2002). Although self-harm and aggression may initially seem distinct, it has long been theorized that aggression and self-harm are linked. According to the two-stage model of suicide and violence (Plutchik, 1995), self-harm and aggression stem from aggressive impulses but display differently. In other words, self-harm occurs when aggressive impulses act violently toward the self while aggression occurs when aggressive impulses act violently toward others. Empirically, a systematic literature review conducted by O'Donnell et al. (2015) provides strong evidence to suggest that aggression and self-harm frequently co-occur. Firstly, it was found that aggression and self-harm were positively associated ($r = 0.12–0.62$). Secondly, individuals who engaged in one of the harmful behaviors were significantly more likely to engage in the other behavior (odds ratio = 1.05–38.55). Thirdly, the co-occurrence rate of self-harm and aggression ranged from 5% to 74%.

Existing literature commonly examined the effect of one variable on another (e.g., regression) or the covariation between variables (e.g., correlation) to reveal the relation between self-harm and aggression (Keenan et al., 2014; Sahlin et al., 2015; Sahlin et al., 2017; Tang et al., 2013). Unlike the variable-centered approach assuming independence among indicators, the person-centered approach has the power to classify individuals into a set of underlying subgroups based on the presentation of symptoms. As such, this method is particularly useful for understanding the underlying nature of co-occurrence between self-harm and aggression and has important nosological and clinical implications. To date, only a few studies have applied latent class/profile analysis in the co-occurrence of self-harm and aggression (Chen et al., 2020; Harford et al., 2013). For example, one study (Chen et al., 2020) identified four subgroups based on self-harming and aggressive behaviors among U.S. high school students: no violent behaviors (71.6% of students), non-fatal suicidal behavior (8.4%), aggressive behavior (15.5%), and combined violent behaviors (4.6%).

Despite progress in this area of work, there remain some unknowns about the co-occurrence of self-harm and aggression. First, although extant research has identified specific patterns of self-harm and different forms of aggression (e.g., physical aggression; Bossarte et al., 2008; Harford et al., 2013), no study has examined the co-occurrence types in terms of self-harm and different aggression that serve different functions. Based on its function, aggression can be reliably subdivided into reactive and proactive aggression. Reactive aggression is a defensive or retaliatory aggressive act in response to real or perceived provocation, and as such it is emotionally charged, poorly controlled, and impulsive. Proactive aggression, on the other hand, is defined as an unemotional, highly controlled, and premeditated aggressive act that is performed to reach a goal (Hubbard et al., 2010). A longstanding hypothesis posited that reactive aggression underlying the association between aggression and suicidal behavior because the act of suicide itself represents a reactive aggressive response to acute psychiatric and interpersonal difficulties (Conner et al., 2003). This association between reactive aggression and suicide-related behaviors in children and adolescents has been confirmed in a meta-analysis (Hartley et al., 2018). Given the closer association between self-harm and reactive aggression than proactive aggression, it is important to identify subgroups based on these behaviors in order to provide a more thorough and in-depth picture of distinct co-occurring patterns. Second, most research on the co-occurrence of self-harm and aggression used cross-sectional data (e.g., Chen et al., 2020; Harford et al., 2013), the issue of stability versus change, or transition, in the profiles of self-harm and aggression across time has received less research attention. Self-harm and aggression vary throughout adolescence as a result of biological, psychological, cognitive, and social development. Self-harm increases rapidly during the early teenage years, especially around the age of 13–15 years (Hawton et al., 2012). Aggression followed a curvilinear trajectory during adolescence, peaking around age 14–15 (Karriker-Jaffe et al., 2008). Thus, adopting a developmental perspective to understand the stability and change between and among different behavioral profiles is valuable for informing early interventions for at-risk groups. The latent transition modeling approach is an effective tool to examine behavioral patterns of changes in profile membership over the development process.

Bullying Victimization is a Potential Transdiagnostic Risk Factor for Self-harm and Aggression

Bullying victimization is a pervasive experience in adolescence. This negative experience is concurrently and prospectively associated with a wide range of mental health problems, such as depression, anxiety, substance use, and so on (Moore et al., 2017). The variety of negative outcomes caused by bullying victimization suggested that bullying victimization is multifinal (Cicchetti & Rogosch, 1996; Kretschmer et al., 2015). Accordingly, bullying victimization might be an important transdiagnostic factor for psychological symptoms. With regard to self-harm and aggression, a theoretical model highlighted the role of bullying victimization in dual-harming behaviors. Drawing from components of the general aggression model and diathesis-stress theories, the cognitive-emotional model of dual-harm proposed that individuals may choose to engage in dual-harm behaviors as an emotional regulation response to their distressing negative emotions triggered by proximal stressors, and one of the important proximal factors is bullying victimization (Shafti et al., 2021). However, with the exception of one study showing that adolescents with dual-harm experienced bullying victimization more

frequently compared to youth with aggression only (Steinhoff et al., 2022), most studies examining the influence of bullying victimization on self-harm (Heerde & Hemphill, 2018; Wu et al., 2021) and aggression (Malamut et al., 2020; Sullivan et al., 2006) separately. For example, in a recent meta-analysis, which exclusively examined the influence of bullying victimization on self-harm, bullying victimization was significantly associated with an increased likelihood of self-harm (Heerde & Hemphill, 2018). In addition, adolescents with more victimized experiences would exhibit more aggression concurrently and over time (Malamut et al., 2020; Sullivan et al., 2006). Therefore, the current study filled this gap by examining how bullying victimization may explain differences in the profiles of self-harm and aggression as well as profiles' transition over half a year among early adolescents.

The Current Study

Few studies have applied a person-centered approach to examine different subgroups of self-harm and aggression from a developmental perspective. Such analysis is critically needed to reveal the co-occurring and transitory nature of these harmful behaviors. Further, there remains a paucity of research on whether bullying victimization is a shared risk underlying both self-harm and aggression. To address these research gaps, the current study has three primary aims. The first aim is to identify homogeneous subgroups or profiles based on combinations of self-harm, reactive aggression, and proactive aggression by employing a Latent Profile Analysis (LPA). Based on prior evidence, it is hypothesized that several profiles of harmful characteristics of adolescents would emerge, including a subgroup of adolescents exhibiting primarily reactive and proactive aggression, a subgroup exhibiting primarily self-harm, a subgroup with co-occurring self-harm and reactive aggression, and a subgroup of adolescents exhibiting neither self-harm nor aggression. For each profile identified in Aim 1, the second aim is to analyze stability and change in membership profile status over six months by employing a Latent Transition Analysis (LTA). It is hypothesized that subgroups exhibiting neither self-harm nor aggression would display the greatest stability across time. Given the rapid development during early adolescence, other subgroups would display a moderate to high degree of transition. The third aim of the study is to test the effects of bullying victimization on profile memberships and transitions. It is hypothesized that adolescents who experience higher bullying victimization would be more likely to be classified and change to at-risk groups (i.e., subgroups that exhibit self-harm, aggression, or both).

Method

Participants and Procedure

Data were collected from seven secondary schools (two urban, one semirural, and four rural) in Zhengzhou City, which is located in the middle of China's Henan province. Two surveys were administered as part of the longitudinal study, at an interval of 6 months, starting at the end of the first semester of Grade 8 in December 2015 and continuing until the end of the second semester in Grade 8 in June 2016. Students reported their self-harm and aggression at Time 1 (T1) and Time 2 (T2). Demographic information and bullying victimization were reported at T1. Data were collected from 2597 students at T1. There was very low attrition ($n = 134$) in the subsequent wave of data collection because participants were either absent from school at the time of data collection or they chose not to participate. Thus, a total of 2463 adolescents [1260 (51.2%) boys; 1203 (48.8%) girls] participated in both two waves of the study. The mean age of participants was 13.93 years ($SD = 0.59$). Adolescents' subjective socioeconomic status (SES) was slightly lower than the midpoint ($M = 2.72$, $SD = 0.73$, actual range = 1–5). Furthermore, the majority of participants (96.9%) belonged to the Han Chinese ethnicity, the vast majority ethnic group in China. The study was approved by the Ethics Committee of the Collaborative Innovation Center of Assessment toward Basic Education Quality, Beijing Normal University. Participants as well as their parents or legal caregivers provided informed consent. Students were informed about the confidentiality of the collected data, their right to skip any questions they did not wish to answer, and the option to stop participating at any time. Then, students completed written questionnaires in classrooms during regular school hours under the supervision of research assistants.

Measures

Self-harm

Adolescents' self-harm was measured by a shortened and modified version of the Deliberate Self-Harm Inventory, which was constructed and validated by Gratz (2001) and adapted to adolescents by Lundh et al. (2007). In the current nine-item version, adolescents were asked whether they have deliberately engaged in any of nine different kinds of self-harming behaviors during the past 6 months, such as "Deliberately bite my skin". Adolescents responded to each item by indicating the number of times from 0 (never) to 4 (five times more) for their self-harming behaviors. Mean scores were used, with higher scores indicating higher

Table 1 Correlations, means, and standard deviations of study variables

	1	2	3	4	5	6	7	8	9	10
1 T1 Self-harm	–									
2 T1 RA	0.25***	–								
3 T1 PA	0.25***	0.71***	–							
4 T2 Self-harm	0.55***	0.22***	0.19***	–						
5 T2 RA	0.24***	0.60***	0.39***	0.27***	–					
6 T2 PA	0.25***	0.46***	0.57***	0.26***	0.65***	–				
7 T1 BV	0.18***	0.31***	0.26***	0.14***	0.24***	0.20***	–			
8 Age	0.00	0.05*	0.09***	−0.01	0.02	0.08***	0.00	–		
9 Subjective SES	0.04*	0.01	0.02	0.04	0.03	0.06**	−0.06***	0.01	–	
10 Gender	0.00	−0.10***	−0.22***	0.07***	−0.09***	−0.22***	−0.15***	−0.06**	−0.01	–
Mean	0.19	0.80	0.29	0.23	0.96	0.33	0.52	13.93	2.72	–
SD	0.48	0.63	0.47	0.50	0.65	0.47	0.72	0.59	0.73	–

RA reactive aggression, *PA* proactive aggression, *BV* bullying victimization, code for gender: boys = 0, girls = 1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

levels of self-harming behavior. The Cronbach's alpha coefficients at T1 and T2 were both 0.87.

Reactive and proactive aggression

Adolescents' aggression was measured by the Reactive–Proactive Aggression Questionnaire (RPQ, Raine et al., 2006). The Chinese version of RPQ had good construct validity, internal consistency, and test-retest reliability (Tuvblad et al., 2016). Proactive aggression was measured using 12 items (e.g., "Had fights with others to show who was on top") and reactive aggression was measured using 11 items (e.g., "Yelled at others when they have annoyed you"). Each item was answered using a 5-point scale from 0 (never) to 4 (always). Items were averaged to form a composite score, with higher scores indicating greater aggression. In the present study, the scale had good reliability ($\alpha =$ 0.92 at T1 and 0.90 at T2 for proactive aggression, $\alpha =$ 0.88 at T1 and 0.86 at T2 for reactive aggression).

Bullying victimization

Bullying victimization was measured using 7 items from Olweus Bully/Victim Questionnaire (Olweus, 1993), and the Chinese version was revised by Zhang and Wu (1999). Students reported how often they had been the targets of different types of bullying victimization at school (e.g., "made fun of you") on a 5-point scale (0 = not at all, 1 = once, 2 = twice, 3 = three or four times, 4 = five times or more). Items were averaged; higher scores indicated greater self-reported bullying victimization. The reliability of the questionnaire was good, and the Cronbach's α of the scale was 0.86.

Demographic variables

Adolescents reported their gender, age, ethnicity, and subjective SES (i.e., "What is your family's current economic situation in the local area?"), responses ranged from 1 (relatively low) to 5 (relatively high) at T1.

Data Analytic Strategy

Firstly, descriptive statistics were explored for the observed variables. Secondly, LPA was applied at each time point to identify subgroups of adolescents based on similar patterns of behavioral problems. LPA is a person-centered method employed to identify homogeneous latent profiles of individuals using self-harm, reactive aggression, and proactive aggression scores as continuous indicators. Thirdly, an autoregressive model designed as an extension of latent profile analysis for longitudinal data, the LTA, was conducted to describe the stability and change of behavioral profiles over six months. Finally, multinomial logistic regression analysis with the manually 3-step approach (Nylund-Gibson et al., 2014) was utilized to examine the effect of bullying victimization on profile membership and transition while controlling for adolescent gender, subjective SES, and age. This manually 3-step approach ensured that the measurement parameters of the latent profiles from the final LPA were fixed when additional variables were introduced to models. The proportions of missing data for the study variables ranged from 0.6% to 4.8%. Full information maximum likelihood (FIML) was used to address missing data. The model parameters were estimated using the maximum likelihood robust (MLR) estimator. Descriptive analyses were conducted in SPSS

Table 2 Model fit information for LPA solutions ranging from 2 to 5 profiles at each time point

	model	AIC	BIC	ABIC	Entropy	*p*-value of LMR	*p*-value of BLRT	SPS (%)
T1	2-profile	9117.88	9175.97	9144.20	0.936	0.2270	<0.001	10.2%
	3-profile	7529.18	7610.51	7566.03	0.957	0.2694	<0.001	3.0%
	4-profile	**6401.70**	**6506.27**	**6449.08**	**0.959**	**0.0004**	**<0.001**	**2.4%**
	5-profile	5740.10	5867.90	5798.00	0.955	0.3099	<0.001	2.0%
T2	2-profile	9354.13	9412.22	9380.45	0.982	0.0001	<0.001	6.3%
	3-profile	8000.32	8081.64	8037.16	0.948	0.0005	<0.001	5.9%
	4-profile	**7226.28**	**7330.85**	**7273.66**	**0.954**	**0.0221**	**<0.001**	**2.6%**
	5-profile	6639.87	6767.67	6697.77	0.953	0.4206	<0.001	1.1%

Bold values emphasize that the 4-profile solution was the most plausible.

AIC Akaike information criterion, *BIC* Bayesian information criterion, *ABIC* adjusted Bayesian information criterion, *LMRT* Lo–Mendell–Rubin test, *BLRT* Bootstrap likelihood ratio test, *SPS* smaller profile size

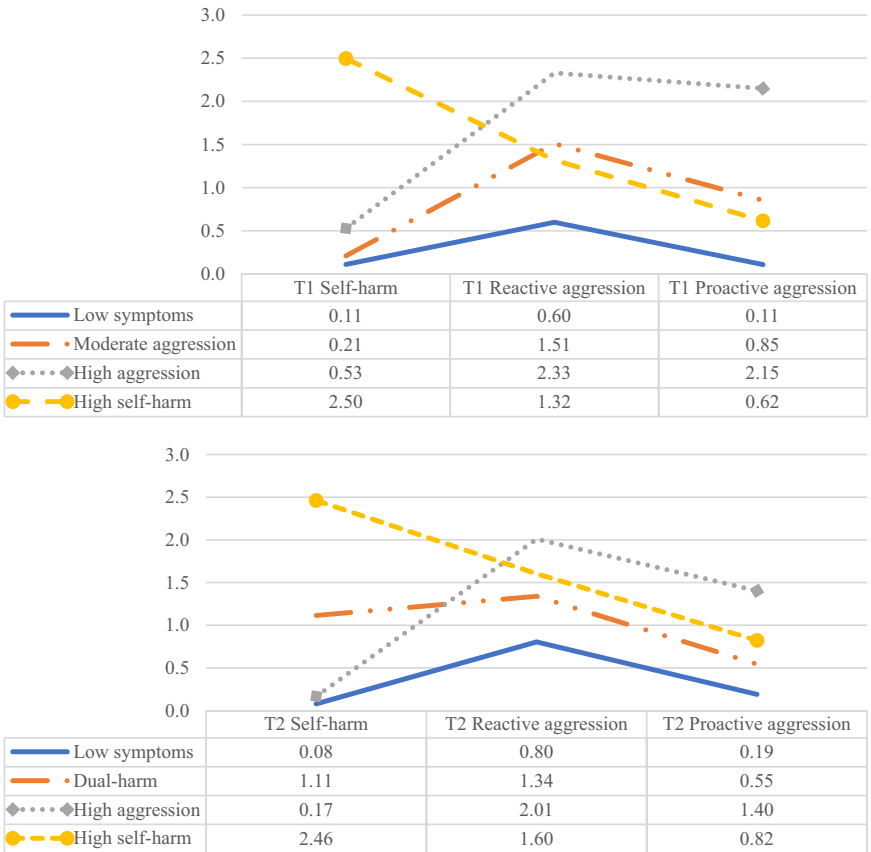

Fig. 1 Self-harm, reactive aggression, and proactive aggression mean for latent profile model at two assessment times

version 20.0, other analyses were conducted using Mplus version 8.3.

Results

Descriptive Statistics

Means and standard deviations for the study variables as well as correlations among the study variables were reported in Table 1.

Latent Profile Analysis

Cross-sectional LPAs were run for T1 and T2 separately. Profile enumeration began with a two-profile solution, followed by exploration of additional models with more latent profiles. The fit indices for the two- to five-profile solutions at each time point are reported in Table 2. These indices suggested that the 4-profile model was the most plausible. Specifically, LPA revealed that the 3-profile solution was better than the 2-profile solution, evidenced by lower AIC, BIC, and ABIC. The 4-profile

Table 3 Transition probabilities from the LTA model

T1	T2			
	Low symptoms profile	Dual-harm profile	High aggression profile	High self-harm profile
Low symptoms profile	0.907	0.055	0.027	0.011
Moderate aggression profile	0.415	0.109	0.438	0.038
High aggression profile	0.222	0.131	0.520	0.127
High self-harm profile	0.182	0.373	0.118	0.327

Table 4 Multinominal logistic regression of demographics and bullying victimization on T1 profiles

Predictor	Moderate aggression profile			High aggression profile			High self-harm profile			Low symptoms profile
	Logit	*SE*	*OR*	Logit	*SE*	*OR*	Logit	*SE*	*OR*	
Gender	**−1.00*****	**0.15**	**0.37**	**−1.23*****	**0.31**	**0.29**	−0.31	0.30	0.74	REF
Subjective SES	0.04	0.09	1.04	0.36	0.20	1.43	0.22	0.19	1.25	REF
Age	**0.25***	**0.12**	**1.29**	**0.73*****	**0.17**	**2.08**	−0.04	0.26	0.96	REF
BV	**0.78*****	**0.09**	**2.19**	**0.79*****	**0.15**	**2.21**	**0.78*****	**0.16**	**2.18**	REF

The significance of Logit is provided. Logit, SE, and OR values are bolded to emphasize that the corresponding predictor had significant effects on the latent profile.

BV bullying victimization, *REF* reference group

$^{*}p < 0.05$, $^{***}p < 0.001$

solution was considered better than the 3-profile solution due to lower AIC, BIC, and ABIC values as well as significant *p*-values of the LMR and BLRT tests. The 5-profile solution, despite having slightly lower AIC and BIC values than the 4-profile solution, was not statistically different from the 4-profile solution according to the LMR test and had a slightly lower entropy value. As a result, the 4-profile solution was deemed the best-fitting model. Four profile groups were depicted for each time point in Fig. 1.

At T1, the first profile included 1981 adolescents (80.4%) who exhibited lower levels of self-harm, reactive aggression, and proactive aggression than the overall sample, this profile thus was referred to as low symptoms profile. The next profile (349 adolescents, 14.2%) reflected adolescents who exhibited moderate reactive and proactive aggression and low self-harm. Thus, moderate aggression was used to describe adolescents in this profile. The third profile (74 adolescents, 3.0%) was characterized by the highest levels of reactive and proactive aggression and low levels of self-harm. Accordingly, this profile was referred to as high aggression profile. The final profile included 59 adolescents (2.4%) who exhibited the highest level of self-harm and moderate reactive and proactive aggression. Therefore, this profile was referred to high self-harm profile. At T2, the first profile included 2022 adolescents (82.1%) who exhibited lower levels of self-harm, reactive aggression, and proactive aggression than the overall sample, this profile thus was referred to as low symptoms profile. The second profile (187 adolescents, 7.6%) was characterized by moderate levels of self-harm and reactive aggression but relatively low levels of proactive aggression, thus terming as dual-harm profile. The third profile (189 adolescents, 7.7%) was characterized by the highest levels of reactive and proactive aggression and low levels of self-harm, thus referring to as high aggression profile. The final profile included 65 adolescents (2.6%) who exhibited the highest level of self-harm and moderate reactive and proactive aggression. Therefore, this profile was referred to high self-harm profile.

Latent Transition Analysis

Before conducting a latent transition analysis, measurement invariance constraints were explored. The LR test was statistically significant (χ^2 *diff* $(12) = 50.31$, $p < 0.001$), indicating a significant difference in goodness-of-fit between the full invariant model and the baseline model. Therefore, the four-profile LTA model with measurement non-invariance was used to further examine the latent profile transitions from T1 to T2. Table 3 presents the transitional probabilities from the LTA model, which quantifies the likelihood of transitions among the aforementioned four profiles from T1 to T2. Adolescents assigned to low symptoms profile showed the highest rate of stability, with 90.7% of them remaining in this profile in T2. The high aggression profile had stability of 52.0%, with

Table 5 Multinominal logistic regression of demographics and bullying victimization on profiles' transition

		LS			DH			HA			HS		
Predictor		Logit	*SE*	*OR*	Logit	*SE*	*OR*	Logit	*SE*	*OR*	Logit	*SE*	*OR*
Gender	LS	REF			**0.51***	**0.24**	**1.67**	−1.35	0.81	0.26	**1.24***	**0.61**	**3.47**
	MA	**−0.92***	**0.44**	**0.40**	REF			−0.84	0.47	0.43	−0.41	0.84	0.67
	HA	−1.66	2.72	0.19	1.75	1.04	5.73	REF			0.40	0.80	1.49
	HS	0.66	1.14	1.94	−0.48	0.79	0.62	NA	NA	NA	REF		
Subjective SES	LS	REF			0.27	0.15	1.32	0.32	0.31	1.38	0.54	0.30	1.71
	MA	0.22	0.27	1.25	REF			0.07	0.29	1.07	0.23	0.46	1.26
	HA	−0.34	0.48	0.72	1.08	1.01	2.94	REF			0.84	0.58	2.31
	HS	1.31	0.93	3.71	0.52	0.78	1.68	−0.36	0.75	0.70	REF		
Age	LS	REF			0.03	0.18	1.03	0.38	0.32	1.46	−0.37	0.34	0.69
	MA	−0.35	0.35	0.71	REF			−0.15	0.33	0.87	−0.42	0.68	0.66
	HA	−1.10	0.74	0.33	−0.70	1.38	0.50	REF			−0.26	0.52	0.77
	HS	1.35	1.23	3.84	0.14	0.70	1.15	1.22	0.95	3.37	REF		
BV	LS	REF			**0.34***	**0.14**	**1.40**	0.62	0.34	1.86	**0.77****	**0.23**	**2.16**
	MA	−0.01	0.24	0.99	REF			0.02	0.25	1.02	0.20	0.33	1.22
	HA	−0.05	0.40	0.95	−0.34	0.52	0.71	REF			0.46	0.36	1.58
	HS	−0.10	0.48	0.91	−0.01	0.43	0.99	−0.39	0.75	0.68	REF		

The significance of Logit is provided. Logit, SE, and OR values are bolded to emphasize that the corresponding predictor had significant effects on the transition of latent profile.

LS low symptoms profile, *MA* moderate aggression profile, *HA* high aggression profile, *HS* high self-harm profile, *DH* dual-harm profile, *BV* bullying victimization, *REF* reference group, *NA* not available

*$p < 0.05$, **$p < 0.01$

most adolescents in this profile transitioning to low symptoms profile (22.2%) in T2. The profile with the lowest stability was high self-harm profile, with 32.7% of adolescents remaining in this profile, 37.3% transitioning toward dual-harm profile, 18.2% transitioning toward low symptoms profile, and 11.8% transitioning toward high aggression profile. Furthermore, adolescents assigned to moderate aggression profile in T1 were likely to transition into high aggression profile (43.8%) and low symptoms profile (41.5%), with 10.9% of adolescents changing toward dual-harm profile and 3.8% changing toward high self-harm profile.

Effect of Bullying Victimization on Profiles and Transitions

Multinomial logistic regressions were conducted to determine how bullying victimization contributed to T1 profiles and transitions while gender, age, and subjective SES included as control variables. Table 4 summarizes the results of bullying victimization on T1 profile. The effects of subjective SES on T1 profiles were not significant. However, adolescent girls were less likely than boys to be classified into the moderate aggression profile ($B = -1.00$, $p < 0.001$, $OR = 0.37$) and high aggression profile ($B = -1.23$, $p < 0.001$, $OR = 0.29$). Adolescents with higher age were associated with increased odds of membership in the moderate aggression profile ($B = 0.25$, $p < 0.05$, $OR = 1.29$) and high aggression profile ($B = 0.73$, $p < 0.001$, $OR = 2.08$) rather than the low symptoms profile. Furthermore, bullying victimization had significant effect on profiles at T1. Specially, adolescents with higher level of bullying victimization were more likely to be classified into in the moderate aggression ($B = 0.78$, $p < 0.001$, $OR = 2.19$), high aggression ($B = 0.79$, $p < 0.001$, $OR = 2.21$), and high self-harm profile ($B = 0.78$, $p < 0.001$, $OR = 2.18$) rather than the low symptoms profile.

Table 5 summarizes the results of bullying victimization on profiles' transitions. Adolescent girls were more likely than boys to transition to the dual-harm profile ($B = 0.51$, $p < 0.05$, $OR = 1.67$) and high self-harm profile ($B = 1.24$, $p < 0.05$, $OR = 3.47$) rather than stay in the low symptoms profile. Adolescent girls assigned to moderate aggression profile at T1 were less likely to transition to low symptoms profile ($B = -0.92$, $p < 0.05$, $OR = 0.40$) compared to transitioning to dual-harm profile. Furthermore, adolescents with higher level of bullying victimization were more likely to transition to the dual-harm profile ($B = 0.34$, $p < 0.05$, $OR = 1.40$) and the high self-harm profile ($B = 0.77$, $p < 0.01$, $OR = 2.16$) rather than staying in the low symptoms profile.

Discussion

Self-harm and aggression might co-occur. However, existing literature commonly utilized cross-sectional data and the variable-centered method, which is not sufficient to understand the co-occurring and transitory nature of self-harm and aggression. In addition, as a salient stressor during adolescence, bullying victimization might be a risk factor for developmental continuity and discontinuity of self-harm and aggression. Hence, the present research employed a person-centered approach to explore the co-occurring types of self-harm, reactive aggression, and proactive aggression, patterns of stability and transition between these types, and how bullying victimization affected behavioral patterns and their stability and transition among a longitudinal sample of early adolescents.

Profiles and Their Transition of Self-harm and Aggression

LPA identified four theoretically meaningful and statistically valid profiles of self-harm, reactive aggression, and proactive aggression at each time but the profiles were slightly different over a half year given the lack of measurement invariance in profiles across the two-time point. Specifically, low symptoms profile, moderate aggression profile, high aggression profile, and high self-harm profile were emerged at T1, while low symptoms profile, dual-harm profile, high aggression profile, and high self-harm profile were found at T2. The identification of meaningful profiles of adolescents based on self-harm and aggression highlighted the heterogeneity within the current sample. Importantly, the finding of dual-harm profile at T2 confirmed the co-occurrence of self-harm and aggression. Besides, the proportion displayed (7.6%) was relatively higher than the co-occurrence rate of self-harm and aggression previously reported by Chen et al. (2020), although it should be noted that this previous study explored profile memberships in middle to late adolescence. Regarding the behavior intensity, the dual-harm profile exhibited moderate and similar levels of self-harm and reactive aggression but low levels of proactive aggression, indicating self-harm tended to co-occur with reactive aggression rather than proactive aggression. This finding further supported the view that reactive aggression underlies the association between aggression and self-harm (Conner et al., 2003). One promising explanation is that both self-harm and reactive aggression have roots in emotional dysregulation (Hartley et al., 2018; Hawton et al., 2012), in contrast, proactive aggression is an unemotional goal-directed behavior (Vitaro et al., 2002).

Moreover, results from the LTA analysis indicated each behavioral profile showed a particular pattern of change and stability over time. Adolescents showing a low symptoms profile followed a highly stable behavioral course, with 90.7% of adolescents remaining in the profile over time. Conversely, high aggression profile and high self-harm profile exhibited moderate to low stability. With regard to the moderate aggression profile, most adolescents transitioned into the high aggression profile and low symptoms profile, with only a small number of adolescents transitioning into the dual-harm profile and high self-harm profile. Taken together, the different profiles that emerged at two time points combined with the stability and transition between and among profiles suggested that early adolescents could experience noticeable changes in patterns of self-harm and aggression even within a short period of time. Longitudinal studies with shorter intervals are needed to reveal rapid changes in self-harm and aggression among early adolescents.

Role of Bullying Victimization

Although bullying victimization is an acknowledged risk for self-harm and aggression (Malamut et al., 2020; Heerde & Hemphill, 2018; Sullivan et al., 2006; Wu et al., 2021), the role of bullying victimization in affecting behavioral patterns of self-harm and aggression as well as their stability and change was scarce. Therefore, the present study examined the effect of bullying victimization to tackle these gaps. Consistent with the hypothesis, adolescents who experience high levels of bullying victimization were more likely to be classified in at-risk profiles (i.e., moderate aggression profile, high aggression profile, and high self-harm profile) relative to adolescents in low symptoms profile. In addition, bullying victimization had significant effects on the transition from low symptoms profiles to other profiles. That is, adolescents assigned to low symptoms profile at T1 with higher levels of bullying victimization tended to transition into the dual-harm profile and high self-harm profile. These results suggested that bullying victimization was a transdiagnostic risk factor for self-harm and aggression. As the great importance placed on peer relationships during adolescence (Brown & Larson, 2009), experiencing bullying victimization represents a particularly salient stressor in the life of adolescents. Given the present finding, interventions should focus on reducing bullying in early adolescence to minimize the risk of self-harm and aggression. In addition, it was worth noting that bullying victimization did not play a role in at-risk profiles' transition. This finding suggested that bullying victimization was a risk factor for the emergence of self-harm and aggression, but being bullied did not exacerbate symptoms for adolescents who already exhibited self-harm and aggression. Accordingly, future research needs to find other potential risk or protective factors that influence the developmental process of behavioral patterns of self-harm and aggression.

Limitations and Future Directions

This study had several limitations that should be noted. First, the transitions of behavioral profiles of self-harm and aggression were only examined over half a year. As previously noted, adolescents' self-harm and aggression develop fast especially during early adolescence (Hawton et al., 2012; Karriker-Jaffe et al., 2008). It, therefore, seems likely that behavioral profiles of self-harm and aggression may display more complex patterns during the whole early adolescence than the current study found. Unfortunately, the data available did not allow to examine patterns of profile membership across a broader developmental range. The current study does, however, provide a preliminary model for future research that might examine these patterns across the entire adolescence. Second, adolescents served as the sole data sources, potentially raising concerns about the influence of reporter bias and the social desirability effect. Further studies need to be done to replicate the current findings using the multiple-informant method.

Conclusion

The coexistence of self-harm and aggression has received increasing attention recently. However, the scientific knowledge about co-occurring types of self-harm and aggression and their developmental process among adolescents was scarce. Further, understanding the antecedents that affected the stability and transition of behavioral patterns could be a key step for prevention and early intervention. The current research employed a person-centered approach to reveal the co-occurring and transitory nature of self-harm, reactive aggression, and proactive aggression among early adolescents, while also demonstrating how bullying victimization influenced the stability and transition of these behavioral patterns. It was found that there was a small subgroup of adolescents for whom self-harm and reactive aggression co-occur. Adolescents with low levels of self-harm and aggression exhibited a stable pattern, while adolescents in at-risk subgroups showed varying degrees of transitional patterns, indicating that self-harm and aggression change dramatically during early adolescence. Moreover, adolescents high in bullying victimization were more likely to be classified in and transition toward at-risk profiles. These findings can be used to guide prevention and intervention strategies for reducing self-harm and aggression.

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Author's Contributions YX participated in the analysis and interpretation of the data, and produced the drafting of the manuscript; YW participated in the analysis and interpretation of the data, and critiqued the output for important intellectual content; YW participated in the analysis of the data and critiqued the output for important intellectual content; HZ participated in the interpretation of the data and critiqued the output for important intellectual content; LY helped edited the manuscript; PR conceived of the study, participated in its design and coordination, and drafted the manuscript. All authors read and approved the final manuscript.

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Data Sharing and Declaration The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval All procedures performed in the present study were in accordance with the recommendations of the Research Ethics Committee of the Beijing Normal University and with the Declaration of Helsinki. Written informed consent was obtained from both adolescents and their caregivers included in the study.

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References

Anderson, C. A., & Bushman, B. J. (2002). Human aggression. *Annual Review of Psychology*, *53*(1), 27–51.

Bossarte, R. M., Simon, T. R., & Swahn, M. H. (2008). Clustering of adolescent dating violence, peer violence, and suicidal behavior. *Journal of Interpersonal Violence*, *23*(6), 815–833.

Brown, B. B., & Larson, J. (2009). Peer relationships in adolescence. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology: Contextual influences on adolescent development* (pp. 74–103). John Wiley & Sons, Inc.

Chen, C. M., Harford, T. C., Grant, B. F., & Chou, S. P. (2020). Association between aggressive and non-fatal suicidal behaviors among US high school students. *Journal of Affective Disorders*, *277*, 649–657.

Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, *8*(4), 597–600.

Conner, K. R., Duberstein, P. R., Conwell, Y., & Caine, E. D. (2003). Reactive aggression and suicide: Theory and evidence. *Aggression and Violent Behavior*, *8*(4), 413–432.

Gratz, K. L. (2001). Measurement of deliberate self-harm: Preliminary data on the deliberate self-harm inventory. *Journal of Psychopathology and Behavioral Assessment*, *23*(4), 253–263.

Han, Z., Zhang, G., & Zhang, H. (2017). School bullying in Urban China: Prevalence and correlation with school climate. *International Journal of Environmental Research and Public Health*, 14(10), 1116.

Harford, T. C., Yi, H. Y., & Grant, B. F. (2013). Other-and self-directed forms of violence and their relationships to DSM-IV substance use and other psychiatric disorders in a national survey of adults. *Comprehensive Psychiatry*, *54*(7), 731–739.

Hartley, C. M., Pettit, J. W., & Castellanos, D. (2018). Reactive aggression and suicide-related behaviors in children and adolescents: A review and preliminary meta-analysis. *Suicide and Life-Threatening Behavior*, *48*(1), 38–51.

Hawton, K., Saunders, K. E., & O'Connor, R. C. (2012). Self-harm and suicide in adolescents. *The Lancet*, *379*(9834), 2373–2382.
Heerde, J. A., & Hemphill, S. A. (2018). Are bullying perpetration and victimization associated with adolescent deliberate self-harm? A meta-analysis. *Archives of Suicide Research*, *23*(3), 353–381.
Huang, J., Tang, J., Tang, L., Chang, H. J., Ma, Y., Yan, Q., & Yu, Y. (2017). Aggression and related stressful life events among Chinese adolescents living in rural areas: a cross-sectional study. *Journal of Affective Disorders*, *211*, 20–26.
Hubbard, J. A., McAuliffe, M. D., Morrow, M. T., & Romano, L. J. (2010). Reactive and proactive aggression in childhood and adolescence: Precursors, outcomes, processes, experiences, and measurement. *Journal of Personality*, *78*(1), 95–118.
Karriker-Jaffe, K. J., Foshee, V. A., Ennett, S. T., & Suchindran, C. (2008). The development of aggression during adolescence: Sex differences in trajectories of physical and social aggression among youth in rural areas. *Journal of Abnormal Child Psychology*, *36*(8), 1227–1236.
Keenan, K., Hipwell, A. E., Stepp, S. D., & Wroblewski, K. (2014). Testing an equifinality model of nonsuicidal self-injury among early adolescent girls. *Development and Psychopathology*, *26*(3), 851–862.
Kretschmer, T., Barker, E. D., Dijkstra, J. K., Oldehinkel, A. J., & Veenstra, R. (2015). Multifinality of peer victimization: Maladjustment patterns and transitions from early to mid-adolescence. *European Child & Adolescent Psychiatry*, *24*(10), 1169–1179.
Lundh, L. G., Karim, J., & Quilisch, E. V. A. (2007). Deliberate self-harm in 15-year-old adolescents: A pilot study with a modified version of the Deliberate Self-Harm Inventory. *Scandinavian Journal of Psychology*, *48*(1), 33–41.
Malamut, S. T., Luo, T., & Schwartz, D. (2020). Prospective associations between popularity, victimization, and aggression in early adolescence. *Journal of Youth and Adolescence*, *49*(11), 2347–2357.
Moore, S. E., Norman, R. E., Suetani, S., Thomas, H. J., Sly, P. D., & Scott, J. G. (2017). Consequences of bullying victimization in childhood and adolescence: A systematic review and meta-analysis. *World Journal of Psychiatry*, *7*(1), 60.
Nylund-Gibson, K., Grimm, R., Quirk, M., & Furlong, M. (2014). A latent transition mixture model using the three-step specification. *Structural Equation Modeling: A Multidisciplinary Journal*, *21*(3), 439–454.
O'Donnell, O., House, A., & Waterman, M. (2015). The co-occurrence of aggression and self-harm: systematic literature review. *Journal of Affective Disorders*, *175*, 325–350.
Olweus, D. (1993). *Bullying at school: What we know and what we can do*. Oxford, UK; Cambridge, USA: Blackwell.
Plutchik, R. (1995). Outward and inward directed aggressiveness: The interaction between violence and suicidality. *Pharmacopsychiatry*, *28*(S2), 47–57.
Raine, A., Dodge, K., Loeber, R., Gatzke-Kopp, L., Lynam, D., Reynolds, C., & Liu, J. (2006). The reactive–proactive aggression questionnaire: Differential correlates of reactive and proactive aggression in adolescent boys. *Aggressive Behavior*, *32*(2), 159–171.
Sahlin, H., Kuja-Halkola, R., Bjureberg, J., Lichtenstein, P., Molero, Y., Rydell, M., & Hellner, C. (2017). Association between deliberate self-harm and violent criminality. *JAMA Psychiatry*, *74*(6), 615–621.
Sahlin, H., Moberg, T., Hirvikoski, T., & Jokinen, J. (2015). Non-suicidal self-injury and interpersonal violence in suicide attempters. *Archives of Suicide Research*, *19*(4), 500–509.
Shafti, M., Taylor, P. J., Forrester, A., & Pratt, D. (2021). The co-occurrence of self-harm and aggression: a cognitive-emotional model of dual-harm. *Frontiers in Psychology*, *12*, 415.
Skegg, K. (2005). Self-harm. *The Lancet*, *366*(9495), 1471–1483.
Slade, K. (2019). Dual harm: the importance of recognising the duality of self-harm and violence in forensic populations. *Medicine, Science and the Law*, *59*(2), 75–77.
Steinhoff, A., Bechtiger, L., Ribeaud, D., Eisner, M., & Shanahan, L. (2022). Self-, other-, and dual-harm during adolescence: a prospective-longitudinal study of childhood risk factors and early adult correlates. *Psychological Medicine*, 1–9. https://doi.org/10.1017/S0033291722000666.
Sullivan, T. N., Farrell, A. D., & Kliewer, W. (2006). Peer victimization in early adolescence: Association between physical and relational victimization and drug use, aggression, and delinquent behaviors among urban middle school students. *Development and Psychopathology*, *18*(1), 119–137.
Tang, J., Ma, Y., Guo, Y., Ahmed, N. I., Yu, Y., & Wang, J. (2013). Association of aggression and non-suicidal self injury: a school-based sample of adolescents. *PLoS ONE*, *8*(10), e78149.
Tuvblad, C., Dhamija, D., Berntsen, L., Raine, A., & Liu, J. (2016). Cross-cultural validation of the reactive-proactive aggression questionnaire (RPQ) using four large samples from the US, Hong Kong, and China. *Journal of Psychopathology and Behavioral Assessment*, *38*(1), 48–55.
Vitaro, F., Brendgen, M., & Tremblay, R. E. (2002). Reactively and proactively aggressive children: Antecedent and subsequent characteristics. *Journal of Child Psychology and Psychiatry*, *43*(4), 495–505.
Wan, Y. H., Hu, C. L., Hao, J. H., Sun, Y., & Tao, F. B. (2011). Deliberate self-harm behaviors in Chinese adolescents and young adults. *European Child & Adolescent Psychiatry*, *20*(10), 517–525.
Wu, N., Hou, Y., Zeng, Q., Cai, H., & You, J. (2021). Bullying experiences and nonsuicidal self-injury among Chinese adolescents: a longitudinal moderated mediation model. *Journal of Youth and Adolescence*, *50*(4), 753–766.
Zhang, W. X., & Wu, J. F. (1999). The Chinese adapted version of the Olweus bullying/victimization questionnaire. *Psychological Development and Education*, *15*(2), 7–11.

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