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Disentangling the effects of peer status and peer victimization on perceived physical health in adolescence

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Abstract

Introduction: Although exposure to peer victimization during adolescence has been linked to poorer (perceived) physical health, little is known about how multiple peer stressors may independently and conjointly be related with adolescent physical health outcomes. The current study investigated the unique, interactive, and cumulative effects of peer victimization and two types of peer status (i.e., peer preference and peer popularity) on adolescent perceived physical health, while separating between- and within-person effects.

Methods: Two hundred and thirty-three adolescents (M_{age} = 12.7 years; 47.2% females) enrolled in two secondary schools in the Netherlands completed self-report measures and sociometric nominations of peer status four times, every 6 months, during the first 2 years of secondary school.

Results: Multilevel analysis showed that adolescents who reported higher levels of peer victimization than their peers also reported more perceived physical health problems. Moreover, when adolescents were exposed to higher levels of peer victimization (as compared with their own average levels), they also reported poorer perceived physical health (as compared with their own average levels). No main or interactive effects of peer status were found and the effect of a cumulative peer stress score emerged to be driven by peer victimization.

Conclusions: Findings revealed both between- and within-person effects of peer victimization on perceived physical health, suggesting that peer victimization may be the most salient peer stressor to affect physical health outcomes in adolescence.

KEYWORDS

adolescence, peer victimization, perceived physical health, popularity, preference, social status

1 | INTRODUCTION

During adolescence, peers increasingly function to fulfill the need to belong and enable social comparison (Brown & Larson, 2009; Hartup & Stevens, 1997). This goes hand in hand with an increased sensitivity to group affiliation and peer status on the positive side but also to episodes of peer exclusion and victimization on the negative side (Somerville, 2013), making negative peer experiences among the most salient stressors in adolescence (Bowker et al., 2000). Accordingly, peer stressors (e.g., low peer status and peer victimization) have been shown to have detrimental consequences for adolescents' mental health (Parker & Asher, 1987; Prinstein & Giletta, 2016) but also for their physical health (e.g., somatic complaints and sleep problems; Lee & Vaillancourt, 2018; Moore et al., 2017; Prinstein & Giletta, 2020). However, not all peer stressors may be related to adolescents' physical health in the same way. Until now, research has mainly focused on the relationship between peer victimization and (perceived) physical health outcomes (Schacter, 2021), so that it is unclear whether results generalize to other peer stressors. This is an important omission, because less severe stressors might also affect health, either

alone or in interaction with other stressors. In addition, few studies have considered the possibility that peer stressors may act in a cumulative manner, as would be the case if the experience of multiple peer stressors, rather than of a single stressor, would affect adolescents the most. This study aimed to address these gaps in the literature. First, it examined the unique and interactive roles that different types of peer status (i.e., peer preference and peer popularity) and peer victimization play in predicting adolescent perceived physical health. Second, it investigated the possible cumulative effects of peer stressors (i.e., types of peer status and peer victimization) on perceived physical health.

Peer victimization is defined as a situation in which youth are the target of peer aggression (Kochenderfer & Ladd, 1996). This stressful experience has been related to poor physical health (Moore et al., 2017). For example, meta-analytic work suggests that victims are approximately two times more likely to experience somatic complaints (e.g., headache and abdominal pain), as compared with nonvictims (Gini & Pozzoli, 2013; Gini et al., 2014; Moore et al., 2017). Moreover, research indicates that adolescents exposed to higher levels of peer victimization tend to need more medical care and to show altered immune system functioning, as revealed by associations with increased levels of systemic inflammation (Copeland et al., 2014). However, this study builds predominantly on studies that investigated between-person associations, which do not necessarily reflect processes, as they occur within a given individual (Curran & Bauer, 2011). That is, even if as compared with adolescents with low exposure to peer victimization, peer victimized adolescents report poorer perceived physical health, it cannot be assumed that when adolescents are exposed to more peer victimization (as compared with their own average exposure level), they also report higher levels of perceived physical health problems (as compared with their own average level). Mounting evidence highlights the importance of examining associations at the within-person level (e.g., Hygen et al., 2020; Lervåg, 2020; Masselink et al., 2018), as these are fundamental to provide knowledge that can more directly guide intervention and prevention efforts. To our knowledge, only Lee and Vaillancourt (2019) examined both the between- and within-person effects of peer victimization on somatic symptoms. They found evidence that when adolescents reported higher levels of peer victimization (as compared with their own average level), they experienced more somatic complaints (as compared with their own average level) at the subsequent assessment. Our study aimed to further investigate the relationship between peer victimization and perceived physical health in a more nuanced manner, by distinguishing within- and between-person associations.

In addition to peer victimization, having low peer status may also be an important source of stress in early adolescence (Cillessen & Mayeux, 2004). In this life period, adolescents often compare themselves with others and they become increasingly aware of the peer hierarchy (Bowker et al., 2000). Research even indicates that if early adolescents are confronted with dilemmas in which they need to choose between increasing status or gaining benefits in other social domains, such as maintaining a friendship or engaging in a romantic relationship, they prioritize peer status more so than children and late adolescents do (LaFontana & Cillessen, 2010). Accordingly, having low status can be a stressful experience and has been shown to affect adolescents' well-being (e.g., Prinstein et al., 2018). For example, a few studies have shown that self-reported social acceptance (e.g., the degree to which youth feel socially accepted, liked, or disliked) is associated with general health (Adam et al., 2011; Joffer et al., 2019) and poorer perceived physical health (Delfabbro et al., 2019). Yet, research considering the effects of peer status on (perceived) physical health is still sparse and it is mostly limited to broad measures of perceived peer status. As a result, less is known about the physical health correlates of more specific indices of peer status, reflecting youth reputations among their peers.

Developmental psychologists have long emphasized the importance of using sociometric methods to adequately assess social status within the peer context (Cillessen & Bukowski, 2018). These methods entail asking every youth within a specific peer context (e.g., classroom, grade, and school) to nominate a limited or unlimited number of peers (e.g., classmates and grademates) in response to one or more criteria (e.g., most popular peers; Cillessen & Marks, 2011; Coie & Dodge, 1982). Thus, sociometric methods make use of nominations from all group members to determine the status of the adolescents within that group and they are recognized as the gold standard to assess peer status (Cillessen & Marks, 2011). Using sociometric methods, researchers have also pointed out the need to distinguish between two types of peer status: peer preference and peer popularity. First, high peer status can indicate that an adolescent is well liked and accepted by their peers (peer preference: the combination of who peers like most and like least). Second, it can also mean that an adolescent has a reputation as being visible in the peer group and having social power (peer popularity: the combination of who peers perceive to be popular and unpopular). Although these two types of peer status can overlap, some adolescents are either well-liked or popular, but not both (Parkhurst & Hopmeyer, 1998). Consistent with this, the two types of peer status are only moderately correlated (see Van den Berg et al., 2020) and have distinctive behavioral profiles (LaFontana & Cillessen, 2002; Prinstein et al., 2018). For example, adolescents who are high on peer preference tend to engage in more prosocial behavior and are seen as trustworthy, whereas adolescents high on peer popularity have a more mixed profile that also includes aggression, delinquency, and engagement in (health) risk behaviors (e.g., substance use; Choukas-Bradley et al., 2015; Cillessen & Mayeux, 2004). Because of these differences, the two types of peer status may also be differentially associated with physical health outcomes.

Although most studies have focused on the role of peer status broadly defined, preliminary work examined associations between peer preference (or its underlying constructs of high acceptance and low rejection) and physical health outcomes

(e.g., Brendgen & Vitaro, 2008; de Bruine et al., 2019; Eisenberger et al., 2017; Plenty & Mood, 2016; Temcheff et al., 2011). These studies revealed that peer preference can have implications for adolescent (perceived) physical health. For example, children who were well-liked by their peers were found to need less medical care years later (Temcheff et al., 2011). Moreover, during adolescence peer preference predicted lower markers of systemic inflammation (i.e., high-sensitivity C-reactive protein [hsCRP]; de Bruine et al., 2019). However, existing work did not yield consistent evidence for a direct link between peer preference and (perceived) physical health. For example, Hartung et al. (2015) only found an indirect association between likability and perceived physical health through perceived social inclusion. Moreover, Brendgen and Vitaro (2008) revealed that peer rejection was related to perceived physical health only for emotionally reactive girls. In sum, results are mixed, although most existing studies seem to support a negative association between peer preference and (perceived) physical health. However, also these studies examined associations only at the between-person level.

Although it can be hypothesized that adolescents who are highly preferred are definitely better off than those who are not, the association between peer popularity and perceived physical health might not be as linear. Nonlinearity could emerge if both being unpopular but also being very popular would be stressful (Prinstein et al., 2011; Schwartz & Gorman, 2011). On the one hand, unpopular adolescents might experience negative consequences, as they have a weak social position in the peer group. On the other hand, popular adolescents might experience negative consequences because they are highly visible within the peer group. Indeed, popular adolescents have been shown to sometimes experience more friendship conflict, engage in unhealthy risk behaviors and have an increased risk for maladjustment (Litwack et al., 2012; Prinstein et al., 2011; Schwartz & Gorman, 2011). Moreover, both the most popular and least popular adolescents in the peer group have been found to be equally at risk for developing externalizing problems (Stoltz et al., 2016), for engaging in health risk behaviors (Prinstein et al., 2011) and for experiencing poorer satisfaction with their social relationships (Ferguson & Ryan, 2019). With regard to physical health outcomes, evidence from two studies (de Bruine et al., 2019; Plenty & Mood, 2016) also suggested the possibility of nonlinear (i.e., curvilinear) associations. One study revealed that, under certain circumstances, high levels of peer popularity predicted elevated inflammation markers (i.e., hsCRP; de Bruine et al., 2019), whereas in the other study, unpopular adolescents reported the lowest levels of general health (Plenty & Mood, 2016). Thus, in addition to the linear effect of peer popularity on perceived physical health, a curvilinear effect should also be considered.

Peer victimization and the two types of peer status may not only be independently associated with adolescents' perceived physical health, but could also act in combination. First, an under-researched possibility is that the two types of peer status interact with one another. Popular adolescents might only report negative health consequences when they also experience low levels of peer preference. For example, popular adolescents might not experience any negative consequence if they are also well-liked, whereas popular adolescents who are not liked might be exposed to additional stress to maintain high levels of popularity. Moreover, in line with cumulative stress models (Evans et al., 2013), adolescents who experience multiple peer stressors may be those at the highest risk for poorer perceived physical health; yet, these models have received little attention in peer relations research. Cumulative stress models pose that instead of the severity and type of stressor, the number of stressors experienced is associated with poorer health (Evans et al., 2013). Early life adversity research has indicated that cumulative adversity is important for predicting physical health outcomes (Jakubowski et al., 2018; Kuhlman et al., 2020). For example, it has been found that the risk for age-related diseases increased as a function of the number of adversities children were exposed to (Danese et al., 2009). This study suggests that for adolescents it could be that not a single specific peer stressor relates to perceived physical health but a sum of different stressors that each threatens overall peer belonging. However, to our knowledge, the extent to which peer stressors may have a cumulative effect on adolescent perceived physical health remains unexamined.

2 | THE PRESENT STUDY

The present study aimed to examine the unique, interactive and cumulative effects of multiple peer stressors (i.e., types of peer status and peer victimization) on perceived physical health. By investigating the unique effects of different peer stressors, this study offers the opportunity to compare the association between each type of stressor and adolescents' perceived physical health, thus shedding light on whether there is any specificity linking peer stressors to perceived physical health (Rudolph et al., in press). Notably, these associations were examined using a longitudinal design that allowed the estimation of both between-person and within-person effects. Our design allowed us to address three clusters of hypotheses. First, we expected that high levels of peer victimization would be associated with poorer perceived physical health at both the between- and within-person level (Gini & Pozzoli, 2013; Lee & Vaillancourt, 2019). Second, we expected that low levels of peer preference would be associated with poorer perceived physical health at both the between- and within-person level (see de Bruine et al., 2019; Delfabbro et al., 2019; Temcheff et al., 2011). Moreover, we hypothesized a quadratic association between peer popularity and poor perceived physical health at the between-person level, based on work suggesting that both low and high levels of peer popularity in a group may be stressful and pose risk for adjustment

(e.g., Prinstein et al., 2011; Schwartz & Gorman, 2011). We also explored an interaction between the two types of peer status (both at the between- and within-person level), to predict poor perceived physical health. Finally, we tested a cumulative risk model (Evans et al., 2013), according to which we expected that, over and above the effect of individual peer stressors, (a) adolescents who experienced overall more peer stressors (i.e., a sum of multiple peer stressors) than other adolescents reported poorer perceived physical health (between-person effect) and (b) when adolescents reported more peer stress (relative to their own peer stress levels) they reported poorer perceived physical health (relative to their own levels of perceived physical health).

3 | METHODS

3.1 | Participants and procedure

Participants were 233 adolescents involved in a larger project (i.e., Peer Power Project) aimed at examining the effects of peer experiences on adolescents' health outcomes in two secondary schools in the Netherlands. This project consisted of four waves of data collection, with ~6 months between consecutive waves. Data collection began in November/December 2016 (Wave 1), when adolescents were in the fall of the first year of secondary school and ended in June 2018 (Wave 4), just before the end of the second year of secondary school. At baseline, information letters and consent forms were distributed to the parents of all pupils enrolled in the first year of secondary school ($n = 459$). Parents were also informed about the purpose of the study during information evenings that took place at adolescents' schools. Consent forms could be sent back by mail or handed in at school. Approximately 57% of the parents returned a consent form and the majority of those who did (87%) gave consent for their child to participate in the study. Adolescents were informed about the study through in-class presentations and they were asked their assent on the testing days. At baseline, only seven adolescents with parental consent refused to take part in the study; moreover, five adolescents were absent on the days of testing and an additional one had moved to a different school. Thus, a total of 215 adolescents took part in the study at Wave 1 (about 47% of the targeted population). Adolescents who did not participate at Wave 1 had the opportunity to join the study at the subsequent waves. Retention rate between consecutive assessments was high (>90%), with 192 adolescents (82%) participating in all waves of data collection. For this analyses, adolescents were included if they participated in at least one of the four waves of data collection. This resulted in an analytic sample of 233 adolescents who at baseline were ~12 years old ($M_{age} = 12.7$ years; SD = 0.5; 47.2% female participants). Most adolescents identified themselves as being Dutch (88%) and at baseline 81.4% reported to live with both their biological parents.

At each wave, participants completed a series of self-report questionnaires and took part in a peer nomination procedure (see Section 3.2). Participants were invited to complete these questionnaires during school time in designated rooms including no more than six pupils at a time. All questionnaires were filled in online, except for the peer nomination procedure that was completed with paper and pencil. This study was approved by the Medical Ethics Committee Brabant, the Netherlands (NL56418.028.16).

3.2 | Measures

3.2.1 | Poor perceived physical health

Perceived physical health symptoms experienced during the last months were assessed with six self-report items. The first item assessed general health (i.e., "In general you could say your health is…") on a 5-point Likert scale that ranged from 1 = "bad" to 5 = "excellent." The other five items assessed somatic symptoms and sleep quality. Specifically, somatic symptoms included headache, stomach ache, loss of appetite and fatigue experienced in the last months. Each of these items (e.g., "In the past months, how many times did you have headaches?") was rated on a 5-point Likert scale (1 = "never" to 5 = "very often"). Sleep quality was assessed with a single question (i.e., "How would you describe your sleep quality in the past month?") answered on a 4-point Likert scale (1 = "very bad" to 4 = "very good").

As the somatic symptoms and sleep quality items were assessed on different metrics, the proportion of maximum scaling (POMS) method (Little, 2013) was used before combining all items in an overall scale. This method transforms each scale to a metric from 0 (=minimum possible) to 1 (=maximum possible), by first making the scale range from 0 to the highest value, and then dividing the scores by the highest value (i.e., POMS = [{observed – minimum}/{maximum – minimum}]). Finally, a perceived physical health score was computed by averaging the transformed responses to the six items (i.e., general health, somatic symptoms, and sleep quality), with higher scores indicating worse perceived physical health. Internal consistency was satisfactory, with Cronbach's α ranging between .69 (Wave 1) and .71 (Wave 4).

3.2.2 | Peer victimization

Peer victimization was measured with the Revised Peer Experiences Questionnaire (Prinstein et al., 2001), including items about overt, relational, and reputational peer victimization. This self-report measure consists of 13 statements (e.g., "A peer hit, kicked or pushed me in a mean and harmful way"), which were answered on a 5-point Likert scale from 1 (= "never") to 5 (= "a few times a week"). A total peer victimization score was computed at each time point by averaging across the 13 items, with higher scores indicating higher levels of peer victimization. Internal consistency was good (Cronbach's α ranged between .84 and .90). No transformation for within-person mean levels of peer victimization was necessary as skewness (1.43) and kurtosis (2) were acceptable.

3.2.3 | Peer status

Peer status was measured with a peer nomination procedure. Adolescents nominated an unlimited number of same- and cross-gender peers within their grade whom they "like the most" (= acceptance) and "like the least" (= rejection; Coie & Dodge, 1982), and whom they found "most popular" (= popularity) and "least popular" (= unpopularity). To ensure anonymity, adolescents were provided with a roster including the names of all pupils in their grade and were asked to report the numbers associated with the grademates they wished to nominate on a separate questionnaire. Grade, rather than classroom, was used as a reference group, given that, although in the Netherlands students spend most of their time at school within their classroom, they still know peers in their grade and have social interactions outside their classroom context (van den Berg et al., 2020). Thus, grade may represent a more ecologically valid reference group than classroom and has the advantage to increase the reliability of peer nomination procedures (see Marks et al., 2013). For each participant, a peer preference score was computed by subtracting the raw total number of nominations received on the "liked least" criterion from the raw total number of nominations received on the "liked most" criterion (Cillessen & Bukowski, 2018). A peer popularity score was computed by subtracting the raw total number of nominations received on the "least popular" criterion from the raw total number of nominations received on the "most popular" criterion (Cillessen & Bukowski, 2018). We used the raw number of total nominations, because in this study grade size was highly similar for the two schools and standardization within schools would have eliminated information on personal deviations from the mean, because each wave would have been standardized separately (Nezlek, 2012; Velásquez et al., 2013). To still account for any difference in the size of the grade between the two school, grade size was added into the analytic models as covariate. Extreme outliers (i.e., >3 SD below or above the mean; $n = 2$ for peer preference and $n = 5$ for peer popularity) were winsorized to the highest value in the distribution.

3.3 | Plan of analyses

All analyses and hypotheses were preregistered and run accordingly (see https://osf.io/ctbmh). To examine both between- and within-person associations, all study variables were initially transformed in the following way. First, to be able to identify between-person effects, person-specific means of (Level 2) peer victimization, peer preference, and peer popularity were computed across all four assessments. Second, to be able to identify within-person effects, within-person deviations (Level 1) in peer victimization, peer preference, and peer popularity were calculated as a given assessment's value minus an adolescent's person mean across all assessments divided by the adolescent's unique standard deviation (i.e., within-person standardized).

For all research questions, a multilevel modeling approach was used. To examine the unique associations between peer stressors (i.e., peer victimization, peer preference, and peer popularity) and perceived physical health (i.e., unique effects models), two multivariate multilevel regression models with random intercepts and random slopes were specified with time at Level 1 and person at Level 2. In the first model, we predicted variations in perceived physical health by between-person (e.g., person-specific means of peer victimization) and within-person (e.g., within-person deviations of peer victimization) levels of peer victimization, peer preference, and peer popularity (Model 1). In the second model, we examined a quadratic trend on top of a linear trend of between-person levels of peer popularity (i.e., quadratic trend of person-specific means of peer popularity; Model 2). Subsequently, to explore whether peer preference interacted with peer popularity (i.e., interaction-effect model; Model 3), we added the interaction term between the two types of peer status at both the between- and within-person level (in this model, the quadratic effect of peer popularity was not included). Specifically, at the between-person level, we added the interaction term between the person-specific means of peer popularity and the person-specific means of peer preference. At the within-person level, we added the interaction term between the within-person deviations of peer popularity and the within-person deviations of peer preference. Finally, to test a cumulative risk model, we used peer victimization, peer acceptance, rejection, and unpopularity as risk

variables to create a cumulative risk metric score. We a priori decided not to include peer popularity in the cumulative score, as it remained unclear to what extent high levels of peer popularity represent a risk factor/stressor (this was tested in Model 2). In line with research on cumulative risk (Evans et al., 2013), each risk variable was dichotomized to reflect either the absence (= "0") or presence (= "1") of the peer stressor. With regard to peer victimization, in line with previous research (Oldenburg et al., 2015; Solberg & Olweus, 2003), adolescents were classified as victims (= "1") when they scored 3 or higher on at least one experience of peer victimization (i.e., one of the 13 items). Adolescents who scored 1 (= "never") or 2 ("one/two times") were thus classified as not victimized. With this approach, adolescents who were exposed to one or more peer victimization form at least three times a month were classified as victims (Solberg & Olweus, 2003). For peer acceptance, adolescents were classified as experiencing risk (i.e., "1") if their scores fell at or below the 25th percentile (reflecting 0/1 nominations). For peer rejection and peer unpopularity, adolescents were classified as experiencing risk (i.e., "1") if their scores were above the 75th percentile (reflecting two or more nominations; Gerard & Buehler, 2004; Hebron et al., 2017). Dichotomizing risk factors based on existing norms or on quartiles in the sample distribution is the most commonly used approach to create indices of cumulative risk and it has been shown to yield valid measures of exposure to multiple risk factors (Evans et al., 2013; MacKenzie et al., 2014; Wade et al., 2018).

All models were adjusted for gender and grade size. Missing data across all variables ranged between 0% and 10.7%, and were completely at random (Little's [1988] missing completely at random test: $\chi^2(1114) = 305.7$, $p = 1.00$). Thus, full information maximum likelihood estimation was used to handle missing data.

4 | RESULTS

4.1 | Descriptive analyses

Table 1 presents bivariate correlations among all study variables across all four waves for descriptive purposes. Peer victimization was associated with poorer perceived physical health across all waves (correlations ranging from .17 to .39). In contrast, both types of peer status were not associated with perceived physical ill health, with the exception of a positive concurrent correlation between peer popularity and perceived physical ill health at Wave 3. Finally, positive correlations between the cumulative peer stress index and perceived physical ill health emerged; specifically, Wave 2 and 3 cumulative peer stress correlated with all perceived physical ill health at all waves, and Wave 4 cumulative peer stress correlated with Wave 1 and 4 perceived physical ill health.

4.2 | Effects of peer stressors on perceived physical health

An intraclass correlation (ICC) of .65 was revealed, indicating that 65% of the variance in perceived physical ill health was due to between-person differences. The ICCs for peer victimization, peer preference, and peer popularity were .48, .64, and .84, respectively. An overview of the unique, interactive, and cumulative models can be found in Table 2. In all models, boys reported lower perceived physical ill health than girls ($\beta = -21$, SE = 0.05, $p < .01$).

4.2.1 | Unique effects model

Both the person-specific mean and within-person deviations of peer victimization were related to perceived physical ill health[1] (see Table 2). Thus, a between-person effect was found, indicating that adolescents reporting higher levels of peer victimization had poorer perceived physical health in comparison with adolescents who scored low on peer victimization. In addition, a within-person effect was revealed, indicating that when adolescents reported more peer victimization experiences (relative to their own mean), they also reported poorer perceived physical health (relative to their own mean level).

For peer status, no significant effects were found, both for the person-specific means as well as for the within-person deviations of peer preference and peer popularity. This indicates that between-person differences and within-person deviations of both types of peer status were not associated with perceived physical ill health. In addition, no quadratic trend was found for the association between peer popularity and perceived physical ill health. Overall, the unique effect models explained 19% of the total variance in perceived physical health.

[1]We also explored whether peer victimization predicted poorer perceived physical health at the subsequent wave, by estimating a cross-lagged model with perceived physical health at time t regressed on peer victimization at time $t-1$. These model did not emerge to fit the data better ($p = .11$).

TABLE 1 Bivariate correlations among study variables

Variable	*M*	SD	Perceived physical health 1	2	3	4	Peer victimization 1	2	3	4	Peer preference 1	2	3	4	Peer popularity 1	2	3	4	Cumulative peer stress 1	2	3	4
Perceived physical health																						
Wave 1	0.31	0.16																				
Wave 2	0.33	0.16	0.64**																			
Wave 3	0.31	0.16	0.61**	0.66**																		
Wave 4	0.33	0.17	0.60**	0.63**	0.78**																	
Peer victimization																						
Wave 1	1.27	0.42	0.37**	0.30**	0.18*	0.17*																
Wave 2	1.32	0.38	0.39**	0.36**	0.28**	0.24**	0.61**															
Wave 3	1.27	0.34	0.31**	0.22**	0.26**	0.21**	0.41**	0.54**														
Wave 4	1.31	0.38	0.30**	0.22**	0.28**	0.33**	0.38**	0.50**	0.52**													
Peer preference																						
Wave 1	2.22	2.92	−0.01	0.03	0.02	.02	−0.20**	−0.17*	−0.12	−0.05												
Wave 2	2.10	3.04	−0.03	0.00	−0.01	.04	−0.19**	−0.17*	−0.14*	−0.13	0.71**											
Wave 3	2.42	2.95	−0.05	−0.01	−0.01	.00	−0.20**	−0.20**	−0.23**	−0.17*	0.61**	0.67**										
Wave 4	2.38	3.00	−0.04	−0.01	0.01	−.03	−0.23**	−0.13	−0.18*	−0.18**	0.57**	0.64**	0.66**									
Peer popularity																						
Wave 1	0.24	3.48	−0.03	0.00	0.07	0.01	−0.10	−0.00	−0.01	−0.06	0.34**	0.32**	0.34**	0.25**								
Wave 2	0.04	4.03	−0.03	−0.00	0.09	0.04	−0.09	0.04	0.04	0.04	0.29**	0.35**	0.33**	0.24**	0.85**							
Wave 3	0.17	4.08	−0.00	0.01	0.15*	0.05	−0.04	0.05	0.06	0.09	0.31**	0.32**	0.32**	0.25**	0.79**	0.86**						
Wave 4	0.02	4.74	−0.01	0.00	0.13	0.02	−0.10	0.04	0.03	0.04	0.31**	0.34**	0.35**	0.26**	0.79**	0.87**	0.90**					
Cumulative peer stress																						
Wave 1	0.88	1.00	0.13	0.09	0.03	0.08	0.43**	0.30**	0.26**	0.19**	−0.58**	−0.60**	−0.50**	−0.39**	−0.40**	−0.37**	−0.35**	−0.36**				
Wave 2	0.97	1.01	0.18**	0.19**	0.15*	0.13*	0.33**	0.47**	0.31**	0.27**	−0.48**	−0.55**	−0.54**	−0.33**	−0.35**	−0.36**	−0.27**	−0.32**	0.56**			
Wave 3	0.95	0.98	0.22**	0.14*	0.14*	0.16*	0.40**	0.37**	0.43**	0.39**	−0.37**	−0.37**	−0.52**	−0.55**	−0.23**	−0.24**	−0.22**	−0.24**	0.48**	0.47**		
Wave 4	0.97	0.93	0.15*	0.12	0.11	0.14*	0.29**	0.25**	0.35**	0.38**	−0.48**	−0.41**	−0.49**	−0.52**	−0.35**	−0.36**	−0.28**	−0.41**	0.48**	0.47**	0.53**	
Gender (% males)	0.53		−0.16*	−0.19**	−0.25**	−0.27**	0.11	−0.04	0.01	−0.03	−0.29**	−0.21**	−0.23**	−0.21**	0.10	0.07	0.04	0.07	0.11	0.05	0.14*	0.12

Note: Gender was dummy-coded (0 = female, 1 = male).

*$p < .05$; **$p < .01$.

TABLE 2 Results of multilevel models predicting perceived physical health from peer victimization, peer preference, and peer popularity

	Unique effects model			Interactive model			Cumulative model		
Predictor	***β***	**SE**	**95% CI**	***β***	**SE**	**95% CI**	***β***	**SE**	**95% CI**
Intercept	.37	0.17	[0.03; 0.70]	.36	0.17	[0.02; 0.70]	.41	0.17	[0.07 0; .76]
Gender	−.43**	0.10	[−63; −22]	−.43**	0.10	[−63; −22]	−.47**	0.11	[−0.68; −0.26]
Time	.02	0.02	[−0.02; 0.07]	.02	0.02	[−0.02; 0.07]	.02	0.02	[−0.02; 0.07]
Grade size	−.09	0.10	[−0.28; 0.10]	−.08	0.10	[−0.28; 0.10]	−.11	0.11	[−0.32; 0.10]
Person-specific means									
Peer victimization	.36**	0.05	[0.26; 0.46]	.36**	0.05	[0.25; 0.46]			
Peer preference	.00	0.02	[−0.04; 0.05]	.00	0.02	[−0.04; 0.05]			
Peer popularity	.02	0.05	[−0.09; 0.02]	.00	0.02	[−0.03; 0.03]			
Peer popularity quadratic trend[a]	.00	0.00	[0.00; 0.00]						
Peer preference × peer popularity				.01	0.04	[−0.07; 0.01]			
Cumulative peer stress							.20**	0.05	[0.08; 0.30]
Within-person deviations									
Peer victimization	.09**	0.02	[0.06; 0.13]	.09**	0.02	[.06; 0.13]			
Peer preference	−.02	0.02	[−0.06; 0.02]	−.02	0.02	[−.06; 0.02]			
Peer popularity	.03	0.02	[−0.01; 0.06]	.03	0.02	[−0.02; 0.07]			
Peer preference × peer popularity				.01	0.02	[−0.04; 0.05]			
Cumulative peer stress							.01	0.02	[−0.03; 0.04]

Abbreviation: CI, confidence interval.

[a]The quadratic trend of peer popularity was tested in a separate model (Model 2). The explained variance in each multilevel models was calculated by computing multilevel model R^2 measures (i.e., $R_t^{2(f)}$), which reflect the proportion of total variance explained by all predictors (Level 1 and 2 predictors) via fixed slopes (see Rights & Sterba, 2019). The $R_t^{(2(f)}$ was 0.19, 0.19, and 0.03 for the unique effects model, the interactive model, and the cumulative model, respectively.

**$p < .01$.

4.2.2 | Interactive effects model

To investigate whether adolescents who experienced high levels of peer popularity but low levels of peer preference reported poorer perceived physical health, an interactive effect of peer popularity and peer preference was tested. No interaction effects were found, neither at the between- nor at the within-person level (see Table 2). This model explained 19% of the total variance in perceived physical health.

4.2.3 | Cumulative effect model

To investigate if the sum of low peer status and high peer victimization were associated with perceived physical ill health, a cumulative effect model was tested. The person-specific mean level of cumulative risk scores, but not within-person deviations, was significantly associated with perceived physical ill health. Thus, adolescents who experienced overall more peer stress (sum of low peer status and high peer victimization) than others adolescents reported poorer perceived physical health. However, when adolescents reported more peer stress (relative to their own peer stress levels), they did not report poorer perceived physical health (relative to their own levels of perceived physical health). The cumulative effect model explained 3% of the total variance in perceived physical health.

As the between-person cumulative effect found in this model could have been driven by the effects of peer victimization, we conducted a follow-up analyses that separated peer victimization from the rest of the cumulative peer stress score (in line with Young et al., 2020). For this model, the cumulative score was recalculated including all peer stressors, except high peer victimization. This model included a person-specific mean score and within-person deviations for both the cumulative risk score and for peer victimization. Results of this model showed no significant associations involving cumulative peer stress (person-specific mean: $\beta = .00$, SE = 0.05, $p = .94$; within-person deviations: $\beta = -.03$, SE = .02, $p = .08$), but only peer victimization (person-specific mean: $\beta = .36$, SE = 0.05, $p < .01$; within-person deviations: $\beta = .09$, SE = 0.02, $p < .01$). These

results indicate that the initial between-person effect of cumulative peer stress was likely driven by the fact that those adolescents who experienced more overall peer stress also experienced more peer victimization than other adolescents.

5 | DISCUSSION

Mounting evidence suggests that adolescents exposed to negative peer experiences, in particular peer victimization, may be at increased risk for poor physical health. This study contributed to this emerging research area by providing an in-depth investigation about how different types of peer stressors may independently and conjointly be related to perceived physical health symptoms during adolescence. Specifically, we examined the unique, interactive and cumulative associations of peer victimization and two forms of peer status, preference, and popularity, on perceived physical health, while differentiating between- and within-person effects. Results showed that adolescents who experienced higher levels of peer victimization than their peers also reported poorer perceived physical health (between-person effect). More importantly, when adolescents experienced more victimization in comparison with their own average levels, they also reported poorer perceived physical health (as compared with their own average levels; within-person effect). These effect were specific to peer victimization, whereas no associations were found between the two types of peer status (i.e., peer preference and peer popularity) and poorer perceived physical health. Moreover, poorer perceived physical health could also not be explained by an interaction between peer preference and peer popularity, and the cumulative effect of peer stress emerged to be driven primarily by peer victimization. Overall, these results indicate that the type of peer stress does matter, suggesting that only peer victimization is associated with adolescent perceived physical health, both at the between- as well as within-person level.

Findings from this study provide consistent and robust evidence linking peer victimization to poorer perceived physical health. At the between-person level, this effect corroborates previous studies showing that victimized youth have poorer perceived physical health, as compared with their non-victimized peers (see meta-analyses of Gini & Pozzoli, 2013; Gini et al., 2014). Consistent with prior work, the magnitude of this effect was moderate. Importantly, the association between peer victimization and perceived physical health also emerged at the within-person level, suggesting that when adolescents experienced more victimization than usual, they also reported poorer perceived physical health than usual. This within-person effect replicates findings from a study by Lee and Vaillancourt (2019), which, to our knowledge, is the only one that also discerned between- and within-person effects. The within-person effect of peer victimization is of particular importance for at least two reasons. First, it provides a better representation of the real-life processes, as we expect them to occur within individuals, and it aligns with theoretical work, suggesting that victimization may be related to (perceived) physical health by shaping adolescents' biological stress systems (Prinstein & Giletta, 2020; Schacter, 2021). Second, within-person effects are not biased by time-invariant unobserved confounders (e.g., personality traits; Lervåg, 2020). Therefore, these within-person effects are more suitable to base intervention strategies upon as they provide more direct evidence that peer victimization and perceived physical health associate with one another. These findings also extends prior work by demonstrating that peer victimization in particular, rather than any given type of negative peer experience, may be a specific and salient form of stress influencing perceived physical health, perhaps as it more directly threaten individual's connections and sense of belonging.

This study also examined the possible impact of two types of peer status, yet neither peer preference nor peer popularity was associated with adolescent perceived physical health. These results are in contrast with previous studies, suggesting that peer status may be associated with physical health outcomes (Brendgen & Vitaro, 2008; de Bruine et al., 2019; Eisenberger et al., 2017; Temcheff et al., 2011). For example, low peer preference has been found to be associated with elevated levels of systemic inflammation (de Bruine et al., 2019). Moreover, neither low nor high popularity was associated with poorer perceived physical health and adolescents who were low on peer preference and high on peer popularity did not have better perceived physical health. The lack of associations between peer status and perceived physical health symptoms could be due to a number of reasons. First, the different association of peer stressors with perceived physical health might stem from differences in the severity of low peer status and peer victimization. On the one hand, peer victimization may represent a more powerful stressor that can generate immediate distress for the victims and, therefore, may affect their perceived physical health in the short run. Conversely, peer status may be a less severe stressor that does not directly have effects on perceived physical health. Notably, low peer status does not represent a single experience or situation of stress but a position in the peer group that is formed across an accumulation of situations and experiences. Therefore, it could be that peer status may have a longer incubation period and the effects of low status can only be observed after a longer period of time (de Bruine et al., 2019; Kuhlman et al., 2020). On the other hand, the lack of effects may simply stem from the fact that peer status and peer victimization were measured using different methodologies. Although peer status was assessed with a sociometric procedure, a self-report measure of peer victimization was used. As also physical health was assessed using self-report, the association between peer victimization and physical health may be (at least in part) due to shared method variance. This shortcoming should be kept in mind when comparing the effects of peer victimization and peer status, and it will be

important for future research to measure both peer stressors with self-report, as well as peer nominations and to utilize longitudinal designs that allow the investigation of possible longer-term effects of peer stressors on adolescent health.

Finally, this study examined whether a count of the number of peer stressors that adolescents were exposed to would associate with their perceived physical health, regardless of the type of stressor. Consistent with cumulative risk models (Evans et al., 2013), this count variable covaried with perceived physical health at the between-person level; adolescents exposed to a higher number of peer stressors also reported poorer perceived physical health than their peers experiencing fewer peer stressors. However, follow-up analyses indicated that this association was primarily driven by peer victimization experiences. This study therefore does not support the notion that peer stressors may be interchangeable; instead, it highlights a specific role of peer victimization as a type of peer stressor that may be particularly salient to understand adolescent poor perceived physical health. Thus, findings from this study suggest that, for clinical practice and intervention efforts, when choices have to be made (e.g., due to limited resources), it is important to assess and focus on peer victimization in particular. However, the lack of a cumulative effect of peer stressors should not be necessarily interpreted as evidence against cumulative risk models. Instead, these null findings may indicate that accumulations of stressors across different domains (e.g., in the family, peer, and academic domain), rather than within the same domain, may be more strongly predictive of health outcomes (Danese et al., 2009). Moreover, the cumulative index count allowed us to combine peer stressors but gave equal weight to each peer stressor. Therefore, it may still be possible that peer victimization is related to perceived physical health differently for adolescents with low versus high levels of peer status. This hypothesis is consistent with recent studies showing that the negative effects of peer victimization on adjustment outcomes were modified by adolescents' peer status (Malamut et al., 2020; Swirsky & Xie, 2021). Exploratory analyses in this sample also yielded preliminary evidence for an interactive model, according to which the association between peer victimization and perceived physical health was stronger for adolescents with low, as compared to high, levels of popularity (see Supporting Information). Future research is warranted to further explore how peer victimization and peer status may interact in predicting physical health outcomes.

This study has a number of strengths, including the multi-wave design, the assessment of multiple peer stressors, the examination of both between- and within-person effects and the preregistration of the study hypotheses and analytic plan. However, results from this study should be interpreted in light of some limitations. First, findings do not allow us to draw any conclusion on the direction of effects between peer victimization and perceived physical health problems. Recent research has shown that the associations between peer victimization and (perceived) physical health is likely bidirectional in nature, with poor (perceived) physical health also increasing the risk for subsequent peer victimization (Lee & Vaillancourt, 2019). As the focus of this study was on comparing the independent and conjoint effects of multiple peer stressors, multilevel models were used, in which bidirectionality of effects could not be tested. Future research examining possible bidirectional effects, for example using random-intercept cross-lagged panel models (Hamaker et al., 2015), is warranted. Second, despite the high retention rate over time, participation rate at baseline was below 50%, which may have affected the reliability of the sociometric measures. To attenuate this problem, we used unlimited nominations within each grade. Yet, although sociometric measures of popularity tend to be reliable even with low participation rates, this may have not been the case for peer preference (Marks et al., 2013). Although this remains a limitation, concerns were alleviated by the pattern of correlations emerged among peer constructs, especially the associations between peer popularity and peer preference, which was highly consistent with prior research (see van den Berg et al., 2020). Third, dichotomizing peer stressors to create a cumulative risk index has a number of shortcomings. Although we computed this index consistently with prior metrics of cumulative risk (e.g., Evans et al., 2013; Wade et al., 2018), the dichotomization process still relied on somewhat arbitrary cut-offs (e.g., using the upper quartile) and may have led us to neglect relevant within-person differences. Finally, we relied on a self-report measure of physical health. Prior work has provided evidence for the validity of self-reported physical health symptoms among adolescents; for example, self-reported symptoms discriminate adequately between ill and healthy youth (Sapin et al., 2005) and correlate with more objective indicators of physical heath (e.g., health visits; Varni et al., 2001). However, as discussed above, the use of self-report to assess both physical health and peer victimization may have yielded inflated associations; thus, future work should attempt to replicate these findings using more objective measures of physical health, such as medical care use/diagnoses or biological markers (e.g., inflammation markers).

In sum, the current study indicates that when examining the role of multiple peer stressors on adolescent perceived physical health in a stringent and nuanced manner, peer victimization emerges as the most relevant predictor. As such, this study extends prior research that examined the effects of single peer stressors in isolation, highlighting that the type of peer stressor matters, and to address physical ill health in adolescence it might especially be important to focus on peer victimization.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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