

Linking Peer Victimization with Sleep in Early Adolescence

by

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Abstract

The present study examined the association between peer victimization and sleep quality in early adolescence. Negative emotional arousal in the context of peer stress was examined as a possible mediator, and both sex and ethnicity were explored as possible moderators of the association between peer victimization and sleep quality. Participants included one hundred-twenty-three fifth and sixth graders at Time 1 (T1; $M_{age} = 12.03$, $SD = .64$). Adolescent, parent, and teacher reports of peer victimization were collected at T1, and adolescent reports of sleep quality were collected at T1 and T2, ten months later. Adolescent-reported, parent-reported, and the cross-informant composite of peer victimization were associated concurrently with poorer sleep quality. Adolescent-reported and composite peer victimization predicted poorer sleep quality over a ten month period, controlling for earlier sleep quality and demographic variables. Sex moderated the prospective association for adolescent, parent, and composite reports, such that peer victimization predicted poorer sleep quality more strongly among girls than boys. Negative emotional arousal did not operate as a mediator. This study contributes more evidence to the developmental-ecological model proposed by El-Sheikh & Sadeh (2015), providing the strongest evidence to date that peer victimization experiences can interfere with sleep in early adolescence. Future research should examine multiple dimensions of peer victimization and sleep, including objective measures.

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I. Introduction

The role of sleep in child and adolescent development is a burgeoning area of research. The growth in research on sleep and child development is related to three types of evidence that demonstrate the significance of sleep, as recently outlined by El-Sheikh and Sadeh (2015). First, people spend much more time in sleep than in any other activity throughout the lifespan. Sleep is especially salient for young children, as they spend more time asleep than awake (Galland, Taylor, Elder, & Herbison, 2012), and young adolescents still spend approximately one-third of their time asleep (Keyes, Maslowsky, Hamilton, & Schulenberg, 2015). Second, although people spend a great deal of time asleep, sleep problems are symptoms of many psychopathologies and the leading cause of parental help-seeking in early childhood (American Psychiatric Association, 2013; Byars, Yolton, Rausch, Lanphear, & Beebe, 2012). Between one-fourth and one-third of adolescents get inadequate sleep nightly (Smaldone, Honig, & Byrne, 2007).

In addition to time asleep and the prevalence of sleep problems, the developmental significance of sleep is evident in research that links sleep problems with mental and physical health problems throughout the lifespan (El-Sheikh & Sadeh, 2015). Numerous studies have linked sleep disruptions in childhood with physical health problems including obesity (see Cappuccio, Taggart, Kandala, & Currie, 2008 for a meta-analysis) and compromised immune system functioning (Opp & Krueger, in press; Knutson, 2012). Sleep disturbances have also been linked with cognitive-academic problems including poor school performance (Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010) and impaired executive functioning (Araujo & Almondes, 2013; Buckhalt, 2011; Sadeh, 2007). Sleep disruptions may also prevent consolidation of information

learned at school into long-term memory (Wilhelm, Prehn-Kristensen, & Born, 2012). Furthermore, as reviewed by Gregory and Sadeh (2012), sleep problems predict internalizing difficulties including anxiety (Gregory, Caspi, Eley, Moffitt, O'Connor, & Poulton, 2005) and depression among adolescents (Roane & Taylor, 2008), and the association between sleep problems and internalizing symptoms may be stronger among young adolescents than younger children (Johnson, Chilcoat, & Breslau, 2000). Sleep problems in childhood and adolescence also predict externalizing problems including oppositional and aggressive behaviors (Kelly & El-Sheikh, 2014), early onset drug use (Wong, Brower, & Zucker, 2009), attention difficulties (O'Callaghan, Mamun, O'Callaghan, Clavarino, Williams, & Bor, 2010), and addiction (Wong, Brower, Gitzgerald, & Zucker, 2004).

A variety of biological, social, and environmental risk factors have been identified as potential causes of sleep dysfunction around the transition to adolescence (El-Sheikh, 2011). One understudied source of sleep disruptions is peer victimization in early adolescence. Rates of peer victimization rise around the transition to adolescence (Nansel, Overpeck, Pilla, Ruan, Simons-Morton, & Scheidt, 2001), and peer victimization experiences are associated with concurrent emotional distress (Nishina & Juvonen, 2005; Nishina, 2012) as well as lasting symptoms of depression and anxiety (Reijntjes Kamphuis, Prinzie, & Telch, 2010). Given that threatening conditions and negative emotions interfere with sleep (Dahl, 1996), peer victimization is a potential source of sleep disruptions in early adolescence (Luntamo, Sourander, Rihko, Aromaa, Helenius, Koskelainen, & McGrath, 2012; Biebl, DiLalla, Davis, Lynch, & Shinn, 2011).

The present study sought to examine (1) whether peer victimization (as reported by adolescents, parents, and teachers) predicts increased sleep problems (as reported by adolescents) over time and (2) whether negative emotional responses to peer stress mediate the prospective

association between peer victimization and sleep problems. Primary innovations of this study include the use of multiple informants of peer victimization and the prospective design following young adolescents across the transition to middle school. The following literature review addresses: (1) sleep within the developmental context of early adolescence, (2) conceptual models linking social-environmental stress with sleep problems, (3) existing studies of the association between peer victimization and sleep problems, (4) preliminary evidence that negative emotional arousal may mediate the association between peer victimization and sleep problems, and (5) the measurement of sleep.

Sleep in Early Adolescence

Early adolescence is a critical development period during which to study sleep, as a variety of biological, social, and contextual changes may affect sleep during this period. In the biological domain, changes due to maturation increase stress on the body during early adolescence, which have been linked with changes in melatonin secretion (Cajochen, Krauchi, & Justice, 2003). Other examples of biological changes related to sleep during adolescence include decreases in slow-wave sleep (Colrain & Baker, 2011) and synaptic pruning of neurons (Campbell & Feinberg, 2009). Early adolescents' circadian rhythm also changes with puberty, such that the initial sleep phase occurs later in the night (Sadeh, Dahl, Shahar, & Rosenblat-Stein, 2009).

Social and other contextual factors may also contribute to sleep difficulties in early adolescence. For example, around the transition to adolescence, negative affect in family interactions increases (Larson, Richards, Moneta, Holmbeck, & Duckett, 1996) and experiences of peer maltreatment escalate (Nansel et al., 2001). In addition, young adolescents often face higher homework and extracurricular demands, which may be linked with increased stress and

sleep dysfunction (Kouzma & Kennedy, 2002). Furthermore, nearly all adolescents in the US have at least one electronic device in their bedrooms (National Sleep Foundation, 2006). Young adolescents spend a significant amount of time on electronic media, TV, DVD, video games, and social media (Gentile, Lynch, Linder, & Walsh, 2004), each of which may impair adolescents' sleep duration and onset of sleep (Hale & Guan, 2014).

Consistent with the range of biological, social, and contextual factors that may interfere with sleep, it is well documented that young adolescents are sleep deprived. Empirical evidence from a summary of findings indicates that between 9 and 11 hours of sleep is recommended for young adolescents (Hirshkowitz, Whiton, Albert, Alessi, Bruni, DonCarlos, & Hillard, 2015; Mercer, Merritt, & Cowell, 1998), yet a significant portion of adolescents obtain less than 7 hours of sleep per night. Based on a nationally representative sample ($n = 44,892$), approximately 35% of eighth graders obtained less than 7 hours of sleep in 2012 (Keyes et al., 2015). Perhaps more alarming, eighth graders reported a 2-hour decrease in nightly sleep between 1991 and 2012, the largest decrease of all other adolescent age groups in the study (Keyes et al., 2015).

Conceptualizing Sources of Sleep Disruptions

Dahl's (1996) model of sleep and arousal regulation provides an explanation about why social-environmental stressors may disrupt sleep. According to Dahl's conceptualization, sleep and emotion are intertwined due to their overlapping regulation within the prefrontal cortex. Emotional arousal is an opponent process to sleep; sources of environmental threat elicit emotional arousal and vigilance, and thereby undermine felt security and impair sleep. Although Dahl's model likely applies to a variety of environmental threats, it has been applied most extensively in the domain of family stress and conflict. An accumulating body of cross-sectional

and longitudinal research, using both subjective and objective measures of sleep, demonstrates that inter-parental and parent-child conflict interferes with children's sleep quantity and quality (El-Sheikh, 2011; El-Sheikh & Sadeh, 2015). For example, El-Sheikh, Buckhalt, Mize, and Acebo (2006) found concurrent associations linking child-reported marital conflict with child-reported sleepiness and actigraphic measures of more frequent and longer night-wakings. Recent longitudinal evidence further establishes the link between family conflict and children's sleep. In a sample of 282 children, physical parent-child conflict predicted reduced sleep continuity (sleep efficiency, long wake episodes) one year later (Kelly, Marks, & El-Sheikh, 2014).

The connection between family stress and children's sleep is one dimension of a broader systems perspective on individual and environmental factors related to sleep (Bronfenbrenner, 1979; El-Sheikh & Sadeh, 2015). El-Sheikh and Sadeh's (2015) model identifies multiple individual factors as well as proximal and distal environmental factors that might support or undermine children's sleep. Individual-child characteristics that influence sleep include neurological and maturational changes. For example, reliable findings have implicated the pineal gland, a biological system, as responsible for melatonin secretions and changes in the circadian sleep cycle (Cajochen et al., 2003; Klerman, Shanahan, & Brotman, 2002). The immediate environmental context refers to children's closest relationships, generally considered family members or caregivers. As discussed above, longitudinal research links parent-child conflict (Kelly, Marks, El-Sheikh, 2014) and marital conflict (El-Sheikh, Hinnant, & Erath, 2015) with disruptions in children's sleep. The social context includes children's peer relationships, friends, and romantic relationships. In an editorial review of contextual factors associated with sleep, Becker, Langberg, and Byars (2015) highlighted that few studies have examined sleep outcomes in the context of peer relationships, yet recent research suggests that community victimization

and peer victimization predict sleep problems (Umlauf, Bolland, Bolland, Tomek & Bolland, 2015; Kliewer & Lepore, 2015; Lepore & Kliewer, 2013). At the most distal level, cultural beliefs shape expectations regarding sleep, and adolescent sleep can vary widely by culture. One study found that average nightly sleep for South Korean adolescents averaged approximately 5 hours per night during the twelfth grade (Yang, Kim, Patel, & Lee, 2005). Whereas research increasingly addresses these multiple contextual influences, one potential determinant of sleep that has been neglected is the social context of peer victimization.

As reviewed below, very few studies have examined associations between peer victimization and sleep, and no study to date has investigated the possible mechanism linking peer victimization with sleep. Dahl (1996) suggested that sleep and arousal are deeply connected, both being regulated by the prefrontal cortex. For example, Yoo, Gujar, Hu, Jolesz, and Walker (2007) found that sleep-deprived participants, compared to controls, showed weaker connectivity between the amygdala and the prefrontal cortex, which is theorized to regulate emotional responses. Thus, victims of peer aggression may be at risk for sleep problems via emotional arousal. Indeed, it is well known that victimized children experience concurrent emotional distress (Nishina & Juvonen, 2005; Nishina, 2012) as well as persistent depression and anxiety (Reijntjes et al., 2010).

Peer Victimization and Sleep

Peer victimization refers to relational, verbal, or physical aggression from peers that may endure over time (Ladd, Kochenderfer, & Coleman, 1997). Peer victimization may occur directly (e.g. kicking, punching, name-calling) or indirectly through gossiping, ignoring, or exclusion from social activities by peers (Eisenberg & Aalsma, 2005; Cullerton-Sen & Crick, 2005). Experiences of peer victimization increase around the transition to adolescence. Around 15% of

young adolescents are victimized on a daily or weekly basis, and approximately 50% report at least occasional peer victimization (Nansel et al., 2001). Young adolescents who are victimized experience anger (Nishina & Juvonen, 2005) and increased externalizing behaviors over time (Reijntjes, Kamphuis, Prinzie, Boelen, Van der Schoot, & Telch, 2011), as well as anxiety and humiliation (Nishina & Juvonen, 2005) and increased internalizing problems and psychosomatic complaints over time (Reijntjes et al., 2010; Gini & Pozzoli, 2009). Peer victimization is also reliably associated with poorer academic achievement (Nakamoto & Schwartz, 2010).

Very few published studies have examined the association between peer victimization and sleep in childhood or adolescence. These studies provide preliminary evidence, yet they are limited by single-item assessments of peer victimization or sleep, single-informant designs, and lack of autoregressive analyses, precluding conclusions about direction of associations. Existing studies of peer victimization and sleep are summarized below, beginning with the most limited designs followed by more rigorous studies.

A cross-sectional study of adolescents ($n = 2,215$, ages 13 - 18) from Finland examined associations between psychosocial stressors, including victimization, and psychosomatic complaints, including sleep (Luntamo et al., 2012). Adolescents provided self-reports of peer victimization and sleep problems. Peer victimization was measured with a subscale of the Strengths and Difficulties Questionnaire (e.g. “How often have you been bullied (1) at school (2) outside school during the past 6 months?”). Frequency of sleep problems was assessed from a single-item (“Have you experienced problems with falling asleep or sleeping?”). Young adolescents who had been victimized more than once per week were 1.5 times more likely to experience sleep problems than those who had experienced victimization less than once per week. A significant positive relationship also existed between peer victimization and headaches

and abdominal pain. Although results of this study are consistent with the conceptualizations reviewed above, the cross-sectional and single-informant design and the narrow assessments of peer victimization and sleep limit the strength of its conclusions.

In another cross-sectional study comprised of 2,766 preadolescents (age 9-12), investigators examined the associations between victim- and bully-status and self-reported psychosomatic complaints (Fekkes, Pijpers, & Verloove-Vanhorick, 2004). Preadolescents reported the frequency of being bullied on a single-item (“How often did other children bully you during this school year?”) and reported whether sleep problems occurred never, sometimes, or often in the last 4 weeks. Results indicated that being victimized was associated with higher rates of health complaints, including a higher rate of sleep problems. Of the participants that were bullied ($n = 390$), 42.2% reported sleep problems compared to 23.4% of those who were neither bullied nor a bully ($n = 2205$). Victimized students also reported higher rates of headache, feeling tense, anxiety, feeling tired, and feeling listless. In addition to physical symptoms, victimized youth reported more emotional problems. They were approximately twice as likely to report crying (4.4%) and approximately seven times as likely to report a strong indication for depression, as measured by the Depression Questionnaire for Children.

Gini (2008) also examined psychosomatic complaints and victimization among 3rd, 4th, and 5th graders ($n = 565$) in northern Italy. Children completed the six-item Peer Victimization Scale (e.g. “Other children tease me with objects or with their hands”, “Other children laugh at me”) and reported how often they experienced “sleep problems” and “feeling tired.” Victimized children were at higher risk for sleeping problems ($OR = 5.77$) and feeling tired ($OR = 4.13$) compared to non-victimized children. Like the studies reviewed above, this study is limited by its cross-sectional design and use of child-reports of both peer victimization and sleep problems.

Biebl et al. (2011) examined associations between peer victimization and physical and mental health problems longitudinally across three waves. The investigators hypothesized that youth who experienced chronic victimization would report more physical health problems, including sleep problems. At Time 1 ($n = 283$, age 5) peer victimization was measured through observations of 20-minute play sessions. Adolescents then completed the Mynard Peer Victimization Scale (MPVS, 16 items) at Time 2 (ages 10 – 18). At Time 3, the adolescents ($n = 70$, ages 12 - 20) again completed the MPVS. Sleep was assessed by self-report on the Physical Health Questionnaire at Time 3. Results revealed an association between chronic victimization and rates of physical health problems, including sleep problems, and this association was exacerbated among adolescents with internalizing symptoms. Additionally, the authors tested for differences in associations between peer victimization and sleep problems by sex. A group comparison revealed a significant victimization by sex interaction, such that girls who were chronically victimized by peers experienced more sleep problems. However, no significant relationship existed for boys. Although, again, results of this study are consistent with conceptual models linking social stress with sleep problems, the assessment of sleep only at Time 3 and as part of a broader battery of physical health problems precludes interpretations about the link between peer victimization and sleep specifically.

In a longitudinal study including 986 seventh grade youth, Lepore and Kliever (2013) expected sleep disturbances to serve as a mechanism that explains the association between peer victimization and academic performance. Peer victimization was self-reported using 12 items from the Problem Behavior Frequency Scales (e.g. “Someone spread a false rumor about you”). Sleep problems were assessed by the validated Sleep/Wake Behavior Problems scale, a 10-item self-report measure which assessed the frequency of sleep disturbances (e.g., “Extremely hard

time falling asleep”). Peer victimization was measured at Time 1, and sleep problems were assessed at Time 1 and six months later at Time 2. Controlling for intrusive thoughts and depressive symptoms at Time 1, peer victimization at Time 1 was associated with a composite of sleep problems across Time 1 and Time 2, and this association did not differ by gender or race. Thus, although sleep problems were assessed at multiple waves, this study did not examine whether peer victimization predicted later sleep problems, controlling for earlier sleep problems.

In a recent study, Tu, Erath, & El-Sheikh (2015) examined whether subjective and actigraphic measures of sleep moderated the relationship between peer victimization and adjustment among a diverse adolescent sample. Although the focus of the study was on sleep as a moderator (sleep moderated the relationship between peer victimization and adjustment problems), they found that peer victimization was moderately correlated with self-reported sleep-wake problems ($r = .36, p < .001$), but not correlated with actigraphic measures of sleep.

These existing studies suggest that peer victimization is associated with poorer sleep among children and young adolescents. However, conclusions about the association are limited due to design and measurement limitations. Among the cross-sectional studies, both peer victimization and sleep were assessed with between one and two items and all peer victimization and sleep measures were self-reported. Two additional studies with multiple time points did not control for earlier sleep when predicting subsequent sleep, precluding directional conclusions. Longitudinal studies that predict change in sleep and include multi-informant or more extensive measurement of peer victimization and sleep are needed.

Mechanisms Linking Peer Victimization with Sleep Disturbances

While the above research offers some preliminary evidence of the association between peer victimization and sleep, no published studies have examined mechanisms linking peer

victimization with sleep problems. Dahl's (1996) model suggests that negative emotional arousal disrupts sleep, and peer victimization is a salient source of negative emotions around the transition to adolescence. Thus, negative emotional arousal in the context of peer stress is a potential mediator of the association between peer victimization and sleep.

Three complementary types of studies provide evidence that peer victimization elicits negative emotional arousal. Some studies examine the association between peer victimization and general internalizing problems, demonstrating the emotional significance of peer victimization (Reijntjes et al., 2010). However, in these studies, peer victimization and internalizing symptoms are measured independent of one another, and the reported experiences of victimization and internalizing distress are not connected in time. Other studies assess children's responses to past experiences of victimization without referring to specific incidents. In these studies, experiences of peer victimization and negative emotions are not necessarily connected in time, but the negative emotion measures refer directly to experiences of peer victimization. Finally, several more recent studies have used daily diary methods to examine real-time connections between specific victimization experiences and emotional responses. Studies of each type are reviewed below.

Reijntjes et al. (2010) conducted a meta-analysis examining the link between peer victimization and internalizing symptoms in both cross-sectional and longitudinal studies. Across 15 longitudinal studies, a significant association existed between peer victimization and later reports of internalizing problems ($r = .18, p < .001, n = 12,361$), with effect sizes ranging from .04 to .41 (Reijntjes et al., 2010). Reijntjes and colleagues concluded that peer victimization is aversive and psychologically costly based on its associations with depressive symptoms, negative self-evaluations, and fear or avoidance of social interactions. Victimized children were

at risk for psychological and emotional distress, and children who reported internalizing symptoms were, in turn, at risk for victimization.

Other types of studies link incidents of peer victimization with negative emotional experiences even more directly. For example, Kochenderfer-Ladd (2004) asked children to report on emotional and coping responses to peer victimization experiences. Participants included 145 elementary aged children (between 5 and 11 years old) who were interviewed for 30 minutes in the fall (T1) and 30 minutes in the spring (T2) of a school year. To assess emotional and coping responses, researchers read a protocol describing scenarios in which children were victimized. Participants were then asked to report on their likely emotional responses if they had experienced the victimization situations. More peer victimization experiences were associated with higher reports of fearful and angry responses. Additionally, emotional responses predicted the coping strategies that the children used. For example, children who experienced more anger and embarrassment were significantly more likely to seek revenge, which further predicted victimization. Thus, peer victimization predicted negative emotions and vigilance, which are incompatible with sleep.

In another longitudinal examination of emotional responses related to peer victimization, Spence, Young, Toon, and Bond (2009) hypothesized that, in response to peer problems, young adolescents would experience more emotional dysregulation (i.e. extended time-course of negative emotions), which would be associated with greater use of maladaptive coping responses (e.g. internalizing, aggression, less social support-seeking). The study included a sample of 255 young adolescents (age 11-14 years) who responded to questionnaires at a three-month interval. Peer victimization was assessed through the Children's Social Experience Questionnaire. Emotional dysregulation was assessed by the Children's Emotional Dysregulation Questionnaire,

which measured control of and recovery from the experiences of anger, fear, and sadness. Peer victimization predicted emotional dysregulation (internalizing and anger) and aggressive coping strategies.

Daily report methods enable researchers to connect particular experiences of peer victimization with negative emotions assessed at the same time or on the same day. Daily report methods can reduce memory distortions and other biases that occur while recalling episodes of peer victimization over a longer period of time (Nishina & Juvonen, 2005). Coie (1990) suggests that daily report methods of peer victimization may provide insight on how recurrent episodes of bullying have a cumulative effect on daily functioning and emotions. Only three studies to date have simultaneously assessed daily reports of peer victimization with daily reports of emotional functioning.

Nishina and Juvonen (2005) examined daily reports of witnessing and experiencing peer victimization and daily reports of negative emotions (anxiety, humiliation, and anger) across two studies. In Study 1 ($n = 95$), middle school participants completed daily questionnaires (at the end of the school day) over four days during a two-week period. Students reported feelings prior to reporting on victimization to reduce the effect of mood changes during the report. Negative affect included 22 items ranging across both positive and negative affect (e.g., feeling worried, nervous, embarrassed or ashamed). Students rated how they “feel right now.” To assess peer victimization, participants were asked two open-ended questions “Did you get picked on, made fun of, insulted, bullied, threatened, shoved, or hit by another student at school today?” Nearly half of the students (46%) had directly experienced peer victimization over the four days of the study. Results from Study 1 indicated that experiences of peer victimization were associated with daily increases in anxiety and humiliation. In study 2 ($n = 97$), similar methods were used, and

anger was added as a dimension of negative affect. On days when students experienced peer victimization but did not witness others being victimized, they reported greater increases in humiliation and anger.

Daily reports of experiencing victimization and negative emotions were also examined in a sample of fifth-grade children ($n = 181$). Morrow, Hubbard, Barhight, and Thomson (2014) examined multiple forms of victimization (physical victimization, verbal, social manipulation, property attacks, and social rebuff). Over eight days, children reported daily on feelings of sadness, anger, embarrassment, and nervousness as a result of multiple forms of peer victimization. Girls reported significantly higher rates of emotional reactivity to social manipulation than boys. Whereas all five forms of peer victimization predicted increased negative daily emotions, physical victimization predicted all four negative emotions independently while controlling the effects of other types of peer victimization.

In an ethnically diverse sample, Nishina (2012) examined daily reports of emotional well-being of sixth graders ($n = 150$) who had been victimized. Nishina hypothesized that physical symptoms, humiliation, and worry would increase as a direct result of peer victimization episodes. Participants reported on five randomly selected days during a two-week period. The students were asked “RIGHT NOW, do you feel...” and then reported on humiliation (five items), worry (four items), and physical symptoms (six items). Humiliation, worry, and physical symptoms were significantly higher on days that students had been victimized.

Thus, multiple types of studies (peer victimization and internalizing symptoms in general, negative emotional responses to peer victimization in general, and specific negative emotions associated with specific incidents of peer victimization) demonstrate that peer victimization is

associated with negative emotional arousal. In addition, several studies have shown that internalizing symptoms and negative emotions predict poorer sleep over time (Kelly & El-Sheikh, 2014; Kouros & El-Sheikh, 2015; Patten, Choi, Gillin, & Pierce, 2000), and that pre-sleep arousal (e.g., racing thoughts, intrusive thoughts, somatic symptoms) is associated with poorer sleep quality (e.g., Smith, Perlis, Smith, Giles, & Carmody, 2000). In the present study, negative emotional arousal in response to peer stress will be examined as a mediator of the association between peer victimization and sleep quality.

Measurement of Sleep

Sleep is a multi-dimensional construct which can be defined and measured behaviorally (e.g., lack of movement, awareness, responsiveness), using subjective or objective methods, and neurologically based on technical brain measurements such as wave-lengths of electrical activity. Typically, sleep has been divided into four dimensions: quality, quantity, sleep architecture, and schedule or circadian aspects (Sadeh, 2015). Quality of sleep is frequently operationalized in sleep studies as night-wakings, sleep efficiency, episodes of disordered breathing (e.g. apnea, snoring), and parasomnias. Sleep duration is typically represented by quantity of time asleep. Sleep architecture is generally measured by obtaining amounts or proportions of slow-wave sleep, REM sleep, or by a spectral distribution of EEG during sleep. Finally, circadian schedules are identified based on sleep onset time, morning rise time, and distribution of naps (see Sadeh, 2015 for a review of sleep measurement).

Sleep can be measured with both subjective and objective methods. Both methodologies have advantages and disadvantages and the inclusion of both is considered more optimal than reliance on one method alone (Sadeh, 2011). Subjective self-reports of sleep are sensitive to individual differences in needs for sleep, and can be used to assess sleep duration, quality (e.g.,

falling asleep easily, sleeping through most of the night), and schedule. Polysomnography (PSG), videosomnography, and actigraphy offer more objective estimates of sleep duration and quality, and PSG can also assess sleep architecture and circadian rhythm (Gregory & Sadeh, 2012; Sadeh, 2015). Whereas objective measures eliminate reporter inaccuracies, such technologies can be costly in time and money, and PSG can be quite burdensome to participants (Lukowski & Bell, 2015). Thus, subjective self-reports are commonly used to measure children's perception of sleep.

The Present Study

Very few studies have examined the association between peer victimization and sleep in early adolescence, and the existing studies are limited by narrow or single-informant measures of peer victimization and sleep, as well as cross-sectional designs or failure to include autoregressive effects of sleep, precluding conclusions about the direction of the association. The present study examined whether adolescent-, parent-, and teacher-reported peer victimization, as well as a cross-informant composite of peer victimization, predicted adolescent-reported sleep quality concurrently and over the course of one year, controlling for earlier levels of sleep quality. Including multiple informants of peer victimization is an important innovation because adolescents, parents, and teachers have complementary perspectives on peer victimization (Ladd & Kochenderfer-Ladd, 2002), and a cross-informant composite provides an estimate of average or overall peer victimization across informants/perspectives. We tested for corroborating evidence linking peer victimization with sleep quality across informants. We hypothesized that adolescent-, parent-, and teacher-reported peer victimization, as well as the cross-informant composite of peer victimization, would each predict poorer sleep quality concurrently and prospectively (controlling for earlier levels of sleep quality).

Beyond the limited research on the association between peer victimization and sleep in early adolescence, mechanisms through which peer victimization may contribute to poorer sleep have not been tested. It is well-established that peer victimization predicts internalizing problems among children and adolescents (Reijntjes et al., 2010), and recent research shows that experiences of peer victimization produce concurrent or same-day negative emotional arousal (Nishina & Juvonen, 2005; Morrow et al., 2014; Nishina, 2012). However, no study to date has examined how these known associations between peer victimization and emotional distress may explain sleep problems. The present study is the first to examine negative emotional arousal (i.e., rumination, intrusive thoughts, physiological arousal, and emotional arousal) as a mediator of the association between peer victimization and poorer sleep quality. Consistent with Dahl's (1996) sleep-arousal model, it is anticipated that negative emotional arousal will partially mediate the prospective association between peer victimization and poorer sleep quality. As exploratory analyses, the present study will also examine sex and race differences in associations among peer victimization, negative emotional arousal, and sleep quality.

II. Method

Participants

One hundred-twenty-three (123) fifth and sixth graders ($M_{age} = 12.03$ years, $SD = .64$) and one parent per child (82% biological mothers, 67% married) participated in the study at Time 1 (T1). The sample of young adolescents included 50% males and 58.5% European Americans, 35% African Americans, and 6.5% of other races/ethnicities. The modal annual family income was between \$35,001 and \$50,000; 21% reported an income of less than \$20,000 and 24% reported an income of more than \$75,000. Teacher reports were obtained for 81% of participants. Ninety-nine (99) adolescents participated at Time 2 (T2; $M_{age} = 12.78$ years, $SD = .63$). Participants with and without T2 data did not differ on age, gender, ethnicity, or income.

Procedures

The short-term longitudinal design of the present study involved two waves of data collection spaced approximately ten months apart. Participants were recruited in two cohorts separated by one year through flyers sent home with fifth and sixth grade students at five elementary schools in the southeastern United States. At T1, parents who responded to the school flyers were given information about the study, and were scheduled for a research visit over the phone in the spring. Teachers completed questionnaires near the end of the school year (May). Adolescents and their parents visited the lab for about two hours in the summer (mostly in June).

Parents were re-contacted during the spring of adolescents' first year in middle school for a follow-up visit (T2). Adolescents and their parents visited the research lab in the spring and

completed questionnaires. Adolescents, parents, and teachers were compensated monetarily. All study procedures were approved by the University Institutional Review Board.

Measures

Peer victimization. At T1, adolescents, parents, and teachers provided reports of peer victimization on well-validated scales. Adolescents completed eight items from the Social Experiences Questionnaire (e.g., “How often do you get pushed or shoved by other peers at school?” and “How often have other kids said mean things about you to keep other people from liking you?”; Crick & Grotpeter, 1996), rated on a 5-point scale (1 = *Almost never* to 5 = *Almost always*). Internal consistency was high ($\alpha = .85$). In addition, parents completed seven items that are commonly used to assess children’s peer victimization experiences (e.g., “Other children try to hurt my child’s feelings by excluding him or her”; Ladd & Kochenderfer-Ladd, 2002; Schwartz, Farver, Chang, & Lee-Shin, 2002), rated on a 5-point scale (0 = *Never* to 4 = *Almost always*). This measure was also highly reliable ($\alpha = .94$). Lastly, teacher-reported victimization was assessed with six items from the Social Behavior Rating Scale (e.g., “Other children hit or push this child,” and “Other children tease or make fun of this child”; Schwartz et al., 2002), rated on a 5-point scale. Internal consistency was high ($\alpha = .91$).

Negative emotional arousal. At T1, adolescents completed the 15-item Involuntary Engagement (IE) subscale of the Responses to Stress Questionnaire (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000) to assess negative emotional arousal in response to peer stress. The IE subscale includes items that capture rumination (e.g., “When problems with other kids come up, I can’t stop thinking about how I am feeling.”), physiological arousal (e.g., “When I have problems with other kids I feel sick to my stomach or get headaches.”), emotional arousal (e.g., “When I have problems with other kids right away I feel really - check all that

apply: angry, sad, scared, worried/anxious, or none”), and intrusive thoughts (e.g., “Thoughts about the problems with other kids just pop into my head.”). Internal consistency of the IE subscale was high ($\alpha = .85$).

Sleep quality. At T1 and T2, adolescents completed five items from the Sleep/Wake Problems Scale of the Sleep Habits Survey (Wolfson & Carskadon, 1998), rated on a 5-point scale (0 = *never* to 4 = *every day/night*). The Sleep Habits Survey and Sleep/Wake Problems Scale have been validated with children and adolescents (Wolfson & Carskadon, 1998). The four items used in the present study include: in the last two weeks, how often have you (1) felt satisfied with your sleep, (2) awakened too early in the morning and couldn’t get back to sleep, (3) had an extremely hard time falling asleep, and (4) had a good night’s sleep. Negatively-valenced items were reverse-scored such that the composite score reflects higher-quality sleep. The internal consistency of the sleep quality composite used in the present study was acceptable at T1 ($\alpha = .61$) and good at T2 ($\alpha = .72$).

Control variables. At T1, parents reported on adolescents’ sex, age, race/ethnicity (European American or ethnic minority), and annual household income.

Plan of Analysis

Descriptive statistics and correlations were computed in SPSS. To examine all aforementioned hypotheses, multiple regression analyses were performed in AMOS which uses full information maximum likelihood estimation. All regression analyses controlled for adolescent age, sex, and race, as well as family income. Separate analyses were conducted with adolescent-, parent-, and teacher-reported peer victimization, as well as a cross-informant composite (mean of adolescent, parent, and teacher reports) of peer victimization, as the predictor. We examined whether T1 peer victimization predicted T1 sleep quality. We also

examined whether T1 peer victimization predicts T2 sleep quality, controlling for T1 sleep quality. In both concurrent and longitudinal analyses, we examined whether either sex or race moderated the association between peer victimization and sleep using standard procedures (Aiken & West, 1991). In cases of moderation, simple slopes linking peer victimization with sleep were computed and plotted for females and males or European Americans and ethnic minorities (Holmbeck, 2001). To test mediation, we examined whether (a) T1 peer victimization predicted T1 negative emotional arousal, (b) T1 negative emotional arousal predicted T2 sleep quality controlling for T1 sleep quality, and (c) the association between T1 peer victimization and T2 sleep quality was reduced or eliminated when both T1 peer victimization and T1 negative emotional arousal were included in the model, controlling for T1 sleep quality (Baron & Kenny, 1986).

III. Results

Preliminary Analyses

Descriptive statistics were computed to obtain the means and standard deviations of the study variables (Table 1). Adolescents, parents, and teachers reported that peer victimization occurred relatively infrequently (e.g., less than “sometimes”), but substantial variability existed across adolescents. Adolescents reported, on average, a low level of negative emotional arousal. At Time 1 and Time 2, adolescents reported moderately good sleep quality during the previous two weeks, though sleep problems were commonly reported on at least some nights (Table 1).

Correlations were conducted for all variables under study (Table 2). As indicated in Table 2, adolescent reports of peer victimization were moderately correlated with parent reports of peer victimization ($r = .51, p < .01$). However, no significant correlation existed between adolescent reports and teacher reports of victimization ($r = .19, p > .10$). Parent and teacher reports of peer victimization were moderately correlated ($r = .40, p < .01$). These correlations converge with existing evidence that multiple informants are useful for a more comprehensive view of peer victimization (Ladd & Kochenderfer-Ladd, 2002). Adolescent-reported, parent-reported, and composite peer victimization were negatively associated with sleep quality at Time 1. Both adolescent-reported and composite peer victimization (Time 1) were negatively correlated with sleep quality at Time 2 (Table 2). Several correlations emerged across observers (adolescent, parent, composite) and negative emotional arousal. However, teacher-reported peer victimization (T1) was not significantly correlated with adolescent-reported sleep or negative emotional arousal concurrently or longitudinally.

Linking Peer Victimization with Sleep Quality

Adolescent-reported peer victimization predicting sleep quality. In the cross-sectional regression analysis, higher annual income was associated with higher T1 sleep quality, but no other demographic variables were independently associated with T1 sleep quality (Table 3, left column). As hypothesized, adolescent-reported peer victimization was negatively associated with T1 sleep quality above and beyond demographic control variables, explaining an additional 12% of the variance in sleep quality. Neither sex nor race moderated the association between adolescent-reported peer victimization and T1 sleep quality.

In the longitudinal regression analysis, T1 sleep quality strongly predicted T2 sleep quality, explaining 17% of the variance in T2 sleep quality (Table 3, right column). No demographic control variables predicted T2 sleep quality. As anticipated, higher adolescent-reported peer victimization predicted lower T2 sleep quality and explained an additional 3% of the variance, controlling for T1 sleep quality and demographic control variables. Both sex and race moderated the association between adolescent-reported peer victimization and T2 sleep quality, and these interactions explained an additional 6% of the variance in T2 sleep quality. As shown in Figure 1, simple slopes analyses revealed that the negative prospective association between peer victimization and T2 sleep quality was stronger among girls ($B = -.68$, $SE = .12$, $\beta = -.57$, $p < .001$) than boys ($B = -.32$, $SE = .09$, $\beta = -.32$, $p < .001$). In addition, as shown in Figure 2, peer victimization predicted poorer sleep among European American adolescents ($B = -.32$, $SE = .09$, $\beta = -.32$, $p < .001$) but not among ethnic minorities adolescents ($B = -.03$, $SE = .09$, $\beta = -.03$, $p = .75$).

Parent-reported peer victimization predicting sleep quality. The cross-sectional analysis again revealed that higher annual income was associated with higher sleep quality at

Time 1; however no other demographic variable was associated with sleep quality concurrently (Table 4). As hypothesized, parent-reported peer victimization was negatively associated with T1 sleep quality, controlling for all else in the model. Parent-reported peer victimization explained an additional 6% of the variance in sleep quality compared to control variables alone. Neither sex nor race moderated the relationship between parent-reported peer victimization and sleep quality concurrently (Table 4, left column).

In the longitudinal regression analysis, no demographic variables predicted T2 sleep quality controlling for earlier levels of sleep quality. In contrast to our hypothesis, parent-reported peer victimization did not predict T2 sleep quality controlling T1 sleep and demographic variables. However, sex moderated the association between parent-reported peer victimization and T2 sleep quality at the non-significant trend level. As shown in Figure 3, simple slopes analyses indicated that parent-reported peer victimization predicted lower T2 sleep quality among girls ($B = -.25, SE = .11, \beta = -.20, p < .05$), but not boys ($B = .09, SE = .11, \beta = .07, p = .42$). Ethnicity did not moderate the association between parent-reported peer victimization and T2 sleep quality.

Teacher-reported peer victimization predicting sleep quality. In the cross-sectional regression analysis (Table 5), income was again positively associated with sleep quality at T1 and no other demographic variables were independently associated with sleep quality. In contrast to our prediction, teacher-reported peer victimization was not associated with T1 sleep quality and no additional variance was explained by including teacher-reported victimization in the model. In the final model (left column, Table 5), sex did not moderate the association between teacher-reported peer victimization and T1 sleep quality. However, race moderated the association between teacher-reported peer victimization and T1 sleep quality at the non-

significant trend level (Figure 4). Simple slopes analyses revealed that peer victimization was associated with poorer sleep quality among ethnic minorities adolescents ($B = -.36, SE = .09, \beta = -.27, p < .01$), but not among European-American adolescents ($B = .06, SE = .13, \beta = .05, p = .63$).

In the longitudinal regression analysis, demographic variables did not predict T2 sleep quality. Contrary to the hypothesis, teacher-reported peer victimization did not predict T2 sleep quality, controlling for T1 sleep quality and demographic controls (Table 5, right column). Neither sex nor race moderated the prospective relationship between teacher-reported peer victimization and T2 sleep quality.

Composite peer victimization predicting sleep quality. In the cross-sectional regression analysis, higher annual income was associated with higher T1 sleep quality, but no other demographic variables were independently associated with T1 sleep quality (Table 6, left column). As hypothesized, composite peer victimization was negatively associated sleep quality concurrently, controlling for all else in the model. Composite peer victimization explained an additional 9% of the variance in T1 sleep quality. Neither sex nor race moderated the association between composite-report of peer victimization and T1 sleep quality.

In the longitudinal regression analysis, no demographics variables predicted T2 sleep quality. As predicted, the composite-report of peer victimization predicted lower levels of T2 sleep quality, controlling for T1 sleep quality levels and demographic variables. The inclusion of the composite-report of peer victimization explained an additional 2% of the variance in T2 sleep quality, beyond the model with T1 sleep quality and demographic controls. In the final model (Table 6, right column), sex moderated the association between the composite-report of peer victimization and T2 sleep quality, and taken together, these interactions explain an additional

3% of variance in T2 sleep quality. As shown in Figure 5, simple slopes analyses indicated that the negative prospective association between the composite-report of peer victimization and T2 sleep quality was stronger among girls ($B = -.59, SE = .10, \beta = -.47, p < .001$) than boys ($B = -.20, SE = .10, \beta = -.18, p < .05$).

Negative Emotional Arousal as a Possible Mediator

Peer victimization predicting negative emotional arousal. Regression analyses were used to examine the concurrent association between peer victimization and negative emotional arousal across informants. Among the demographic variables, sex and annual income were concurrently associated with adolescent-reports of negative emotional arousal. As hypothesized, adolescent-, parent-, and composite-reported peer victimization were positively associated with T1 negative emotional arousal (see Tables 7, 8, & 10, respectively) and they explained an additional 21%, 10%, and 14% of the variance in negative emotional arousal, respectively, controlling for all demographic variables. However, teacher-reported peer victimization was not associated with negative emotional arousal concurrently (see Table 9) and explained no additional variance in adolescent-reported negative emotional arousal.

Negative emotional arousal predicting sleep. In the cross-sectional regression analysis (Table 11, left column), higher annual income was associated with higher T1 sleep quality, but no other demographic variables were independently associated with T1 sleep quality. As hypothesized, T1 adolescent-reported negative emotional arousal was negatively associated with T1 sleep quality, explaining an additional 13% of the variance in T1 sleep quality. In the longitudinal regression analysis, no demographic variables predicted T2 sleep quality. Additionally, T1 negative emotional arousal did not predict T2 sleep quality, controlling for earlier levels of sleep and demographic variables. Sex did not moderate the relationship between

negative emotional arousal and sleep quality at either T1 or T2. However, race did moderate the relationship longitudinally, such that greater levels of negative emotional arousal predicted poorer sleep quality for ethnic minorities ($B = -.42, SE = .14, \beta = -.25, p < .01$), but not European Americans ($B = .18, SE = .14, \beta = .12, p = .19$).

Further mediation analyses were not conducted because T1 negative emotional arousal did not predict T2 sleep quality. Although T1 negative emotional arousal was associated with T1 sleep quality, mediation analyses with all variables measured concurrently are susceptible to alternative directional interpretations, particularly given evidence that poorer sleep quality contributes to negative emotional arousal (e.g., Baum, Desai, Field, Miller, Rausch, & Beebe, 2014).

IV. Discussion

The present study examined whether peer victimization predicts subjective sleep quality concurrently and across time in early adolescence. Sex and race were explored as possible moderators of the association between peer victimization and sleep quality, and negative emotional arousal was examined as a possible mediator. This study advances the existing literature in several ways. First, multiple informants of peer victimization were included, such that some analyses were not subject to common method variance. Second, to our knowledge, this study is the first to examine the association between peer victimization and sleep quality prospectively, with autoregressive control of earlier sleep quality. Third, more comprehensive, multi-item measures of peer victimization and sleep were used, improving upon the single-item measures in most of the existing literature on peer victimization and sleep. Lastly, negative emotional arousal was examined as a potential mechanism linking peer victimization with poorer sleep quality.

Linking peer victimization with sleep quality. Findings from the present study corroborate existing evidence linking higher levels of peer victimization with poorer sleep and advance the scientific literature using a conservative longitudinal and multi-informant design. In addition to cross-sectional associations between peer victimization and poorer sleep quality, adolescent-reported peer victimization predicted poorer sleep quality over 10 months, controlling for earlier sleep quality and demographic variables. The longitudinal association between adolescent-reported peer victimization and T2 sleep quality was moderated by sex, such that peer victimization predicted poorer sleep quality more strongly for girls than boys. Moreover, parent-

reported peer victimization was associated with lower sleep quality at T1, and a marginal interaction effect with sex revealed that parent-reported peer victimization predicted lower T2 sleep quality among girls, but not among boys. In contrast, teacher-reported peer victimization was not associated with T1 or T2 sleep quality. However, the cross-informant (adolescent, parent, and teacher) composite of peer victimization was associated concurrently with T1 sleep quality and predicted poorer T2 sleep quality, controlling for T1 sleep quality and demographic variables. This longitudinal association was also moderated by sex, such that composite peer victimization predicted poorer sleep quality more strongly among girls than boys.

Few studies have examined the association between peer victimization and sleep, yet there is converging evidence based on relatively large samples that victimized children and adolescents report more frequent difficulties with sleep. Most prior studies have been limited by narrow or single-item measures, single-informant designs, and cross-sectional analyses (Luntamo et al., 2012; Fekkes, Pijpers, & Verloove-Vanhorick, 2004; Gini, 2008). Some prior studies have used prospective designs to examine peer victimization and sleep difficulties, but these studies were also limited by single-informant designs and failed to control for earlier levels of sleep difficulties (Biebl et al., 2011; Lepore & Kliever, 2013). The present study offers new evidence that adolescent-reported peer victimization predicts poorer sleep quality over time, controlling for earlier sleep quality as well as age, sex, race, and family income. Further, some results suggested that the association between peer victimization and poorer sleep quality may not be limited to same-informant designs, particularly among adolescent girls, for whom both parent-reported and composite peer victimization also predicted poorer sleep quality longitudinally.

Moderation by sex. Although both adolescent-reported and composite peer victimization predicted poorer sleep quality over time among boys and girls, adolescent-report, parent-report, and composite models suggested that the association between peer victimization and poorer sleep quality is stronger among girls than boys. To our knowledge, only two prior studies have examined sex differences in the association between peer victimization and sleep. Consistent with results of the present study, Biebl et al. (2011) found that chronically victimized girls reported more sleep problems than chronically victimized boys. In contrast, Kliewer and Lepore (2013) tested but did not find evidence that sex moderated the association between peer victimization and sleep. Thus, although results are not entirely consistent, existing studies provide some evidence that girls are more susceptible to sleep problems in the context of peer victimization than boys.

One reason that girls' sleep may be particularly affected by peer victimization involves sex differences in the content and structure of peer relationships during early adolescence. In a review of sex differences in social relationships, Rose and Rudolph (2006) reported that boys more frequently engage in large groups and are more likely to establish dominance hierarchies. Competition- and dominance-oriented behaviors and attributes are particularly salient among boys during pubertal development (Geary, 1999). Girls spend more time in dyadic and small-group interaction, and they demonstrate more empathy, nurturing, and self-disclosure than boys. Girls also report greater concerns about positive peer evaluations, maintaining connections in close relationships, and the status of relationships than boys (Benenson & Benarroch, 1998; Rose & Rudolph, 2006). Thus, peer victimization experiences may be perceived as more normative and syntonetic with the relatively competitive culture of adolescent boys than with the relatively cooperative culture of adolescent girls. As such, peer victimization may produce more

psychological discordance among girls, and thereby disrupt their sleep to a greater degree than boys.

Mechanism linking peer victimization with sleep. Dahl's sleep-arousal model suggests that stressful or threatening events (e.g. peer victimization, marital conflict) produce a state of vigilance that undermines sleep, as vigilance and sleep are opposing processes regulated, in part, by the prefrontal cortex (Dahl, 1996). Consistent with Dahl's theory, recent studies have shown that family stress and conflict predicts emotional distress which, in turn, predicts poorer sleep (Kelly & El-Sheikh, 2013). Yet, no studies have examined whether emotional distress mediates the association between peer victimization and sleep.

Peer victimization is a well-studied source of stress in the peer domain in early adolescence. Substantial evidence, both cross-sectional and longitudinal, has linked peer victimization with internalizing symptoms and negative self-evaluations (Reijntjes et al., 2010). Beyond the considerable amount of literature that has linked peer victimization with internalizing symptoms more generally, several studies have demonstrated that imagining or recalling experiences of peer victimization creates emotional distress (Kochenderfer-Ladd, 2004; Nishina & Juvonen, 2005).

Given the emotional distress associated with peer victimization, it is possible that peer victimization interferes with sleep via emotional arousal or distress. Indeed, several studies have shown that internalizing symptoms and negative emotions predict poorer sleep over time. For example, Patten, Choi, Gillin, and Pierce (2000) found, in a large adolescent sample ($n = 7960$), that participants who reported notable depressive symptoms were approximately 50% more likely to develop sleep problems four years later. Kelly and El-Sheikh (2014) reported that children's depression symptoms predicted fewer sleep minutes and lower sleep quality over a

one year period. In another study, children wore actigraphs for seven consecutive nights and parents were contacted nightly to report on sleep and mood throughout the day. Children took longer to fall asleep and exhibited more sleep activity on nights when they experienced more negative moods earlier in the day (Kouros & El-Sheikh, 2015).

The studies reviewed above indicate that peer victimization and negative emotions each predict poorer sleep outcomes over time. Along with evidence that peer victimization is associated with negative emotions, we hypothesized that negative emotional arousal in the context of peer stress would mediate the association between peer victimization and poorer sleep quality. As expected in the present study, peer victimization was associated with negative emotional arousal, and in concurrent models, negative emotional arousal was associated with poorer sleep quality. However, negative emotional arousal did not predict poorer sleep quality over time, controlling for earlier sleep quality, precluding strong evidence that negative emotional arousal mediates the prospective association between peer victimization and sleep quality in the present study.

One factor that may have mitigated mediational evidence in the present study is that the measure of negative emotional arousal in the context of peer stress is more narrowly focused than measures of negative emotions in other studies which show that negative emotions predict poorer sleep quality over time. For example, Kelly and El-Sheikh (2014) used the Children's Depression Inventory (CDI; Kovacs, 1984) to record participants' internalizing symptoms. They found that depressive symptoms (e.g. negative feelings and mood) at T1 predicted poorer sleep quality at T2. The CDI provides a broad and generalized picture of internalizing problems (e.g., "I am sad all the time" or "I am sad once in a while"). However in the present study, negative emotional arousal refers specifically to problems with peers. Thus, broadening the scope of

negative emotional arousal to include more general emotional-upset may improve the chances of detecting a mediation effect. However, some valuable understanding of the emotional experience of peer victimization may be lost.

Another potential explanation for the failure to detect prospective mediational evidence concerns the content of the measure of negative emotional arousal in the present study. Items from the Involuntary Engagement subscale of the Responses to Stress Questionnaire refer to intrusive thoughts (e.g., “Thoughts about the problems with other kids just pop into my head.”), rumination (e.g., “When problems with other kids come up, I can’t stop thinking about how I am feeling.”), emotional arousal (e.g., “When I have problems with other kids right away I feel really - check all that apply: angry, sad, scared, worried/anxious, or none”), and physiological distress (e.g., “When I have problems with other kids I feel sick to my stomach or get headaches.”). These items may more adequately describe internalizing symptoms, similar to anxiety, than externalizing symptoms like anger and frustration, which may predict sleep disruptions equally or more strongly than internalizing symptoms. Kochenderfer-Ladd (2004) found that anger and frustration in response to peer victimization predicted coping strategies like revenge, whereas anxious emotions (e.g., fear) predicted less arousing strategies, such as seeking advice. Furthermore, Kelly and El-Sheikh (2014) recently reported that externalizing symptoms predicted later sleep/wake problems. Thus, a measure of negative emotional arousal that better captures both internalizing (e.g., fear, sadness) and externalizing (e.g., anger, frustration) emotions may be more likely to mediate the prospective association between peer victimization and poorer sleep quality.

Limitations and Future Directions

The results of the current study advance the existing evidence that peer victimization and sleep problems are associated in early adolescence, particularly by showing that higher levels of peer victimization predict poorer sleep quality over time. The current study also provides consistent, albeit exploratory, evidence that the longitudinal association between peer victimization and poorer sleep quality is stronger for adolescent girls than boys.

Despite these strengths and innovations, several limitations of the current study point to important directions for future research. First, the moderately-sized, school-based sample may have yielded results that would not generalize to a higher-risk or clinical sample. It will be important to test the same hypotheses in a sample with clinical-level difficulties with peer victimization or sleep problems. Second, although the sample was relatively diverse, allowing exploratory tests of ethnicity as a moderator of the association between peer victimization and sleep, interactions between peer victimization and ethnicity were inconsistent. For example, adolescent-reported peer victimization predicted poorer sleep quality over time for European Americans, but not ethnic minorities. However, in a cross-sectional analysis, teacher-reported peer victimization was associated with poorer sleep quality for ethnic minorities, but not European Americans. A larger sample would increase power to detect more reliable ethnic differences, if they exist. The ethnic context of peer victimization and sleep warrants further study.

In addition to sample characteristics, several measurement limitations of the present study are important to consider. In particular, although the measure of sleep quality included more items than sleep measures in most other studies of peer victimization, it did not capture multiple dimensions of sleep, and the present study lacked objective measures of sleep. Self-reported

sleep quality measures are subject to multiple biases (e.g., mood, memory), and such reporter biases could be overcome with more objective measures of sleep quality, such as actigraphy. Further, more extensive subjective measures may be better equipped to measure specific dimensions of sleep. For example, sleep diaries have been shown to be more reliable for measuring sleep duration and schedule than questionnaires (Sadeh, 2015). Thus, more comprehensive and objective measures will enable future research to examine diverse dimensions of sleep (e.g. sleep duration, sleep schedule; Sadeh, 2015) as related to peer victimization. This is particularly important given that the association between sleep and negative emotions (and perhaps peer victimization) may vary depending on the dimension of sleep being measured (e.g., Kelly & El-Sheikh, 2014).

The inclusion of multiple informants of peer victimization is an important feature of the present study, and some evidence emerged that parent-reported peer victimization predicted poorer sleep quality, along with evidence that adolescent-reported peer victimization (and composite peer victimization) predicted poorer sleep quality. However, the present study failed to find consistent support for hypotheses across all informants, as teacher-reported peer victimization was not directly associated with sleep quality in cross-sectional or longitudinal models. Inflated estimates due to common informant variance is one widely accepted explanation for why self-reports of peer victimization are more strongly associated with self-reports of adjustment outcomes (Hawker & Boulton, 2000). Despite the problem of common-informant variance, adolescents themselves arguably have the most important perspective on their experiences of peer victimization (Card & Hodges, 2008) as well as their sleep quality. Indeed, adolescents are aware of peer victimization experiences that others do not frequently observe (Felix, Sharkey, Green, Furlong, & Tanigawa, 2011). Although teachers (and parents)

may provide a more objective perspective than adolescents, victimization frequently goes unnoticed by teachers who are often absent from settings in which children are victimized (e.g. playgrounds, bathrooms, lunchroom). Parents' and teachers' absence from specific contexts at school may lead to underestimation of peer victimization (Card & Hodges, 2008; Ladd & Kochenderfer-Ladd, 2002). Future research should continue to examine the degree to which actual peer victimization experiences—measured through multiple methods—interfere with sleep. It will be particularly important to examine cyber-victimization experiences, which may occur closer to bedtime and particularly disrupt sleep.

The present study employed rigorous methods (longitudinal, multiple informants) and provided evidence that adolescent-reported and composite peer victimization predict poorer adolescent-reported sleep quality over time among boys and girls; parent-reported peer victimization also predicted poorer sleep quality among girls. This study contributes more evidence to the developmental-ecological model proposed by El-Sheikh & Sadeh (2015), providing the strongest evidence to date that peer victimization experiences can interfere with sleep in early adolescence. Future research should examine multiple dimensions of peer victimization and sleep, including objective measures.

References

- Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. Sage.
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders, (DSM-5®). *American Psychiatric Pub.*
- Araujo, D. F., & Almondes, K. M. (2013). Sleep and cognitive performance in children and pre-adolescents: A review. *Biological Rhythm Research*, doi:10.1080/09291016.2013.790136.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173.
- Baum, K. T., Desai, A., Field, J., Miller, L. E., Rausch, J., & Beebe, D. W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. *Journal of Child Psychology and Psychiatry*, 55(2), 180-190.
- Becker, S. P., Langberg, J. M., & Byars, K. C. (2015). Advancing a biopsychosocial and contextual model of sleep in adolescence: A review and introduction to the special issue. *Journal of Youth and Adolescence*, 44(2), 239-270.
- Benenson, J. F., & Benarroch, D. (1998). Gender differences in responses to friends' hypothetical greater success. *The Journal of Early Adolescence*, 18(2), 192-208.

- Biebl, S. J., DiLalla, L. F., Davis, E. K., Lynch, K. A., & Shinn, S. O. (2011). Longitudinal associations among peer victimization and physical and mental health problems. *Journal of Pediatric Psychology*.
- Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA; Harvard University Press.
- Buckhalt, J. A. (2011). *Children's sleep, sleepiness, and performance on cognitive tasks (WMF Press Bulletin No. 2)*. Retrieved from Woodcock-Munoz Foundation website:
<http://woodcock-munoz-foundation.org/press/pressbulletins.html>
- Byars, K. C., Yolton, K., Rausch, J., Lanphear, B., & Beebe, D. W. (2012). Prevalence, patterns, and persistence of sleep problems in the first 3 years of life. *Pediatrics*, *129*(2), 276-284.
- Cajochen, C., Kräuchi, K., & Wirz-Justice, A. (2003). Role of melatonin in the regulation of human circadian rhythms and sleep. *Journal of Neuroendocrinology*, *15*(4), 432-437.
- Campbell, I. G., & Feinberg, I. (2009). Longitudinal trajectories of non-rapid eye movement delta and theta EEG as indicators of adolescent brain maturation. *Proceedings of the National Academy of Sciences*, *106*(13), 5177-5180.
- Cappuccio, F. P., Taggart, F. M., Kandala, N. B., & Currie, A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. *Sleep*, *31*(5), 619.
- Card, N. A., & Hodges, E. V. (2008). Peer victimization among schoolchildren: Correlations, causes, consequences, and considerations in assessment and intervention. *School Psychology Quarterly*, *23*(4), 451.
- Coie, J. D. (1990). 13 Toward a theory of peer rejection. *Peer rejection in childhood*, 365.
- Colrain, I. M., & Baker, F. C. (2011). Changes in sleep as a function of adolescent development. *Neuropsychology Review*, *21*(1), 5-21.

- Connor-Smith, J. K., Compas, B. E., Wadsworth, M. E., Thomsen, A. H., & Saltzman, H. (2000). Responses to stress in adolescence: measurement of coping and involuntary stress responses. *Journal of Consulting and Clinical Psychology, 68*(6), 976.
- Crick, N. R., & Grotpeter, J. K. (1996). Children's treatment by peers: Victims of relational and overt aggression. *Development and Psychopathology, 8*(02), 367-380.
- Cullerton-Sen, C., & Crick, N. R. (2005). Understanding the effects of physical and relational victimization: The utility of multiple perspectives in predicting social-emotional adjustment. *School Psychology Review, 34*(2), 147.
- Dahl, R. E. (1996). The regulation of sleep and arousal: Development and psychopathology. *Development and Psychopathology, 8*(01), 3-27.
- Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Medicine Reviews, 14*(3), 179-189.
- Eisenberg, M. E., & Aalsma, M. C. (2005). Bullying and peer victimization: Position paper of the Society for Adolescent Medicine. *Journal of Adolescent Health, 36*(1), 88-91.
- El-Sheikh, M. (Ed.). (2011). *Sleep and development: Familial and socio-cultural considerations*. Oxford University Press.
- El-Sheikh, M., Buckhalt, J. A., Mize, J., & Acebo, C. (2006). Marital conflict and disruption of children's sleep. *Child Development, 77*(1), 31-43.
- El-Sheikh, M., Hinnant, J. B., & Erath, S. A. (2015). Marital conflict, vagal regulation, and children's sleep: A longitudinal investigation. *Monographs of the Society for Research in Child Development, 80*(1), 89-106.

- El-Sheikh, M., & Sadeh, A. (2015). I. Sleep and development: introduction to the monograph. *Monographs of the Society for Research in Child Development*, 80(1), 1-14.
- Fekkes, M., Pijpers, F. I., & Verloove-Vanhorick, S. P. (2004). Bullying behavior and associations with psychosomatic complaints and depression in victims. *The Journal of Pediatrics*, 144(1), 17-22.
- Felix, E. D., Sharkey, J. D., Green, J. G., Furlong, M. J., & Tanigawa, D. (2011). Getting precise and pragmatic about the assessment of bullying: The development of the California Bullying Victimization Scale. *Aggressive Behavior*, 37(3), 234-247.
- Galland, B. C., Taylor, B. J., Elder, D. E., & Herbison, P. (2012). Normal sleep patterns in infants and children: A systematic review of observational studies. *Sleep Medicine Reviews*, 16(3), 213-222.
- Geary, D. C. (1999). Evolution and developmental sex differences. *Current Directions in Psychological Science*, 8(4), 115-120.
- Gentile, D. A., Lynch, P. J., Linder, J. R., & Walsh, D. A. (2004). The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance. *Journal of Adolescence*, 27(1), 5-22.
- Gini, G. (2008). Associations between bullying behaviour, psychosomatic complaints, emotional and behavioural problems. *Journal of Pediatrics and Child Health*, 44(9), 492-497.
- Gini, G., & Pozzoli, T. (2009). Association between bullying and psychosomatic problems: A meta-analysis. *Pediatrics*, 123(3), 1059-1065.
- Gregory, A. M., & Sadeh, A. (2012). Sleep, emotional and behavioral difficulties in children and adolescents. *Sleep Medicine Reviews*, 16(2), 129-136.

- Gregory, A. M., Caspi, A., Eley, T. C., Moffitt, T. E., O'Connor, T. G., & Poulton, R. (2005). Prospective longitudinal associations between persistent sleep problems in childhood and anxiety and depression disorders in adulthood. *Journal of Abnormal Child Psychology*, 33(2), 157-163.
- Hale, L., & Guan, S. (2014). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*.
- Hawker, D. S., & Boulton, M. J. (2000). Twenty years' research on peer victimization and psychosocial maladjustment: A meta-analytic review of cross-sectional studies. *Journal of Child Psychology and Psychiatry*, 41(4), 441-455.
- Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., & Hillard, P. J. A. (2015). National Sleep Foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health*, 1(1), 40-43.
- Johnson, E. O., Chilcoat, H. D., & Breslau, N. (2000). Trouble sleeping and anxiety/depression in childhood. *Psychiatry Research*, 94(2), 93-102.
- Kelly, R. J., & El-Sheikh, M. (2014). Reciprocal relations between children's sleep and their adjustment over time. *Developmental Psychology*, 50(4), 1137.
- Kelly, R. J., Marks, B. T., & El-Sheikh, M. (2014). Longitudinal relations between parent-child conflict and children's adjustment: The role of children's sleep. *Journal of Abnormal Child Psychology*, 42(7), 1175-1185.
- Kelly, R. J., & El-Sheikh, M. (2013). Longitudinal relations between marital aggression and children's sleep: The role of emotional insecurity. *Journal of Family Psychology*, 27(2), 282.

- Keyes, K. M., Maslowsky, J., Hamilton, A., & Schulenberg, J. (2015). The great sleep recession: Changes in sleep duration among US adolescents, 1991–2012. *Pediatrics*, 135(3), 460-468.
- Klerman, E. B., Shanahan, T. L., Brotman, D. J., Rimmer, D. W., Emens, J. S., Rizzo, J. 3., & Czeisler, C. A. (2002). Photic resetting of the human circadian pacemaker in the absence of conscious vision. *Journal of Biological Rhythms*, 17(6), 548-555.
- Kliewer, W., & Lepore, S. J. (2015). Exposure to violence, social cognitive processing, and sleep problems in urban adolescents. *Journal of Youth and Adolescence*, 44(2), 507-517.
- Knutson, K. L. (2012). Does inadequate sleep play a role in vulnerability to obesity? *American Journal of Human Biology*, 24(3), 361-371.
- Kochenderfer- Ladd, B. (2004). Peer victimization: The role of emotions in adaptive and maladaptive coping. *Social Development*, 13(3), 329-349.
- Kouros, C. D., & El- Sheikh, M. (2015). Daily mood and sleep: Reciprocal relations and links with adjustment problems. *Journal of Sleep Research*, 24(1), 24-31.
- Kouzma, N. M., & Kennedy, G. A. (2002). Homework, stress, and mood disturbance in senior high school students. *Psychological Reports*, 91(1), 193-198.
- Kovacs, M. (1984). The children's depression, inventory (CDI). *Psychopharmacology bulletin*, 21(4), 995-998.
- Ladd, G. W., & Kochenderfer-Ladd, B. (2002). Identifying victims of peer aggression from early to middle childhood: Analysis of cross-informant data for concordance, estimation of relational adjustment, prevalence of victimization, and characteristics of identified victims. *Psychological Assessment*, 14(1), 74.

- Ladd, G. W., Kochenderfer, B. J., & Coleman, C. C. (1997). Classroom peer acceptance, friendship, and victimization: Distinct relation systems that contribute uniquely to children's school adjustment?. *Child Development, 68*(6), 1181-1197.
- Larson, R. W., Richards, M. H., Moneta, G., Holmbeck, G., & Duckett, E. (1996). Changes in adolescents' daily interactions with their families from ages 10 to 18: Disengagement and transformation. *Developmental Psychology, 32*(4), 744.
- Lepore, S. J., & Kliewer, W. (2013). Violence exposure, sleep disturbance, and poor academic performance in middle school. *Journal of Abnormal Child Psychology, 41*(8), 1179-1189.
- Lukowski, A. F., & Bell, M. A. (2015). On sleep and development: Recent advances and future directions. *Monographs of the Society for Research in Child Development, 80*(1), 182-195.
- Luntamo, T., Sourander, A., Rihko, M., Aromaa, M., Helenius, H., Koskelainen, M., & McGrath, P. J. (2012). Psychosocial determinants of headache, abdominal pain, and sleep problems in a community sample of Finnish adolescents. *European Child & Adolescent Psychiatry, 21*(6), 301-313.
- Mercer, P. W., Merritt, S. L., & Cowell, J. M. (1998). Differences in reported sleep need among adolescents. *Journal of Adolescent Health, 23*(5), 259-263.
- Morrow, M. T., Hubbard, J. A., Barhight, L. J., & Thomson, A. K. (2014). Fifth-grade children's daily experiences of peer victimization and negative emotions: Moderating effects of sex and peer rejection. *Journal of Abnormal Child Psychology, 42*(7), 1089-1102.
- Nakamoto, J., & Schwartz, D. (2010). Is peer victimization associated with academic achievement? A meta-analytic review. *Social Development, 19*(2), 221-242.

- Nansel, T. R., Overpeck, M., Pilla, R. S., Ruan, W. J., Simons-Morton, B., & Scheidt, P. (2001). Bullying behaviors among US youth: Prevalence and association with psychosocial adjustment. *Journal of the American Medical Association*, 285(16), 2094-2100.
- National Sleep Foundation. (2006). 2006 Sleep in America poll. Washington, DC: National Sleep Foundation.
- Nishina, A. (2012). Microcontextual characteristics of peer victimization experiences and adolescents' daily well-being. *Journal of Youth and Adolescence*, 41(2), 191-201.
- Nishina, A., & Juvonen, J. (2005). Daily reports of witnessing and experiencing peer harassment in middle school. *Child Development*, 76(2), 435-450.
- O'Callaghan, F. V., Al Mamun, A., O'Callaghan, M., Clavarino, A., Williams, G. M., Bor, W & Najman, J. M. (2010). The link between sleep problems in infancy and early childhood and attention problems at 5 and 14 years: Evidence from a birth cohort study. *Early Human Development*, 86(7), 419-424.
- Opp, M.R., Krueger, J.M. Sleep and immunity: A growing field with clinical impact. *Brain Behavior and Immunity*. (in press), [http:// dx.doi.org/10.1016/j.bbi.2015.03.011](http://dx.doi.org/10.1016/j.bbi.2015.03.011)
- Patten, C. A., Choi, W. S., Gillin, J. C., & Pierce, J. P. (2000). Depressive symptoms and cigarette smoking predict development and persistence of sleep problems in US adolescents. *Pediatrics*, 106(2), e23-e23.
- Reijntjes, A., Kamphuis, J. H., Prinzie, P., & Telch, M. J. (2010). Peer victimization and internalizing problems in children: A meta-analysis of longitudinal studies. *Child Abuse & Neglect*, 34(4), 244-252.

- Reijntjes, A., Kamphuis, J. H., Prinzie, P., Boelen, P. A., Van der Schoot, M., & Telch, M. J. (2011). Prospective linkages between peer victimization and externalizing problems in children: A meta- analysis. *Aggressive Behavior, 37*(3), 215-222.
- Roane, B. M., & Taylor, D. J. (2008). Adolescent insomnia as a risk factor for early adult depression and substance abuse. *Sleep, 31*(10), 1351.
- Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological Bulletin, 132*(1), 98.
- Sadeh, A. (2007). Consequences of sleep loss or sleep disruption in children. *Sleep Medicine Clinics, 2*(3), 513-520.
- Sadeh, A. (2011). Sleep assessment methods. *Sleep and Development: Familial and Socio-Cultural Considerations, 355-371*.
- Sadeh, A. (2015). III. Sleep assessment methods. *Monographs of the Society for Research in Child Development, 80*(1), 33-48.
- Sadeh, A., Dahl, R. E., Shahar, G., & Rosenblat-Stein, S. (2009). Sleep and the transition to adolescence: A longitudinal study. *Sleep, 32*(12), 1602.
- Schwartz, D., Farver, J. M., Chang, L., & Lee-Shin, Y. (2002). Victimization in South Korean children's peer groups. *Journal of Abnormal Child Psychology, 30*(2), 113-125.
- Smaldone, A., Honig, J. C., & Byrne, M. W. (2007). Sleepless in America: Inadequate sleep and relationships to health and well-being of our nation's children. *Pediatrics, 119*(Supplement 1), S29-S37.
- Smith, M. T., Perlis, M. L., Smith, M. S., Giles, D. E., & Carmody, T. P. (2000). Sleep quality and presleep arousal in chronic pain. *Journal of Behavioral Medicine, 23*(1), 1-13.

- Spence, S., De Young, A., Toon, C., & Bond, S. (2009). Longitudinal examination of the associations between emotional dysregulation, coping responses to peer provocation, and victimization in children. *Australian Journal of Psychology*, 61(3), 145-155.
- Tu, K. M., Erath, S. A., & El-Sheikh, M. (2015). Peer victimization and adolescent adjustment: The moderating role of sleep. *Journal of Abnormal Child Psychology*, 1-11.
- Umlauf, M. G., Bolland, A. C., Bolland, K. A., Tomek, S., & Bolland, J. M. (2015). The effects of age, gender, hopelessness, and exposure to violence on sleep disorder symptoms and daytime sleepiness among adolescents in impoverished neighborhoods. *Journal of Youth and Adolescence*, 44(2), 518-542.
- Wilhelm, I., Prehn-Kristensen, A., & Born, J. (2012). Sleep-dependent memory consolidation—What can be learnt from children?. *Neuroscience & Biobehavioral Reviews*, 36(7), 1718-1728.
- Wolfson R & Carskadon MA (1998). Sleep schedules and daytime functioning in adolescents. *Child Development*, 69, 875-887.
- Wong, M. M., Brower, K. J., & Zucker, R. A. (2009). Childhood sleep problems, early onset of substance use and behavioral problems in adolescence. *Sleep Medicine*, 10(7), 787-796.
- Wong, M. M., Brower, K. J., Fitzgerald, H. E., & Zucker, R. A. (2004). Sleep problems in early childhood and early onset of alcohol and other drug use in adolescence. *Alcoholism: Clinical and Experimental Research*, 28(4), 578-587.
- Yang, C. K., Kim, J. K., Patel, S. R., & Lee, J. H. (2005). Age-related changes in sleep/wake patterns among Korean teenagers. *Pediatrics*, 115(Supplement 1), 250-256.
- Yoo, S. S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep: A prefrontal amygdala disconnect. *Current Biology*, 17(20), R877-R878.

APPENDICES

Appendix A

Measures

Demographic Information

Child Information

1. Sex:

2. Child Date of Birth and Age:

3. Ethnic group (Circle one)

- | | |
|---------------------|----------------------------|
| a. African American | d. Native American |
| b. Asian | e. Spanish Descent |
| c. Caucasian | f. Other (please specify): |
- _____

Parent/Guardian Information (person completing questionnaires)

4. Your age:

Family Information

5. Annual Household Income (Circle one)

- a. Less than 10,000
- b. 10,001-20,000
- c. 20,001-35,000
- d. 35,001-50,000
- e. 50,001-75,000
- f. More than 75,000

Peer Victimization – Self Report (T1)

Please answer the following questions about how often you have these experiences at school.

		Almost never		Sometimes		Almost always
1	How often do you get pushed or shoved by other peers at school?	1	2	3	4	5
2	How often does another peer exclude you when they want to get back at you for something?	1	2	3	4	5
3	How often does another kid say they won't like you unless you do what they want you to do?	1	2	3	4	5
4	How often do you get hit by another kid at school?	1	2	3	4	5
5	How often are you left out on purpose when it's time to do an activity?	1	2	3	4	5
6	How often have other kids told lies about you to make other kids not like you anymore?	1	2	3	4	5
7	How often have other kids said mean things about you to keep other people from liking you?	1	2	3	4	5
8	How often does a kid who is mad at you get back at you by not letting you be in their group anymore?	1	2	3	4	5

Peer Victimization – Parent Report (T1)

Please rate the extent to which each description applies to your child’s experiences with other children.

		Never	1	Sometimes	2	3	Almost always	4
1	My child is picked on by other children.	0	1	2	3	4		
2	My child is called names by other children.	0	1	2	3	4		
3	Other children say negative or mean things about my child to other children.	0	1	2	3	4		
4	My child is teased or made fun of by peers.	0	1	2	3	4		
5	Other children hit or push my child.	0	1	2	3	4		
6	Other children ignore my child to be mean.	0	1	2	3	4		
7	Other children try to hurt my child’s feelings by excluding him or her.	0	1	2	3	4		

Peer Victimization – Teacher Report (T1)

For each of the following statements, please circle the number that best describes this child.

		Never true of the child		Sometimes true of the child		Almost always true of the child
1	Other children hit or push this child.	1	2	3	4	5
2	Other children tease or make fun of this child.	1	2	3	4	5
3	Other children pick on or bully this child.	1	2	3	4	5
4	Other children gossip or say mean things about this child.	1	2	3	4	5
5	Other children ignore this child to be mean.	1	2	3	4	5
6	Other children try to hurt this child's feelings by excluding him/her.	1	2	3	4	5

Adolescent Reported - Negative Emotional-Arousal (T1)

		Not at all	A little	Some	A lot
1	When problems with other kids come up, I can't stop thinking about how I'm feeling.	1	2	3	4
2	When I have problems with other kids, I can't stop thinking about what I did or said.	1	2	3	4
3	When I have problems with other kids, I can't stop thinking about why they happen to me.	1	2	3	4
4	I keep remembering what happened with the other kids or can't stop thinking about what might happen.	1	2	3	4
5	When I'm having problems getting along with other kids, I can't stop thinking about them when I try to sleep, or I have bad dreams about them.	1	2	3	4
6	Thoughts about the problems with other kids just pop into my head.	1	2	3	4
7	When I have problems with other kids I feel sick to my stomach or get headaches.	1	2	3	4
8	I get really jumpy when I'm having problems getting along with other kids.	1	2	3	4
9	When I have problems with other kids, I feel it in my body. Check all that happen:	1	2	3	4
	My heart races <input type="checkbox"/>			My breathing speeds up <input type="checkbox"/>	
	I feel hot or sweaty <input type="checkbox"/>			My muscles get tight <input type="checkbox"/>	
	None of these <input type="checkbox"/>				
10	When I have problems with other kids right away I feel really:	1	2	3	4

(**Check all that apply**; remember to circle a number, too)

Angry Sad Scared
 Worried/anxious None of these

11	When problems with other kids come up, I get upset by things that don't usually bother me.	1	2	3	4
12	My thoughts start racing when I'm having a tough time with other kids.	1	2	3	4

13	When I'm having a problem with other kids, sometimes I act without thinking.	1	2	3	4
14	When I have problems with other kids, sometimes I can't control what I do or say.	1	2	3	4
15	When problems with other kids happen, I can't always control what I do. (Remember to circle a number)	1	2	3	4
Check all that happen:					
	I can't stop eating	<input type="checkbox"/>	I can't stop talking		
	I do dangerous things		I have to keep fixing/checking things	<input type="checkbox"/>	
	None of these	<input type="checkbox"/>		<input type="checkbox"/>	
		<input type="checkbox"/>			

Sleep Quality (T1 and T2)

In the **last two weeks**, how often have you ... (Mark one answer for every item)

	Never	Once	Twice	Several times	Everyday/ night
1. Felt satisfied with your sleep?	0	1	2	3	4
2. Awakened too early in the morning and couldn't get back to sleep?	0	1	2	3	4
3. Had an extremely hard time falling asleep?	0	1	2	3	4
4. Had a good night's sleep?	0	1	2	3	4

Appendix B

Tables & Figures

Table 1.

Descriptive statistics for continuous variables

	N	Mean (SD)
T1 Age	121	12.0 (.64)
T1 Income	119	4.1 (1.6)
T1 Adolescent-reported peer victimization	122	2.0 (.87)
T1 Parent-reported peer victimization	123	.94 (.73)
T1 Teacher-reported peer victimization	100	1.5 (.67)
T1 Composite peer victimization	123	.014 (.80)
T1 Negative emotional arousal	122	2.0 (.58)
T1 Sleep quality	120	2.8 (.86)
T2 Sleep quality	98	2.7 (.91)

Table 2.

Correlations among study variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Child age	-										
2. Child sex	-.24**	-									
3. Ethnicity	-.33**	.06	-								
4. Household income	.12	.02	-.51**	-							
5. Adolescent-reported PV	-.05	.03	.06	-.22*	-						
6. Parent-reported PV	-.08	-.10	.07	-.13	.51**	-					
7. Teacher-reported PV	-.80	-.06	.05	-.19	.19	.40**	-				
8. Composite PV	-.05	-.04	.06	-.23*	.78**	.84**	.71**	-			
9. Negative emotional arousal	-.06	.16	.04	-.19*	.53**	.32**	.08	.42**	-		
10. T1 sleep quality	.13	.04	-.12	.20*	-.41**	-.31**	-.09	-.38**	-.39**	-	
11. T2 sleep quality	-.05	.06	-.06	.10	-.44**	-.20	-.11	-.37**	-.23**	.42**	-

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$

Table 3.

Adolescent-reported peer victimization predicting sleep quality concurrently and longitudinally

	T1 Sleep Quality				T2 Sleep Quality			
	Step of Entry		Final Model		Step of Entry		Final Model	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Step 1: T1 Outcome								
T1 Sleep Quality					.43 (.10)	.41***	.28 (.09)	.27**
R ²					17%			
Step 2: Controls								
Age	.17 (.12)	.13	.16 (.11)	.12	-.15 (.13)	-.11	-.13 (.12)	-.10
Sex	.11 (.15)	.06	.13 (.14)	.07	.00 (.17)	.00	.09 (.15)	.05
Ethnicity	.02 (.16)	.01	-.03 (.14)	-.02	-.06 (.17)	-.04	-.12 (.16)	-.07
Annual Income	.11 (.05)	.19*	.06 (.05)	.10	-.00 (.05)	-.00	-.03 (.05)	-.04
$\Delta R^2 / R^2$	6%				1% / 18%			
Step 3: Predictors								
Adolescent-reported PV	-.38 (.08)	-.39***	-.42 (.08)	-.43***	-.34 (.09)	-.34***	-.32 (.09)	-.32***
$\Delta R^2 / R^2$	12% / 18%				4% / 22%			
Step 4: Interactions								
Adolescent-PV*Sex			-.02 (.12)	-.02			-.35 (.14)	-.23**
Adolescent PV*Race			.13 (.12)	.09			.30 (.13)	.20*
$\Delta R^2 / R^2$			4% / 22%				6% / 28%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.

Parent-reported peer victimization predicting sleep quality concurrently and longitudinally

	T1 Sleep Quality				T2 Sleep Quality			
	Step of Entry		Final Model		Step of Entry		Final Model	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Step 1: T1 Outcome								
T1 Sleep Quality					.43 (.10)	.41***	.42 (.10)	.39***
R ²					17%			
Step 2: Controls								
Age	.17 (.12)	.13	.14 (.12)	.10	-.15 (.13)	-.11	-.15 (.13)	-.11
Sex	.11 (.15)	.06	.04 (.15)	.03	.00 (.17)	.00	.01 (.16)	-.01
Ethnicity	.02 (.16)	.01	.02 (.15)	.01	-.06 (.17)	-.04	-.08 (.17)	-.04
Annual Income	.11 (.05)	.19*	.09 (.05)	.17~	-.00 (.05)	-.00	-.02 (.05)	-.00
$\Delta R^2 / R^2$	6%				1% / 18%			
Step 3: Predictors								
Parent-reported PV	-.33 (.10)	-.29***	-.30 (.10)	-.26***	-.08 (.11)	-.07	.09 (.11)	.07
$\Delta R^2 / R^2$	6% / 12%				0% / 18%			
Step 4: Interactions								
Parent PV*Sex			-.09 (.16)	-.05			-.34 (.18)	-.18~
Parent PV*Race			.02 (.15)	.01			.03 (.17)	.01
$\Delta R^2 / R^2$			0% / 11%				2% / 20%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.

Teacher-reported peer victimization predicting sleep quality concurrently and longitudinally

	T1 Sleep Quality				T2 Sleep Quality			
	Step of Entry		Final Model		Step of Entry		Final Model	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Step 1: T1 Outcome								
T1 Sleep Quality					.43 (.10)	.41***	.45 (.10)	.43***
R ²					17%			
Step 2: Controls								
Age	.17 (.12)	.13	.18 (.12)	.13	-.15 (.13)	-.11	-.16 (.13)	-.12
Sex	.11 (.15)	.06	.09 (.15)	.05	.00 (.17)	.00	-.01 (.16)	-.01
Ethnicity	.02 (.16)	.01	.02 (.15)	.01	-.06 (.17)	-.04	-.08 (.17)	-.04
Annual Income	.11 (.05)	.19*	.10 (.13)	.17~	-.00 (.05)	-.00	-.01 (.05)	-.02
$\Delta R^2 / R^2$	6%		1% / 18%					
Step 3: Predictors								
Teacher-reported PV	-.05 (.13)	-.04	.06 (.13)	.05	-.14 (.14)	-.10	-.08 (.13)	-.06
$\Delta R^2 / R^2$	0% / 6%		2% / 20%					
Step 4: Interactions								
Teacher PV*Sex			.05 (.19)	.02			-.23 (.20)	-.11
Teacher PV*Race			-.38 (.21)	-.16~			.21 (.23)	.09
$\Delta R^2 / R^2$			2% / 8%				2% / 22%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 6.

Composite-reported peer victimization predicting sleep quality concurrently and longitudinally

	T1 Sleep Quality				T2 Sleep Quality			
	Step of Entry		Final Model		Step of Entry		Final Model	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Step 1: T1 Outcome								
T1 Sleep Quality					.43 (.10)	.41***	.35 (.09)	.33***
R ²	17%							
Step 2: Controls								
Age	.17 (.12)	.13	.14 (.11)	.11	-.15 (.13)	-.11	-.16 (.12)	-.12
Sex	.11 (.15)	.06	.07 (.14)	.04	.00 (.17)	.00	.03 (.16)	.02
Ethnicity	.02 (.16)	.01	-.03 (.15)	-.02	-.06 (.17)	-.04	-.10 (.16)	-.06
Annual Income	.11 (.05)	.19*	.06 (.05)	.11	-.00 (.05)	-.00	-.02 (.05)	-.04
$\Delta R^2 / R^2$	6%		1% / 18%					
Step 3: Predictors								
Composite PV	-.37 (.09)	-.35***	-.35 (.09)	-.34***	-.30 (.10)	-.27**	-.20 (.10)	-.18*
$\Delta R^2 / R^2$	9% / 15%		2% / 20%					
Step 4: Interactions								
Composite PV*Sex			.02 (.14)	.01			-.40 (.15)	-.23**
Composite PV*Race			-.05 (.13)	-.03			.22 (.14)	.14
$\Delta R^2 / R^2$			1% / 16%				3% / 23%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 7.

Adolescent-reported peer victimization predicting T1 negative emotional arousal

	T1 Negative Emotional Arousal			
	Step of Entry		Final Model	
	B (SE)	β	B (SE)	β
Step 1:				
Age	-.02 (.08)	-.02	-.00 (.07)	-.00
Sex	.19 (.10)	.17~	.18 (.09)	.16*
Ethnicity	-.11 (.10)	-.09	-.07 (.09)	-.06
Annual Income	-.09 (.03)	-.23**	-.04 (.03)	-.11
R ²	9%			
Step 3: Main Effects				
Adolescent-reported PV			.33 (.05)	.51***
$\Delta R^2 / R^2$			21% / 30%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.
 ~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 8.

Parent-reported peer victimization predicting T1 negative emotional arousal

	T1 Negative Emotional Arousal			
	Step of Entry		Final Model	
	B (SE)	β	B (SE)	β
Step 1:				
Age	-.02 (.08)	-.02	.01 (.08)	.01
Sex	.19 (.10)	.17~	.24 (.10)	.21*
Ethnicity	-.11 (.10)	-.09	-.12 (.10)	-.10
Annual Income	-.09 (.03)	-.23**	-.07 (.03)	-.20*
R ²	9%			
Step 3: Main Effects				
Parent-reported PV			.26 (.07)	.32***
$\Delta R^2 / R^2$			10% / 19%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 9.

Teacher-reported peer victimization predicting T1 negative emotional arousal

	T1 Negative Emotional Arousal			
	Step of Entry		Final Model	
	B (SE)	β	B (SE)	β
Step 1:				
Age	-.02 (.08)	-.02	-.02 (.08)	-.02
Sex	.19 (.10)	.17~	.20 (.10)	.17~
Ethnicity	-.11 (.10)	-.09	-.11 (.10)	-.09
Annual Income	-.09 (.03)	-.23**	-.08 (.03)	-.22*
R ²	9%			
Step 3: Main Effects				
Teacher-reported PV			.05 (.08)	.05
$\Delta R^2 / R^2$			0% / 9%	

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.
 ~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 10.

Composite-reported peer victimization predicting T1 negative emotional arousal

	T1 Negative Emotional Arousal			
	Step of Entry		Final Model	
	B (SE)	β	B (SE)	β
Step 1:				
Age	-.02 (.08)	-.02	.00 (.07)	.00
Sex	.19 (.10)	.17~	.22 (.09)	.19*
Ethnicity	-.11 (.10)	-.09	-.08 (.09)	-.07
Annual Income	-.09 (.03)	-.23**	-.05 (.03)	-.13
R ²	9%			
Step 3: Main				
Effects				
Composite PV			.30 (.06)	.41***
$\Delta R^2 / R^2$	14% / 23%			

Note. PV = Peer victimization

For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

~ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 11.

Negative emotional arousal predicting sleep quality concurrently and longitudinally

	T1 Sleep Quality				T2 Sleep Quality			
	Step of Entry		Final Model		Step of Entry		Final Model	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Step 1: T1 Outcome								
T1 Sleep Quality					.43 (.10)	.41***	.43 (.10)	.40***
R ²					17%			
Step 2: Controls								
Age	.17 (.12)	.13	.16 (.11)	.12	-.15 (.13)	-.11	-.14 (.13)	-.10
Sex	.11 (.15)	.06	.23 (.14)	.13	.00 (.17)	.00	-.03 (.16)	-.02
Ethnicity	.02 (.16)	.01	-.05 (.14)	-.03	-.06 (.17)	-.04	-.05 (.17)	-.03
Annual Income	.11 (.05)	.19*	.07 (.05)	.10	-.00 (.05)	-.00	-.00 (.05)	-.00
$\Delta R^2 / R^2$	6%				1% / 18%			
Step 3: Main Effects								
Adolescent-reported NEA	-.57 (.12)	-.39***	-.55 (.12)	-.37***	-.10 (.14)	-.06	.18 (.19)	.12
$\Delta R^2 / R^2$	13% / 19%				0% / 17%			
Step 4: Interactions								
NEA*Sex			-.15 (.17)	-.08			-.03 (.19)	-.02
NEA*Race			.16 (.19)	.07			-.60 (.23)	-.24**
$\Delta R^2 / R^2$			1% / 20%				7% / 24%	

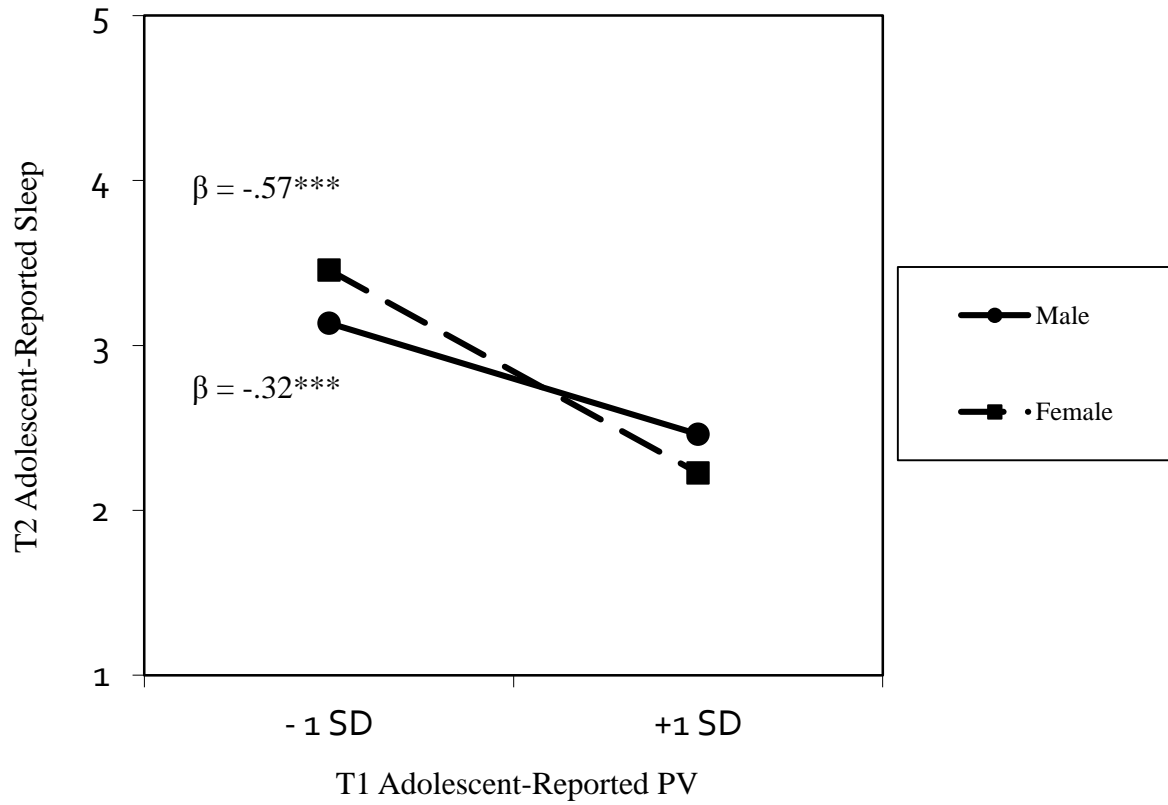
Note. PV = Peer victimization

NEA = Negative emotional arousal. For sex, male = 0 and female = 1. For ethnicity, European American = 0 and ethnic minority = 1.

$\sim p < .10$, $*p < .05$, $**p < .01$, $***p < .001$

Figure 1.

Prospective associations between T1 adolescent-reported peer victimization and T2 sleep quality among males and females

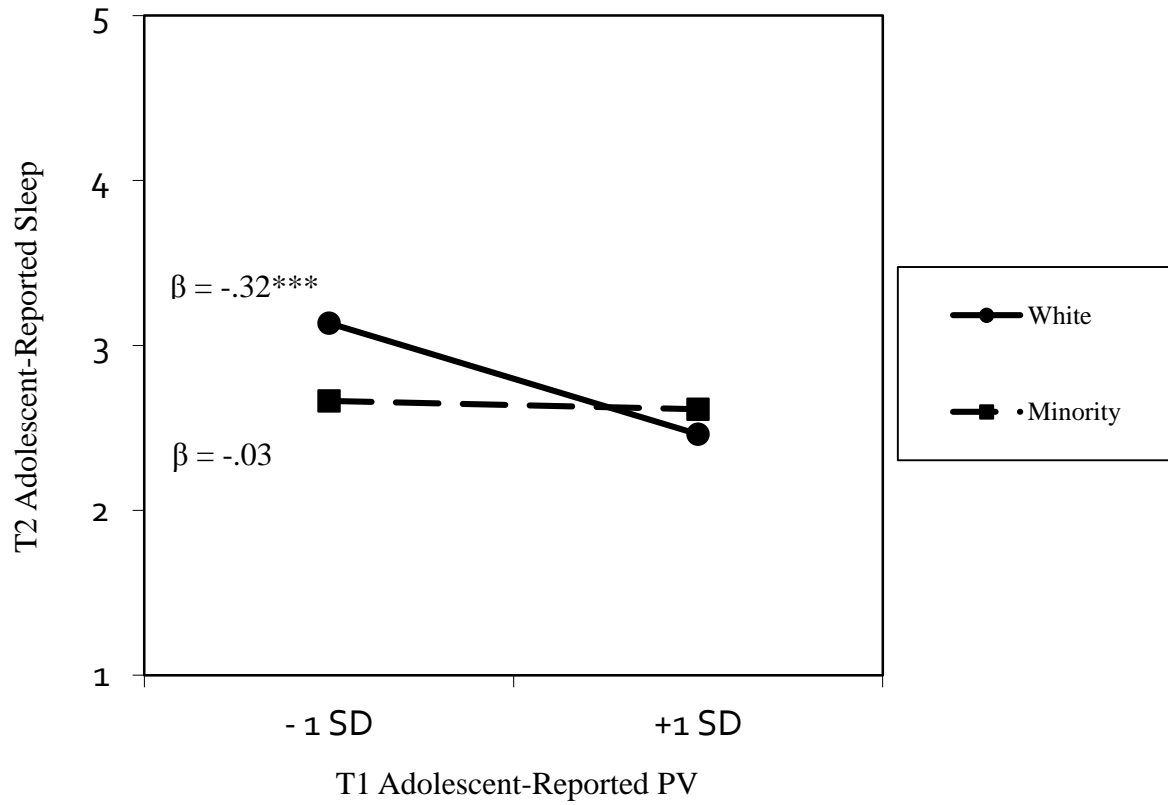


Note. PV = Peer victimization

*** $p < .001$

Figure 2.

Prospective associations between T1 adolescent-reported peer victimization and T2 sleep quality among European Americans and ethnic minorities

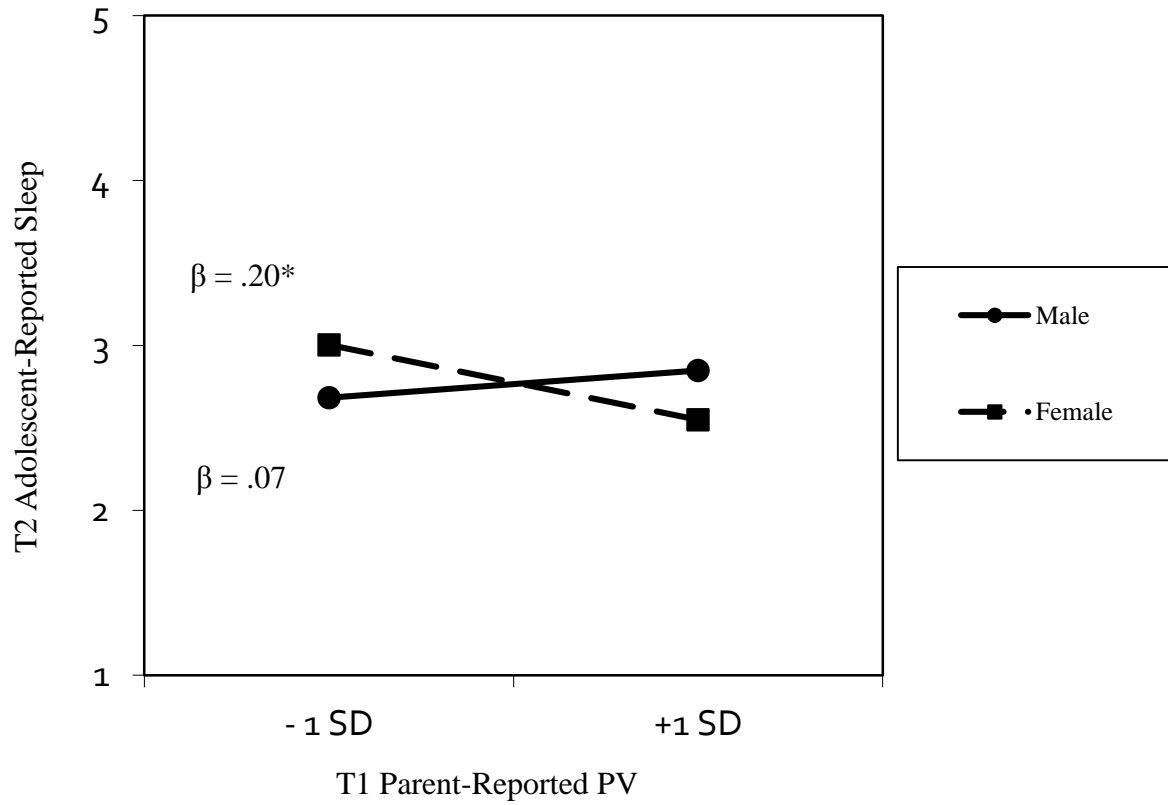


Note. PV = Peer victimization

*** $p < .001$

Figure 3.

Prospective associations between T1 parent-reported peer victimization and T2 sleep quality among males and females

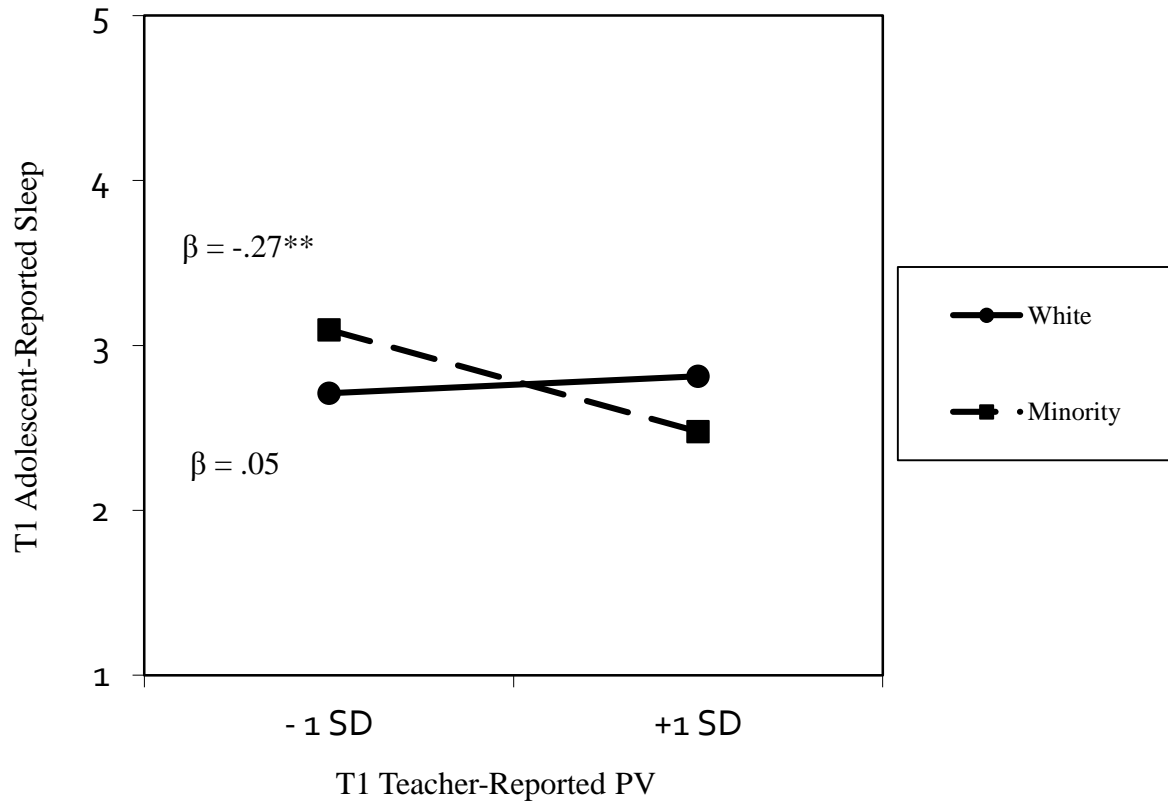


Note. PV = Peer victimization

* $p < .05$

Figure 4.

Concurrent associations between T1 teacher-reported peer victimization and T1 sleep quality for European Americans and ethnic minorities

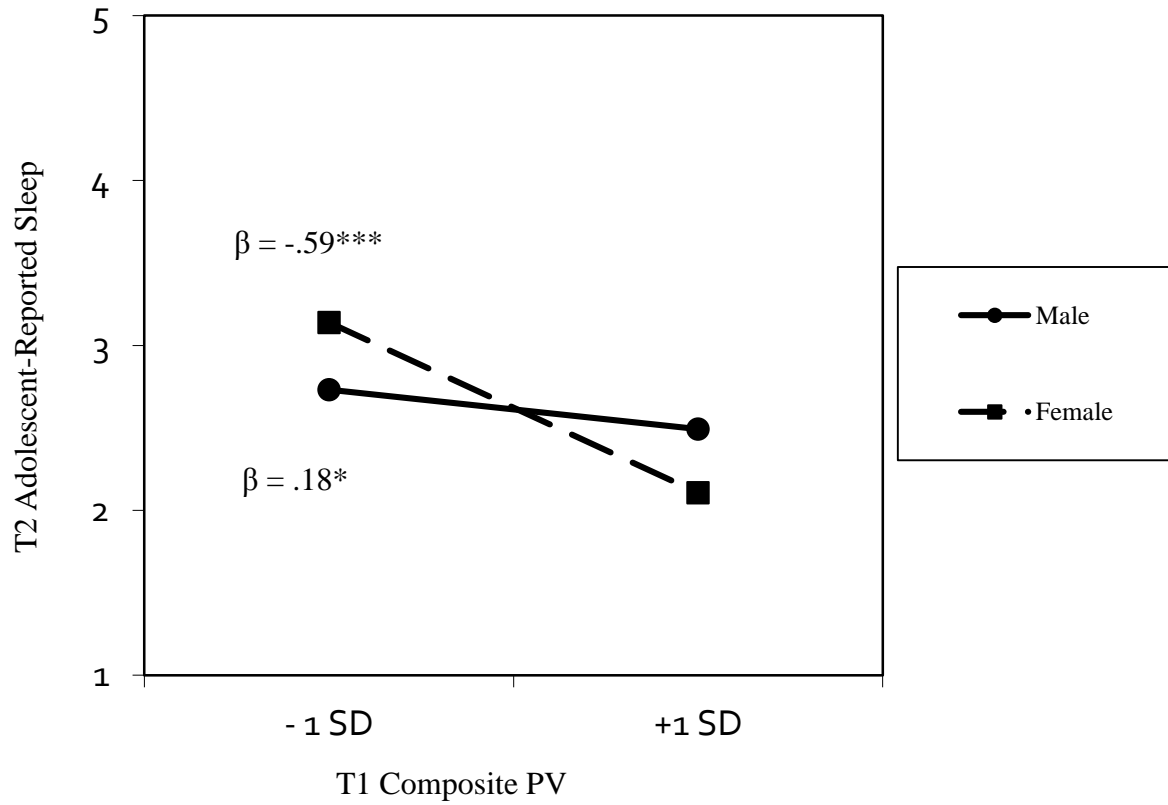


Note. PV = Peer victimization

** $p < .01$

Figure 5.

Prospective associations between T1 composite peer victimization and T2 sleep quality among males and females

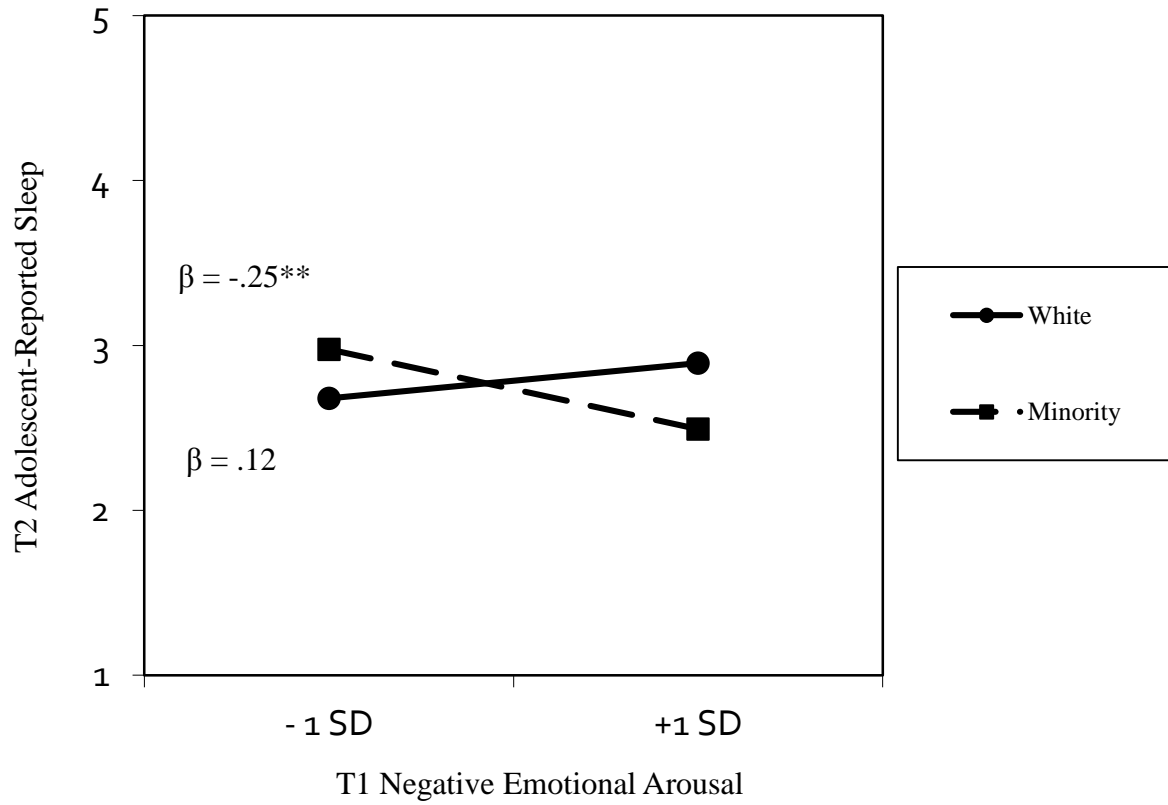


Note. PV = Peer victimization

*** $p < .001$, * $p < .05$

Figure 6.

Prospective associations between T1 negative emotional arousal and T2 sleep quality among European Americans and ethnic minorities



Note. PV = Peer victimization

** $p < .01$