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The Role of Sleep in the Relationship Between Victimization and Externalizing Problems in Adolescents

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Abstract

Victimization is linked to externalizing outcomes in adolescents and recent theorizing suggests that sleep plays a role in this relationship; however, there is little evidence examining sleep as a mediator. This study examines associations between victimization experiences and changes in aggression, delinquency, and drug use. Data were obtained from three waves of a school-based study with middle-school youth ($n = 785$; 55 % female; 20 % African American; $M = 12.32$, $SD = .51$ years at T1), and path analyses were used to test the key hypotheses. Analyses controlling for major life events, demographic factors, and school site revealed that victimization indirectly affected delinquency and drug use, but not aggression, through its relationship with sleep problems. Further, the effects of sleep problems on drug use were specific to females. These data suggest that intervening to address sleep problems resulting from victimization may serve to reduce some forms of externalizing behavior.

Keywords

Victimization; Adolescents; Delinquency; Drug use; Aggression; Sleep problems

Introduction

Exposure to violence is a persistent and vexing problem that threatens the health and well-being of a high proportion of adolescents in the United States (Finkelhor et al. 2010, 2013).

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Authors' Contributions D.S. and W.K. jointly conceived and designed the study, D.S. ran the analyses, interpreted the data, and composed the original draft of the manuscript. W.K. and S.L. selected study measures, supervised data collection, and provided feedback and assistance with drafts of the manuscript. All authors approved the final manuscript.

Conflict of Interest The authors report no conflict of interests.

Ethical Approval The study was approved by the Institutional Review Boards at Virginia Commonwealth University (VCU) and Temple University (TU). All procedures performed in this study were in accordance with the ethical standards of Virginia Commonwealth University and Temple University and with the 1964 Helsinki declaration and its later amendments of comparable ethical standards.

Informed Consent Written informed consent was provided by the maternal caregiver and assent was provided by the adolescent before initiating the data collection.

More than 60 % of adolescents report having been exposed to some form of violence during their lifetime, and nearly half of those exposed report having been directly victimized (i.e., being hit, punched, assaulted with a weapon; Finkelhor et al. 2013). These rates of victimization are alarming because youth victimization is linked to externalizing problems, such as delinquency and substance use, that can put adolescents at great risk for harm (Reijntjes et al. 2011; Fowler et al. 2009; McDonald and Richmond 2008). Based on emerging research and theorizing, this investigation focuses on the role of sleep problems in explaining the relationship between exposure to violence and elevated risk for externalizing behaviors, such as substance use, delinquency, and aggression, among adolescents. Exposure to violence is associated with poorer sleep outcomes (van Geel et al. 2016), and poor sleep has been linked to externalizing problems, possibly due to cognitive and social-emotional effects of poor sleep. Identifying factors that contribute to the relationship between exposure to violence and externalizing problems in adolescents will help to inform theory and prevention research.

Victimization and Externalizing Outcomes in Adolescents

A review of cross-sectional and longitudinal studies examining the impact of victimization on adolescent adjustment found that exposure to victimization was positively correlated with externalizing behaviors in adolescents (Fowler et al. 2009). For example, a recent study found that exposure to violence was positively related to alcohol, drug, and cigarette use among a sample of urban adolescents (Zimmerman and Posick 2016). Further, the evidence suggests that effect sizes for this relationship are similar across race and sex, even though African Americans tend to be exposed to higher levels of victimization, mainly due to the higher likelihood of living in high-risk (i.e., low-SES) environments, and males tend to report higher levels of externalizing behaviors compared to females. However, due to the selective sampling of single-sex studies (e.g., inpatient samples, residents of homeless shelters), evidence on the effect of victimization on externalizing outcomes across sex may be attenuated and warrants further examination.

There are several well-established theories linking victimization and externalizing behaviors. However, none explicate the role of sleep quality in these associations. Social cognition theory (Bandura 1986) suggests that exposure to violence models externalizing behaviors, namely aggression, as an appropriate behavior. Furthermore, high levels of exposure to violence may prime adolescents for violent encounters, ultimately facilitating the development of a hostile attribution bias in benign social situations (Dodge and Somberg 1987). Likewise, adolescents exposed to high levels of violence may develop a decreased physiological sensitivity to exposure to violence, leaving them more likely to engage in externalizing behaviors. What the current study proposes, however, is that exposure to violence (i.e., victimization) leads to a decrease in sleep quality, which in turn leads to the manifestation of externalizing behaviors. Only one study to date has examined sleep problems as a mediator of the relationship between victimization and externalizing outcomes in adolescence (Rubens et al. 2014), finding that sleep problems appeared to mediate the relationship between exposure to victimization and delinquent behaviors. This study, however, used a cross-sectional research design, limited its analyses to Latino adolescents, and only examined delinquent outcomes.

Victimization and Sleep Problems

An emerging body of research has examined how victimization influences sleep quality (and quantity) in adolescents. Specifically, findings suggest that adolescents exposed to higher levels of victimization report more sleep problems (e.g., less time spent sleeping, tiredness) than adolescents who are not victimized (Kliewer and Lepore 2014; Lepore and Kliewer 2013). Furthermore, a recent meta-analysis by van Geel et al. (2016) revealed a moderate, positive association between victimization and sleep problems in both children and adolescents. These results elucidate how exposure to victimization can negatively impact an adolescent's sleep quality.

Building upon previous work by Lepore (Lepore 1992, 1997; Lepore et al. 1996), Kliewer et al. (1998) proposed a social cognitive processing model to understand the mechanism linking exposure to victimization to negative psychological outcomes in adolescents. The model hypothesizes that adolescents who are victimized may develop intrusive thoughts in response to their experience, which in turn may lead to increased levels of depressive and anxious symptoms. More recently, Kliewer and Lepore (2014) found that these intrusive thoughts also could be linked to increases in adolescent-reported sleep problems. Thus, it is likely that victimization also is an important contributing factor to the development of adolescent sleep problems. Moreover, sleep problems have been implicated in the development of externalizing problems in adolescents, and may provide one potential mechanism through which victimization leads to externalizing problems in adolescents. An emerging body of literature has examined the link between adolescent victimization and sleep problems (van Geel et al. 2016), and the current study aims to address this question, as well as its implications for the manifestation of later externalizing outcomes.

Sleep Problems and Externalizing Outcomes

Previous research has found that sleep problems tend to increase in adolescence, in part due to developmental changes related to puberty, but also due to an increase in independence that consists of determining one's own bedtime, spending more time away from home with friends, and/or through extracurricular activities (Moran and Everhart 2012). There is general consensus that adolescents need roughly 9–10 h of sleep per night; however, only 20 % of adolescents report obtaining this amount of sleep per night (Moran and Everhart 2012). Subsequently, adolescents experiencing sleep problems tend to exhibit decreased cognitive functioning, which in turn has been associated with increases in externalizing behaviors (for review, see Astill et al. 2012). A recent review by Becker et al. (2015) explored the current state of the literature examining the associations between sleep quality (and quantity) and various adolescent outcomes. As a whole, the literature suggests that decreased sleep quantity and quality are associated with decreased cognitive functioning, particularly within the prefrontal cortex. Further, this decreased cognitive functioning consistently has been linked with higher levels of irritability and impulsivity, and ultimately the higher probability of adolescents engaging in various externalizing behaviors.

Currently, the literature examining the link between sleep problems and delinquent outcomes shows mixed findings. For example, Peach and Gaultney (2013) found that adolescents who slept less reported higher levels of sensation seeking, lower levels of impulse control, and

subsequently higher levels of delinquent outcomes than their better-rested counterparts. Further, Clinkinbeard et al. (2011) found that adolescents who reported 7 or fewer hours of sleep per night reported significantly more delinquent behaviors compared to those adolescents receiving 8–10 h of sleep per night. Although these associations were present concurrently, the evidence is less clear for longitudinal studies. A study by Wong et al. (2009) found that increases in sleep problems were associated with delinquency and various substance use behaviors concurrently and longitudinally. However, using a nationally representative sample, Catrett and Gaultney (2009) found concurrent, but not longitudinal associations between sleep problems and delinquency. Lastly, Mrug et al. (2012) did find longitudinal associations between sleep problems and delinquency, but this association was no longer significant after controlling for demographic factors and other covariates.

Sleep problems also have been linked to aggressive behavior. For example, Ireland and Culpin (2006) found that decreased sleep quality and quantity were associated concurrently with aggressive behavior in a sample of detained adolescents, and Gregory and O'Connor (2002) found that sleep problems at age 4 were positively associated with aggressive behavior in adolescence. Further, Gregory et al. (2008) found that parent-reported adolescent sleep problems were associated with aggressive behavior in young adulthood. These studies reveal a link between sleep problems and aggression that is persistent over time; however, the literature examining this association during early adolescence is scant and warrants further examination.

As for substance use behaviors, McKnight-Eily et al. (2011) found that adolescents obtaining less than 8 h of sleep per night reported more alcohol, cigarette, and marijuana use than adolescents who obtained an adequate amount of sleep. Another study by Pasch et al. (2012) found that adolescent sleep problems were positively related to substance use behaviors during adolescence, and that this relationship was reciprocal over time. Additional studies also have examined the link between poor sleep hygiene (e.g., different weekday/weekend sleep schedules, nighttime preference) and substance use outcomes (Pasch et al. 2010; Pieters et al. 2010), strengthening the association between sleep and substance use behaviors.

In sum, adolescent sleep is an important contributor to adolescent aggressive, delinquent, and substance use outcomes individually, both concurrently and longitudinally. Furthermore, victimization increases the probability of adolescents exhibiting externalizing behaviors, perhaps due to the increased sleep problems experienced by victimized adolescents. However, the literature examining aggressive behavior during early adolescence is limited and longitudinal findings for delinquent outcomes are mixed. As such, it is important to determine how each of these outcomes uniquely relates to sleep problems during early adolescence. Early adolescence is an important time to examine the influence of sleep on externalizing outcomes because it is a developmental period when we begin to see a significant increase in externalizing behaviors (Bongers et al. 2004). By examining the roles that sleep plays in the relationship between victimization and each externalizing outcome separately, the current study will provide useful information for prevention researchers regarding potential mechanisms through which victimization influences various adolescent externalizing behaviors.

The Current Study

Sleep is an important factor that may explain some of the association between victimization and externalizing outcomes in adolescents. Although there are relatively well-established associations between each of these constructs, to our knowledge this complete path model has not been tested using longitudinal data. In the current study, we address this gap by utilizing a longitudinal design with an ethnically and economically diverse sample, extensive behavioral and environmental measures, and multiple externalizing outcomes (i.e., aggression, delinquency, and substance use), as victimization and sleep problems may have differential associations with these outcomes. Using three waves of data, we hypothesized that adolescent victimization at Time 1 would be positively associated with sleep problems at Time 2 (6 months after T1), as well as with each individual externalizing outcome at Time 3 (6 months after T2). Second, we hypothesized that sleep problems at Time 2 would be positively associated with each externalizing outcome at Time 3. Third, we hypothesized that sleep problems at Time 2 would mediate the association between adolescent victimization at Time 1 and each externalizing outcome at Time 3. Lastly, because previous research regarding sex differences in externalizing outcomes among victimized adolescents is equivocal (Fowler et al. 2009), we conducted multiple group analyses to examine if any of our hypothesized outcomes differed across sex.

Methods

Overview

Data for this study were originally collected as part of a multi-site, multi-wave two-group randomized controlled trial testing the efficacy of a behavioral intervention designed to promote adjustment among adolescents exposed to community violence and peer victimization using expressive writing (Lepore and Smyth 2002). Adolescents in the experimental group wrote for 20 min once a week for 6 weeks about their thoughts and feelings toward violence. Control participants wrote for the same amount of time and number of sessions, but writing focused on daily routines and other topics unrelated to violence. Participants in the current study include adolescents from both the experimental and control arms of the trial at Time 1 (T1), Time 2 (T2), and Time 3 (T3) assessment points. Intervention condition had no effects on current study variables, but was nonetheless included as a covariate in all analyses.

Participants

Participants for the current study were 785 seventh graders from three middle schools within the Philadelphia, PA and Richmond, VA metropolitan areas. The original trial recruited 1274 adolescents and 986 of those adolescents received parental consent and provided assent to participate in the trial (77 % recruitment rate). Of these 986 students, 785 had valid data on the main predictors and outcomes of interest at T1, T2, and T3 assessment points and were eligible for the current study. Although full information maximum likelihood (FIML) was used to estimate missing values for outcome variables, 201 students were missing demographic data (i.e., race and/or age) and thus estimates were not computed for these individuals. Adolescents were roughly 12 years of age at Time 1 ($M = 12.32$, $SD = .51$) and

55 % of the sample was female. Roughly 20 % of the sample identified as African American and 80 % of the sample identified as Caucasian, Latino, or another race/ethnicity.

Procedures

The Institutional Review Boards at Virginia Commonwealth University and Temple University approved all study procedures. Each measure was administered using a computer-assisted survey interview (CASI, Saw tooth Software, Inc.). Each respondent was provided with a headset-equipped laptop and completed the CASI during a class period. Data from the first measurement wave (T1) were collected in the middle of the fall semester of 7th grade, data from the second measurement wave (T2) were collected 6 months later in the spring of 7th grade, and data from the third measurement wave (T3) were collected 6 months later in the fall of 8th grade.

Measures

Victimization—Level of victimization was assessed at T1 using a subset of items from a modified version of the *Survey of Children's Exposure to Community Violence* (Richters and Saltzman 1990). This self-report index consists of 7 items assessing the frequency with which an adolescent is directly victimized (e.g., “slapped, punched, or hit”). Respondents indicated how often (1 = never to 6 = 20 or more times) they had been directly victimized within the past year. A mean item score was computed for victimization, with higher scores indicating higher levels of victimization. Although the reliability for this measure was low ($\alpha = .59$ T1), it is unlikely that because an adolescent had experienced one form of victimization (e.g., hit, slapped, or punched) that he/she would experience another, particularly if it is much more serious (e.g., hearing gunshots outside the home). Further, this measure has been widely used in previous studies and has demonstrated strong validity (Fowler et al. 2009).

Sleep Problems—Sleep problems were assessed at T1 and T2 using the *Sleep/Wake Behavior Problems Scale* (Wolfson and Carskadon 1998). This previously validated, self-report measure consists of 10 items assessing the frequency with which adolescents experience erratic sleep-wake behaviors (e.g., “extremely hard time falling asleep”). Respondents indicated how often (1 = never to 5 = every day or every night) they experienced these problems over a 2-week period. Cronbach's alpha was acceptable ($\alpha = .73$ T1; $\alpha = .82$ T2). Scores were summed to create a mean item score for sleep problems, with higher scores indicating more sleep problems. In addition, descriptive data were collected regarding general adolescent sleep/wake behaviors (e.g., hours slept per night, average bed time, average wake time).

Externalizing Problems—Externalizing problems were assessed at T2 and T3 using previously validated, self-report subscales from the *Problem Behavior Frequency Scale* (Farrell et al. 2000). Overall level of aggression was assessed using 18-items from three separate subscales regarding physical aggression (e.g., “shoved or pushed someone”), non-physical aggression (e.g., “picked on someone”), and relational aggression (e.g., “spread a false rumor about someone”). Cronbach's alpha for each subscale was acceptable ($\alpha = .66-.80$ T2; $\alpha = .72-.84$ T3). Drug use was assessed using a 9-item subscale regarding the use of

various substances (e.g., alcohol, marijuana, inhalants), and Cronbach's alpha for this subscale was good ($\alpha = .89$ T2; $\alpha = .88$ T3). Lastly, delinquency was assessed using a 6-item subscale regarding various delinquent behaviors (e.g., "stolen something," "purposely damaged property"). Cronbach's alpha for this subscale was acceptable ($\alpha = .75$ T2; $\alpha = .76$ T3). For each subscale, respondents indicated how often (1 = never to 6 = 20 or more times) they engaged in each behavior in the past 30 days. A mean item score was calculated for each outcome (e.g., aggression, delinquency, drug use), with higher scores indicating higher levels of each externalizing behavior.

Control Variables—Life events, age, sex, race, family structure (living in a single-parent vs. two-parent household), school, and intervention condition (experimental vs. control) were controlled for in all models. Race was dichotomized into African American versus other race/ethnicity (i.e., Asian, Caucasian, bi-racial, multi-racial) because previous research suggests that African American adolescents tend to be exposed to higher baseline levels of victimization (Fowler et al. 2009) than adolescents of other races/ethnicities. In addition, school was dummy-coded to reflect the different locations of the schools (i.e., Philadelphia vs. Richmond) in the study. Life events were assessed via nine items that reflected potential stressors within the adolescent's family life that occurred within the past year. Sample items included moving, changing schools, family member becoming ill, and death of a family member. Adolescents reported the absence or presence of these events and items were summed to create a total score for life events, with higher score indicating more life events experienced by the adolescent.

Analytic Strategy

All analyses were run in *Mplus* version 7.2 (Muthen and Muthen 2012) to test the hypotheses that victimization at T1 would be positively associated with sleep problems at T2, which would be positively associated with each externalizing outcome at T3. Additionally, we tested if there was an indirect association between victimization at T1 and each externalizing outcome at T3 through sleep problems at T2. A total of three path analyses were run, one for each externalizing outcome. All models controlled for prior levels of sleep problems and the externalizing outcome of interest, as well as adolescent age, sex, race, family structure, previous life events, intervention condition, and school. Missing data on all outcome variables were imputed using FIML estimation, and bootstrap standard errors and confidence intervals were obtained for all parameter estimates. Following the recommendations of Hu and Bentler (1999), several goodness-of-fit indices were used to evaluate model fit, including comparative fit index (CFI; Bentler 1992), the root mean square error of approximation (RMSEA; Browne and Cudeck 1993), and the standardized root mean square residual (SRMR; Hu and Bentler 1999). Models with a CFI value at or above .90, a RMSEA value at or below .05 (Jackson et al. 2009), and a SRMR value at or below .08 (Hu and Bentler 1999) were considered to have a good fit.

We also conducted multiple group analyses to test if any of our hypothesized relationships differed by sex. Analyses consisted of creating a constrained model where all path coefficients were fixed to be equal across sex, and an unconstrained model where path coefficients were free to vary by sex. A total of six models were run, two for each

externalizing outcome. Missing data on outcome variables also were imputed using FIML estimation and bootstrap standard errors and confidence intervals were obtained for all parameter estimates. When comparing models, several indices (i.e., CFI, RMSEA, SRMR) were used to assess model fit. In addition, differences in BIC values greater than 10 indicated significant differences in model fit, with lower values favoring the constrained model (Raftery 1993). Lastly, differences in χ^2 values between the constrained and unconstrained models were calculated using likelihood ratio testing described in Schumacker and Lomax (2004). Using a χ^2 distribution table, model differences found to be above the critical value indicated for $p < .05$ were significant and considered to favor the unconstrained model, suggesting model differences by sex.

Results

Attrition Analyses

Participants who had valid data on all predictors ($N = 785$) were compared with participants who were excluded in the current analyses ($N = 201$) due to missing data on several predictor variables. These two groups were compared on baseline (i.e., T1) levels of victimization, sleep problems, each externalizing outcome, and all control variables, using Chi square or t tests as appropriate. Results showed that participants in the current sample experienced fewer stressful life events, $t(984) = -3.75, p < .001$; committed fewer aggressive $t(978) = -3.18, p < .01$ or delinquent acts, $t(980) = -3.60, p < .001$; and experienced fewer sleep problems, $t(982) = -2.98, p < .001$. Chi square analyses revealed that participants excluded from the current sample tended to reside in two-parent households, Chi square(1) = 25.60, $p < .001$; to be of a race other than African American, Chi square(1) = 4.20, $p < .05$; and to attend the school in Philadelphia, Chi square(2) = 157.52, $p < .001$. Participants who had valid data on all predictors did not differ from participants with missing data on baseline levels of victimization, drug use, age, sex, or intervention condition.

Descriptive Statistics and Correlations Among Study Variables

Table 1 provides information regarding the proportion of adolescents experiencing each form of victimization. The most common forms of victimization reported by adolescents were being hit, slapped or punched, or hearing gunshots while inside their homes. Less common reports of victimization included being chased, hearing gunfire at school, being threatened, being beaten up or mugged, or being asked to use/sell drugs. Regarding sleep/wake behaviors at T1, adolescents reported going to bed, on average, around 10:00 p.m. and waking up around 6:30 a.m.—roughly 8½ h of reported sleep per weeknight. Adolescents reported taking roughly 20 min to fall asleep, waking up, on average, once or twice throughout the night. Time 2 reports of sleep/wake behaviors were similar, but adolescents obtained even less sleep per night (~7½ h) than at T1.

Means, standard deviations, and Pearson zero-order correlations are presented in Table 2. To address the skewed distributions among the victimization and aggression measures, a log transformation was applied to the scores of these variables prior to our analyses based on the recommendations of Tabachnick and Fidell (2007). As seen in Table 2, victimization at T1 was positively associated with sleep problems at T1 and T2 as well as with each outcome

(i.e., aggression, drug use, delinquency) at T2 and T3. Further, sleep problems at T2 were positively associated with each outcome at T3.

Delinquency—Figure 1 displays the results of the path model for delinquent behavior. The data fit the model adequately ($N = 785$; $\chi^2(10) = 59.39$, $p < .001$; RMSEA = .08, 90 % CI [.06–.10]; SRMR = .02; CFI = .94). As seen in Fig. 1, victimization at T1 was positively associated with sleep problems at T2, after controlling for sleep problems at T1. Sleep problems at T2 were positively associated with delinquency at T3, after controlling for previous levels of delinquency, intervention condition, age, sex, race, school, family structure, and previous life events. The dummy-coded “school 2” variable was negatively associated with delinquency at T3, suggesting that adolescents from the Richmond schools reported fewer delinquent behaviors than students from the Philadelphia school. Further, victimization at T1 was not significantly associated with delinquency at T3; however, there was a significant indirect effect of victimization at T1 on delinquency at T3 through sleep problems at T2. Lastly, the multiple group analysis (see Table 3) favored a constrained model, indicating no moderation by sex.

Drug Use—Figure 2 displays the results of the path model for drug use. The data fit the model adequately ($N = 782$; $\chi^2(10) = 53.91$, $p < .001$; RMSEA = .08, 90 % CI [.06–.10]; SRMR = .02; CFI = .94). As in the prior model, victimization at T1 was positively associated with sleep problems at T2, after controlling for sleep problems at T1. Victimization at T1 was not significantly associated with drug use at T3, and sleep problems at T2 were positively associated with drug use at T3, after controlling for previous levels of drug use, intervention condition, school, sex, age, race, family structure, and previous life events. Further, there was an indirect effect of victimization at T1 on drug use at T3 through sleep problems at T2. The multiple group analysis for drug use favored an unconstrained model, indicating moderation by sex. Results indicated that for males, there was no significant association between sleep problems at T2 and drug use at T3, whereas for females there was an association.

Aggression—Figure 3 displays the results of the path model for aggression. The data fit the model marginally well ($N = 783$; $\chi^2(10) = 99.31$, $p < .001$; RMSEA = .11, 90 % CI [.09–.13]; SRMR = .03; CFI = .92). As hypothesized, victimization at T1 was positively associated with sleep problems at T2, after controlling for sleep problems at T1. Aggression at T2 was positively associated with aggression at T3, and life events at T1 were positively associated with aggression at T3. However, there were no significant associations between victimization at T1 or between sleep problems at T2 and aggression at T3. Further, there was no indirect effect of victimization at T1 on aggression at T3 through sleep problems at T2. Lastly, the multiple group analysis favored a constrained model, indicating no moderation by sex.

Discussion

Victimization within the community continues to plague adolescents across the United States, and this exposure consistently is linked to increases in externalizing psychopathology (Fowler et al. 2009). Furthermore, sleep has emerged as an important indicator of adolescent

mental health and behavioral outcomes (Becker et al. 2015). For example, research has found that inadequate sleep quality and quantity negatively impacts adolescent emotional, behavioral, and cognitive functioning (Bub et al. 2011; El-Sheikh et al. 2010, 2013). Although an emerging body of literature has begun to explore how victimization may play a role in adolescent sleep, only one study to date has examined how victimization influences adolescent sleep quality and quantity, which in turn influences adolescent externalizing outcomes (Rubens et al. 2014). The purpose of the current study was to build upon previous research by examining the mediating role of sleep in the relationship between victimization and multiple externalizing outcomes (i.e., aggression, drug use, delinquency) during adolescence.

Overall, our findings provide support for the hypothesis that adolescent victimization is associated with delinquent and drug use behaviors over time. The data also support the hypothesis that sleep problems associated with victimization mediate the relationship between victimization and delinquent and drug use behaviors over time. Our longitudinal findings are consistent with prior cross-sectional analyses (Rubens et al. 2014). Contrary to our predictions, victimization was neither directly nor indirectly (through sleep problems) associated with aggressive behavior over time. We do not have data to explain the unexpected findings with aggressive behavior. However, it is possible that other forms of aggression not assessed in our study may be more appropriate to examine. For example, Gregory et al. (2008) found that adolescent sleep problems were associated with reactive, but not proactive, aggression. The association between sleep and reactive aggression may be stronger than other subtypes—or even overall aggression—because reactive aggression is marked by impulsivity, which is a consequence of poor sleep quality. Given the appropriate data, these associations should be tested with proactive aggression.

Our findings regarding the multiple group analyses revealed that the hypothesized pathways from victimization to delinquent outcomes, through sleep problems, are similar for male and female early adolescents. These results are supported by previous research that finds that the effects of victimization (Fowler et al. 2009) and sleep (Becker et al. 2015) on externalizing outcomes—when assessed individually—are similar across sex. Interestingly, this pathway was not similar for males and females regarding drug use behaviors. In our sample, we found that sleep problems were positively associated with drug use behaviors in females, but not males. It is possible that this sex-specific association is driven by comorbid psychopathology. Specifically, research indicates that substance use behaviors (among other externalizing outcomes) may be influenced by comorbid psychopathology, such as internalizing problems (Johnson and Breslau 2001). Further, given that females tend to report an increase in internalizing symptoms during early adolescence (Ge et al. 2006), it is plausible that they would be more susceptible to drug use behaviors compared to their male counterparts who also reported sleep problems. Future studies should keep in mind potential moderators (i.e., sex, internalizing problems, trauma history) that may influence the relationships between victimization, sleep, and drug use outcomes.

There are many factors that may influence sleep problems for individuals as they enter adolescence, such as increased independence, more time spent with friends, and the ability to determine one's own bedtime. The current findings suggest that community-level factors

—particularly victimization—also should be considered in understanding what factors influence an adolescent’s sleep patterns. Although not tested in the current study, an emerging body of research suggests that intrusive thought processes may be driving the association between victimization and sleep problems in adolescents (Kliewer and Lepore 2014; Lepore and Kliewer 2013). What our data do suggest, however, is that victimization experienced within the past year is linked with sleep problems as late as 6 months after exposure. Although we do not have experimental evidence for a causal pathway between the two constructs, the present findings confirm the presence of a lasting association between victimization and adolescent sleep problems, irrespective of previous sleep difficulties and stressful life events.

Consistent with previous reports (Becker et al. 2015; Clinkinbeard et al. 2011; Gruber et al. 2012), adolescents in the current sample reported sleeping, on average, about 8½ h per night, which is below the recommended 9–10 h of sleep per night (Moran and Everhart 2012). Further, the negative behavioral outcomes associated with decreased sleep quantity were apparent after adolescents lacked, on average, just 1 h of sleep per night. Recent research has begun to explore potential mechanisms through which sleep problems lead to these negative behavioral outcomes. Specifically, evidence suggests that decreased sleep quantity and quality negatively impacts cognitive functioning within the prefrontal cortex, which is associated with decreased inhibition and increased impulsivity, ultimately leading to the greater likelihood of engaging in risk-taking behaviors such as drug use and delinquent acts (Peach and Gaultney 2013; Pieters et al. 2015). Continued research investigating this link will help to uncover how sleep problems lead to externalizing outcomes in at-risk youth.

Another important implication of our findings is that adolescents continue to lack adequate amounts of sleep per night and the behavioral consequences of these sleep problems are apparent early during adolescence. Because adolescence is a developmental period when individuals undergo significant amounts of cognitive, physical, and social maturation that will shape their behavior into young adulthood, our data suggest that intervention is necessary as soon as possible. Addressing the issue of victimization early in adolescence (or even earlier during childhood) is one approach that can help to reduce the likelihood of adolescents developing sleep problems, which may then help to protect them from engaging in impulsive, risk-taking behaviors due to decreased cognitive functioning. For example, a tiered intervention approach (Winston et al. 2015) could employ a universal intervention to address the issues of sleep quality and quantity among adolescents, while more focused interventions could be directed towards youth that are at a particularly high risk for externalizing outcomes due to either current victimization or other environmental stressors (e.g., low SES). Alternatively, focused interventions also could address intrusive thoughts, which may be linked to poor sleep. Because intrusive thoughts are not readily controlled, techniques implemented to aid in control may simultaneously improve sleep. For example, progressive relaxation, mindfulness meditation, and focused breathing may focus the mind, reduce the probability of unwanted, intrusive thoughts, and thus improve sleep quality. Examining these intervention methods should be a goal of future research.

The current study had several strengths, particularly its longitudinal design, which helps to establish the directionality of our hypothesized associations. Further, examining multiple

externalizing outcomes individually allowed us to determine how victimization and sleep problems influence a variety of negative behavioral outcomes. Lastly, our ability to control for previous levels of psychopathology and other life events that could influence an adolescent's behavior allowed us to minimize potential effects of other relevant environmental factors on adolescent sleep and externalizing outcomes. In sum, these findings shed light on the important roles that sleep plays in predicting externalizing outcomes among victimized youth and prove useful for prevention efforts.

Despite the strengths of the current study, there are several limitations. First, we assessed all variables using adolescent self-report measures, which might lead to shared-method variance among the reports. Further, sleep was assessed using a subjective measure (i.e., self-report), which is subject to reporter bias. By using more objective measures of sleep such as Actigraph watches, future studies could more accurately capture the degree to which adolescents engage in various sleep/wake behaviors. Additionally, we did not assess the mechanisms through which victimization lead to sleep problems, or through which sleep problems lead to each externalizing outcome. Although previous evidence supports several known mechanisms, it will be important for future studies to examine these mechanisms in order to confer causality in the proposed pathway from the current study. Also, it is important to note that individuals who were excluded from analyses tended to report engaging in more externalizing behaviors, resided in two-parent households, and were from the Philadelphia area. Thus, replication of these analyses with a more deviant sample of adolescents from various regions would help to strengthen the generalizability of these results.

Another limitation of this study is the use of self-report measures for our outcome variables. Although adolescents are more likely to report behaviors that are unknown to their parents, such as drug use, multiple reporters for behavioral and environmental questionnaires would serve to strengthen the reliability of these reports. Further, we examined victimization as a composite measure, thus we could not assess the degree to which specific events may have contributed to the association between victimization and sleep problems. Lastly, we did not assess other forms of community violence, such as witnessing violence. It is possible that other forms of community violence differentially impact adolescent sleep and behavioral outcomes. Assessment of the current structural pathway with both victimization and witnessing violence as predictors would help to further inform prevention research.

Conclusion

The current study extends prior research on the role of sleep in the relationship between victimization and externalizing problems during early adolescence. This is the second study to examine the mediating role of sleep in the relationship between victimization and externalizing outcomes, and the first to examine this pathway longitudinally with multiple forms of externalizing behaviors. Results suggest that exposure to victimization increases sleep problems, which in turn contributes to the development of drug use and delinquency during adolescence. Further, the effects on substance use behaviors appear to differ for females, perhaps due to increases in internalizing problems among females during early

adolescence. Researchers should use these findings to develop effective intervention programs that address sleep and victimization among at-risk youth.

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Biographies

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Fig. 1.

Path model of longitudinal associations between direct victimization, sleep problems, and delinquency, controlling for prior levels of constructs, life events, demographic variables, intervention condition, and school location (not shown). All coefficients are standardized. Note A significant indirect effect of direct victimization on delinquency through sleep was detected ($\beta = .01$, $p < .05$). * $p < .05$; ** $p < .01$

Fig. 2.

Path model of longitudinal associations between direct victimization, sleep problems, and drug use, controlling for prior levels of constructs, life events, demographic variables, intervention condition, and school location (not shown). All coefficients are standardized. A significant indirect effect of direct victimization on drug use through sleep was detected for the whole sample ($\beta = .02, p < .05$). *Note* Estimates for males are presented to the *left of the forward slash mark* and estimates for females are presented to the *right of the forward slash mark*. * $p < .05$; ** $p < .01$

Fig. 3. Path model of longitudinal associations between direct victimization, sleep problems, and aggression, controlling for prior levels of constructs, life events, demographic variables, intervention condition, and school location (not shown). All coefficients are standardized. *Note* No significant indirect effect of direct victimization on aggression through sleep was detected ($\beta = -.002$, $p > .05$). * $p < .05$; ** $p < .01$

Table 1

Proportion of adolescents victimized within the past year

Actually been slapped, punched, or hit by someone?	47.2 %
Heard the sound of gunfire outside when you were in or near your home?	44.5 %
Been chased by gangs or older kids?	11.8 %
Heard the sound of gunfire outside when in or near the school building?	9.3 %
Actually been threatened with serious physical harm by someone?	7.4 %
Actually been beaten up or mugged?	6.3 %
Actually been asked to use illegal drugs or get involved in selling illegal drugs?	5.1 %

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Table 2

Means, standard deviations (*SD*), and Pearson zero-order correlations among core study variables in each model

	1.	2.	3.	4.	5.	6.	7.	8.	9.	Mean (<i>SD</i>)
1. T1 Victimization	–									8.54 (1.02)
2. T1 Sleep problems	.33**	–								18.96 (6.08)
3. T2 Sleep problems	.28**	.68**	–							19.16 (6.61)
4. T2 Aggression	.41**	.40**	.47**	–						.99 (1.08)
5. T2 Drug use	.17**	.21**	.22**	.38**	–					1.08 (.35)
6. T2 Delinquency	.26**	.34**	.33**	.56**	.57**	–				1.11 (.33)
7. T3 Aggression	.31**	.30**	.33**	.69**	.28**	.43**	–			.79 (1.03)
8. T3 Drug use	.13**	.22**	.28**	.35**	.48**	.47**	.44**	–		1.06 (.26)
9. T3 Delinquency	.21**	.29**	.31**	.41**	.31**	.55**	.56**	.51**	–	1.10 (.28)

* $p < .05$;

** $p < .01$

Table 3

Model fit indices for multiple group analyses

	Adjusted BIC	χ^2 (df)	CFI	RMSEA (90 % CI)	SRMR
Delinquency					
Constrained model [†]	4658.77	84.17 (30)	.94	.07 (.05–.09)	.04
Unconstrained model	4682.83	65.95 (18)	.94	.08 (.06–.10)	.03
Drug use					
Constrained model [†]	4589.21	80.20 (30)	.93	.07 (.05–.08)	.04
Unconstrained model	4608.24	57.40 (18)*	.95	.08 (.05–.10)	.02
Aggression					
Constrained model [†]	6443.56	123.84 (30)	.91	.09 (.07–.11)	.04
Unconstrained model	6467.85	106.27 (18)	.92	.11 (.09–.13)	.03

Favored models—taking into account all fit indices—are marked with a dagger. Differences in BIC values greater than 10 suggest significant differences in model fit by sex, with the lower value being the better fitting model. Likelihood Ratio Tests also were conducted, with significant *p* values indicating statistically significant differences between the two models, favoring the unconstrained model. Cutoff values used for CFI, RMSEA, and SRMR were .90, .05, and .08, respectively

* *p* < .05