

Larose-Grégoire, É., Bernier, A., Dirks, M., & Perrier, R. (2018). Associations between sleep consolidation in infancy and peer relationships in middle childhood. *Social Development, 27*, 308-321.

Abstract

Sleep plays an important role in many aspects of children's development. Research on children's sleep and their peer relationships has begun to emerge in the last years. However, these studies are mostly cross-sectional. The current study aimed to investigate the associations between infant sleep and peer relationships in middle childhood. The sample comprised 72 children. Sleep was measured at 1 year using a sleep diary completed by mothers. In the second and third grades of elementary school (7 and 8 years of age), mothers and fathers reported on their children's functioning with peers. When they were in third grade, children were interviewed regarding their friendship quality with a best friend. Results revealed negative associations between children's sleep consolidation (i.e., ratio of nighttime sleep) and parent-reported peer problems, and positive associations between sleep consolidation and perceived friendship quality. These findings suggest that well-regulated sleep in infancy may help children develop the skills necessary for later appropriate social functioning in peer contexts.

Keywords: sleep, peer relationships, friendship

Associations between Sleep Consolidation in Infancy and Peer Relationships in Middle Childhood

Children's peer relationships begin to emerge in the preschool years (Hay, Payne, & Chadwick, 2004), and the ability to engage in competent interactions with peers is a key developmental milestone that develops throughout childhood and adolescence (Monahan & Booth-LaForce, 2016). Peer relationships play a significant role in children's emotional and cognitive development (Bagwell & Schmidt, 2013), including language development (Mashburn, Justice, Downer, & Pianta, 2009), problem-solving abilities (Fawcett & Garton, 2005), and academic achievement (Wentzel & Caldwell, 1997). Children's peer acceptance may also serve a protective function against the development of externalizing problems (Hay et al., 2004) and contribute to resilience in certain adverse circumstances, such as ecological disadvantage or exposure to family violence (Criss, Pettit, Bates, Dodge, & Lapp, 2002).

For these reasons, a key social task for children is the development and maintenance of high-quality friendships (Hartup, 1993; Poulin & Chan, 2010). Friendship is defined as a close, reciprocal relationship between two children, which differs from other peer relationships in the intensity of the shared affective ties and in the amount of time spent together (Bukowski, Newcomb, & Hartup, 1998; Dunn, 2004). Friendship protects young children from social isolation and adaptation problems (Erath, Flanagan, Bierman, & Tu, 2010; Laursen, Bukowski, Aunola, & Nurmi, 2007) and increases children's emotional understanding (Bagwell & Schmidt, 2013). As such, high-quality friendships are associated with higher levels of self-esteem (Franco & Levitt, 1998), happiness (Demir & Weitekamp, 2007), prosocial behavior (Monahan & Booth-LaForce, 2016), and social adjustment (Berndt, 2002).

Establishing positive peer relationships and making friends is, however, more difficult for

some children than for others (Grych & Fincham, 1990). Research has traditionally focused on the behavioral and emotional underpinnings of these differences. For instance, it has been observed that engaging in physical aggression is associated with lower acceptance from the peer group (Brendgen, Vitaro, Turgeon, & Poulin, 2002) and greater peer rejection (Salmivalli, Kaukiainen, & Lagerspetz, 2000). In contrast, greater use of prosocial behaviors is associated with enhanced friendship quality and less conflictual relationships (Cillessen, Jiang, West, & Laszkowski, 2005). Higher levels of anxiety and depression also relate to poorer peer relationships (de Matos, Barrett, Dadds, & Shortt, 2003); for example, depressed children report lower relational quality with their best friend (Brendgen et al., 2002).

More recently, there has been interest in identifying the biological factors underpinning individual differences in peer relationships (e.g., Murray-Close, 2013). Notably, child sleep is beginning to receive attention as a potential predictor of peer relationships (Vaughn, Elmore-Staton, Shin, & El-Sheikh, 2015). However, this literature is just emerging and based mostly on concurrent data, which greatly limits the conclusions that can be drawn regarding directionality of associations. Yet, unveiling possible influences of children's sleep on their peer relationships is important, given the significant impact of peer relationships on child development, along with evidence that child sleep can be improved with brief behavioral intervention, especially among young children (Meltzer & Mindell, 2014). Aiming to contribute to this emerging literature, this study examined the associations between infant sleep and children's subsequent relationships with peers and friends.

Sleep and child emotional and behavioral development

During infancy and early childhood, children spend more time sleeping than in all other activities combined (Jenni, Molinari, Caflisch, & Largo, 2007; Kohyama, 1998), which suggests

that sleep plays a crucial role in child health and development (Dahl, 1996). Indeed, empirical research has documented that sleep is important for brain development (Feinberg, Higgins, Khaw, & Campbell, 2006; Peirano & Algarín, 2007), physical health (Knutson, 2012) and immune function (Bryant, Trinder, & Curtis, 2004). In later childhood, sleep problems may also impact academic performance (Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010).

Importantly for our purposes, a great deal of research has found associations between sleep difficulties and behavioral and emotional difficulties that are also linked to poor relationships with peers. Sleep difficulties are associated with increased behavioral problems (Sadeh, Gruber, & Raviv, 2002) and higher levels of anxiety and depression (Alfano, Zakem, Costa, Taylor, & Weems, 2009). Although these results are based on contemporaneous assessments of child sleep and functioning, other studies suggest that poor sleep may induce a developmental cascade leading to adjustment difficulties in the long run. Gregory and O'Connor (2002) found that children's sleep problems at 4 years of age were associated with depression and anxiety in mid-adolescence, while controlling for stability in emotional problems. Even among younger children, sleep difficulties may bear on children's subsequent adjustment. Touchette et al. (2007) reported that, after accounting for prior hyperactivity-impulsivity and inattention, children who slept less in early childhood had higher levels of hyperactivity-impulsivity at 6 years than those who slept persistently more. Bélanger, Bernier, Simard, Desrosiers, and Carrier (2015) found that greater sleep quality among 2 year-old children was associated with less parent-reported externalizing symptoms two years later, controlling for initial symptom levels. Overall, there is evidence to suggest that early childhood may be a sensitive period for the effects of sleep on children's behavioral and emotional functioning, possibly entailing some longer-term consequences. Given that children's emotional and

behavioral adjustment is closely tied to their capacity to develop high-quality peer relationships as described earlier, it may be expected that sleep affects children's ability to make friends and, generally, to function in the peer group.

Sleep and children's social functioning

Nearly all studies that have investigated the links between children's sleep and social functioning have collected data at only one time point. For example, Vaughn et al. (2015) reported that preschool children experiencing poorer sleep quality (e.g., more night awakenings) were more likely to initiate negative interactions with peers, and were also more likely to receive negative nominations on a sociometric task; in contrast, greater sleep duration was related to greater acceptance by peers and higher social engagement and motivation. Hatzinger et al. (2008) reported that kindergarteners with lower sleep quality were more likely to be victimized by peers. Another cross-sectional study found that school-age children with varied sleep problems (e.g., sleep onset delay, problems sleeping through the night) presented higher risk for peer problems, as reported by parents and children themselves (Wiater et al., 2005). Likewise, among school-age children, sleep problems and daytime sleepiness were positively associated with concurrent peer problems and negatively related to prosocial behaviors (Hoedlmoser, Kloesch, Wiater, & Schabus, 2010). Another study suggested that more problematic sleep behaviors (e.g., sleeping too little, staying up late when their parents think they are asleep) were associated with lower concurrent friendship satisfaction, increased peer rejection, and increased loneliness among elementary-school children (Becker, 2014).

Overall, these studies strongly suggest the presence of concurrent links between children's sleep and their social functioning with peers. However, their cross-sectional designs fall short of suggesting directionality: it appears just as likely that children's social difficulties

and related worries may interfere with their sleep as the other way around. To our knowledge, only one longitudinal study has investigated this relation. Results indicated that compared to normal ($n = 10$) or good sleepers ($n = 18$), preschool children who were poor sleepers ($n = 9$) reported more negative peer relationships once they reached adolescence, as part of a general questionnaire assessing several aspects of adolescents' perceived physical and psychological functioning (Brand et al., 2015). Although based on a small sample, these results suggest that early sleep difficulties might perhaps hinder children's ability to make friends and to function in the peer group, conceivably starting in elementary school.

The current study

Overall, there is evidence that adequate sleep may contribute to many aspects of children's development, including optimal social functioning. To our knowledge, however, nearly all published studies pertaining to child sleep and social functioning are cross-sectional, which may inflate observed relations while also limiting the capacity to ascertain direction of effects. Some also used a single informant to assess child sleep and social functioning, which could create spurious associations. Accordingly, this study set out to investigate the associations between sleep during infancy and children's subsequent peer relationships at early school age using multi-informant assessments. We used maternal sleep diaries to assess infants' sleep, questionnaires completed by both parents to assess children's general functioning in the peer group at school-age, and a child interview to measure the quality of children's best friendship.

Developmental considerations guided the choice of our sleep index. More mature sleep patterns are established gradually during infancy and toddlerhood (Davis, Parker, & Montgomery, 2004), characterized notably by a decrease in daytime sleep (Acebo et al., 2005; National Sleep Foundation, 2004) and a consolidation of sleep into the night period (Iglowstein,

Jenni, Molinari, & Largo, 2003). There are, however, important individual differences in these developments (Iglowstein et al., 2003), and studies suggest that these differences are meaningful. During infancy, the proportion of sleep taking place at night has been shown to relate positively to important markers of cognitive development such as later language ability (Dionne et al., 2011) and executive functioning (Bernier, Beauchamp, Bouvette-Turcot, Carlson, & Carrier, 2013). As a result, the proportion of nighttime sleep can be considered a meaningful index of sleep consolidation in infancy, and will be used here to assess individual differences in infants' sleep.

Overall, longitudinal studies suggest that early sleep difficulties can impair aspects of children's subsequent behavioral and emotional adjustment with documented links to peer relationships. In addition, cross-sectional studies show concurrent links between children's sleep and social functioning with peers at different ages. Accordingly, we expected that more consolidated sleep in infancy (1 year) would be associated with fewer parent-reported peer problems and better perceived friendship quality in middle childhood (second and third grades). Given some studies that found associations between child temperament and sleep (Atkinson, Vetere, & Grayson, 1995; Ottoni, Lorenzi, & Lara, 2011), or between temperament and peer relationships (see Coplan & Bullock, 2012), we controlled for infant temperament. Also, given some evidence for links between sibling relationships and peer relationships (e.g., Wolke & Samara, 2004), we controlled for the number of siblings in the family.

Method

Participants

This study was part of an ongoing larger longitudinal study on child socio-emotional and cognitive development. The sample consisted of 72 children (43 girls) living in a large Canadian

metropolitan area. Families were recruited from random birth lists provided by the Ministry of Health and Social Services. Criteria for participation included a full-term pregnancy and the absence of any known child physical or mental disability. Sociodemographic information was gathered when infants were 8 months old. At that time, mothers were between 20 and 45 years old ($M = 31.94$) and had an average of 15.60 years of education (varying from 11 to 18 years). Fathers were between 23 and 44 years old ($M = 33.85$), and had 15.43 years of education on average (varying from 11 to 21 years). Average family income (in Canadian dollars) varied from less than \$20,000 to over \$100,000, with a mean situated in the \$60,000 – \$79,000 bracket. The majority of mothers (87.5%) and fathers (76.4%) were European Canadian.

Procedure

At the beginning of the study, parents provided informed consent, and following each time point, parents received financial compensation and children received a small present (e.g., toy). Data were collected in four waves. First, when children were aged 1 year, mothers were given instructions to complete a diary of their child's sleep patterns for a period of 72 hours. Second, mothers reported on their children's temperament at 15 months. Third, when children were in second (mean age = 7.80 years) and third grades (mean age = 8.72 years), both parents completed the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) to assess their child's relationships with peers. Parents were invited to complete the questionnaires independently and to return them by mail in provided prepaid envelopes. Finally, in third grade, children completed an adapted version of the Friendship Quality Questionnaire (FQQ; Parker & Asher, 1993) in an interview format to assess the perceived quality of their best friendship. Children were asked to name their five closest friends in class, and the experimenter wrote their names on a sheet of paper. When children said that they could not think of five friends in their

class, they were told it was okay to provide the names of other friends at their school. Then, the experimenter asked children to identify their very best friend from that list, and put an asterisk next to the chosen child's name. The child was then instructed to think about that friend while answering various questions about their relationship (the FQQ questions described below). The experimenter helped children by reading the questions aloud and including the name of the chosen best friend in each question.

Measures

Sleep diaries. The sleep diary is a noninvasive measure widely used in sleep research with infants and children (Sadeh, 2011). It records the child's sleep-wake pattern as it unfolds in cycles of 24 hours over three consecutive days. The diary represents all periods of the sleep-wake cycle, as for every half-hour the parent indicates whether the child is awake or asleep. The parent is asked to report any unusual event that might have disturbed the child's sleep pattern (e.g., illness, visitors staying late at night). In this study, mothers were asked to complete the diary during a period that represented a fairly usual sleep routine for their 1-year-old. Studies have shown that a period of three days represents the optimal duration to obtain reliable data while accounting for mothers' compliance in filling out infant diaries (St. James-Roberts & Plewis, 1996), and allows for good concordance on estimates of sleep duration with actigraphy, an objective sleep measure based on motor activity (Bélanger, Simard, Bernier, & Carrier, 2014; Sekine et al., 2002). To increase reliability of estimates and decrease the odds of chance findings, data were averaged across the three days of assessment. The average ratio of nighttime sleep to total (24-hour) sleep was used in all subsequent analyses.

Infant Characteristics Questionnaire (ICQ; Bates, Freeland, & Lounsbury, 1979).

Mothers were asked to fill out the 32-item ICQ when their child was aged 15 months. The ICQ is

divided into four temperamental dimensions: unadaptability, persistence, difficultness, and social fear. On a 7-point Likert scale, mothers were asked to assess their perceptions of their child's characteristics. The ICQ has good psychometric properties, including satisfactory internal consistency, temporal stability, and cross-reporter correspondence (see Bates et al., 1979; Guerin & Gottfried, 1994).

In the present study, only the unadaptability subscale was significantly related to one of the key study variables (specifically, to peer problems reported by mothers, as described below; all other r s involving other temperament dimensions $< .14$, p s $> .24$). Unadaptable temperament was, therefore, retained as a covariate in the main analyses. Examples of unadaptability items include "How does your baby typically respond to a new person?"; "How well does your baby adapt to new experience eventually?"; or "How does your baby typically respond to being in a new place?". Internal consistency for the unadaptability subscale in this sample was $\alpha = .57$, which is comparable to the alphas obtained in other studies (e.g., $\alpha = .65$; Demers, Bernier, Tarabulsky, & Provost, 2010). ICQ data were missing for 11 children.

Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). Mothers and fathers were asked to fill out the 25-item SDQ when their child was in second and third grade. The SDQ is divided into five subscales each comprised of five items: hyperactivity, emotional symptoms, conduct problems, peer problems and prosocial behaviors. On a 3-point Likert scale ranging from 0 (*not true*) to 2 (*certainly true*), parents were asked to describe their child's behavior within the past six months. The SDQ shows good internal consistency ($\alpha = .73$) and test-retest reliability ($r = .62$; Goodman, 2001). It also shows excellent convergent validity with other measures of children's adjustment such as the parent form of the Rutter Children Behavior Questionnaire (r s = $.78 - .88$; Goodman, 1997) and the Child Behavior Checklist (r s = $.59 - .87$;

Goodman & Scott, 1999).

In the current study, the peer problems subscale was used to examine children's difficulties in their peer relationships. Examples of items include "Has at least one good friend" (reversed); "Generally liked by other children" (reversed); or "Picked on or bullied by other children". Given the correlations between second and third grade scores on this subscale for both mothers ($r = .70, p < .001$) and fathers ($r = .75, p < .001$), scores were averaged across the two years for each parent. In light of evidence that mothers and fathers provide valid and non-redundant information (Arseneault et al., 2003), their scores were kept separate (internal consistency: $\alpha = .76$ for both mothers and fathers). SDQ data were missing for 2 mothers and 12 fathers.

Friendship Quality Questionnaire (FQQ; Parker & Asher, 1993). The original FQQ is a self-report measure that contains 40 items assessing the perceived quality of children's best friendship and their perceptions of various qualitative aspects of that friendship on a 5-point Likert scale ranging from 1 (*not at all true*) to 5 (*really true*). The FQQ has six subscales: validation and caring (e.g., "Makes me feel good about my ideas"), conflict resolution (e.g., "Make up easily when we have a fight"), conflict and betrayal (e.g., "Argue a lot"), help and guidance (e.g., "Helps me so I can get done quicker"), companionship and recreation (e.g., "Always sit together at lunch"), and intimate exchange (e.g., "Always tell each other our problems"). The FQQ shows good internal consistency ($\alpha = .95$; Franco & Levitt, 1998) and test-retest reliability ($r = .75$; Baker & Hudson, 2013).

In the current study, children were asked to complete a shortened 12-item version. The decision to use a briefer version was based on practical considerations, aiming to keep child burden to a reasonable level. Four subscales from the initial FQQ were used: conflict resolution,

conflict and betrayal, help and guidance, and companionship and recreation. The three items that showed the highest factor loadings on each of these scales in the original factor analysis (Parker & Asher, 1993) were retained. In keeping with the usual use of the FQQ (Franco & Levitt, 1998; Nangle, Erdley, Newman, Mason, & Carpenter, 2003), a total score (the mean of the 12 items, reversed when needed) was derived and used as the index of friendship quality ($\alpha = .64$). FQQ data were missing for 20 children.

Analytic plan

The patterns of missing data were examined first. Then, missing data were imputed and descriptive analyses conducted to examine variable distributions. Next, correlations between dependent variables (i.e., peer problems and friendship quality) and potentially confounding variables were conducted. Then, given that the three dependent variables represent different aspects of one construct (children's social functioning with peers), we ran a multivariate regression to estimate the contribution of sleep to the prediction of children's overall social functioning. Finally, we ran separate regression analyses to estimate the unique contribution of sleep to the prediction of children's peer problems (mother- and father-reported) and friendship quality.

Results

Preliminary analyses

We first examined the patterns of missing data with Little's test, which revealed that data were missing completely at random, $X^2 = 6.33$, $p = .39$. Nonetheless, because Little's test has low power (Enders, 2010), we also examined whether complete and incomplete cases differed on any available data. The analyses showed that children with missing data were more likely to be girls (80% vs. 52% in the non-missing group; $p < .001$). No other statistically significant or

practically relevant group differences were found on paternal and maternal education, family income, number of siblings, temperament, or sleep. Consequently, to maintain our full sample size, we imputed missing values using the multiple imputation procedure available in SPSS 24.0. Note that multiple imputation works well with smaller samples (down to $N = 50$) and when as much as 50% of the data are missing (Graham, 2009). Ten imputations were used, with missing data estimated from all other data available (including child sex as per the analysis above) to maximize the precision of imputed data (Enders, 2010). Analyses were run on each imputed data set and results subsequently pooled.

Table 1 presents the descriptive statistics for all measured variables. All variables showed satisfactory variability and normal or near-normal distributions. Next, we examined whether sociodemographic variables (family socio-economic status [SES: standardized average of paternal and maternal education and family income], child sex, and number of siblings) were related to our dependent variables (i.e., peer problems and friendship quality). Only the number of siblings in the family was significantly associated with peer problems as reported by mothers ($r = .27, p = .02$) and fathers ($r = .31, p = .01$). However, given documented relations between family SES and child sleep (El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010) and known sex differences in peer functioning (Oberle, Schonert-Reichl, & Thomson, 2010), we also controlled for these variables with the aim of conducting conservative tests. Child unadaptable temperament was significantly related to peer problems reported by mothers ($r = .24, p = .04$) and was also included as a covariate.

The zero-order correlations among the study variables are displayed in Table 2. The ratio of nighttime sleep showed significant relations with peer problems assessed by mothers ($r = -.43, p < .001$), peer problems assessed by fathers ($r = -.36, p = .002$), and child-reported friendship

quality ($r = .28, p = .02$). Inter-parental concordance was high for the peer problems scale ($r = .62, p < .001$). However, no relations were found between child-reported friendship quality and peer problems reported by mothers ($r = .02, ns$) or by fathers ($r = .06, ns$).

Main analyses

Given the conceptual overlap between the dependent variables, we first conducted a multivariate regression considering these three variables jointly as indicators of children's social functioning. The assumptions of regression models were respected: there were no problematic extreme scores, homoscedasticity was respected, and the residuals were normally distributed. The analysis revealed a significant effect of ratio of nighttime sleep on children's overall social functioning ($\Lambda = .69, F(3,64) = 9.71, p < .001$). After accounting for the covariates (family SES, child sex and temperament, and the number of siblings), a higher ratio of nighttime sleep was associated with less peer problems reported by mothers ($t = -3.93, p < .001$, unstandardized 95% CI [-.022, -.007]) and fathers ($t = -3.23, p = .002$, unstandardized 95% CI [-.020, -.005]), and with higher child-reported friendship quality ($t = 2.90, p = .005$, unstandardized 95% CI [.009, .050]).

Given these significant multivariate results, separate multiple regression analyses were conducted next to investigate the associations between child sleep and peer problems and friendship quality, while controlling for covariates. In each equation, family SES, child sex and temperament, and the number of siblings were entered in the first block, followed by the ratio of nighttime sleep. The results of the regression analyses are presented in Table 3.

The first model revealed that after accounting for the covariates, ratio of nighttime sleep accounted for 16% of variance in peer problems reported by mothers, $F(5,66) = 6.32, p < .001$. Children with more mature sleep patterns during infancy had fewer peer problems as reported by

their mothers ($b^* = -.42, p < .001$). In the second model, ratio of nighttime sleep accounted for 11% of the variance in peer problems reported by fathers, $F(5,66) = 4.71, p < .001$. Children with more mature sleep patterns during infancy had fewer peer problems as reported by their fathers ($b^* = -.36, p = .002$). Finally, in the third model, ratio of nighttime sleep uniquely predicted 10% of children's friendship quality, $F(5,66) = 2.28, p = .06$. Children with more mature sleep patterns reported a higher-quality relationship with their best friend ($b^* = .35, p = .005$).

Discussion

Although cross-sectional studies reveal links between sleep and children's social functioning, longitudinal studies on this subject are scarce; thus we examined associations between nocturnal sleep consolidation in infancy and social functioning with peers and friends in middle childhood. The results provided evidence for associations between sleep consolidation, operationalized as the ratio of nighttime sleep, and later peer relationships and friendship. Children with greater sleep consolidation at 1 year had fewer peer problems, as evaluated by both their parents in second and third grade; they also reported that their best friendship was of higher quality. All relations held after controlling for family socioeconomic status, child sex and temperament, and the number of siblings in the family.

These findings are consistent with those of previous cross-sectional studies that found associations between sleep and peer relationships (e.g., Hoedlmoser et al., 2010; Wiater et al., 2005), and between sleep and friendship (Becker, 2014). They are also in line with the results of the only longitudinal study, to our knowledge, that focused on sleep and social functioning. Brand et al. (2015) found that children who had poorer sleep at age 5 (assessed during a one-night EEG recording in the home) had less positive peer relationships at age 14. The present study adds to these findings by suggesting that sleep assessed as early as 1 year of age relates to

different aspects of social functioning according to three different reporters in middle childhood, a period in which socialization with peers is a central developmental task (Hartup, 1984). Importantly, we found that sleep consolidation predicts later peer functioning even after controlling for temperament during infancy, indicating that infant sleep is not merely a marker of infants' capacities for emotional and behavioral regulation that would also impact their later ability to make friends.

Specifically, the results draw attention to the importance of consolidation of sleep during the nocturnal period in infancy. This sleep index, which has previously been found to relate to children's executive functioning (Bernier et al., 2013; Bernier, Carlson, Bordeleau, & Carrier, 2010) and language development (Dionne et al., 2011), also predicts subsequent relationships with peers and best friend. This suggests that the attainment of sleep consolidation around the age of 1 is important not only for children's cognitive development, but also for their subsequent social functioning.

The time delay between assessments suggests that a developmental cascade entailing a series of intervening events may be responsible for the links observed here between early sleep consolidation and subsequent functioning with peers and with a best friend in middle childhood. As already mentioned, sleep has lasting and significant consequences for behavioral, cognitive and emotional outcomes in childhood, many of which could, in turn, impact children's social functioning. For instance, both language and executive functioning, which have been found to relate to sleep as mentioned above, have also been linked to children's peer relationships (Holmes, Kim-Spoon, & Deater-Deckard, 2016; Menting, Van Lier, & Koot, 2011), possibly due to their role in supporting children's capacity to inhibit their impulses and regulate their behavior. In fact, behavior itself is linked to both sleep and peer relationships: for instance, better

sleep in toddlerhood predicts lower aggression in preschool years (Bélanger et al., 2015), and children displaying aggressive behaviors are often more rejected by their peers (Newcomb, Bukowski, & Pattee, 1993). Furthermore, sleep difficulties are associated with more emotional difficulties, such as symptoms of depression and anxiety (Gregory & O'Connor, 2002), which in turn are associated with lower friendship quality with the best friend (Brendgen et al., 2002). Overall, the current results are best viewed through a developmental lens, as they are likely to reflect the combined effects of several behavioral, emotional and cognitive mediators. Further research is needed to decipher these mechanisms and their interplay.

Of note, mothers' and fathers' reports of their children's peer problems were highly correlated to each other ($r = .62$, in line with the meta-analytic $r = .59$ reported by Achenbach, McConaughy, & Howell, 1987, for child and adolescent behavioral and emotional problems). However, parental reports of children's peer relationships were unrelated to children's own perceptions of the quality of their best friendship. This is not unexpected, given that the SDQ provides information on children's general functioning in the peer group, which can differ from their relationship with a close friend. Indeed, many low-accepted children nonetheless have a best friend (Parker & Asher, 1993), and Lansford et al. (2006) found that there was no difference in friendship quality between rejected, average, or popular school-age girls. In fact, there is much evidence to suggest that children experiencing difficulties in the larger peer group can nonetheless have high-quality relationships with their best friend and derive benefits from that friendship, namely lower levels of loneliness (Erdley, Nangle, Newman, & Carpenter, 2001; Parker & Asher, 1993) and anxiety (Bukowski, 2001), as well as favorable global self-worth (Fordham & Stevenson-Hinde, 1999) and happiness (Demir & Weitekamp, 2007). Therefore, the current finding that sleep was related to both parent-reported general functioning in the peer

group and children's perceived quality of their best friendship is stimulating on both methodological and conceptual grounds. While suggesting that the links between sleep consolidation in infancy and later social functioning are found across reporters (child, mother, and father) and thus are arguably robust, the findings also suggest that sleep during infancy could be consequential for at least two distinct aspects of children's social functioning in middle childhood.

Limitations and Future Research

This study presents some methodological limitations that call for careful interpretation of the results. First, given the non-experimental design, we cannot make causal inferences. Moreover, the sample was composed of mostly college-educated and European Canadian parents, which limits generalizability. Given also its relatively small size, observed estimates may be not stable, thus the exact effect sizes obtained should be interpreted with caution. Regarding missing data, it is important to bear in mind that the missing-at-random assumption is unverifiable (Enders, 2010). We used multiple imputation because Little's test was non-significant (which suggests that data were missing completely at random), and that only one of the t-tests revealed a significant difference between children with and without missing data (on child sex, which may be a fortuitous finding due to the number of tests run). Together, these findings suggested that it was reasonable to assume that data were missing at random, but this cannot be demonstrated formally. Another limitation is that sleep was measured with sleep diaries completed by mothers on three days. Although this duration provides reliable measurement (Bélanger et al., 2014; St. James-Roberts & Plewis, 1996), more days of assessment would provide richer data, and diaries are subjective measures that yield less individual variation than do objective sleep assessments (Sadeh, 2008). One should also bear in

mind that the SDQ is a measure of children's social behavior, broadly, and not their peer relationships, specifically. The peer relationships subscale does include items assessing the quality of children's relationships; nonetheless, it will be important to examine the associations between sleep quality and other indices of peer relationships. In particular, it may be critical to assess interpersonal functioning from the perspective of peers, including acceptance and victimization, as parents may not be aware of all the experiences that children are having with peers. For this reason, our consideration of children's perception of their relationship with their best friend makes for a richer picture of their social functioning; in future studies, it will be important to obtain information about friendship quality from the friend, as well (e.g., Rose & Asher, 2004).

Despite these limitations, this study contributes to the emerging literature on sleep and social functioning by revealing that school-age children have fewer peer problems and better self-reported friendship quality when they had greater nocturnal sleep consolidation in infancy. To our knowledge, this is the first study to investigate the relation between sleep and social functioning with peers and friends using measures at multiple time points and multi-informant assessments. Overall, the current findings highlight the importance of sleep early in life for children's peer relationships and friendships in elementary school. Further research is needed to investigate the child and environmental factors that may account for this association.

References

- Acebo, C., Sadeh, A., Seifer, R., Tzischinsky, O., Hafer, A., & Carskadon, M. A. (2005). Sleep/wake patterns derived from activity monitoring and maternal report for healthy 1- to 5-year-old children. *Sleep*, *28*(12), 1568–1977. Retrieved from <http://www.journalsleep.org/ViewAbstract.aspx?pid=26284>
- Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin*, *101*, 213–232. doi:10.1037/0033-2909.101.2.213
- Alfano, C. A., Zakem, A. H., Costa, N. M., Taylor, L. K., & Weems, C. F. (2009). Sleep problems and their relation to cognitive factors, anxiety, and depressive symptoms in children and adolescents. *Depression and Anxiety*, *26*, 503–512. doi:10.1002/da.20443
- Arseneault, L., Moffitt, T. E., Caspi, A., Taylor, A., Rijdsdijk, F. V., Jaffee, S. R., ... Measelle, J. R. (2003). Strong genetic effects on cross-situational antisocial behaviour among 5-year-old children according to mothers, teachers, examiner-observers, and twins' self-reports. *Journal of Child Psychology and Psychiatry*, *44*, 832–848. doi:10.1111/1469-7610.00168
- Atkinson, E., Vetere, A., & Grayson, K. (1995). Sleep disruption in young children. The influence of temperament on the sleep patterns of pre-school children. *Child: Care, Health and Development*, *21*, 233–246. doi:10.1111/j.1365-2214.1995.tb00754.x
- Bagwell, C. L. & Schmidt, M. E. (2013). *Friendships in childhood and adolescence*. New York, NY: Guilford Press.
- Baker, J. R. & Hudson, J. L. (2013). Friendship quality predicts treatment outcome in children with anxiety disorders. *Behaviour Research and Therapy*, *51*, 31–36. doi:10.1016/j.brat.2012.10.005

- Bates, J. E., Freeland, C. A. B., & Lounsbury, M. L. (1979). Measurement of infant difficultness. *Child Development, 50*(3), 794–803. Retrieved from <http://www.jstor.org/stable/1128946>
- Becker, S. P. (2014). External validity of children's self-reported sleep functioning: Associations with academic, social, and behavioral adjustment. *Sleep Medicine, 15*, 1094–1100. doi:10.1016/j.sleep.2014.06.001
- Berndt, T. J. (2002). Friendship quality and social development. *Current Directions in Psychological Science, 11*, 7–10. doi:10.1111/1467-8721.00157
- Bélangier, M.-È., Bernier, A., Simard, V., Desrosiers, K., & Carrier, J. (2015). Sleeping toward behavioral regulation: Relations between sleep and externalizing symptoms in toddlers and preschoolers. *Journal of Clinical Child & Adolescent Psychology*. Online first publication. doi:10.1080/15374416.2015.1079782
- Bélangier, M.-È., Simard, V., Bernier, A., & Carrier, J. (2014). Investigating the convergence between actigraphy, maternal sleep diaries and the Child Behavior Checklist as measures of sleep in toddlers. *Frontiers in Psychiatry, 5*, article 158. doi:10.3389/fpsyt.2014.00158
- Bernier, A., Beauchamp, M. H., Bouvette-Turcot, A.-A., Carlson, S. M., & Carrier, J. (2013). Sleep and cognition in preschool years: Specific links to executive functioning. *Child Development, 84*, 1542–1553. doi:10.1111/cdev.12063
- Bernier, A., Carlson, S. M., Bordeleau, S., & Carrier, J. (2010). Relations between physiological and cognitive regulatory systems: Infant sleep regulation and subsequent executive functioning. *Child Development, 81*, 1739–1752. doi:10.1111/j.1467-8624.2010.01507.x
- Brand, S., Hatzinger, M., Stadler, C., Bolten, M., von Wyl, A., Perren, S., ... Holsboer-Trachsler, E. (2015). Does objectively assessed sleep at five years predict sleep and psychological functioning at 14 years? – Hmm, yes and no! *Journal of Psychiatric Research, 60*, 148–

155. doi:10.1016/j.jpsychires.2014.10.007

- Brendgen, M., Vitaro, F., Turgeon, L., & Poulin, F. (2002). Assessing aggressive and depressed children's social relations with classmates and friends: A matter of perspective. *Journal of Abnormal Child Psychology*, *30*, 609–624. doi:10.1023/A:1020863730902
- Bryant, P. A., Trinder, J., & Curtis, N. (2004). Sick and tired: Does sleep have a vital role in the immune system? *Nature Reviews Immunology*, *4*, 457–467. doi:10.1038/nri1369
- Bukowski, W. M. (2001). Friendship and the worlds of childhood. *New Directions for Child and Adolescent Development*, *91*, 93–106. doi:10.1002/cd.7
- Bukowski, W. M., Newcomb, A. F., & Hartup, W. W. (1998). *The company they keep: Friendships in childhood and adolescence*. New York, NY: Cambridge University Press.
- Cillessen, A., Jiang, X. L., West, T., & Laszkowski, D. (2005). Predictors of dyadic friendship quality in adolescence. *International Journal of Behavioral Development*, *29*, 165–172. doi:10.1080/01650250444000360
- Coplan, R. J. & Bullock, A. (2012). Temperament and peer relationships. In M. Zentner & R. L. Shiner (Eds), *Handbook of temperament* (pp. 442-461). New York, NY: Guilford Press.
- Criss, M. M., Pettit, G. S., Bates, J. E., Dodge, K. A., & Lapp, A. L. (2002). Family adversity, positive peer relationships, and children's externalizing behavior: A longitudinal perspective on risk and resilience. *Child Development*, *73*, 1220–1237. doi:10.1111/1467-8624.00468
- Dahl, R. E. (1996). The impact of inadequate sleep on children's daytime cognitive function. *Seminars in Pediatric Neurology*, *3*, 44–50. doi:10.1016/S1071-9091(96)80028-3
- Davis, K.F., Parker, K.P., & Montgomery, G.L. (2004). Sleep in infants and young children: Part one: Normal sleep. *Journal of Pediatric Health Care*, *18*, 65–71. doi:10.1016/S0891-

5245(03)00149-4

de Matos, M. G., Barrett, P., Dadds, M., & Shortt, A. (2003). Anxiety, depression, and peer relationships during adolescence: Results from the Portuguese national health behaviour in school-aged children survey. *European Journal of Psychology of Education, 18*, 3–14. doi:10.1007/BF03173600

Demers, I., Bernier, A., Tarabulsky, G. M., & Provost, M. A. (2010). Maternal and child characteristics as antecedents of maternal mind-mindedness. *Infant Mental Health Journal, 31*, 94–112. doi:10.1002/imhj.20244

Demir, M. & Weitekamp, L. A. (2007). I am so happy cause today I found my friend: Friendship and personality as predictors of happiness. *Journal of Happiness Studies, 8*, 181–211. doi:10.1007/s10902-006-9012-7

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*, 179–189. doi:10.1016/j.smr.2009.10.004

Dionne, G., Touchette, E., Forget-Dubois, N., Petit, D., Tremblay, R. E., Montplaisir, J. Y., & Boivin, M. (2011). Associations between sleep-wake consolidation and language development in early childhood: A longitudinal twin study. *Sleep, 34*, 987–995. doi:10.5665/SLEEP.1148

Dunn, J. (2004). *Children's friendships: The beginnings of intimacy*. Malden, MA: Blackwell Publishing.

El-Sheikh, M., Kelly, R. J., Buckhalt, J. A., & Hinnant, J. B. (2010). Children's sleep and adjustment over time: The role of socioeconomic context. *Child Development, 81*, 870–

883. doi:10.1111/j.1467-8624.2010.01439.x
- Enders, C.K. (2010). *Applied missing data analysis*. New York: The Guilford Press.
- Erath, S. A., Flanagan, K. S., Bierman, K. L., & Tu, K. M. (2010). Friendships moderate psychosocial maladjustment in socially anxious early adolescents. *Journal of Applied Developmental Psychology, 31*, 15–26. doi:10.1016/j.appdev.2009.05.005
- Erdley, C. A., Nangle, D. W., Newman, J. E., & Carpenter, E. M. (2001). Children's friendship experiences and psychological adjustment: Theory and research. *New Directions for Child and Adolescent Development, 91*, 5–24. doi:10.1002/cd.3
- Fawcett, L. M. & Garton, A. F. (2005). The effect of peer collaboration on children's problem-solving ability. *British Journal of Educational Psychology, 75*, 157–169. doi:10.1348/000709904X23411
- Feinberg, I., Higgins, L. M., Khaw, W. Y., & Campbell, I. G. (2006). The adolescent decline of NREM delta, an indicator of brain maturation, is linked to age and sex but not to pubertal stage. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 291*, R1724–R1729. doi:10.1152/ajpregu.00293.2006
- Fordham, K. & Stevenson-Hinde, J. (1999). Shyness, friendship quality, and adjustment during middle childhood. *Journal of Child Psychology and Psychiatry, 40*, 757–768. doi:10.1111/1469-7610.00491
- Franco, N. & Levitt, M. J. (1998). The social ecology of middle childhood: Family support, friendship quality, and self-esteem. *Family Relations, 47*, 315–321. doi:10.2307/585262
- Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A research note. *Journal of Child Psychology and Psychiatry, 38*, 581–586. doi:10.1111/j.1469-7610.1997.tb01545.x

- Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*, 1337–1345. doi:10.1097/00004583-200111000-00015
- Goodman, R. & Scott, S. (1999). Comparing the Strengths and Difficulties Questionnaire and the Child Behavior Checklist: Is small beautiful? *Journal of Abnormal Child Psychology, 27*, 17–24. doi:10.1023/A:1022658222914
- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549–576. doi:10.1146/annurev.psych.58.110405.085530
- Gregory, A. M. & O'Connor, T. G. (2002). Sleep problems in childhood: A longitudinal study of developmental change and association with behavioral problems. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*, 964–971. doi:10.1097/00004583-200208000-00015
- Grych, J. H. & Fincham, F. D. (1990). Marital conflict and children's adjustment: A cognitive-contextual framework. *Psychological Bulletin, 108*, 267–290. doi:10.1037/0033-2909.108.2.267
- Guerin, D. W. & Gottfried, A. W. (1994). Developmental stability and change in parent reports of temperament: A ten-year longitudinal investigation from infancy through preadolescence. *Merrill-Palmer Quarterly, 40*, 334–355. doi:10.1080/016502597384992
- Hartup, W. W. (1984). The peer context in middle childhood. In W.A. Collins (Ed.), *Development during middle childhood: The years from 6 to 12* (pp. 240–282). Washington, D.C.: National Academy Press
- Hartup, W. W. (1993). Adolescents and their friends. *New Directions for Child and Adolescent Development, 60*, 3–22. doi: 10.1002/cd.23219936003

- Hatzinger, M., Brand, S., Perren, S., Stadelmann, S., von Wyl, A., von Klitzing, K., & Holsboer-Trachsler, E. (2008). Electroencephalographic sleep profiles and hypothalamic–pituitary–adrenocortical (HPA)-activity in kindergarten children: Early indication of poor sleep quality associated with increased cortisol secretion. *Journal of Psychiatric Research, 42*, 532–543. doi:10.1016/j.jpsychires.2007.05.010
- Hay, D. F., Payne, A., & Chadwick, A. (2004). Peer relations in childhood. *Journal of Child Psychology and Psychiatry, 45*, 84–108. doi:10.1046/j.0021-9630.2003.00308.x
- Hoedlmoser, K., Kloesch, G., Wiater, A., & Schabus, M. (2010). Self-reported sleep patterns, sleep problems, and behavioral problems among school children aged 8-11 years. *Somnologie, 14*, 23–31. doi:10.1007/s11818-010-0450-4
- Holmes, C. J., Kim-Spoon, J., & Deater-Deckard, K. (2016). Linking executive function and peer problems from early childhood through middle adolescence. *Journal of Abnormal Child Psychology, 44*, 31–42. doi:10.1007/s10802-015-0044-5
- Iglowstein, I., Jenni, O. G., Molinari, L., & Largo, R. H. (2003). Sleep duration from infancy to adolescence: Reference values and generational trends. *Pediatrics, 111*, 302–307. doi:10.1542/peds.111.2.302
- Jenni, O. G., Molinari, L., Caflisch, J. A., & Largo, R. H. (2007). Sleep duration from ages 1 to 10 years: Variability and stability in comparison with growth. *Pediatrics, 120*, e769–e776. doi:10.1542/peds.2006-3300
- Knutson, K. L. (2012). Does inadequate sleep play a role in vulnerability to obesity? *American Journal of Human Biology, 24*, 361–371. doi:10.1002/ajhb.22219
- Kohyama, J. (1998). Sleep as a window on the developing brain. *Current Problems in Pediatrics, 28*, 73–92. doi:10.1016/S0045-9380(98)80054-6

Lansford, J., Putallaz, M., Grimes, C., Schiro-Osman, K., Kupersmidt, J., & Coie, J. (2006).

Perceptions of friendship quality and observed behaviors with friends: How do sociometrically rejected, average, and popular girls differ? *Merrill-Palmer Quarterly*, 52(4), 694–720. Retrieved from <http://www.jstor.org/stable/23096030>

Laursen, B., Bukowski, W. M., Aunola, K., & Nurmi, J. E. (2007). Friendship moderates

prospective associations between social isolation and adjustment problems in young children. *Child Development*, 78, 1395–1404. doi:10.1111/j.1467-8624.2007.01072.x

Mashburn, A. J., Justice, L. M., Downer, J. T., & Pianta, R. C. (2009). Peer effects on children's

language achievement during pre-kindergarten. *Child Development*, 80, 686–702. doi:10.1111/j.1467-8624.2009.01291.x

Meltzer, L. J. & Mindell, J. A. (2014). Systematic review and meta-analysis of behavioral

interventions for pediatric insomnia. *Journal of Pediatric Psychology*, 39, 932–948. doi:10.1093/jpepsy/jsu041

Menting, B., Van Lier, P. A., & Koot, H. M. (2011). Language skills, peer rejection, and the

development of externalizing behavior from kindergarten to fourth grade. *Journal of Child Psychology and Psychiatry*, 52, 72–79. doi:10.1111/j.1469-7610.2010.02279.x

Monahan, K. C. & Booth-LaForce, C. (2016). Deflected pathways: Becoming aggressive,

socially withdrawn, or prosocial with peers during the transition to adolescence. *Journal of Research on Adolescence*, 26, 270–285. doi:10.1111/jora.12190

Murray-Close, D. (2013). Psychophysiology of adolescent peer relations I: Theory and research

findings. *Journal of Research on Adolescence*, 23, 236–259. doi:10.1111/j.1532-7795.2012.00828.x

Nangle, D. W., Erdley, C. A., Newman, J. E., Mason, C. A., & Carpenter, E. M. (2003).

- Popularity, friendship quantity, and friendship quality: Interactive influences on children's loneliness and depression. *Journal of Clinical Child and Adolescent Psychology*, 32, 546–555. doi:10.1207/S15374424JCCP3204_7
- National Sleep Foundation. (2004). Sleep in America poll. Retrieved from <https://sleepfoundation.org/sites/default/files/FINAL%20SOF%202004.pdf>
- Newcomb, A. F., Bukowski, W. M., & Pattee, L. (1993). Children's peer relations: A meta-analytic review of popular, rejected, neglected, controversial, and average sociometric status. *Psychological Bulletin*, 113, 99–128. doi:10.1037/0033-2909.113.1.99
- Oberle, E., Schonert-Reichl, K. A., & Thomson, K. C. (2010). Understanding the link between social and emotional well-being and peer relations in early adolescence: Gender-specific predictors of peer acceptance. *Journal of Youth and Adolescence*, 39, 1330–1342. doi:10.1007/s10964-009-9486-9
- Otoni, G. L., Lorenzi, T. M., & Lara, D. R. (2011). Association of temperament with subjective sleep patterns. *Journal of Affective Disorders*, 128, 120–127. doi:10.1016/j.jad.2010.06.014
- Parker, J. & Asher, S. (1993). Friendship and friendship quality in middle childhood: Links with peer acceptance and feelings of loneliness and social dissatisfaction. *Developmental Psychology*, 29, 611–621. doi:10.1037/0012-1649.29.4.611
- Peirano, P. D. & Algarín, C. R. (2007). Sleep in brain development. *Biological Research*, 40, 471–478. doi:10.4067/S0716-97602007000500008
- Poulin, F. & Chan, A. (2010). Friendship stability and change in childhood and adolescence. *Developmental Review*, 30, 257–272. doi:10.1016/j.dr.2009.01.001
- Rose, A. J. & Asher, S. R. (2004). Children's strategies and goals in response to help-giving and

- help-seeking tasks within a friendship. *Child Development*, *75*, 749–763. doi:10.1111/j.1467-8624.2004.00704.x
- Sadeh, A. (2008). Commentary: Comparing actigraphy and parental report as measures of children's sleep. *Journal of Pediatric Psychology*, *33*, 406–407. doi:10.1093/jpepsy/jsn018
- Sadeh, A. (2011). Sleep assessment methods. In M. El-Sheikh (Ed.), *Sleep and development: Familial and socio-cultural considerations* (pp. 355–371). New York, NY: Oxford University Press.
- Sadeh, A., Gruber, R., & Raviv, A. (2002). Sleep, neurobehavioral functioning, and behavior problems in school-age children. *Child Development*, *73*, 405–417. doi:10.1111/1467-8624.00414
- Salmivalli, C., Kaukiainen, A., & Lagerspetz, K. (2000). Aggression and sociometric status among peers: Do gender and type of aggression matter? *Scandinavian Journal of Psychology*, *41*, 17–24. doi:10.1111/1467-9450.00166
- Sekine, M., Chen, X., Hamanishi, S., Wang, H., Yamagami, T., & Kagamimori, S. (2002). The validity of sleeping hours of healthy young children as reported by their parents. *Journal of Epidemiology*, *12*, 237–242. doi:10.2188/jea.12.237
- St. James-Roberts, I. & Plewis, I. (1996). Individual differences, daily fluctuations, and developmental changes in amounts of infant waking, fussing, crying, feeding, and sleeping. *Child Development*, *67*, 2527–2540. doi:10.2307/1131638
- Touchette, É., Petit, D., Séguin, J. R., Boivin, M., Tremblay, R. E., & Montplaisir, J. Y. (2007). Associations between sleep duration patterns and behavioral/cognitive functioning at school entry. *Sleep*, *30*(9), 1213–1219. Retrieved from <http://www.journalsleep.org/>

[ViewAbstract.aspx?pid=26943](#)

Vaughn, B. E., Elmore-Staton, L., Shin, N., & El-Sheikh, M. (2015). Sleep as a support for social competence, peer relations, and cognitive functioning in preschool children.

Behavioral Sleep Medicine, 13, 92–106. doi:10.1080/15402002.2013.845778

Wentzel, K. R. & Caldwell, K. (1997). Friendships, peer acceptance, and group membership:

Relations to academic achievement in middle school. *Child Development, 68*, 1198–

1209. doi:10.1111/j.1467-8624.1997.tb01994.x

Wiater, A. H., Mitschke, A. R., Widdern, S. V., Fricke, L., Breuer, U., & Lehmkuhl, G. (2005).

Sleep disorders and behavioural problems among 8- to 11-year-old children. *Somnologie,*

9, 210–214. doi:10.1111/j.1439-054X.2005.00073.x

Wolke, D. & Samara, M. M. (2004). Bullied by siblings: Association with peer victimisation and

behaviour problems in Israeli lower secondary school children. *Journal of Child*

Psychology and Psychiatry, 45, 1015–1029. doi:10.1111/j.1469-7610.2004.t01-1-00293.x