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Using Parental Report To Identify Children At Risk For Poor Sleep And Daytime Problems

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RUNNING HEAD: **Identifying Children At Risk For Poor Sleep And Daytime Problems**

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ABSTRACT

Objective: To examine objective sleep patterns and the daytime behavioral, emotional and academic functioning of school-age children above and below the clinical cutoff score for the Child Sleep Habits Questionnaire (CSHQ), which is a parental-report-based measure of sleep disturbances.

Participants. 48 boys and 74 girls aged 7–11 years.

Methods: Participants' sleep was assessed in their home environment using a miniature actigraph (AW-64 series; Mini-Mitter, Sunriver, OR, USA) for five consecutive weeknights. The parents provided their child's report card and completed a battery of questionnaires that included the CSHQ, the Child Behavior Checklist, a demographic questionnaire and a health questionnaire.

Results. Children that were above the cutoff score of the CSHQ had later objectively measured sleep schedule, were less likely to obtain the recommended amount of sleep for their age, had higher levels of internalizing and externalizing symptoms and a higher prevalence of clinical levels of externalizing and internalizing problems, had lower grades in English and French as a Second Language, and were more likely to fail these subjects. Discriminant analysis revealed that information from the objective sleep and emotional/behavioral and academic measures could significantly discriminate between those with or without parent-reported sleep disturbance.

Conclusion. Parental reports of sleep disturbances can be used to identify children at increased risk for sleep, emotional, behavioral and academic problems. Such questionnaires should be incorporated into clinical practice and school-based evaluations with the goal of identifying undiagnosed children who might be at risk for poor adjustment related to night- and daytime difficulties.

INTRODUCTION

Sleep problems affect approximately 25% of all children, with some prevalence estimates reaching upwards of 40% (Ipsiroglu, Fatemi, Werner, Paditz, & Schwarz, 2002; Owens, 2008; Schlarb, Gulewitsch, Weltzer, Ellert, & Enck, 2015; Spruyt, O'Brien Louise, Cluydts, Verleye Gino, & Ferri, 2005). These disturbances can take many forms, including dyssomnias (such as insomnia) and parasomnias (such as sleepwalking) (American Academy of Sleep, 2014; American Psychiatric Association, 2013). Regardless of the source of a sleep disturbance or the way in which it manifests, the end result is disrupted sleep, which is known to affect the psychological functioning and academic, neurocognitive and behavioral performance of a child (Curcio, Ferrara, & De Gennaro, 2006; Dewald, 2010; Durmer & Dinges, 2005; Eide & Showalter, 2012; Gruber et al., 2014; Touchette, 2007). Many parents and educators tend to overlook sleep problems or underestimate their impact on the daily functioning of children (Chervin, Archbold, Panahi, & Pituch, 2001; Gruber, Constantin, Frappier, Brouillette, & Wise, 2017; National Commission on Sleep Disorders Research, 1992; Rosen, Zozula, Jahn, & Carson, 2001; Smaldone, Honig, & Byrne, 2007; Stein, Mendelsohn, Obermeyer, Amromin, & Benca, 2001). Furthermore, even when parents suspect that their child's sleep might be suboptimal, it unclear whether their observations are sufficient to warrant specialized assessment and potential intervention in terms of the child's sleep or daytime functioning.

Sleep has been shown to be associated with an array of key behavioral, cognitive, and emotional processes that are essential for optimal behavioral regulation, emotional regulation, and academic performance (Fallone, 2001; Killgore, 2010; Kopasz, 2010; Ma, 2015; Sadeh, Gruber, & Raviv, 2003; Touchette, 2007). Meta-analyses revealed that sleep duration in school-aged children is positively associated with executive functioning and multiple domains of cognitive

function, and negatively associated with internalizing and externalizing behavior (Astill, Van der Heijden, Van IJzendoorn, & Van Someren, 2012; Chaput et al., 2016). This is because the neural areas that govern emotional regulation and executive functions are sensitive to sleep deficiency (Alhola & Polo-Kantola, 2007; Dinges, 1997; Drummond, 1999; Durmer & Dinges, 2005; Goldstein & Walker, 2014; Gujar, 2011; Harrison & Horne, 1998; Jens, 2005; Killgore, 2010; Linde & Bergstrom, 1992; Ma, 2015; Mesulam, 1990; Nilsson, 2005; Yoo, 2007). In addition, it has been suggested that sleepiness induced by poor or insufficient sleep could be associated with behavioral outcomes, such as conduct problems, reduced attention, and poor cognitive processing (Calhoun et al., 2012). Another hypothesis suggests that sleep is required for optimal neuroplasticity and that poor or insufficient sleep could impair such processing, resulting in poor behavioral, cognitive, or emotional outcomes (Tononi & Cirelli, 2006; Tononi & Cirelli, 2014).

Objective measures of sleep, such as actigraphy and polysomnography, are assigned greater research credibility than parental reports of children's sleep habits. Some previous studies have found that there are only low correlations between objective and subjective measures of sleep, suggesting that subjective reports are not a valid means to assess children's sleep (Werner, Molinari, Guyer, & Jenni, 2008). However, other studies have shown that sleep questionnaires provide valuable information that cannot be obtained using objective measures of children's sleep, and therefore should be used as a complementary strategy (Holley, Hill, & Stevenson, 2010). For example, because the social context in which sleep occurs is important for pediatric sleep, proxy reporters (e.g., the parents) are needed to report such information. Only subjective reports from caregivers can capture information such as whether the child sleeps alone, the darkness of room used for sleep, specific activities that occur prior to sleep initiation, the desired sleep schedule, screen time in bed, etc. Although previous reports raised concern that many of the parent-based

sleep measures have not been validated for clinical use, some measures used to assess pediatric sleep disorders, such as the The Children's Sleep Habits Questionnaire (CSHQ ; Owens, Spirito, & McGuinn, 2000), have been validated against clinical populations and have been shown to provide relevant and distinct norms for clinical and non-clinical populations (Lewandowski, Toliver-Sokol, & Palermo, 2011). Another limitation of objective sleep measures such as polysomnographic assessment is that they are typically lab-based and do not measure sleep habits in the natural setting. Feasibility is another issue that tends to be better addressed by subjective sleep measures. Whereas parents, educators and clinicians might have difficulty accessing an objective sleep assessment, they can easily use questionnaires based on parental reports. Furthermore, while polysomnography and actigraphy provide information on sleep and sleep patterns, they fail to identify behavioral sleep disturbances (e.g., bedtime resistance, insomnia) or reasons for nighttime movements (e.g., sleepwalking). For these reasons, using a parental report could offer many advantages for an early screening. However, there is a gap regarding the extent to which subjective sleep measures are associated with a child's daytime functioning.

The CSHQ (Owens, Spirito, & McGuinn, 2000) is a multidimensional pediatric screening tool commonly used to screen for a broad range of sleep problem. It is easy to score and fast to administer while comprehensive in assessing a broad range of sleep disturbances, as well as daytime sleepiness and sleep schedule. An evidence-based psychometric review of parent- and child-reported pediatric sleep measures (Lewandowski et al., 2011) determined that this measure is a "well-established'' multidimensional sleep measure for children, as assessed using criteria developed by the American Psychological Association (APA) Division 54 Evidence-Based Assessment (EBA) Task Force. These criteria include: (a) the existence of valid and reliable data

on the measure; (b) the availability of the measure with instructions on its use and scoring; and (c) the use of the measure by other investigators with findings published in a peer-reviewed journal.

A few studies have examined the association between parental reports on the CSHQ and objective measures of children's sleep, such as actigraphy or polysomnography (PSG) (Holley, Hill, & Stevenson, 2010; Markovich, Gendron, & Corkum, 2015; Urfer-Maurer et al., 2018). A shorter actigraphy-measured total sleep time (TST) was associated on the CSHQ with parent-reported sleep duration problems, longer sleep onset delays, more night wakings, more bedtime resistance, and more parasomnias. In addition, a longer actigraphy-measured sleep onset latency (SOL) was related to more parent-reported sleep onset delay, sleep-disordered breathing, and daytime sleepiness (Holley, Hill, & Stevenson, 2010). Furthermore, additional actigraphy-based assessments showed that less actigraphic TST and more wakings after sleep onset were associated with more parent-reported night wakings. Two studies compared results obtained using the CSHQ and PSG (Markovich et al., 2015; Urfer-Maurer et al., 2018). One found no association between parent-reports and PSG sleep measures, while the other found that maternal reports of children's sleep on the CSHQ corresponded moderately with objective measures of TST, sleep efficiency, and SOL assessed with in-home PSG (Markovich et al., 2015).

The CSHQ has been used in multiple studies assessing sleep in community samples as it relates to screen time use and has been used to measure sleep in multiple clinical populations (e.g., Lucas, Mulraney, & Sciberras, 2017; Lycett, Mensah, Hiscock, & Sciberras, 2015; Parent, Sanders, & Forehand, 2016) and their association with social, emotional, and behavioral functioning. Also, several previous studies used the CSHQ in conjunction with measures of internalizing or externalizing behaviors, found that child externalizing behavior problems and child daytime sleepiness contributed to parenting stress (Byars, Yeomans-Maldonado, & Noll,

2011). In addition, parental reports of bedtime resistance on the CSHQ were associated with externalizing problems (Gruber et al., 2012).

While developing the CSHQ, Owens et al. assessed CSHQ ratings for a community sample of school-aged children and a clinical sample of children diagnosed with pediatric sleep disorders (Owens, Spirito, & McGuinn, 2000). However, no previous study has assessed the sleep, behavioral and academic correlates of CSHQ ratings in a community sample of students who were not previously diagnosed with a pediatric sleep problem. This is important because if parental reports of sleep disturbances are able to distinguish children at risk for sleep, emotional, behavioral and academic problems, such questionnaires could be incorporated into clinical practice and school-based evaluations as a feasible tool for identifying undiagnosed children who might be at risk for poor adjustment related to night- and daytime difficulties.

Although some researchers and clinicians may use sleep questionnaires to screen for child sleep problems, the literature suggests that sleep is not screened on a routine basis in many pediatric, psychiatric, psychological, or educational settings. For example, a survey conducted with 626 pediatricians in the US found only about one quarter of the respondents screened toddlers and school-aged children for snoring, and only 38.3% regularly questioned the adolescents themselves about their sleep (Owens, 2001). Thus, despite acknowledging the importance of sleep problems, many pediatricians fail to screen adequately for them, especially in older children and adolescents. Other healthcare professionals also lack the skills and knowledge required to effectively screen or treat pediatric sleep problems (Meltzer, Phillips, & Mindell, 2009). For example, a survey of 212 directors of clinical psychology internship programs found that only 6% of the programs offered formal comprehensive courses on sleep (Meltzer et al., 2009). The vast majority of the surveyed directors acknowledged that their affiliated schools provided inadequate

sleep education. Indeed, 41% of programs offered no training whatsoever on diagnosing or treating sleep disorders (Meltzer et al., 2009). This is a concern, given that sleep problems are found at a very high rate in those experiencing academic or mental health problems.

The school-age years are a period of transition for the neural systems that govern the capacity for self-regulation. Because these changes occur just before the development of a biological tendency toward phase delay, this period affords a unique window of opportunity. At this time, it is important to help children to learn, refine, and consolidate good sleeping habits, as this may prevent them from establishing unhealthy habits that can spiral into a pattern of extremely delayed bedtime and the associated sleep deprivation that is seen in many adolescents (Dahl, 2004). Developing healthy sleep at a young age has been shown to create a foundation for integrating these habits into daily life in later years. This suggests that the early identification and treatment of sleep problems could set the stage for an easier transition to adolescence. In addition, early screening could allow difficulties to be identified before they grow more problematic and difficult to treat and/or worsen existing cognitive or behavioral problems. Therefore, screening and treating sleep problems is of paramount importance during the school-age years. Hence, the goal of the present study was to examine objective sleep patterns and the daytime behavioral, emotional and academic functioning of school-age children above and below the clinical cutoff score of the CSHQ (Owens et al., 2000).

Pronounced gender differences have been observed in the manifestation of behavioral problems: girls present with higher levels of internalizing problems, while boys present with higher levels of externalizing problems (Crick & Zahn–Waxler, 2003; Demmer, Hooley, Sheen, McGillivray, & Lum, 2017). Sleep disturbances are known to be associated with both internalizing and externalizing problems (Rubens, Evans, Becker, Fite, & Tountas, 2017; Sadeh, Tikotzky, &

Kahn, 2014). There is no information regarding the extent to which gender modulates the way better or worse sleep tracks with the level of behavioral or emotional problems in school-age children. It is therefore not clear whether there are gender differences in the nature of the associations between behavioral, emotional, or academic problems in school-age children with high or low levels of sleep problems. Thus, another goal of this study was to examine differences in the cognitive, behavioral/emotional, and externalizing or internalizing behaviors in boys and girls with different levels of sleep disturbance.

We hypothesized that, compared to children below the clinical cutoff score on the CSHQ, children with sleep disturbance scores at or above the cutoff score will: 1) have less efficient and shorter objectively measured sleep; 2) exhibit poorer emotional, behavioral and academic functioning; 3) be less likely to obtain the recommended amount of sleep; and 4) be more likely to present with clinically significant levels of emotional/behavioral symptoms and academic failure. 5) In addition, we hypothesized that girls in the group having high sleep disturbance scores would manifest more internalizing symptoms compared to boys, that boys in the group having high sleep disturbance scores would manifest more externalizing problems, and that there would be no gender difference in academic performance. Given that our ultimate goal is to identify a simple, feasible and reliable tool to identify children at risk for sleep and related behavioral and academic problems, we also wanted to know if children with more daytime problems could be 'traced back' to their CSHQ-determined sleep disturbance group. We further hypothesized that 6) performance on the behavioral, emotional and academic performance measures would allow us to successfully classify the children to their CSHQ-determined sleep disturbances groups.

METHODS

Participants. Power Analysis. We based our power calculation on a previous study that investigated the associations (Becker, Ramsey, & Byars, 2015; Faul, Erdfelder, Lang, & Buchner, 2007a) between sleep and behavior in children and adolescents using similar design and measures. In the previous study the effect sizes were found to be of large size for internalizing behavior (Becker et al., 2015). We used G-Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007b) to calculate a priori power analyses for MANOVA with an alpha of 0.05, a power of 0.80, for 2 groups, 1 predictor, and 6 response variables to estimate the sample size that would allow detection of an equivalent effect size. We determined that a total sample size 104 subjects would be sufficient to detect such an effect size. In addition, we calculated sensitivity analyses for MANOVA with an alpha of 0.05, a power of 0.80, for 2 groups, 1 predictor, and 6 response variables to estimate the minimum detectable effect size, $f^2(V)$, to be 0.12, corresponding to a medium to large effect size (Becker et al., 2015; Faul et al., 2007a).

A total of 280 questionnaires were sent; 130 (44%) were completed, and five (1%) were returned but incomplete. Thus, the overall response rate was 44%. The mean age of the total sample respondents was similar to that of the original sample. Based on the school's information regarding parental marital status and ethnicity, there was no difference in these parameters between the responders and non-responders. The families that were approached live in the same geographic areas and are typical of the target population with respect to their Socio-Economic Status and ethnicity. Participants were excluded if a parent reported that their child had a physical/mental health/sleep disorder that interfered with sleep, or a mental health disorder that required hospitalization, residential care and/or the current use of a psychotropic medication known to interfere with sleep (e.g., stimulant medication for ADHD). Based on these exclusion criteria, we excluded 8 children.

The final sample consisted of 122 participants: 48 boys and 74 girls aged 7–11 years (mean = 8.59, standard deviation (SD) = 1.87). Most of the participants were Caucasian (69.2%), with the remainder classified as Mixed Ethnicity (18.9%), Asian (9.9%), Hispanic (2 %), and African–American (1%). The participants were recruited from elementary schools of the Riverside School Board, which governs the public education of the English-speaking population of Montreal's south shore. These schools use the same educational curricula, apply the same grading systems, and work under the same educational requirements of the Ministry of Education.

The majority of children (87.3%) came from families in which the parents were married, 7% came from families in which the parents were separated or divorced, and 5.6% came from families with a single mother. In terms of education, 52% of the mothers and 45.3% of the fathers had university-level educations, 30% of the mothers and 29.8% of the fathers had college level educations, and 18% of the mothers and 24.8% of the fathers had high school educations. Regarding income, 6.5% of the households had annual combined incomes <$25,000, 35.9% had annual incomes of $25,000–$65,000, 19.6% had annual incomes of $65,000–$95,000, and 38% had annual incomes >$95,000.

Procedure

Children were invited to participate in the study and their parents received a package that included a consent form and a flyer. Upon parental consent and child assent, each participant's sleep pattern was assessed in the home environment using a miniature actigraph (AW-64 series; Mini-Mitter, Sunriver, OR, USA). An actigraph was delivered to the child's home, and parents were instructed to attach it to the child's nondominant wrist at bedtime for 5 consecutive nights (Monday through Friday). Parents were also asked to keep a diary of their child's daily bedtime and wake time (sleep log) during the same period. Sleep was monitored on weeknights during the

regular academic year, excluding school holidays. A research assistant kept in close contact with each family throughout the week, texting them in the evening to remind them complete the sleep logs and make sure the child wore the Actiwatch. The parents received a battery of questionnaires that included the CSHQ (Owens et al., 2000), the Child Behavior Checklist (CBCL) (Achenbach, 1991), a demographic questionnaire and a health questionnaire. The parents were asked to complete and return all questionnaires and to provide the child's most recent report card. The study was approved by the Research Ethics Board at the Douglas Research Center (Montreal, Canada) and the Research Ethics Board of the Riverside School Board (Montreal, Canada). Informed consent was obtained from the parents of all participants.

Measures

Sleep. 1) Actigraphy. Nighttime sleep was monitored by actigraphy, which has been shown to be a reliable method for evaluating sleep. The utilized Actiware Sleep 3.4 software package (Mini-Mitter) applies a sleep-scoring algorithm that was previously validated and found to display a high degree of correspondence with polysomnographic data (Littner, 2003; Werner et al., 2008). The actigraphic data were analyzed in 1-minute epochs. The total number of activity events was computed for each epoch; if the threshold sensitivity value of the mean score during the active period was exceeded, the epoch was considered to be waking in nature. Otherwise, the epoch was considered to be sleep. In the present study we used (a) the sleep schedule, including the times of sleep start and sleep end; (b) the sleep time, which was the total sleep period; and (c) sleep efficiency, which was the percentage of time in bed spent sleeping. These measures were averaged over the five weeknights. 2) Daily sleep logs. Bedtimes and wake times were taken from sleep logs that were maintained by the parents. 3) Reported sleep problems were examined using the CSHQ which is a retrospective 33-item parent questionnaire (Owens et al., 2000) This sleep-screening

instrument was designed to identify behaviorally and medically based sleep problems in school-age children. The CSHQ includes items exploring a number of key sleep domains and shows good validity and reliability (Owens et al., 2000). The 33 items on the CSHQ are grouped into eight subscales exploring a number of key sleep domains: (1) bedtime resistance (comprising six items); (2) sleep-onset delay (one item); (3) sleep duration (three items); (4) sleep anxiety (four items); (5) night waking (three items); (6) parasomnia (seven items) (7) sleep-disordered breathing (three items); and (8) daytime sleepiness (eight items). Parents were asked to recall children's recent sleep behavior during a typical week. Items were rated on a 3-point scale: usually if the particular sleep behavior occurred 5 to 7 times per week, sometimes if 2 to 4 times per week, and rarely if no or a single instance was recorded in a given week. Scores were adjusted to reflect the fact that a higher score was indicative of increased sleep disturbance. A total CSHQ score of 41 is considered to be the clinical threshold; children with scores equal to or above the clinical cut-off score are considered to have sleep disturbance (and are herein described as 'above the cutoff score'), whereas those with a score below 41 are considered within the normal range.

Behavioral/Emotional Functioning. Overall behavioral functioning was examined using the CBCL, which is a 113-item parental questionnaire assessing child behavior and emotional problems (Achenbach, 1991). The CBCL is a commonly employed parental measure of youth symptoms, assessing a wide range of problems, and featuring Internalizing and Externalizing Scales. Several studies have confirmed replicability of the psychometric structure of the CBCL and high reliability, validity, and sensitivity of the scales (Achenbach, Verhulst, Baron, & Althaus, 1987; Crijnen, Achenbach, & Verhulst, 1997). In the present study, we focused on the Externalizing (i.e., Rule-Breaking and Aggressive Behavior categories) and Internalizing

(anxious-depressed somatic complaints and withdrawn/depressed scales) scales. T-scores (converted from raw scores) provided cutoff points for criteria in the borderline/clinical range. The relevant T-score cutoff was 60 for the Externalizing and Internalizing scales, with higher scores indicating more behavior problems.

Academic Performance. Parents were asked to provide a copy of their child's most recent report card. Grades were given on a scale of 0 to 100. We focused on grades in English language, French as a Second Language and Mathematics, as these grades are considered to be the most predicative of academic abilities (Duncan et al., 2007) and have been shown to be sensitive to poor or insufficient sleep (Duncan et al., 2007; Gruber, Somerville, Enros, Paquin, Kestler, Gillies-Poitras, 2014).

Demographics. Information regarding education, marital status, and household income was collected through a background questionnaire.

Health. Health information was collected using the Health Related Questionnaire (HRQ) (Corkum et al., 2018). This measure contains 27 items that assess major physical/mental health/sleep disorders.

ANALYSES

Statistical Analysis

The participants were divided into two groups based on their total CSHQ score, with those at/above and below the cutoff score placed in the Above the Cut Point Score group (ACPSG) and below the Cut Point Score Group (BCPSG), respectively. In order to compare the characteristics of participants in the two sleep disturbances groups, demographics characteristics were considered

to be dependent variables and were compared across the groups using either one-way analysis of variance or Chi squared analysis, depending on the nature of the data.

To assess group differences in behavior/emotional functioning, academic performance or actigraphic sleep measures while controlling for multiple comparisons, we used three parallel multivariate analyses of variance (MANCOVA) with the group (ACPSG vs. BCPSG) and gender as independent variables and the actigraphic sleep measures, CBCL scores and report card grades as the dependent variables, and age as a covariate. Before we carried out the multivariate analyses, we tested all potential independent variables for multicollinearity by assessing variance inflation factors (VIFs). There was no concern regarding multicollinearity, as the VIFs of the independent variables were all <5.

To determine the prevalence of sleep deprivation, psychopathology and academic underachievement in each group, we performed the following analyses: 1) We reclassified the assumed sleep durations into short (<9 h), recommended (9-11 h) and long (>11 h) categories (Hirshkowitz, 2015) and used Chi-squared tests to compare the percentage of children who obtained the recommended amount of sleep in each group. 2) We reclassified the Internalizing and Externalizing scores into control (T score <60) and clinical (≥60) categories and used Chi-squared tests to compare the percentage of children above and below the clinical cutoff scores in each group. 3) We reclassified the students' grades in math and languages as <60 (Fail), 60-74 (Pass) and >74 (Succeed), and used Chi-squared tests to compare the percentage of Success, Pass and Fail scores in each group.

Discriminant analysis (DA) was performed to determine the capability of the sleep measures, emotional/behavioral measures, and grades that showed between-group differences to correctly classify children into the ACPSG versus BCPSG. DA may be used to predict group

membership with a dichotomous categorical dependent variable and several continuous independent variables (Neal, Matson, & Belva, 2012) and to create a model to predict which variables best discriminate between groups. Here, we entered the sleep disturbance status as the grouping variable (i.e., ACPSG vs. BCPSG) and the actigraphic sleep duration information, CBCL score, Internalizing score, Externalizing score and report card grades in English and French as a Second language (the subjects whose grades showed a between-group difference) as predictors. We hypothesized that the combined measures as a whole would significantly discriminate between children with and without a sleep disturbance.

RESULTS

66 (44 Girls, 22 Boys) of the participants CSHQ score were at/below the cut off scores and were therefore placed in the Below The Cut Off Scores group (BCPSG) and 56 (30 Girls, 26 Boys) participants were a and were placed in the Above The Cut Off Scores group (ACPSG). Table 1 presents the means and SDs for the objective sleep measures, behavioral/emotional functioning and the academic performance and of children in the two groups.

Between-group Comparisons of Sleep, Behavioral/Emotional Functioning and Academic Performance

Group Differences in Objective Sleep Measures. MANOVA revealed that there was a significant group main effect ($F(5, 121)=3.05$, $p < 0.01$). Univariate post-hoc analyses showed that the sleep start and end times were delayed in the ACPSG compared to the BCPSG. No significant main effect was found for gender and there was no significant group-by-gender interaction.

Group Differences in Behavioral/Emotional Functioning. MANOVA revealed a significant group main effect ($F(5, 121)=13.99$, $p < 0.001$). Univariate post-hoc analyses showed that the Internalizing and Externalizing scores were significantly higher in the BCPSG compared to the

ACPSG. No significant main effect was found for gender and there was no significant group-by-gender interaction.

Group Differences in Academic Performance. MANOVAs revealed significant main effects for group ($F(3, 119)=4.55$, $p < 0.005$). Students in the ACPSG had significantly lower grades in English and French as a Second Language compared to students in the BCPSG. No significant main effect was found for gender and there was no significant group-by-gender interaction.

Between-group Comparisons of the Prevalence of Sleep Deprivation, Pathological Behavior and Academic Failure

Frequencies and Chi Square Values are Presented in Table 2. Chi-square tests revealed the following: 1) A lower percentage of children in the ACPSG obtained the recommended amount of sleep, as measured by the actigraphy, compared to children in the BCPSG. 2) There was a higher prevalence of children with scores above the clinical cutoff of the CBCL for both Internalizing and Externalizing scales in the ACPSG compared to the BCPSG. 3) Chi-square tests revealed that the prevalence of children with succeeding or passing grades in English and French as a Second Language was higher in the BCPSG compared to the ACPSG. In contrast, the prevalence of children with failing grades in these subjects was higher in the ACPSG compared to the BCPSG.

Discriminant Analysis

Table 3 presents bivariate correlations across continuous variables. Wilks' lambda was significant ($\lambda = 0.72$, $\chi^2 = 38.73$, $p < 0.001$) indicating that all of the measures together could significantly discriminate between the sleep disturbance groups. One function emerged in the discriminant function analysis. The standardized canonical discrimination coefficients were -0.50 for French as a Second Language, 0.45 for internalizing problems, 0.60 for externalizing problems, and -0.50 for assumed sleep. A canonical correlation of 0.53 indicated that the model accounted for 100%

of the between-group variation. Discriminant function analysis based on the actigraphic sleep duration score, CBCL score, Internalizing score, Externalizing score and academic performance in English and French as a Second Language correctly assigned 79.1% of the children in the BCPSG and 70.2% of the children in the ACPSG.

DISCUSSION

One aim of the present study was to compare the sleep, emotional, behavioral and academic functioning of boys and girls with and without parentally reported sleep disturbances. The results showed that compared to children in the in comparison to children in the BCPSG, children in the ACPSG had delayed objectively measured sleep patterns and were less likely to obtain the recommended amount of sleep for their age based on actigraphic data. They also had higher ratings for internalizing and externalizing symptoms and a higher prevalence of clinical levels of externalizing and internalizing problems. Finally, their grades in English and French as a Second Language were lower and they were more likely to fail these subjects. There were no gender differences in the extent to which sleep disturbances were associated with behavioral or academic outcomes.

Another aim of the present study was to examine whether using information from sleep, emotional, behavioral and academic measures relevant to significant daytime and nighttime challenges would allow children to be classified into their respective sleep disturbance groups. Indeed, such information was significantly able to predict group membership and accounted for nearly all of the variance between the two sleep disturbance groups. These findings suggest that a simple, easily accessible measure can be used to identify a large proportion of children with sleep, behavioral, socio-emotional, and academic challenges with minimal burden on parents, and then used to identify individuals who are at risk for difficulties. We propose that the CSHQ will be used

with the goal of early detection and prevention of sleep, academic and behavioral difficulties. Within this framework, we expect to identify students who may benefit from additional interventions to better address academic or behavioral concerns. This could allow for improved screening of children who may be at risk for multiple difficulties. This, in turn, could form the basis for developing innovative preventative and non-pharmacological intervention methods for both typically developing youth and those with mental health challenges. If this strategy is found to work, sleep questionnaires could be used as a first step in identifying a child who has a high likelihood of suffering from sleep disturbances and potential behavioral and academic problems

Sleep disorders are among the most common problems faced by a school-age child, but these problems are frequently overlooked by adults in a child's environment (Chervin et al., 2001; Gruber, Constantin, Frappier, Brouillette & Wise, 2017; National Commission on Sleep Disorders Research, 1992; Rosen et al., 2001). Children who are poor sleepers experience early and continuing difficulties in academic performance, emotional regulation and behavioral regulation. Children with undiagnosed sleep disturbances may be misdiagnosed and treated for ADHD-like or mood/anxiety-like symptoms while the root cause of these problems (i.e., their sleep disturbance) is neglected. The present study shows that we can use parent-based questionnaires as a means to identify children at risk for significant sleep, behavioral, emotional and academic challenges.

Limitations and Future Directions

The cross-sectional nature of this study did not allow to determine the nature of the associations between sleep disturbances and daytime functioning. The relationships between sleep disturbances and academic, emotional and behavior problems in children are both complex and bidirectional (Quach, Nguyen, Williams, & Sciberras, 2018; Shanahan, 2014; Williams,

Berthelsen, Walker & Nicholson, 2017). Several longitudinal studies have shown that early sleep problems are associated with later sleep problems as well as social-emotional problems and psychiatric, behavioral, and cognitive outcomes (Greene, Gregory, Fone, & White, 2015; Gregory, Agnew-Blais, Matthews, Moffitt, & Arseneault, 2017; Mindell, Leichman, DuMond, & Sadeh, 2017; Philbrook, Shimizu, Buckhalt, & El-Sheikh, 2018). However, we do not yet know the degree to which information derived from the identification of sleep problems during the school-age years can be used to predict specific challenges in the years to come. In addition, the mechanisms underlying these bidirectional relationships have not been well established. Multiple explanations may be proposed to account for the observed interplay of sleep, emotion, and behavior. Any or all of them might reflect an underlying genetic or brain abnormality. Alternatively, the sleep problems could lead to cognitive and attentional challenges over time, or having attentional of behavioral challenges could lead to sleep difficulties, which in turn further worsen these challenges. It remains to be established whether sleep problems serve as a precursor to these difficulties, or whether these difficulties may contribute to the development of sleep problems. Future research using longitudinal, experimental and more methodologically rigorous research will be required to delineate the nature and directions of the associations between sleep and academic, emotional and behavior problems in children.

The reliance on reported data for both sleep and internalizing/externalizing problems is likely to have introduced reporting biases. However, the inclusion of objective sleep data have reduced this risk.

There has been some research on how treating pediatric sleep apnea improves cognition and behavioral problems (Soylu et al., 2013; Zhu et al., 2014). The studies that have measured and reported changes in cognitive or behavioral outcomes following sleep intervention include the

following: 1) RCTs that examined the impact of adenotonsillectomy on children (Cardoso, Pompéia, & Miranda, 2018; Marcus et al., 2013; Taylor et al., 2016; Thomas et al., 2017; Waters et al., 2017); 2) experimental studies showing the impact of sleep restriction or extension on daytime behavior or academic performance e.g., (Baum et al., 2014; Garner et al., 2017;Gruber, Cassoff, Frenette, Wiebe & Carrier, 2012; Sadeh et al., 2003); and 3) school-based sleep health education programs or delaying school start time e.g. (Gruber, Somerville, Bergmame, Fontil & Paquin, 2016; Wahlstrom & Owens, 2017). The data obtained from these different studies collectively indicate that sleep improvement has beneficial impacts on daytime behavior and cognitive functioning. However, this has yet to be reported in relation to the impact of behavioral intervention on sleep disorders among school-age children. There is a lack of empirical data that can teach us whether children who get off to a poor start in in terms of behavioral sleep disorders and related daytime problems can catch up or sustain gain attained from behavioral sleep interventions. Longitudinal studies have documented that poor sleepers in childhood remain poor sleepers as they grow up, and that they develop mental health challenges (Combs et al., 2016; Tamana et al., 2018). We need to further examine whether this trajectory could be modified by early prevention and intervention related to poor sleep.

Conclusion

Parental reports of sleep disturbances can be used to distinguish children at risk for sleep, emotional, behavioral and academic problems. Such questionnaires should be incorporated into clinical practice and school-based evaluations with the goal of identifying undiagnosed children who might be at risk for poor adjustment related to sleep problems and downstream daytime difficulties.

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Table 1

Means and standard deviations (SDs) for sleep, behavioral/emotional and academic performance of children in the different sleep groups

		Below The Cut Point (N=66)						Above The Cut Point (N=56)						
		Girls		Boys		Total		Girls		Boys		Total		
		M (95% CI)	SD	M (95% CI)	SD	M (95% CI)	SD	M (95% CI)	SD	M (95% CI)	SD	M (95% CI)	SD	Observed power
Actigraphy														
	Sleep start time	20:49 (20:40-20:57)	0:31	20:27 (20:12-20:41)	0:41	20:41 (20:33-20:48)	0:36	20:58 (20:38-21:17)	0:57	21:07 (20:52-21:10)	0:38	21:02 (20:50-21:14)	0:49	0.91
	Sleep end time	6:29 (6:23-6:36)	0:23	6:15 (6:03-6:27)	0:33	6:25 (6:19-6:30)	0:27	6:31 (6:20-6:42)	0:32	6:36 (6:27-6:45)	0:23	6:33 (6:26-6:40)	0:28	0.74
	Sleep duration (minutes)	489.47 (477-502)	44.51	499.38 (486-513)	37.97	492.77 (483-502)	42.41	476.77 (455-499)	63.79	471.04 (455-487)	43.65	474.11 (460-488)	54.96	0.32
	Sleep efficiency	80.89 (79.3-	5.96	81.02 (79.5-	4.10	80.94 (79.8-	5.38	79.60 (76.4-	9.23	78.96 (76.3-	7.28	79.31 (77.2-	8.31	0.12

		82.5)		82.5)		82.1)		82.8)		81.6)		81.4)		
Child Behavior Checklist														
	Internalizing	48.47	9.56	48.00	9.41	48.31	9.50	54.83	13.32	58.73	8.60	56.67	11.41	0.99
	scale	(45.8-		(44.5-		(46.2-		(50.1-		(55.6-		(53.8-		
		51.2)		51-5)		50.5)		59.6)		61.8)		59.6)		
	Externalizing	48.05	9.39	45.86	9.16	47.31	9.30	54.03	11.43	58.12	10.07	55.96	10.90	0.99
	scale	(45.4-		(42.4-		(45.2-		(49.9-		(54.5-		(53.2-		
		50.7)		49.3)		49.4)		58.1)		61.7)		58.7)		
Report Card Grades														
	English	78.95	9.71	78.52	8.05	78.81	9.14	76.33	12.14	70.30	9.66	73.53	11.38	0.81
		(76.2-		(75.4-		(76.7-		(72.0-		(66.8-		(70.6-		
		81.7)		81.6)		80.9)		80.7)		73.8)		76.4)		
	French as	82.25	12.35	81.33	13.13	81.95	12.51	75.13	13.54	69.76	15.51	72.64	14.60	0.84
	second	(78.7-		(76.3-		(79.1-		(70.3-		(64.1-		(68.9-		
	language	85.8)		86.4)		84.8)		80.0)		75.4)		76.4)		
	Mathematics	78.02	12.01	82.00	8.50	79.30	11.09	76.16	14.53	73.26	12.59	74.82	13.62	0.50
		(74.6-		(78.7-		(7.68-		(71.0-		(68.7-		(71.3-		
		81.5)		85.3)		81.8)		81.4)		77.8)		78.3)		

Note: Observed power reported for difference between Above/Below the Cut Point Groups.

Table 2

Frequencies and chi square values of insufficient sleep, behavior/emotional symptoms, and academic problems in the groups below and above the cut off score.

		Below The Cut Point (BTCP) (N=66)		Above The Cut Point (ATCP) (N=56)		
		n	%	n	%	X^2
Actigraphy Sleep Duration						
	< 9 hours	8	12.1	14	25	4.47*
	9-11 hours	56	84.8	42	75	
	> 11 hours	2	3	0	0	
Child Behavior Checklist (CBCL)						
Internalizing Scales	Normal (<60)	57	87.7	32	58.2	14**
	Sub-Clinical (61-64)	4	6.2	8	14.5	
	Clinical (65-100)	4	6.2	15	27.3	
Externalizing Scales	Normal (<60)	59	90.8	33	60	14**
	Sub-Clinical (61-64)	1	1.5	8	14.5	
	Clinical (65-100)	5	7.5	14	27.3	

Report Card Grades						
French as Second Language	Fail (<60)	4	6.2	6	10.7	5.75*
	Pass (61-74)	11	16.9	17	30.4	
	Succeed (75-100)	50	76.9	33	58.9	
English	Fail (<60)	3	4.5	7	12.5	7.4*
	Pass (61-74)	18	27.3	24	42.9	
	Succeed (75-100)	45	68.2	25	44.6	
Mathematics	Fail (<60)	4	4.5	7	12.5	7.4*
	Pass (61-74)	16	27.3	24	42.9	
	Succeed (75-100)	45	68.2	25	44.6	

Notes. *p<.05; ** p<.001. The recommended amount of sleep is 9-11 hours per Hirshkowitz et al., 2015 *Sleep Health, 1*(4), 233-243.

Table 3

Correlations among actigraphy, Children's Behavioral Checklist (CBCL), and report card variables

Variable	1	2	3	4	5	6	7
Actigraphy							
1. Weekday actual sleep time (min)							
2. Weekday sleep end time	.06						
3. Weekday sleep efficiency	.32**	.13*					
CBCL							
4. Internalizing problems	.04	-.07	-.05				
5. Externalizing problems	.20**	-.19**	-.08	.64**			
Report card grades							
6. French second language immersion	.22**	-.05	.19**	-.07	-.12		
7. Math	.13	.12	.22**	-.17*	-.31**	.43**	
8. Language arts	.03	.15*	.30*	-.14	-.30**	.45**	.67**

Note. * $p < .05$, ** $p < .01$