Subjective and objective sleep and self-harm behaviors in young children: A general population study

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ABSTRACT

Significant association between sleep disturbances and suicidal ideation and/or attempts is reported in adults and adolescents. However, there is paucity of studies exploring the association between sleep and self-harm behaviors (SHB) in young children and are limited to only subjective sleep measures. We examined the association between SHB and both subjective and objective sleep in a population-based sample of 5–12 yr old. Parents of every student in 3 local school (K-5) districts ($n=7312$) was sent a screening questionnaire. Randomly selected children from this sample underwent a comprehensive history, physical examination, a 9-h overnight polysomnogram and completed several questionnaires. Among the final sample ($n=693$), 27 children had SHB with adjusted prevalence of 3%. There was no difference in age, gender, obesity, or socioeconomic status in subjects with or without SHB. Significantly more children with SHB had subjective sleep difficulty and depression. Difficulty maintaining sleep and frequent nightmares were associated with SHB independent of depression or demographics. Polysomnographic %REM-sleep was significantly higher in the SHB group after adjusting for demographics and depression. These data indicate that parent reported sleep disturbances are independently associated with SHB. It is possible that higher REM-sleep is a non-invasive biomarker for risk of self-harm behaviors in young children.

1. Introduction

Suicide is the tenth leading cause of death in the United States (Kochanek et al., 2011). According to the 2009 National vital statistics report, there were 36,547 deaths from suicide with a death rate of 11.9 for 100,000. The number of deaths from suicide in the 5–14 age group were 266 in the year 2009 in USA, with a suicide death rate of 0.7 for 100,000 (Kochanek et al., 2011). For every completed suicide, several non-lethal suicide attempts occur (Pfeffer, 1988; Maris, 2002). Suicidal thoughts and attempts in children, collectively can not only lead to mortality but also can cause significant morbidity as a result of non-lethal injury (Pfeffer, 1997; Doshi et al., 2005).

Several factors are known to increase the risk of suicidal ideation and/or attempts including sleep disturbances (Ialongo et al., 2004; Bernert and Joiner, 2007). Numerous studies in adults suggest strong association between sleep disturbances and suicidal ideation, suicidal attempts and completed suicide. (Fawcett et al., 1990; Turvey et al., 2002; Fujino et al., 2005; McCall et al., 2010; Bjørngaard et al., 2011). Similarly, several studies in adolescents found an association between suicide and sleep disturbances (Tishler et al., 1981; Choquet and Menke, 1989; Choquet and Kovess, 1993; Vignau et al., 1997; Roberts et al., 2001; Bailly et al., 2004; Liu, 2004; Barbe et al., 2005; Bernert and Joiner, 2007; Fitzgerald et al., 2011; Lee et al., 2012). However, most of these studies in children were in subjects aged 13 years or more except for the study by Roberts et al. (2001) and Barbe et al. (2005). Roberts et al. (2001) found that in children (age 10 to 17 yr) insomnia or hypersomnia increased risk of suicidal ideation. Barbe et al. (2005) examined depressed children of 7 to 17 years of age and found that depressed suicidal children presented more frequently with insomnia. Both of these studies had a sample of children that were relatively younger; however, to our knowledge none have examined the association of sleep and self-harm behaviors in general population sample of children younger than 10 years old. Additionally, the sleep disturbances were assessed by only subjective report in these two studies with relatively younger children (Roberts et al., 2001; Barbe et al., 2005). However, the subjective report of sleep is limited in comparison to sleep assessment as done by a comprehensive polysomnogram. An objective polysomnogram provides data on physiological sleep

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measures such as rapid eye movement (REM) sleep and non-rapid eye movement sleep (NREM) along with objective measures of sleep latency, REM-latency, sleep efficiency, etc. Thus, it is important to assess both subjective and objective polysomnographic sleep in children with self-harm behaviors.

Sleep disturbances are common in children with a prevalence of 20–30% (Stores, 1996; Anders and Eiben, 1997; Liu et al., 2000; Owens et al., 2000; Sadeh et al., 2000; Singareddy et al., 2009). In this study we examined the relationship between subjective and objective polysomnographic sleep and self-harm behaviors in young children aged 5–12 yr. We hypothesize that young children with self-harm behaviors will have increased subjective and objective sleep disturbances.

2. Methods

2.1. Subjects

Subjects for this study were participants in the Penn State Children's Cohort, a population-based study of sleep related breathing disorder. A detailed description of the study design and methods of data collection have been previously reported (Bixler et al., 2008, 2009). The study was designed in two phases. In the first phase, general information from the parents about their child's sleep and behavioral patterns was collected using a screening questionnaire based on the survey published by Ali et al. (1993) validated to identify children at high risk for sleep related breathing disorder. This questionnaire was sent home to parents of every elementary school student in 3 local school districts ($n=7312$) with a 78.5% response rate. In the second phase of this study, each year 200 children were selected from the questionnaires that were returned that year. The second phase of the study was completed in six years from year 2000 till 2006. Using a stratification of grade, sex, and risk for sleep related breathing disorder, we randomly selected children from each stratum to maintain representativeness of the original sample. Seven hundred children completed phase 2, for a response rate of 70%. We contrasted the subjects who completed the polysomnogram recording with those who completed the phase 1 questionnaire but were not selected for phase 2. There were no significant differences in age, gender, and race between the two groups. Six hundred and ninety three children who had complete data on sleep and self-harm behavior related questions were considered for this study. This study was approved by the Institutional Review Board at Penn State College of Medicine. Informed consent from parents of all participants and assent from all children was obtained prior to participation.

2.2. Key measurements

Detailed history was obtained from the parent who accompanied the child to the sleep laboratory including demographic information, medical history, psychiatric history, and medication history. Parents also completed several questionnaires pertaining to sleep and behavior including the Pediatric Behavioral Scale (Lindgren and Koeppl, 1987) and the Child Behavior Checklist (CBCL), a widely used tool for assessment of childhood behavioral abnormalities (Achenbach and Rescorla, 2001). Each child also underwent a comprehensive physical examination.

Questions about sleep and self-harm behaviors were completed by the parent of the child as a part of pediatric behavioral scale. The parent was asked to rate these questions on sleep and self-harm behaviors over the past two months, on a 4-point Likert scale from 0 to 3 with 0 "Almost never or not at all," 1 "Sometimes or just a little," 2 "Often or pretty much," and 3 "Very often or very much." The questions about self-harm behaviors included the following: (1) "talks about harming or killing self" and (2) "deliberately harms self or attempts suicide". Subjective sleep disturbances were defined as parent report of "often or pretty much" or "very often or very much" on the following questions: (1) "has trouble falling asleep" as difficulty initiating sleep (DIS), (2) on either one or both probes "sleep is restless or disturbed; often tosses and turns in sleep" or "wakes up often in the night" as difficulty maintaining sleep (DMS), (3) "sleeps more than most other children" as excessive daytime sleepiness (EDS), and (4) on the probe "has nightmare or bad dreams" as frequent nightmares. Depressive symptoms were assessed using the subscale "withdrawn depressed" from the Child Behavioral Checklist (CBCL).

Obesity was defined as 95th percentile of body mass index (BMI) adjusted for age and gender. Socioeconomic status (SES) was assessed based on the professional status of the parent (Gregory et al., 2009). Parent occupation was defined as professional if the parent had either a professional or managerial occupation and as non-professional if the parent was unemployed, disabled, retired, a student, or had a secretarial or non-managerial occupation. Children with at least one parent defined as professional were considered to be of relatively high SES; children with neither parent being defined as professional were considered to be of low SES.

All children underwent a 9-h PSG with a parent present in a sound-attenuated, light and temperature controlled room in our General Clinical Research Center. Children's bedtime and waketime were approximated to their typical sleep times. Each child was monitored with an infrared video and a computerized system (24 analog channel and 10 dc channel TS amplifier using Gamma software, Grass Telefactor, Inc.) including four channels of electroencephalogram (EEG), 2-channel bilateral electrooculogram (EOG), and chin and anterior tibial electromyogram (EMG). Respiration was assessed throughout the night by use of a thermocouple at nose and mouth (model TCT R, Grass Telefactor, Inc) nasal pressure transducer (MP 45–871 $\pm$ 2 cm H_2O, Validyne Engineering Cort), and piezoelectric thoracic and abdominal respiratory effort belts (model 1312, Sleepmate). A subjective estimate of snoring was obtained from parental report. In addition, we obtained an objective estimate of snoring during the PSG by monitoring breathing sounds with a microphone attached to the throat (model 1250, Sleepmate Technologies), as well as a separate room microphone. All-night hemoglobin oxygen saturation was obtained by pulse oximeter (model 8800, Nonin Medical) attached to the finger. A single-channel electrocardiogram (ECG) was also recorded. All PSG records were scored in accordance with The American Thoracic Society standards for cardiopulmonary sleep studies in children (American Thoracic Society, 1996). Apneas and hypopneas were scored by two different trained scorers, and discrepancies were resolved by the senior author (EOB). Obstructive apnea was defined as a cessation of airflow ≥ 5 s and an out-of-phase strain gauge movement. A hypopneic event was defined as a reduction of airflow of approximately 50% with an associated decrease in oxygen saturation (SpO2) $\geq 3\%$ or an associated breathing related arousal. Based on these data an apnea/hypopnea index (AHI) was calculated [(apneas+hypopneas)/hours of sleep]. Central apneas were not included in the AHI calculation.

2.3. Statistical analysis

The children were divided into two groups [SHB (self-harm behavior) group and No-SHB group] based on the response of parents on self-harm behaviors related questions. Children who were rated by the parent as "Almost never or not at all" on both probes were included in the "No-SHB" group and the children who were rated as "Sometimes or just a little", "Often or pretty much" or "Very often or very much" on either one or both self-harm behaviors related probes were included in the "SHB" group.

All statistical analyses were performed with SPSS software for Windows (version 17.0; SPSS, Chicago, IL). Data are reported as mean $\pm$ S.D. or proportions (percentages). The groups with versus without SHB were compared by χ^2 or analysis of variance (ANOVA) for significant differences in demographic and clinical features. To test the hypothesis that subjective sleep disturbances are associated with SHB we used multivariable logistic regression analysis with corresponding odds ratios and 95% confidence intervals (CIs) for the relative association between the presence of sleep disturbances and SHB. To control other factors likely to affect sleep and/or self-harm behaviors, we used four different models (Table 3). In each of these models we included depression and one of the demographic variables (age, gender, obesity, or SES) in addition to the sleep disturbance. We used this method in order to protect the stability of the model, as the number of subjects with self-harm behaviors was relatively small ($n=27$). In order to test the hypothesis that young children with SHB versus without SHB will have more objective sleep disturbances, a one-way between groups multivariate analysis of covariance (MANCOVA) was performed to investigate group differences in mean polysomnographic measures. $P < 0.05$ was used as the criterion for statistical significance.

We accounted for the sampling probability from phase 1 to phase 2 enrollments in all of the analyses to generate population level estimates and to make inference back to population from which the phase 2 study participants were selected.

3. Results

Among the final sample of 693 children, 27 had self-harm behaviors (SHB) and 666 children did not have self-harm behaviors (No-SHB). The adjusted prevalence of self-harm behaviors in this general population sample was 3%. Children in the two groups (SHB versus No-SHB) did not differ in age, gender, obesity, or socioeconomic status (Table 1). Children with self-harm behaviors had significantly higher T scores on depression ($P < 0.001$)(Table 1).

Subjective sleep disturbances in children with or without self-harm behaviors are presented in Table 2. Significantly more children with self-harm behaviors had difficulty initiating sleep ($P < 0.001$), difficulty maintaining sleep ($P < 0.001$), excessive daytime sleepiness ($P < 0.001$), and frequent nightmares ($P < 0.001$). Multivariable logistic regression model showed that difficulty maintaining sleep and frequent nightmares were associated with self-harm behaviors even after controlling for depression (see