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 26 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; Bjørgaard 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...
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 that was returned that year. 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 stratified sampling method, a questionnaire was mailed to parents. 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 ± S.D. or proportions (percentages). The groups with versus without SHB were compared by χ² 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 1). 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.

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
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