

Pilot Study to Determine Feasibility of Measuring Sleep Hygiene and ADHD in Mother, Father and School-Aged Child

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Abstract

Children who have Attention-Deficit/Hyperactivity Disorder (ADHD) are more likely to have sleep problems than peers without ADHD. These problems affect quality and quantity of sleep which may exacerbate or mimic ADHD symptoms. Consistent sleep hygiene can ameliorate some sleep problems. However, at least 50% of children with ADHD have a parent with the disorder. These adults are likely to have sleep problems and executive function deficits that can make establishing and maintaining consistent sleep hygiene difficult. The purpose of this pilot study was to determine feasibility of a) 6-10-year-old children with ADHD tolerating actigraphy watches and completing sleep diaries with parent help, and b) of both mother and father completing surveys about their own sleep hygiene and ADHD symptoms as well as surveys about the child's sleep and sleep hygiene. A convenience sample of five parent-child triads was recruited from a small private school in the Southeast. Children had a diagnosis of ADHD, were between 6-10 years old, understood English. None of the children had begun puberty, had physiologic sleep problems, or had co-morbid Autism, Tourette syndrome, or anxiety disorder. All parents lived with the participating child, and read and wrote English. Parents did not have physiological sleep problems. Children were able to complete diaries and wear actigraphy watches while both parents were able to complete instruments for themselves and/or their child. The in person session with parent and child will focus on instruction on the actigraphy watches; parents will complete instruments in their home and return them with the watch to the principal investigator (PI) at the end of seven days. These results substantiated the feasibility of the protocol and will guide a larger study to determine relationships and effect sizes of identified variables and child sleep.

Keywords: Attention-Deficit/Hyperactivity Disorder (ADHD); Child sleep; Autism; Sleep hygiene

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Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is among the most commonly diagnosed disorders in children (Centers for Disease Control and Prevention) and persists into adulthood in approximately two-thirds of cases. The American Psychiatric Association (APA) reports a prevalence of ADHD of about 5% among U.S. children between the ages of 4 and 17 years, although parent report indicates prevalence may be as high as 11% (about 6.4 million) of U.S. children. In addition to developmentally inappropriate hyperactivity, impulsivity, and inattention, children

with ADHD often have one or more comorbidity [1-11]. The comorbidities may include mood disorders, oppositional defiant disorder, aggression, learning disorders, and sleep problems. Sleep in this population is of critical importance since adequate sleep is linked to working memory, learning efficiency, cognitive development, impulse control, and attention, all of which may be already impaired by ADHD.

The connection between ADHD and sleep in children is complex with possible common neurological and genetic components. Between 50% and 70% of families report their child with ADHD has some kind of sleep problem, either physiological, behavioral,

or a combination of both. Poor sleep puts these children at even greater risk for cognitive deficits, memory deficits, and poor growth. In addition, poor sleep can exacerbate or possibly mimic ADHD symptoms, and can decrease quality of life [11-26].

Research on children's healthy sleep often focuses on family or parent habits, knowledge and guidance of child sleep. Evidence suggests that children's and parents' sleep habits and sleep health include knowledge misconceptions, poor habits, poor adherence to routines and unmet sleep needs. In contrast, the 2014 poll conducted by the National Sleep Foundation showed that children whose parents enforced regular rules about caffeine consumption, regular bedtime and smartphone use before bed slept between 0.6 hrs and 0.9 hrs more than those whose parents had no rules or enforced the rules sporadically.

Few studies include what role parents' ADHD symptoms play in enforcing household rules. Even fewer specifically address sleep hygiene in mother and father, although it is often the first line of treatment recommended for all sleep problems. Sleep hygiene typically includes having a consistent bedtime, a bedtime routine that is practiced in the same order at the same time each night, a comfortable sleeping environment, limiting caffeine within three hours of bedtime, and turning off television, computer or other electronic devices one hour before bedtime. Sleep hygiene education and other interventions have been shown to improve sleep hygiene and sleep in children with neurodevelopmental disorders, including ADHD [27-30]. However, multiple aspects of sleep hygiene require impulse control, maintenance of a pattern of behavior, and attention to timing. These behaviors typically prove difficult for children with ADHD, who often are deficient in executive function. If a parent also has ADHD and executive function deficits, impulse control, family routines, and schedules may be particularly difficult. Further, research has shown that which parent has ADHD affects the family dynamic and parenting practices differently [31-40].

This pilot project is the first step toward developing a sleep hygiene intervention directed at both parents and children affected by ADHD. The procedures established in the small pilot were modified and will be used in a larger study to determine the effect sizes for: 1) The relationships between sleep hygiene in school-aged children with ADHD and their mothers' and fathers' sleep hygiene and ADHD symptoms, and 2) The amount of total variance in sleep of school-age children with ADHD that is explained by each parent's ADHD symptoms, mothers' sleep hygiene, and child sleep hygiene [41-50].

Method

The design for the pilot study was descriptive, cross-sectional, and hypothesis generating with the intent to observe and describe relationships between the variables. The Institutional Review Board at University of Alabama at Birmingham approved the pilot. A convenience sample was recruited from a summer camp for children with ADHD and from the lower school (grades K-4) of a private K-12 academy for children with learning differences. Flyers about the study were distributed to campers and academy students. In addition, the researcher attended a parents' meeting at the camp and set up a table at the academy during parent-

teacher meetings. The camp was sponsored by and operated at the academy, which is in a suburban area of a large southeastern city. Of the 18 children at camp and 89 children enrolled in the lower school, ten expressed interest in participating the study and were screened. Five child-mother-father triads met eligibility criteria and were ultimately enrolled. Four male children and one female child participated along with both parents. Mean age was 8.8 years. All child participants were white and had a diagnosis of ADHD, documented by a psychologist or pediatrician according to DSM-IV or DSM-V criteria, and available in school records. Four children lived with birth parents and one child was adopted. Four of the children regularly took medication for ADHD. None of the children took medication for sleep. All parents were married, had at least a baccalaureate degree, and annual incomes above \$100,000. None of the participants reported any physiologic sleep problems such as sleep apnea, night terrors or enuresis (**Table 1**).

The demographic information form, completed by parents, included requests for age, grade, gender, comorbidities, parent income, parent marital status, parent ADHD status, and child and parent medication use. Family income was used as a proxy for socioeconomic status. Demographic data will be used to describe the sample.

The Rating Scale for Pubertal Development is a parent-report form that includes 3 general questions as well as 2 questions specific to boys and 3 questions specific to girls. Scores above 3 indicate early puberty. Cronbach's alpha for the parent-report form is 0.68-0.78.

The Children's Sleep Hygiene Questionnaire is a 33-item, parent-report survey aimed at assessing multiple dimensions of child sleep habits. The survey is based on parent recall of the child's sleep over a typical week. It is designed for ages 4-10 years and has a Cronbach's alpha between 0.68-0.78. Total scores above 41 indicate sleep problems.

The Children's Sleep Hygiene Scale is a 22-item parent report survey assessing behaviors and activities surrounding sleep in children between 2 and 12 years old. Total possible score ranges from 6 to 42, with higher scores indicating better sleep hygiene. Cronbach's alpha is 0.76 for children between 4 and 12 years old.

The Conners-3 Parent Rating Scale is a 108-item, parent report survey used to help diagnose ADHD in children. Raw scores are totaled and translated into a probability percentile. Higher scores indicate greater likelihood of ADHD diagnosis. Cronbach's alpha ranges from 0.71 to 0.98.

The Sleep Hygiene Index is a 13-item survey assessing sleep hygiene in adults. Total possible score ranges from 0 to 52, with higher scores indicating poorer sleep hygiene. Cronbach's alpha is 0.71- 0.75

The Barkley Adult ADHD Rating Scale-IV is an 18-item self-report survey that assesses symptoms of inattention, impulsivity, and hyperactivity in adults. The surveys are scored according to age, in 10 year intervals, with raw scores totaled then translated into percentiles. Percentages above the 93rd percentile indicate high likelihood of ADHD. Percentages above 84th percentile indicate borderline symptoms of ADHD. Cronbach's alpha is 0.914 for total scores.

Table 1 The demographic information form, completed by parents, included requests for age, grade, gender, comorbidities, parent income, parent ADHD status.

| Variable | N% | M(SD) |
|---------------------------------|---------|-------|
| Age (Years) | | |
| 8 | 2 (40) | - |
| 9 | 1 (20) | 9 (1) |
| 10 | 2 (40) | - |
| Child Gender | | |
| Male (M) | 2 (40) | - |
| Female (F) | 1 (20) | - |
| Race | | |
| Caucasian | 5 (100) | - |
| Yearly house hold income | | |
| >\$100,000 | 5 (100) | - |
| Parent Education level | | |
| Mother | | |
| College graduate | 1 (20) | - |
| Beyond college | 4 (80) | - |
| Father | | |
| College graduate | 2 (40) | - |
| Beyond college | 3 (60) | - |
| Reported Sleep Problems | | |
| Child | | |
| Yes | 4 (80) | - |
| No | 1 (20) | - |
| Mother | | |
| Yes | 2 (40) | - |
| No | 4 (60) | - |
| Father | | |
| Yes | 2 (40) | - |
| No | 3 (60) | - |

Data collection for the pilot study took place in a private classroom of the academy directly after school. In each case, the mother and child attended the data collection session and signed consent/assent. The mother was presented with the seven surveys to complete: the demographic survey, the Rating Scale for Pubertal Development [8] the Sleep Hygiene Index (SHI) [31] and Barkley Adult ADHD Rating Scale (BAARS-IV) [4], the Children's Sleep Hygiene Scale (CSHS) [20], the Children's Sleep Habits Questionnaire (CSHQ) [39], and the Connors 3-P Connors 3-Parent rating scale [12].

Survey completion required 30 to 45 min of time. During this time, the child was given small toys and art supplies to help with distraction and allow the mother to concentrate. Once the surveys were complete, child and mother participated in a brief education session to learn to use the sleep diary and the actigraphy monitor (Phillips Respironics, Bend, OR 97702). The actigraphy monitor contains an accelerometer, which detects movement. It has been shown to be a reliable method of distinguishing sleep from wake [44]. The PI put the watch on each child's non-dominant wrist before beginning the 10-15-min education session to ensure the child would tolerate the watch and to ensure the watch would work correctly. Each child received a small plastic box and stickers to decorate the box. The box served as a safe place to store the

watch while the child was bathing or swimming. The child and mother were instructed to use actigraphy and the sleep diary for the next seven consecutive days and nights. The PI planned a date and time with the mother to call in the middle of the seven-day period to check for any questions or problems with actigraphy. Two surveys for the father, BAARS-IV and SHI, were sent home with the mother. A second date was set for the mother to return the watch and the father's two surveys to the school in a plain brown envelope. Each family was given a copy of the actigraphy report as well as a \$5 gift card to local restaurant.

Results

The pilot procedures were generally successful, with no watches lost and minimal missing data. One child only wore the watch at night, providing no baseline activity with which to compare sleep movement. In addition, several parents gave few details on the sleep diaries, although bedtimes and wake times were recorded. Evidence indicates that thorough education on actigraphy results in higher compliance, more thorough diary information and thus better data [17]. All five children were able to tolerate wearing the actigraphy device and returned it in working order to the researcher.

Most importantly, results of the pilot showed deficits in total sleep time for all child participants with the maximum sleep time of any participant at 8.85 hrs, and a mean of 7.85 hrs. Recommended sleep time for school-age children is between 9 and 12 hrs for each 24 hrs period [41]. Two of the children had average sleep onset latencies of greater than or equal to 39 min. In addition, two of the children scored above the cut-point of 41 on the CSHQ indicating sleep problems. Two of the five fathers had total ADHD scores on the BAARS above 36, pointing to 96% likelihood of ADHD. Finally, two parents indicated their sleep hygiene fell into middle ranges of the SHI, and reported that their child's sleep hygiene was at mid-range of the CSHS. Interestingly, sleep hygiene habits of some families were similar in parent and child. For example, in one family, parents reported going to bed stressed or worried at times, and reported their child also went to bed feeling upset or worried. In another family, parents reported going to bed or getting up at different times of day and they reported similar behavior in their child. Results are displayed in **Table 2**. Given the small sample size, statistical analysis beyond descriptive frequencies was not conducted.

Discussion

The results of this pilot project demonstrated feasibility of study method as well as potential associations between sleep hygiene in parents and children who have ADHD. Sleep problems reported subjectively in children with ADHD include bedtime resistance, trouble falling asleep, nighttime waking's, and difficulty waking in the morning [38]. Problems documented by objective measures such as polysomnography and actigraphy, although inconsistent, have included variability in REM sleep, prolonged sleep onset latency, and lower sleep efficiency [1].

These sleep problems have also been associated with exacerbation of ADHD symptoms as well as decreased quality of life for child and family [46]. Despite the small sample in our pilot, expected

Table 2 Potential associations between sleep hygiene in parents and children who have ADHD.

| Variable | M (SD) | Range | Possible Score |
|---------------------|---------------|-------------|-----------------------------------|
| CSHQ Score | 42.2 (8.23) | 36-55 | 33-99 (Cut Score 41) |
| CSHS Score | 28.85 (2.22) | 25.10-30.77 | 6-42 (higher=better hygiene) |
| Mother SHI | 16 (4.69) | 10-23 | 0-52 (higher=poorer hygiene) |
| Father SHI | 15 (3.31) | 12-19 | 0-52 (higher=poorer hygiene) |
| Mother BAARS | 23.8 (5.4) | 18-32 | 36=93 rd % (age 40-59) |
| Father BAARS | 31.2 (8.14) | 19-40 | 36=93 rd % (age 40-59) |
| SOL (minutes) | 24.87 (17.02) | 8.18-46.5 | - |
| Total sleep (hours) | 7.85 (.981) | 6.52-8.85 | - |
| Night wakings | 61.89 (13.86) | 47.43-77 | - |

sleep problems were noted in children and high frequencies of ADHD among families, with high levels of ADHD symptoms in the father of one family and both parents in another family. Deficits in child sleep duration were also not surprising, given that the 2014 "Sleep in America Poll" reported at least 90% of children routinely got less than the recommended amount of sleep [7]. Matches between parent and child sleep hygiene is a finding that has not, to our knowledge, been previously demonstrated.

Parent sleep habits have been demonstrated to affect sleep in school-age and adolescent children with later maternal bedtime and shorter paternal sleep duration associated with shorter adolescent sleep, and shorter parent sleep duration and sleep/wake patterns associated with shorter sleep duration of school-age children [10,28]. It is interesting that our pilot also showed similarities in specific sleep hygiene behaviors in parents and children. Isolating specific behaviors may be key in developing an intervention that is successful in improving sleep in children with ADHD, whose parents also have the disorder.

In addition to interesting research findings, the pilot project also validated most study procedures and suggested several modifications that will serve to streamline and strengthen data collection in the next phase of the study. First, recruitment took place within a small, private school with a large concentration of children with ADHD but a small pool (100 children) of eligible children between ages 6-10 years. Of the five child participants, four were male, all children were white and from families whose annual incomes exceeded \$100,000. While this sample reflects the national pattern of 3:1 male:female ratio of ADHD diagnoses (CDC.gov., 2011), the racial and socio-economic levels do not reflect the general population. The next phase of the study will require the researcher to expand recruitment to other schools and venues in the region to identify a larger and a more diverse sample. Next, having mothers complete multiple surveys while their young child with ADHD waited, resulted in frustration and decreased concentration for the mothers. Going forward, the surveys will be sent home for parents to complete, and meeting time between researcher and parent(s) and child will be focused on education about the actigraphy watch and the accompanying sleep diary. Finally, since all families were able to

provide documentation of ADHD diagnosis or gave permission for the researcher to access school documentation, the researcher will eliminate the Conners 3-P ADHD rating scale. This will spare parents' time and eliminate possible subjectivity in ADHD diagnosis.

Findings are limited by very small sample size and homogeneity of sample and could be a reflection of sample bias. Comparison of sleep hygiene is also somewhat limited by using different instruments for parents and children, although no single instrument has demonstrated validity and reliability for both populations. In addition, use of parent report for child sleep surveys may introduce some unintended bias of inaccuracy [38]. The authors were interested in sleep habits of children between the ages of six and 10 years because they are young enough to be influenced by parents, to be pre-pubertal, and yet old enough to be toilet-trained and to sleep independently. Sleep self-report tools for children in this age group have not yet been developed.

Strengths of the study included the use of actigraphy as an objective measure of sleep, and inclusion of ADHD symptoms and sleep hygiene in mothers and fathers as well as children as variables. In addition, the child participants were screened to exclude those who had entered puberty or had co-morbid conditions that often interfere with or change sleep and despite research showing parent ADHD influences home environment and family routines [27], no studies have examined the influence of parent ADHD on child sleep hygiene and ultimately child sleep.

Important information was obtained through this pilot project not only to validate procedures for the next phase of this research, but to spark interest in connections between child and parent ADHD and sleep hygiene. Given that ADHD affects at least 5% of children between ages 4 and 17 years, that at least 50% of children with ADHD have a parent with the disorder, and that sleep problems are a common co-morbidity of ADHD, it is crucial to explore relationships between mother's and father's ADHD symptoms, mother's and father's sleep hygiene, child sleep hygiene and sleep in the child with ADHD. Future research could focus on isolating individual elements of sleep hygiene that may be shared by parents and children and developing interventions that can target those elements in families.

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