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SCIENTIFIC INVESTIGATIONS

Effect of sleep habits on academic performance in schoolchildren age 6 to 12 years: a cross-sectional observation study

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Study Objectives: Sleep plays a vital role in the cognitive and neurodevelopmental outcome of children; therefore, adequate sleep is needed to improve academic performance. The primary objective of this study was determine the prevalence of sleep behaviors and their effect on academic performance in schoolchildren age 6–12 years and to translate the findings into greater opportunity for healthy development and academic success.
Methods: Our study included 791 healthy children between ages 6 and 12 years from schools that are parts of the Central Board of Secondary Education in the South Indian urban population. Pro forma and The Children's Sleep Habits Questionnaire (CSHQ in local language translation) was given to the parents, and any doubts regarding the questionnaire were clarified during parent-teacher meetings. The previous 2 cycles of academic grades for these children were collected and categorized into A, B, and C grades accordingly. Then a statistical analysis of the completed CSHQ questionnaires was performed.
Results: On analyzing the CSHQ questionnaire, 71.9% of the children studied had a score higher than 41, which is in the clinical range indicating a significant prevalence of altered sleep habits. Other risk factors included nocturnal enuresis (3.5%), snoring (10.6%), night terrors (8%), and teeth grinding (6.4%).
Conclusions: Altered sleep habits have a major effect on the academic performance of the school-age children. Assessment of sleep habits should be included in routine pediatric office visits.
Keywords: quality of sleep, sleep hygiene, sleep disorders, academic performance
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BRIEF SUMMARY
Current Knowledge/Study Rationale: Sleep habits in children are often under-appreciated and parents are not aware of the impact they have on their child's overall well-being. There is a need to enlighten parents to incorporate sleep cycle regulation in good parenting.
Study Impact: Our study emphasizes the fact that sleep habits influence the academic performance and behavior of children.

INTRODUCTION

Sleep plays a vital role in the cognitive development and neurodevelopment of children; therefore, adequate sleep is needed to improve academic performance. Several studies have reported the prevalence of sleep disorders in children. Sleep is most important for adolescent and child development. Bedtime resistance, sleep anxiety, sleep duration, night wakings, sleep-disordered breathing, parasomnias, and daytime sleepiness all constitute disturbance in sleep habits.[1] It has been hypothesized that academic grades are significantly affected in a child with sleep disturbance. This finding is supportive of the neurobiologic theories of information integration and processing during sleep. These are the basic key aspects of the current study. There is limited research from India on sleep behaviors of children and their effect on academic performance The purpose of the current study was to obtain relevant sleep disorder information from children representing a south Indian urban population. A study of sleep habits in children and their effects on academic performance may emphasize the importance of understanding sleep habits and disturbances in children and also would help in advocating for the importance of sleep for children and its role in providing greater opportunity for healthy development and academic success.

METHODS

This cross-sectional observation study was approved by the institutional ethical committee of Sri Ramachandra University. The study population was composed of schoolchildren aged 6–12 years and was conducted in an urban population in Chennai representing south India. From the schools that consented, a Central Board of Secondary Education English medium school was selected for the study. Permission for the study was obtained from the school authority. Informed consent was requested, and the details about the study were sent to the parents through the school diary. Children whose parents provided consent were recruited in the study. Through a structured proforma enlisting demographic details as well as some of the known risk factors for altered sleep habits were obtained from the parents during a school visit and a detailed physical examination was done. Parents who did not consent to the study and the children who

were categorized under certain exclusion criteria (known case of bronchial asthma, developmental disorder, seizure disorder, endocrine disorder, and chronic medication use) were excluded from the study. In parent-teacher meetings, pro forma and The Children's Sleep Habits Questionnaire (CSHQ [in local language translation]) were given to the parents and any doubts regarding the questionnaire were clarified. Completed questionnaires were collected. The Indian education system follows periodic assessment with 2 written examinations separated by a span of 4 months and followed by a parent-teacher meeting during which academic performance is assessed. The previous 2 cycles of academic grades of the participating children were collected and categorized into A, B, and C grades accordingly (**Table 1**). Then a statistical analysis of the completed CSHQ questionnaires was performed using IBM SPSS software (Armonk, NY) and parametric tests were performed. A 2-sided value of $P < .05$ was considered statistically significant.

The CSHQ[2] is a 33-item sleep-screening questionnaire completed by a parent that examines 8 sleep domains: parasomnias, bedtime resistance, sleep duration, sleep onset delay, night waking, sleep anxiety, daytime sleepiness, and sleep-disordered breathing. It is designed and validated to identify sleep problems in school-age children over the preceding week. Responses are rated on a 3-point Likert-type scale. A score of 1 indicates that a behavior occurs never or 1 time during the week, a score of 2 indicates that it occurs 2 to 4 times a week, and a score of 3 indicates that a behavior occurs 5 or more times a week. A higher score on this instrument is indicative of more disturbed sleep.[2] A total sleep disturbances score higher than 41 indicates a pediatric sleep disorder, as this cutoff accurately identifies 80% of children with a clinically diagnosed sleep disorder.

CSHQ was designed by clinical researchers at Brown University for children aged 4–12 years to screen for the most common sleep problems in this age groups. The CSHQ is not intended to be used to diagnose specific sleep disorders but rather to identify sleep problems and the possible need for further evaluation. A total CSHQ cutoff score of 41 generated by analysis of the receiver-operating-characteristic curve correctly yielded a sensitivity of 0.80 and specificity of 0.72. One study showed that the CSHQ is a reliable and internally consistent scale, and it proved to be a useful optional tool in Indian schoolchildren.[3]

RESULTS

The current study included 791 children between 6 to 12 years of age (54.9% were males). The mean age of children was 9.08 years with no significant sex predilection. The mean bedtime and wake-up time for all children during weekdays was 9:30 PM and 6:45 AM,

respectively. The total sleep duration was highest among children younger than 8 years. The mean nighttime sleep duration was 8.5 hours across all ages. Girls had a slightly increased average sleep duration of 8.5 hours per night; boys had an average of 8.2 hours per night. A total of 9.6% of study participants were overweight and 4.6% had obesity, of whom 76.4% and 83.8%, respectively, had disordered sleep habits. A total of 16.8% of patients were poor academic performers and 55.8% were average academic performers. The prevalence of sleep-disordered breathing was 10.6%.

In the current study it was observed that the duration of sleep over all ages was below the recommendations. Forty-six percent of the children had night awakenings more than once per night. The bivariate regression coefficient suggests that a 1-unit increase in night wakening results in a 0.044-point decrease in academic grade, which was statistically significant.

On analyzing the CSHQ, nocturnal enuresis was usually reported in 3.5% of study participants. Snoring was found in 10.6%, night terrors in 8%, and grinding of teeth in 6.4%. By using the CSHQ, other risk factors affecting grades were analyzed. Altered sleep habits were found in 46% and 34% of children who watched television or used gadgets in the bedroom, respectively. All of the children who had nighttime incontinence had altered sleep habits.

On analysis of individual sleep domain with each academic performance, it was found that the mean of altered sleep habits increases among the average and poor academic performers in comparison with good academic performers, except for daytime sleepiness (**Table 6**).

DISCUSSION

The study primarily aimed to investigate the correlation between sleep behaviors in children aged 6–12 years and their academic performance. Most of the available studies compared the academic performance of adolescents and adults in relation to sleep habits; few studies are available with regard to younger children.

Barathy et al[4] studied sleep patterns in outpatient children aged 1–12 years (mean age 6.25 ± 3.2 years), whereas the present study included 791 children aged 6–12 years who were almost equally distributed in all age groups.

Studies by Barathy et al[4] and Srinivasa Murthy et al[5] showed average sleep duration of 9.3 hours (1–12 years old) and 12.5 hours (preschoolers), respectively. Chatput et al[6] showed longer average sleep duration observed among children aged 1–3 years. It can be inferred that as children get older sleep duration decreases (**Table 2**), whereas the current study showed average

Table 1—Grading system for assessing academic performance.

Grades	Percentage Range	Academic Performance
A	81–100	Good
B	61–80	Average
C	0–60	Poor

Table 2—Average sleep duration of study population.

Age (years)	Average Sleep Duration (hours)
6	9.2
7	9.1
8	8.5
9	8.2
10	7.8
11	7.4
12	7.3

sleep duration of 8.2 hours. It is implied that higher average sleeping hours are required for children who are poor academic achievers. An average sleep time of 9–11 hours per night among children age 6–13 years is advised to minimize behavioral issues.[5]

Screen time and location of television viewing are key factors influencing sleep habits. In the current study, 16% of children watched television in the bedroom and had a CSHQ score higher than 41, demonstrating a statistically significant correlation with altered sleep habits. A total of 13% of children had screen time less than 1 hour per day, 66% had screen time of 1–2 hours per day, and 21% of children had screen time more than 2 hours per day. Barathy et al[4] showed that 32.6% of children had daily screen time more than 2 hours. Owens et al[7] stated that watching television in the bedroom and amount of time spent watching television are strong predictors for behavioral problems in children with altered sleep patterns. Therefore, it can be concluded that restriction of screen time will pave the way for the development of healthy children.

Approximately 9.6% of study participants were overweight and 4.6% were at an obese level. Of these, 76.4% and 83.8%, respectively, were experiencing altered sleep habits. The study by Zametkin et al[8] showed that children at overweight and obese levels are more likely to have higher rates of anxiety disorders, depression, and other psychopathologic issues. Therefore, it is important to allow at least 30 minutes to an hour of daily sports training and physical activities to reduce body mass index in children.

Kahn et al[9] showed that among 43% of children who had altered sleep habits for more than 6 months, 21% were poor sleepers and failed 1 or more years of school; this percentage was significantly higher than that found among those without sleep problems. Meijer et al[10] showed that 15% of children reported sleep problems, of whom 43% had difficulty getting up in the morning and 25% did not feel rested.

Wolfson et al[11] performed a sleep-habits survey at 4 high schools. It was found that students of older ages reported decreasing hours of sleep because of later bedtimes.

Academic performance

In support of the hypothesis of the current study, there was a significant relationship with a value of $P < .001$ between altered sleep habits and academic performance (**Table 3**). A total of 92.5% of grade C academic performers and 83.2% of grade B academic performers had altered sleep habits (**Table 4**). Univariate regression coefficient analysis with CSHQ score and academic grade, respectively, as independent and dependent variables presented with positive associations between them. A 1-unit increase in CSHQ total score results in a 3.801-point decrease in academic grade (**Table 5**), which is supported by a study done by Joseph et al[1] showing that a 1-unit increase of CSHQ score results in a 0.18-point decrease in academic grade. From the aforementioned analysis, altered sleep habits are strongly correlated with poor academic performance. Fallone et al[12] recommend that reduced sleep time in healthy children for 1 week would lead to cognitive and learning deficits.

On further univariate analysis of CSHQ score with subscale as independent variable and academic performance as dependent variable, there was significant correlation with some of the sleep domains such as bedtime resistance, sleep anxiety, parasomnias, sleep-disordered breathing, and night wakings and statistically significant correlation with academic grades (**Table 6**). There was no significant correlation between daytime sleepiness and academic grade. However, Joseph et al[1] showed significant correlation between CSHQ subscales (parasomnias, sleep-disordered breathing, and daytime sleepiness) and academic grade. The difference may have arisen because analysis was done using CSHQ score, but the Pediatric Daytime Sleepiness Scale would have been a more precise parameter for assessing daytime sleepiness.

Academic performance and subscales

Bedtime resistance

Blader et al[13] showed that 27% of children studied had bedtime resistance, which was supported in the current study with a univariate regression coefficient of 0.233 in relation to academic performance as a dependent variable (**Table 6**). Owens et al[2] observed that bedtime resistance is one of the predictors of altered sleep habits and was the most common sleep problem.

Sleep anxiety

Univariate regression coefficient analysis suggests that a one-unit increase in sleep anxiety results in a 0.235-point decrease in academic grade, which was statistically significant and supported by Dayal et al[14] and Sandman et al.[15]

Night waking

Ravikiran et al[16] showed that 25% of children studied had night awakenings. Also, Ming et al[17] observed that night awakenings and prolonged sleep onset may further compromise sleep

Table 3—Children's Sleep Habits Questionnaire score with academic grade.

Variable	Regression Coefficient	P
CSHQ score	−0.426	< .001

CSHQ = Children's Sleep Habits Questionnaire.

Table 4—Relationship between sleep habits and academic performance.

	CSHQ		P
	Clinical Range of CSHQ	**Normal**	
Grade A	79 (36.4%)	138 (66.6%)	< .001
Grade B	367 (83.2%)	74 (16.8%)	< .001
Grade C	123 (92.5%)	10 (7.5%)	< .001

CSHQ = Children's Sleep Habits Questionnaire.

Table 5—Univariate regression coefficient analysis: Children's Sleep Habits Questionnaire with academic grade.

Variable	Unstandardized Coefficients	Standard Coefficients	t	Significance
Constant	−52.79		83.173	< .001
Grade	−3.801	−.426	−13.211	< .001

Table 6—Univariate analysis of academic grades with Children's Sleep Habits Questionnaire subscales.

CSHQ Variable	Regression Coefficient	P
Bedtime resistance	−0.233	< .001
Sleep onset delay	0.045	.210
Sleep duration	0.023	.528
Sleep anxiety	−0.235	< .001
Night wakening	−0.279	< .001
Parasomnias	−0.265	< .001
Sleep-disordered breathing	−0.394	< .001
Daytime sleepiness	−0.400	.260

CSHQ = Children's Sleep Habits Questionnaire.

integrity and quality, if it was combined with insufficient sleep duration and undesirable sleep schedules. Univariate regression coefficient analysis of the current study observed that a one-unit increase in night waking resulted in a 0.279-point decrease in academic grade and was statistically significant.

Sleep-disordered breathing

In the current study 10.6% of children had sleep-disordered breathing, whereas this percentage was lower according to studies done by Ravikiran et al,[16] Smedje et al,[18] and Cai et al.[19] Gupta et al[20] showed that 11.4% of children had sleep-disordered

breathing, well within the range found in the current study. Univariate regression coefficient analysis suggests that a one-unit increase in sleep-disordered breathing results in 0.394-point decrease in academic grade, which was statistically significant (**Table 6**). Joseph et al[1] also described a similar observation. Sleep-disordered breathing is a leading factor in learning difficulties and functional impairment at school.

Parasomnias

Univariate regression coefficient analysis suggests that a one-unit increase in parasomnias results in a 0.265-point decrease in

academic grade, which was statistically significant (**Table 6**). Joseph et al[1] showed that parasomnias, an abnormal sleep behavior, was associated with a regression coefficient of -1.023 when academic grade was taken as the dependent variable.

Daytime sleepiness

A total of 33.4% of children studied had daytime sleepiness, which was also observed by Barathy et al.[4] All the other factors, except daytime sleepiness, would be correctly marked by the parents because they do not observe their child during the day when they are at school. A study done by Shin et al[21] showed that the prevalence of excessive daytime sleepiness increased significantly with a decline in school performance.

Limitations

Limitations of the current study are as follows: (1) Clinical assessment of sleep disturbance was lacking and information bias was not excluded. (2) CSHQ does not have classification levels (mild, moderate, severe). A score above 41 is considered to be in the "clinical" range. (3) Assessment of academic performance was done only for a given period of time. Therefore, average final grade point for the academic year was not taken into account. (4) Because this is a cross-sectional study, long-term complications were not followed up. (5) Daytime sleepiness can be best assessed by the teachers or the children themselves rather than parents, but they were not involved in the process of answering the questionnaire. Therefore, a self-objective questionnaire such as the Pediatric Daytime Sleepiness Scale would be more useful for assessment rather than the CSHQ alone.

CONCLUSIONS

CSHQ is a useful screening tool for assessing altered sleep habits in the population studied. Poor school performance is statistically correlated with poor or inadequate sleep quality rather than inability of the child. It has a major effect on academic performance. Questions about the sleep habits and duration of bedtime television watching should be included in routine pediatric office visits; thus, the importance of sleep should be emphasized during the clinical visit.

ABBREVIATIONS

CSHQ, Children's Sleep Habits Questionnaire

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SUBMISSION & CORRESPONDENCE INFORMATION

DISCLOSURE STATEMENT