

Prevalence of Pediatric Sleep Disorders and their Relationship with Vitamin D Levels in Indian Children

Divya A Varghese¹, Vinitha Prasad²

ABSTRACT

Sleep disorders in children are often unrecognized and underreported in India.

Aims and objectives: Our study aims to find the prevalence of sleep disorders among children aged 5–15 years and to determine the relationship between serum 25 (OH) vitamin D levels and sleep disorders in children.

Materials and methods: This is a cross-sectional prospective study conducted in the pediatric OPD of a tertiary care hospital in Kochi, India. Fifty children satisfying the inclusion and exclusion criteria were taken up for the study. Data were collected using the Pediatric Sleep Questionnaire (Chervin, University of Michigan). A blood sample was collected for serum 25-hydroxy vitamin D estimation using the chemiluminescent protein binding assay. Comparison between the vitamin D levels and sleep disorders was made by the Fischer's exact test and Wilcoxon rank-sum test.

Results: The prevalence of sleep disorders in our study was 88% with parasomnias being the most common sleep disorder. Vitamin D deficiency was seen in 78% of children and 22% had vitamin D insufficiency. The mean vitamin D level was much lower in children with sleep-related breathing disorder (SRBD) ($p = 0.02$), excessive daytime sleepiness ($p = 0.031$), and restless leg syndrome (RLS) ($p = 0.007$) when compared to children without these disorders. The prevalence of vitamin D deficiency was more among children with SRBD when compared to children without SRBD ($p = 0.04$).

Conclusion: The study concludes that there is a high prevalence of sleep disorders in studied children and vitamin D deficiency is an associated risk factor for sleep disorders.

Keywords: Age, Daytime sleepiness, Excessive daytime sleep, Gender, Insomnia, Obstructive sleep apnea, Restless legs syndrome, Sleep apnea, Sleep-related breathing disorders.

Indian Journal of Sleep Medicine (2022): 10.5005/jp-journals-10069-0095

INTRODUCTION

Pediatric sleep disorders remain a relatively unexplored domain of research in India. There are various types of sleep disorders in children such as insomnia, excessive daytime sleepiness, sleep-related breathing disorders (SRBD), restless legs syndrome (RLS), and parasomnias or bedtime problems such as somnambulism, nocturnal enuresis, and bruxism. Inadequate sleep in children has negative effects on mood, emotion regulation, behavior, and cognitive functioning such as attention, learning, and memory.^{1–3} Hence, there is a need to heighten our awareness of the prevalence of pediatric sleep disorders. The reversible causes of sleep disorders should be identified and treated as they have significant implications on normal child health and development.

Vitamin D, the sunshine vitamin, has gone beyond the gut and bone. Apart from calcium absorption, it plays a pivotal role in cell growth, cell differentiation, as well as immunomodulation. Vitamin D deficiency has been linked to a wide range of diseases from rickets, hypertension, and myopathic diseases to proneness to infection, autoimmune disorders, metabolic syndromes, and even cancers.⁴ Despite India being a tropical country with plenty of sunshine, studies here have shown that 75–100% of the general Indian population suffers from vitamin D deficiency.⁵

Studies in adults have demonstrated a correlation between the deficiency of vitamin D levels and excessive daytime sleepiness, sleep-related breathing disorders, restless leg syndrome, and nocturnal enuresis.^{6–10} To add to these studies, we attempted to find the prevalence of pediatric sleep disorders and to understand the relationship between sleep disorders and vitamin D levels in children.

¹Department of Pediatrics, Credence Hospital, Trivandrum, Kerala, India

²Department of Pediatrics, Amrita Institute of Medical Sciences, Kochi, Kerala, India

Corresponding Author: Vinitha Prasad, Department of Pediatrics, Amrita Institute of Medical Sciences, Kochi, Kerala, India, e-mail: vinithaprasad@aims.amrita.edu

How to cite this article: Varghese DA, Prasad V. Prevalence of Pediatric Sleep Disorders and their Relationship with Vitamin D Levels in Indian Children. *Indian J Sleep Med* 2022;17(1):1–4.

Source of support: Nil

Conflict of interest: None

AIMS AND OBJECTIVES

- To determine the prevalence rate of sleep disorders in children aged 5–15 years.
- To assess the vitamin D levels and to investigate the relationship between different sleep disorders and vitamin D levels in children aged 5–15 years.

MATERIALS AND METHODS

This is a cross-sectional hospital-based prospective study initiated after approval from the institutional ethical committee board. Fifty randomly selected children aged between 5 and 15 years who came for well-child visits to the department of pediatrics at a tertiary level hospital over the period of 1 year, were included in the study. Children with acute illness, chronic systemic illness,

bronchial asthma, neurological disorders, and children on long-term medication or vitamin D supplementation were excluded from the study.

The pediatric sleep questionnaire was used to estimate the prevalence of sleep disorders. This questionnaire designed by Dr Chervin from the University of Michigan is the survey screening tool for childhood sleep disorders in our study.^{11,12} It contains two validated component scales, for sleep-related breathing disorders such as obstructive sleep apnea (OSA), and for restless legs/periodic limb movements syndrome (RLS/PLMS). The SRBD scale of the pediatric sleep questionnaire was used to study the prevalence of sleep-related breathing disorders in children.

Insomnia was diagnosed in children who answered positively to questions pertaining to difficulty in the initiation and maintenance of sleep.

Excessive daytime sleepiness was diagnosed using the modified Epworth sleepiness scale. An Epworth sleepiness score >10 confirmed the presence of excessive daytime sleepiness. Parasomnias such as bed-wetting, somnambulism, and bruxism were diagnosed in children who answered positively to having bed wets, sleepwalking, and teeth grinding during sleep. The RLS/PLMS scale of the pediatric sleep questionnaire was used to assess sleep related movement diseases in children.

After obtaining informed consent, the parent of the child was instructed on how to fill out the questionnaire. The questionnaire was translated to the regional language Malayalam for parents who preferred so. The parents were advised to answer the questionnaire based on their child's sleep general sleep pattern for the past 3 months.¹³

Serum levels of 25-hydroxy vitamin D were measured using the chemiluminescent protein binding assay. Vitamin D deficiency is defined as 25(OH)D below 20 ng/mL, and vitamin D insufficiency as 25(OH)D of 21–29 ng/mL. Our definitions for deficient, insufficient, and sufficient levels of vitamin D are derived from the values suggested by the US endocrine society.¹⁴

The descriptive analysis was performed by calculating the frequency, percentage, mean, and standard deviation (SD). Fisher's exact test was used to compare categorical variables and Wilcoxon rank-sum test was used to compare continuous variables. A significant difference was assumed when $p < 0.05$. The SPSS 16.0 statistical package was used for the statistical calculations.

RESULTS

Our study analyzed 50 apparently healthy children, aged between 5 and 15 years, using the validated pediatric sleep questionnaire. The mean age of children included in the study was 10 years. Thirty-eight percent of the children were male and 62% were females (Table 1).

Sleep disorders were present among 88% of the children we studied. The most common sleep disorders were parasomnias (54%). Among the parasomnias, nightmares were found in 42% of children, nocturnal enuresis was found in 18%, bruxism was found in 16%, and nighttime screaming spells were found in 4% and somnambulism was found in 2% of the children (Fig. 1).

Other common sleep disorders were SRBD (46%), and excessive daytime sleepiness (42%). Restless leg syndrome was seen in 16% of children and insomnia was seen in 12% of the children.

Among the 50 children assessed, vitamin D deficiency was present in 39 (78%) children whereas vitamin D insufficiency was present in 11 (22%) children. None of the children assessed had vitamin D levels in the recommended range.

Table 1: Demographic characteristics of children

	Mean ± SD
Age (years)	10.0 ± 3.6
Median age (years)	10
Number of children aged 5–10 years (n = 27)	16.60 ± 6.80
Number of children aged 10–15 years (n = 23)	14.41 ± 5.78

SD, standard deviation

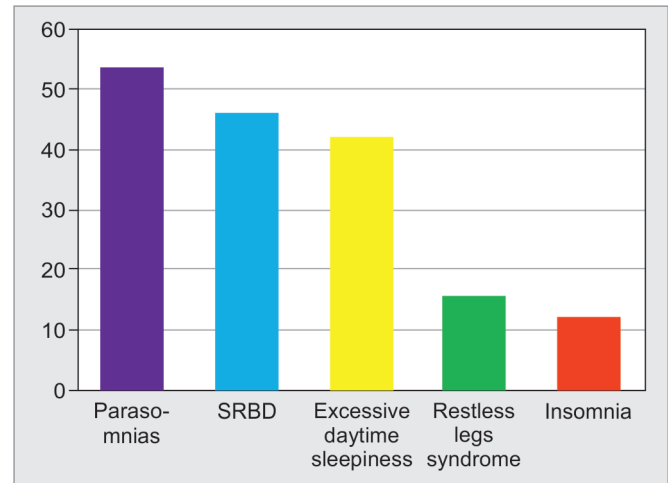


Fig. 1: Percentage distribution of sleep disorders

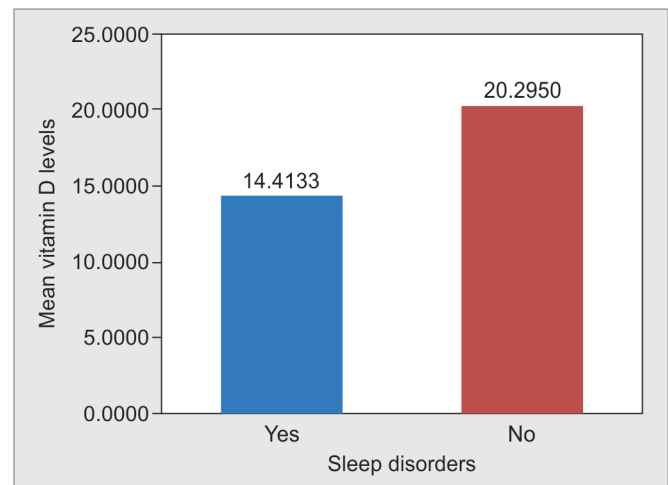


Fig. 2: Mean vitamin D levels in children with and without sleep disorders

Fisher's exact statistical test was performed to find out the prevalence of children with and without sleep disorders among vitamin D deficient children (Fig. 2). The percentage of children with vitamin D deficiency was statistically higher in children with SRBD than in children without SRBD ($p = 0.04$) (Fig. 3). Vitamin D deficiency was higher in children with excessive daytime sleepiness. However, statistically, it was seen as a borderline significance ($p = 0.068$) (Fig. 4). We found no statistically significant association between the vitamin D deficiency and other sleep disorders like insomnia ($p = 0.604$), teeth grinding ($p = 0.4$), bed-wetting ($p = 0.645$), sleepwalking ($p = 0.78$), nightmares ($p = 0.471$), and screaming ($p = 0.605$) or sleep-related movement disorders ($p = 0.66$).

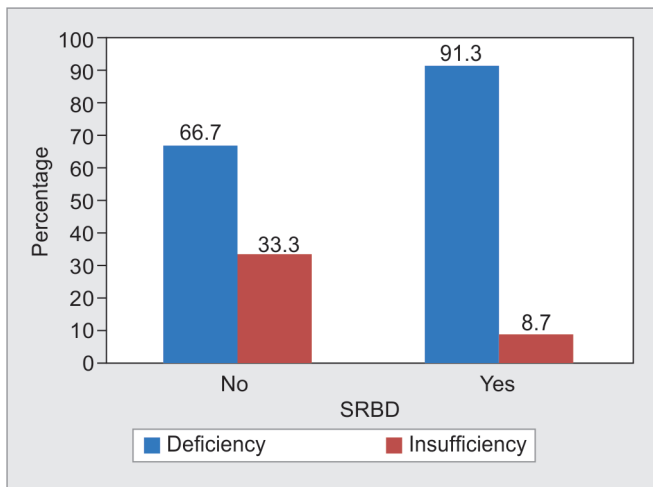


Fig. 3: Association of sleep-related breathing disorders in children with vitamin D deficiency

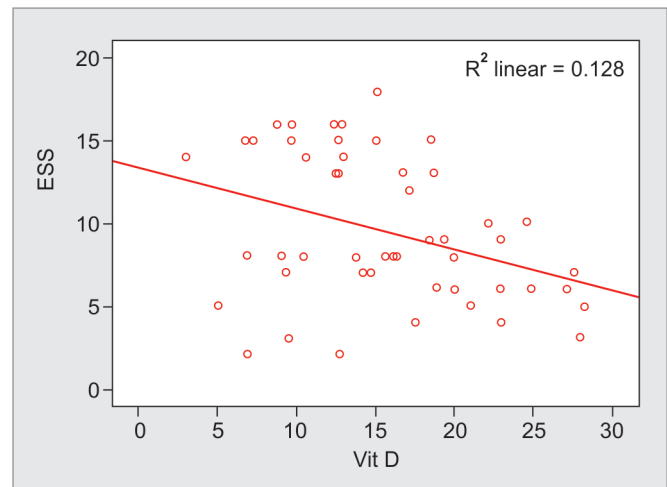


Fig. 5: Graph correlating vitamin D levels and Epworth sleepiness scale (ESS)

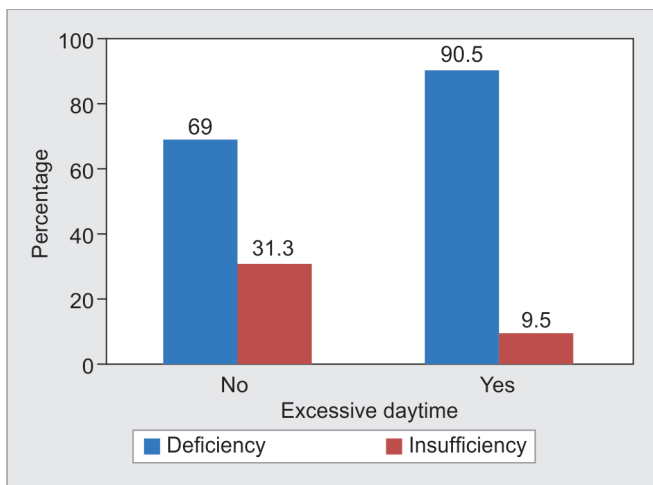


Fig. 4: Association of excessive daytime sleepiness and vitamin D deficiency

Correlation between vitamin D levels and sleep disorders was done using Wilcoxon rank-sum test. It showed the mean vitamin D levels in children with SRBD ($p = 0.020$), excessive daytime sleepiness ($p = 0.031$) and restless leg syndrome ($p = 0.007$) was significantly lower in children with these sleep disorders when compared to children without these sleep disorders. We found no statistically significant difference among the mean vitamin D levels in children with and without other sleep disorders such as insomnia ($p = 0.934$), teeth grinding ($p = 0.729$), bed-wetting ($p = 0.608$), sleepwalking ($p = 0.412$), nightmares ($p = 0.488$), and screaming ($p = 0.703$).

Spearman's correlation was done between the vitamin D levels, SRBD scale, and Epworth sleepiness scale. It was found that the SRBD score ($p = 0.002$, $r = 0.169$) was negatively correlated with vitamin D levels. Correlation between the Epworth sleepiness score and vitamin D levels showed that as the Epworth score was higher ($p = 0.014$, $r = 0.128$), the vitamin D levels were lower. Although the amount of correlation was negligible, it is noteworthy that the Epworth sleepiness score and SRBD score showed a negative correlation with vitamin D levels (Fig. 5).

DISCUSSION

We studied that there was a high prevalence of sleep disorders in children. We also studied that the prevalence of vitamin D deficiency was significantly high in our study population.

The prevalence of sleep disorders in our study was significantly higher when compared to the previous studies done in India by Suri et al. (47.5%)¹⁴ and Bharti et al. (42.7%).¹⁵ Among sleep disorders, we had a higher prevalence of SRBD, excessive daytime sleepiness, nightmares, and bruxism compared to the other studies. There were differences in the setting, assessed age-group, and questionnaire used when compared to the above-mentioned studies.

We also found a significant correlation between vitamin D deficiency and sleep-related breathing disorders, excessive daytime sleepiness, and sleep-related movement disorders.

McCarty et al.,⁶ studied the relationship between vitamin D deficiency and excessive daytime sleepiness in adults. The results concluded that there was an inverse correlation between excessive daytime sleepiness and vitamin D levels among subjects without vitamin D deficiency. This was similar to the result we found in our study. An observational cross-sectional study was conducted on 176 obese and non-obese children with and without OSA (mean age: 6.8 ± 0.8 years).⁷ Vitamin D levels were reduced in both obese children and children with OSA. Even in our study, we found that mean vitamin D levels were reduced in children with sleep-related breathing disorders than in children without SRBD ($p = 0.020$).

Other studies by Oran et al. and Balban et al. have shown that there is an association between vitamin D deficiency and restless legs syndrome.^{8,9} In our study too, we found that mean vitamin D levels were significantly reduced in children with restless legs syndrome than in children without the same ($p = 0.007$). Li et al.¹⁰ showed a statistically significant relation between nocturnal enuresis and vitamin D deficiency in children aged between 5 and 7 years. However, we found no relationship between nocturnal enuresis and vitamin D levels in our study ($p = 0.608$).¹⁶

The possible connection between vitamin D and sleep disorders is due to the presence of vitamin D receptors in the anterior and posterior hypothalamus, substantia nigra, midbrain central gray,

raphe nuclei, oral pontine reticular nucleus, and caudal pontine reticular nucleus. Those are the areas in the brain which control the initiation and maintenance of sleep.¹⁷

Melanin is another possible factor correlating sleep and vitamin D; vitamin D synthesis is affected by the level of melanin in the skin. The role of melanin in sleep can be explained by the action of the melanin-concentrating hormone that has a role in sleep promotion, the onset of sleep, and stabilizing REM sleep.¹⁸ Therefore, melanin levels may also act as a mediator for the relationship between sleep disorders and vitamin D. Vitamin D deficiency causes immune dysregulation such as elevation of circulating IL-6, TNF α , and NF κ B, which causes sleepiness symptoms.¹⁹ Therefore, it is postulated that low concentrations of 25(OH)D may contribute to poor sleep quality by directly modulating the immune-regulating substances. Appropriate supplementation of vitamin D has been shown to improve hypersomnia and restless leg syndrome in adult studies.²⁰ Hence we feel there is scope to explore this further in the pediatric population.

CONCLUSION

The total prevalence of sleep disorders in our study was 88% with parasomnias being the most prevalent. Vitamin D deficiency was seen to be more in children with sleep-related breathing disorders and excessive daytime sleepiness than in children without these sleep disorders. Sleep-related movement disorders were also seen in children with lower vitamin D levels.

Hence, early detection of sleep disorders and appropriate treatment is necessary not only for the overall well-being of the child but also to prevent long-term complications which manifest as various systemic illnesses. As vitamin D deficiency was identified as a risk factor for sleep disorders maintaining normal vitamin D levels may prevent sleep disorders, and improve sleep quality.

Limitations of the Study

Our study had some limitations. The small sample size was a limitation. This was a questionnaire-based study to assess sleep disorders rather than using an objective methodology such as polysomnography. Lastly, as the questionnaires were filled by parents, there could have been an element of parental interpretive bias. The translated version of the questionnaire to the regional language was not validated. However, all the parents preferred using the English version of the questionnaire.

ACKNOWLEDGMENTS

Authors would like to thank Dr Chervin from the University of Michigan for allowing us to use the questionnaire for our study. We would also like to thank Dr KR Sundaram, Department of Biostatistics, Amrita Institute of Medical Sciences, for assistance with statistical analysis.

ORCID

Divya A Varghese  <https://orcid.org/0000-0002-8725-9343>

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