Original Article

Sleep Patterns and Dysfunctions in Children with Learning Problems

Ramkumar Aishworiya, [1]*MRCPCH, MMed (Paediatrics)*, Po Fun Chan, [2]*MRCP, MMed (Internal Medicine)*, Jennifer SH Kiing, [1]*FRACP, FAMS,* Shang Chee Chong, [1]*MRCPCH, MMed (Paediatrics)*, Stacey KH Tay, [1]*MRCPCH, MMed (Paediatrics)*

Abstract

Introduction: This study aimed to determine the sleep patterns and dysfunctions in children with learning problems in comparison against a local population-based sample. Materials and Methods: Parents of 200 children with learning problems and 372 parents of a local population-based sample of typically developing (TD) children were recruited to complete a questionnaire on their child's sleep patterns and sleep problems. The Children's Sleep Habits Questionnaire (CSHQ) is a validated parent-reported sleep screening questionnaire that contains 54 items identifying sleep behaviours in children. Results: The mean age of the sample was 4.2 years (SD: 1.4; range, 2 to 6 years). Sleep duration was similar between the 2 groups. The difference in mean CSHQ subscale scores between children with learning problems and TD children was significant for sleep-disordered breathing (1.3 vs 1.2, *P* = 0.001). Among children with learning problems, 36.5% snored (vs 26.6% of TD children), 30.5% had noisy breathing (vs 18.8%), and 9.0% (vs 4.6%) experienced difficulty breathing 2 or more times a week. Children with learning problems woke up in a more irritable mood (*P* = 0.01), had more difficulty in getting out of bed (*P* <0.001), and took a longer time to be alert (*P* <0.001). They exhibited fewer behaviours of daytime drowsiness (*P* = 0.009). Among this group of children, 15.0% of parents reported that their child had a sleep problem compared to 9.0% in the TD group. Conclusion: Sleep breathing disorders and symptoms of morning sleepiness are more prevalent in children with learning problems. Symptoms of daytime lethargy are similar between the 2 groups. We suggest that a simple outpatient screening targeted at these problems be instituted in the initial workup of any child with learning difficulties.

Ann Acad Med Singapore 2016;45:507-12

Key words: Behavioural problems, Learning Disabilities, Singapore, Sleep duration

Introduction

Sleep problems in preschool children are common and they are even more prevalent and persistent in children with learning disabilities. In addition to causing both child and parent significant distress at bedtime and during the night, [1,2] sleep problems also compound daytime functional difficulties and even play a role in the development of daytime behavioural problems.[3]

Approximately 25% of typically developing (TD) preschool children have sleep problems pertaining to bedtime resistance, sleep onset delays and night awakenings.[4-7] Prevalence rates for sleep problems in children with developmental disorders vary from 13% to 86%[8] and are significantly higher than those found in TD children.[9]

Sleep problems have also been clearly shown to influence neurobehavioural outcomes. Consequently, recognising and treating conditions such as mild sleep-disordered breathing have been shown to improve learning and academic outcomes.[10] Effective treatment of sleep problems has also resulted in the alleviation of many neurobehavioural problems.[11] In addition, abbreviated sleep durations and other sleep problems have been associated with externalising symptoms and attention deficit hyperactivity disorder (ADHD) in children.[12]

[1]Department of Paediatrics, Khoo Teck Puat-National University Children's Medical Institute, National University Health Systems, Singapore
[2]Division of Medicine, National University Health Systems, Singapore
Address for Correspondence: Dr Aishworiya Ramkumar, Department of Paediatrics, Khoo Teck Puat-National University Children's Medical Institute, National University Health Systems, 1E Kent Ridge Road, NUHS Tower Block Level 12, Singapore 119228.
Email: aishworiya_ramkumar@nuhs.edu.sg

Despite the well established association between sleep problems and neurobehavioural outcomes, sleep disorders have not been comprehensively evaluated in Singaporean children with learning disabilities. Of note, it has been shown that Singaporean preschool children have a significantly shorter sleep duration compared with Caucasian populations.[13] Hence, it is likely that the same may be seen in Singaporean children with learning disabilities.

The aim of this study was to compare the sleep patterns and dysfunctions of Singaporean children with learning difficulties against a local population-based sample of TD children.

Materials and Methods

Study Population

Eligible children were those who were between 2 to 7 years old and residing in Singapore. A total of 372 TD children were enrolled from 27 childcare centres countrywide and 200 children with a range of learning and behavioural problems were consecutively recruited from the Child Development Unit (CDU), National University Hospital (NUH), Singapore. Those patients who had learning and behavioural problems had been diagnosed clinically and/or through psychological assessment with a variety of learning problems such as specific learning disorders that included dyslexia, specific language impairment and learning disorder in written expression. Among the TD children, 950 questionnaires were given out at the childcare centres and 372 usable questionnaires were returned (a response rate of 40%). The questionnaire included a question on the presence of any diagnosed learning disability or sleep disorder. Children with a history of any form of learning problem were excluded from the TD group and those with any previously diagnosed sleep disorder were excluded from both the TD and learning problems group.

Materials and Methods

The questionnaire survey used in this study was based on the Children's Sleep Habits Questionnaire (CSHQ), a validated parent-report sleep screening questionnaire that contained 54 items identifying sleep behaviours in children. Parents were instructed to tick the relevant answers to the questions or write brief statements.

The first part of the survey contained questions regarding the child's demographics, including age, gender and race. The second part evaluated the quantity and quality of sleep. Thirty-three sleep-disturbance items were grouped into 8 subscales: bedtime resistance, sleep-onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep-disordered breathing and daytime sleepiness. Parents were asked to state the frequency of these disorders and behaviours by checking a 3-level frequency scale ranging from daily to less than once a week. Parents also had to list their perception regarding the presence of a sleep problem, rate its severity and state the treatment sought.

Questionnaires were given to families of TD children through the administrators/teachers of 27 childcare centres and kindergartens. Children with learning problems were recruited by doctors in the study team during their consultation at the CDU.

Ethics approval for the study was obtained from the National Healthcare Group Domain Specific Research Board, Singapore.

Data Analysis

This was a cross-sectional study with data accrued from parental reports. All analyses were carried out using Statistical Package for Social Sciences (SPSS) for Windows Version 16.0. Comparisons of categorical variables were statistically evaluated using a likelihood ratio chi-square test and continuous variables were assessed using one-way analysis of variance (ANOVA). All statistical significance was set at $P < 0.05$. P values were calculated using the independent samples t-test.

Results

Demographics

The mean age of children included in the analyses (n = 572) was 4.2 years (SD: 1.4). Children with learning problems were significantly older compared with TD children (4.5 years vs 4.1 years, $P = 0.002$). There was also significantly more males represented in the group with learning problems (75.6% vs 50.5%, $P < 0.0001$) (Table 1).

Table 1. Demographic Data of Study Subjects

Characteristic	Typically Developing Children		Children with Learning Problems	
Subgroup	**n**	**% of Total Sample***	**n**	**% of Total Sample***
Age (years)				
2	45	12.1	21	11.6
3	70	18.8	23	12.7
4	83	22.3	53	29.3
5	78	21.0	35	19.3
6	50	13.4	30	16.6
7	0	0	18	9.9
Gender				
Female	170	45.7	47	22.9
Male	188	50.5	155	75.6

*Note: Numbers may not add up to total due to sporadic missing data. Percentages may not total 100 because of rounding.

Table 2. Sleep Duration in Study Subjects

	Typically Developing Children		Children with Learning Problems		*P* Values
	Mean	SD	Mean	SD	
Bedtime, h	9.48 pm	02.35	9.08 pm	04.07	0.05
Rise time, h	7.25 am	00.38	7.46 am	01.49	0.01
Night awakenings duration, minutes	8	23.7	17	42.1	0.02
Night sleep duration, hours	8.53	00.56	9.04	01.11	0.79
Nap duration, hours	1.58	00.03	1.47	00.05	0.07

SD: Standard deviation

Sleep Quantity

Mean sleep duration per night was 9 hours and 4 minutes in children with learning problems. No significant difference in night sleep and nap durations were found between the TD and learning problems groups, although children in the latter group rose later and slept earlier. Children with learning problems also displayed a longer duration of night awakenings (Table 2).

Sleep Quality

Sleep resistance was the most prevalent problem in both groups of children, followed by sleep-wake transition problems, night awakenings, sleep dysfunctions and sleep-disordered breathing. At least 50% of children with learning problems had specific sleep problems that occurred 2 or more times a week; these included delaying of bedtime (learning problems 58.5% vs TD 56.7 %, $P = 0.912$), requirement of bedtime routines (learning problems 53.5% vs TD 52.5 %, $P = 0.678$) and fear of sleeping alone (learning problems 50.0% vs TD 37.4 %, $P = 0.347$). These problems were also highly prevalent in the TD group and there was no significant difference in sleep resistance problems between the 2 groups. The domain scores for parasomnias were also comparable between the 2 groups and not statistically significant. The results were not different when gender and age specific analysis were carried out between both groups.

Sleep-Disordered Breathing

The primary symptom of sleep-disordered breathing in preschool children was snoring, occurring in 30% of all children surveyed. Of note, 26.6% of TD children and 36.5% of children with learning problems snored at least twice a week ($P = 0.012$). Apart from snoring, 30.5% of children with learning problems had noisy breathing (TD 18.8%) and 9.0% (TD 4.6%) experienced difficulty in breathing 2 or more times a week. Children with learning problems scored higher than TD children in all symptoms of sleep-disordered breathing (Table 3) and exhibited more frequent and severe sleep-disordered breathing problems. The mean domain score was thus higher in children with learning problems as compared to that of TD children (1.21 vs 1.05, $P < 0.001$). Further analysis by gender showed that among males, there was still a statistically significant difference in the overall score for sleep-disordered breathing between the TD and the learning problems groups (mean, 1.26 and 1.10; $P < 0.001$). This was not the case among females.

Clinically obvious sleep apnoea was observed to be rarely encountered and was found only in 6 of the 572 cases surveyed.

Table 3. Sleep Quality Measures in Study Subjects

	Typically Developing Children		Children with Learning Problems		*P* Values
	Mean	SD	Mean	SD	
Bedtime resistance and anxiety	1.79	0.43	1.79	0.42	0.874
Night waking and sleep duration	1.33	0.41	1.38	0.49	0.294
Parasomnia	1.16	0.31	1.19	0.37	0.328
Sleep-disordered breathing	1.05	0.40	1.21	0.44	<0.001
Snores	1.24	0.64	1.48	0.74	<0.001
Breathes noisily	1.12	0.58	1.36	0.69	<0.001
Breathes with difficulty	0.95	0.38	1.06	0.49	0.007
Stops breathing	0.89	0.36	0.94	0.33	0.102

SD: Standard deviation

Morning and Daytime Behaviour

In children, morning and daytime behaviour could be a reflection of the child's function and alertness during the day, which in turn may be impacted by the quality of sleep the child has. Hence, this is one of the subscales in the CHSQ. Overall, symptoms of morning sleepiness were more frequent in the group with learning problems and this difference was statistically significant (P <0.001). Self-waking was more common in children with learning problems, even though the mean wake time was 20 minutes later than that of TD children (P <0.001). Children with learning problems woke up in a more irritable mood (P <0.011), had more difficulty getting out of bed (P <0.001), and took a longer time to be alert (P <0.001). However, children with learning problems exhibited fewer behaviours of daytime sleepiness compared to TD children (P = 0.009). Children with learning problems were less likely to fall asleep while watching television or when riding in a vehicle compared to TD children (P = 0.033 and P = 0.0012, respectively) (Table 4). These results did not differ when gender and age specific analysis were carried out between the 2 groups.

Parental Perception

Parental perception was assessed with regards to the presence of sleep problems as well as the degree of sleep deprivation in the child. Fifteen percent (n = 30) of children with learning problems were observed by their parents to have significantly more sleep problems compared to 9% of TD children (n = 33, P <0.001). However, they were not perceived to be more sleep-deprived by their parents (learning problems 21% vs TD 16%, P = 0.157).

Discussion

Similar to previously published studies in other paediatric populations, this study confirmed that Singaporean children with learning problems had more sleep problems than TD children. These sleep problems were specifically in the areas of sleep-disordered breathing and daytime sleepiness. Problems in other domains such as sleep resistance also occurred more frequently in children with learning problems, although this difference was not statistically significant. Of note, sleep duration was similar between the 2 groups.

The increased prevalence of sleep problems in the learning problems group was supported by the fact that 15% of parents in this group reported that their child had a sleep problem, compared to the 9% in TD children. Yet, given that these children did not have a shorter sleep duration, this finding suggests that in this local population, parents may have observed sleep difficulties other than absolute deficits in sleep quantity. Sleep quality, symptoms of sleep-disordered breathing, and poor morning and daytime behaviours may also have contributed to a parent's perception of a sleep problem.

Among the study subjects in general, there was a wide range of frequent sleep disturbances spanning more than 10 items on the questionnaire. Among the children with learning problems, 81.5% of them had at least 1 frequent sleep problem (co-sleeping was excluded as a sleep problem as it is culturally acceptable in our local context). This finding is in the upper range of reported rates of sleep problems in children with developmental problems (44% to 86%).[14-20] However, direct comparison of the frequency of sleep disorders across studies is difficult as different instruments have been used to ascertain data.

Table 4. Morning and Daytime Behaviour in Study Subjects

	Typically Developing Children		Children with Learning Problems		*P* Values
	Mean	SD	Mean	SD	
Morning sleepiness	1.70	0.54	1.29	0.30	<0.001
Awakened by others in the morning	2.06	0.79	1.67	0.73	<0.001
Wakes up in a bad mood	1.46	0.63	1.57	0.72	0.011
Has difficulty getting out of bed	1.60	0.71	1.89	0.79	<0.001
Takes a long time to be alert	1.10	0.31	1.48	0.66	<0.001
Daytime sleepiness	1.36	0.37	1.27	0.38	0.009
Seems tired during the day	1.51	0.64	1.49	0.66	0.705
Falls asleep watching television	1.65	0.91	1.21	0.47	0.033
Falls asleep riding in a vehicle	1.82	0.90	1.51	0.86	0.012

SD: Standard deviation

Apart from the increased occurrence of sleep-disordered breathing symptoms, CSHQ subscale scores and severity ratings were similar in both groups of children in the other areas and did not reveal any significant difference. Looking at the higher scores for sleep-disordered breathing among children with learning problems, further analysis seemed to suggest that this occurred primarily among males. However, we note that the number of females among the subjects may be inadequate to detect a statistically significant difference as the study was not planned for subgroup analysis by gender. Of note, snoring was more common in children with learning problems although this symptom was not validated by further polysomnography as this was a questionnaire-based study. Nonetheless, this is noteworthy and important to assess in patients with learning problems, especially as mild forms of sleep-disordered breathing is likely to be detrimental to a child's daytime cognitive, emotional and behavioural well-being.[21] Younger children with this problem have been observed to be hyperactive and emotionally labile, while older ones may have trouble paying attention and completing tasks.[22] Early treatment of sleep-disordered breathing during years of rapid brain development may enable children to fulfill their academic and psychosocial potential.

Despite suffering from more serious sleep disturbances such as sleep-disordered breathing, children with learning problems did not exhibit the lethargy expected of the sleep-deprived. Instead, they appeared more active in the day and less prone to falling asleep when riding in vehicles or watching television as compared with the TD sample. However, they did have more symptoms of morning sleepiness, were observed to have woken up in a worse mood, had greater difficulty in getting out of bed, and took a longer time to be alert as compared with TD children. This suggests that younger children tend to present with emotional lability and hyperactivity when sleep-deprived, with irritability best observed upon waking. The morning behaviour of a young child is therefore likely to be a better indicator of his quality of sleep. Parental perception based on a child's active nature during the day may thus cause an underestimation of the true prevalence of sleep disorders in children with learning problems.

In view of the likely higher prevalence of sleep-disordered breathing in children with learning problems and the potential reversibility, an efficacious screening tool is necessary for use in clinical visits. Screening should additionally pick up symptoms of morning sleepiness that appears to be a consistent symptom in these children. Current screening algorithms such as BEARS (B = Bedtime issues, E = Excessive daytime sleepiness, A = Night awakenings, R = Regularity and duration of sleep, S = Snoring) Questionnaire focus mainly on bedtime problems, awakenings and daytime sleepiness, which do not figure strongly in the local learning disabled population. In contrast, the questions in the sleep-disordered breathing subscale of the CSHQ specifically screen for disordered breathing in sleep and morning drowsiness. It is thus more discriminating in picking up real problems in our population.

Based on this, we suggest that simple outpatient screening that consist of the following questions be instituted in the initial workup of any child with learning difficulties:

- Does your child wake up in a bad mood?
- Does your child have difficulty getting out of bed?
- Does your child take a long time to become alert?
- Does your child snore?
- Does your child breathe noisily during sleep? (E.g. snorts and grunts)
- Does your child experience difficulty in breathing during sleep?

Further studies and explanations are required to evaluate and differentiate harmless sleep problems. Many of the disturbances encountered in children with learning problems were also equally prevalent in TD children, and may cause no adverse effect on the development of a child. Certain parasomnias may be distressing to the parent but leaves no lasting impact. Further analysis of the various sleep disturbances will thus allow medical professionals to safely offer reassurance to help distressed parents cope when encountering a sleep disorder in a developmentally-delayed child. Moreover, this being an observational study, we can only show an associative link between learning problems and sleep problems; a causative link in either direction cannot be conclusively shown. Future studies can be designed to specifically see if the presence of learning problems gives rise to sleep problems or vice versa. In addition, a limitation of our study is that we do not have data reflecting the socioeconomic background of the study participants. Given that the family's socioeconomic status and home setting are potential factors that may impact sleep in general, these would be important to take into consideration in future studies. Lastly, use of objective measures of sleep quality and sleep problems such as actigraphy and formal sleep studies (polysomnography) in those patients who report on their history of sleep problems will help to further verify and quantify the presence of sleep dysfunction in these patients.

Conclusion

Sleep-disordered breathing problems are likely more common in children with learning problems. Morning sleepiness and behavioural problems associated with waking are also more prevalent in these children although daytime lethargy is similar to that in TD children. We recommend that

all children with learning difficulties be actively screened for sleep problems using the suggested outpatient screening questions during every consultation.

Acknowledgement

The authors would like to thank all the principals and teachers of childcare centres in Singapore who had rendered their assisstance in the distribution and collection of questionnaires. The authors would also like to thank Ms Chen Zhaojin from the Department of Community, Occupational and Family Medicine, National University of Singapore, for her assistance in statistical analysis.

REFERENCES

1. Doo S, Wing YK. Sleep problems of children with pervasive developmental disorders: correlation with parental stress. Dev Med Child Neurol 2006;48:650-5.
2. Polimeni MA, Richdale AL, Francis AJ. A survey of sleep problems in autism, Asperger's disorder and typically developing children. J Intellect Disabil Res 2005;49:260-8.
3. Sheldon SH. Insomnia in children. Curr Treat Options Neurol 2001;3:37-50.
4. Armstrong KL, Quinn RA, Dadds MR. The sleep patterns of normal children. Med J Aust 1994;161:202-6.
5. Jenkins S, Owen C, Bax M, Hart H. Continuities of common behavior problems in preschool children. J Child Psychol Psychiatry 1984;25:75-89.
6. Johnson CM. Infant and toddler sleep: a telephone survey of parents in one community. J Dev Behav Pediatr 1991;12:108-14.
7. Scher A, Tirosh E, Jaffe M, Rubin L, Sadeh A, Lavie P. Sleep patterns of infants and young children in Israel. Int J Behav Dev 1995;18:701-11.
8. Didden R, Sigafoos J. A review of the nature and treatment of sleep disorders in individuals with developmental disabilities. Res Dev Disabilities 2001;22:255-72.
9. Richdale A, Gavidia-Payne S, Francis A, Cotton S. Stress, behavior, and sleep problems in children with an intellectual disability. J Intellect Dev Disabil 2000;25:147-61.
10. Gozal D, O'Brien L, Row BW. Consequences of snoring and sleep disordered breathing in children. Pediatr Pulmonol Suppl 2004;26:166-8.
11. Chervin RD, Ruzicka DL, Giordani BJ, Weatherly RA, Dillon JE, Hodges EK, et al. Sleep-disordered breathing, behavior, and cognition in children before and after adenotonsillectomy. Pediatrics 2006;117: e769-78.
12. Golan N, Shahar E, Ravid S, Pillar G. Sleep disorders and daytime sleepiness in children with attention-deficit/hyperactive disorder. Sleep 2004;27:261-6.
13. Aishworiya R, Chan PF, Kiing J, Chong SC, Laino AG, Tay SKH. Sleep behaviour in a sample of preschool children in Singapore. Ann Acad Med Singapore 2012;41:99-104.
14. Cotton S, Richdale A. Brief report: parental descriptions of sleep problems in children with autism, Down syndrome, and Prader-Willi syndrome. Res Dev Disabil 2006;27:151-1.
15. Couturier JL, Speechley KN, Steele M, Normal R, Stringer B, Nicolson R. Parental perception of sleep problems in children of normal intelligence with pervasive developmental disorders: prevalence, severity, and pattern. J Am Acad Child Adolesc Psychiatry 2005;44:815-22.
16. Gail Williams P, Sears LL, Allard A. Sleep problems in children with autism. J Sleep Res 2004;13:265-8.
17. Hering E, Epstein R, Elroy S, Iancu DR, Zelnik N. Sleep patterns in autistic children. J Autism Dev Disord 1999;29:143-7.
18. Liu X, Hubbard JA, Fabes RA, Adam JB. Sleep disturbances and correlates of children with autism spectrum disorders. Child Psychiatry Hum Dev 2006;37:179-91.
19. Richdale AL, Prior MR. The sleep/wake rhythm in children with autism. Eur Child Adolesc Psychiatry 1995;4:175-86.
20. Wiggs L, Stores G. Sleep patterns and sleep disorders in children with autistic spectrum disorders: insights using parent report and actigraphy. Dev Med Child Neurol 2004;46:372-80.
21. Owens JA, Mehlenbeck R, Lee J, King MM. Effect of weight, sleep duration, and comorbid sleep disorders on behavioral outcomes in children with sleep-disordered breathing. Arch Pediatr Adolesc Med 2008;162:313-21.
22. Lamberg L. Sleep-disordered breathing may spur behavioral, learning problems in children. JAMA 2007;297:2681-3.