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ORIGINAL ARTICLE

Sleep problems are associated with poor outcomes in remedial teaching programmes: A preliminary study

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Aim: Problematic behaviour and deficient academic performance have been reported in children with sleep problems, but whether sleep problems are common among children presenting with primary behavioural and performance concerns in remedial programmes is not well studied. We studied this possibility in 80 Australian school children aged 6–15 years and then compared 15 of these children from mainstream schools to 15 demographically matched children in specialist behavioural programmes for problematic behaviour and academic difficulties.

Methods: Parents completed the Child Behaviour Checklist and the Sleep Disorders Scale for Children. Questionnaires assessed behaviour, academic performance and symptoms of diverse sleep disorders, expressed as T-scores (mean (SD) = 50 (10)). Teachers rated students' academic performance (A, B, C, D, E).

Results: When compared with the 15 controls, the 15 index children had significantly more sleep problems, in addition to parental concerns about school performance. In the total sample ($n = 80$), poor sleep including symptoms of daytime sleepiness, parasomnias, behavioural sleep problems and combined sleep problems was associated with poor academic performance and daytime behavioural issues.

Conclusions: This preliminary study suggests that children in remedial school programmes may have poor sleep compared with those in mainstream schools. Sleep problems were associated with problematic behaviour and poor academic performance. If sleep disturbances worsen daytime behaviour, then diagnosis and treatment of underlying sleep disorders could offer a novel therapeutic opportunity.

Key words: academic performance; behaviour; paediatrics; remedial schooling; sleep.

Disturbed sleep is common in Australian children, with up to one in four Australian children reporting frequent sleep problems (3–5 times per week or more).[1] These sleep problems include initiating and maintaining sleep (sleep onset insomnia, night-time awakenings, etc.) in 23%, snoring in 17%, parasomnias (including sleep–wake transition disorders (restless legs, rhythmic movement disorders, etc.), arousal disorders (sleep walking, night terrors, etc.) and excessive daytime sleepiness in 20%.

Chronic sleep problems have negative effects on children's daytime performance. Clinically significant levels of problematic behaviours are common,[2–8] as are impaired cognitive and school performance.[3,6,9,10] Sleep problems have been reported in children with challenging and problematic behaviour or poor school performance.[9,11,12] Two previous studies have found an over-representation of children with problem sleep behaviours in special schools for behavioural management and specialised academic assistance.[13,14] No studies of this type have been undertaken in Australia. This raises the question of whether children and adolescents who have disturbed sleep are over-represented within the many remedial specialist programmes that cater for children with special social or academic needs in Australian schools.

Children with consistently oppositional or disruptive behaviour and subsequent risk of academic failure within the South Australia public education system can be withdrawn from mainstream schooling for an initial period of 10 weeks for assistance in improving behaviour, compliance and potentially academic and social outcomes. Sleep patterns in students attending these specialist behavioural programmes or remedial teaching classes are unknown. As the literature suggests a relationship between behaviour, academic performance and sleep disturbance, an investigation of the frequency and range of sleep problems in these students was thought beneficial. We hypothesised that children with problematic and oppositional daytime behaviour in specialist behavioural programmes would have a greater frequency of sleep problems compared with children in mainstream classrooms.

Key Points

1. Parent reports suggest that children in Australian remedial school programmes may have poor sleep compared with their mainstream school peers.
2. Sleep problems are associated with increased problematic behaviour and poor academic performance.
3. Improving sleep may offer important novel opportunities for behavioural intervention.

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Materials and Methods

Subjects

From April to July 2004, families of children attending intakes in four specialist behavioural schools were approached to be participants in the project as 'index children'. Each centre had approximately 10 students present during the period of data collection. Once an index child and family had agreed to participate, all students from the index child's mainstream classroom were approached and invited to participate.

A total of 580 questionnaire packs were distributed to 11 schools – four specialist behavioural units were given 10 packs each, seven mainstream schools were each given between 50 and 170 (school A = 60, school B = 50, school C = 60, school D = 60, school E = 70, school F = 70, school G = 170, total 540). Children who had ≥5 missing responses from the 26 Sleep Disturbance Scale for Children (SDSC) were excluded ($n = 5$). For children who had <5 missing responses on the SDSC ($n = 5$, with a total of 13 missing responses), means for group (index or control) and age for that item were substituted. The final sample consisted of 15 index and 65 control children.

From the mainstream school sample of 65, 15 children were selected and matched as closely as possible to each individual index child. Because of an over-representation of boys in the index group, exact matching of gender was not possible and resulted in four females in the control group compared with only two in the index group. Ages of index and control children were matched within 24 months and were not significantly different between groups (index mean age (standard deviation, SD) = 11.8 (2.4), range 6.1–15.5 years; control mean age (SD) = 11.1 (2.2), range 8.0–15.1 years; $P > 0.05$). Groups were ethnically homogenous and both groups had similar numbers of household members per family (both $P > 0.05$). With maternal education reported for only nine index children and 12 controls, matching for this surrogate measure of socio-economic status was not possible and was significantly lower in the index group ($P = 0.03$).

Tools

Sleep was assessed with the SDSC,[15] a well-validated and standardised 26-item parental report questionnaire. Responses to two items were recorded by parents on a 5-point intensity scale: 'How many hours sleep does your child get on most nights?' (1 = 9–11 h, 2 = 8–9 h, 3 = 7–8 h, 4 = 5–7 h and 5 ≤ 5 h) and 'How long after going to bed does your child usually fall asleep?' (1 ≤ 15 min, 2 = 15–29 min, 3 = 30–44 min, 4 = 45–60 min and 5 ≥ 60 min) (The remaining items used a 5-point frequency scale (1 = never, 2 = occasionally (1–2 times per month), 3 = sometimes (1–2 times per week), 4 = often (3–5 times per week) and 5 = always). Responses were grouped into six symptom subscale clusters:[15] (i) behavioural sleep problems of initiating and maintaining sleep (prolonged sleep onset, night awakenings, etc.); (ii) sleep breathing difficulties (frequency of snoring, sleep apnea and difficulty breathing); (iii) arousal (sleepwalking, nightmares and sleep terrors); (iv) sleep–wake transition (hypnic jerks, restless legs, head banging, rocking, sleep talking, etc.); (v) excessive somnolence (morning and daytime sleepiness, etc.); and (vi) sleep hyperhydrosis (night sweating). A Total Sleep Problem score was derived by summing all item scores. Standardised norms were used to calculate T-scores (mean = 50, SD = 10). Normative values and means derived from children aged 6.5–15.3 years[15] were used to classify our subjects aged 6.1–15.5 years. Parents were instructed to consider sleep in their child, when healthy, during the previous 6 months. Subjects were categorised as being sleep disturbed if their SDSC subscale T-score was ≥60.

Behaviour was assessed with the Child Behaviour Checklist (CBCL),[16] a standardised and age-normed questionnaire that gives three main behaviour factor scores (Competent, Internalised and Externalised behaviour) with an additional four subscales (Social problems, Thought problems, Attention problems and 'Other' problems) all summed into a Total Behaviour Problem Score as per Achenbach.[16] All scales were transformed into T-scores with a mean (SD) = 50 (10).[16] T-scores between 67 and 70 were classified as borderline problematic behaviours and T-scores >70 were clinical problematic behaviours.[16]

Academic performance was rated by both parents and teachers. Parents rated their child's school performance on a 4-item subscale of the CBCL. In item one, parents rated the child's performance in six subject areas on a scale of: failing = 0, below average = 1, average = 2, above average = 3, from which a mean school grade was calculated. Items two and three asked whether the child had attended a special class, or had repeated a grade (yes = 0, no = 1, don't know = 0). Item four asked whether the child had any problems at school (yes = 0, no = 1). Scores were summed and transformed into T-scores with a mean (SD) of 50 (10).[16]

Teachers also rated students' academic performance. To facilitate comparison of students' grades from diverse grading systems, teachers were asked to rate the student on a scale utilised in previous studies[17,18] where: A = top of the class, B = above average, C = average, D = below average, E = failing, F = bottom of the class. These were transformed to a numerical scale (A = 1, B = 2, etc.).

Protocol

Parents were asked to complete the CBCL, the SDSC and consent forms at home and return them to school. All index children from specialist behavioural programmes were given a movie voucher to compensate them for their time and participating schools were offered a book voucher for their school library. Parents and teachers were told the aim of the study was 'to increase our understanding of sleep in children and to determine if there is a connection between sleep, behaviour and academic performance'. Sleep, behaviour and academic ratings were kept separate and confidential.

Any child presenting with significant sleep problems was contacted and referred to specialists where necessary. Ethics approval was obtained from the Human Research Ethics Committees (University of South Australia) and the South Australian Department of Education and Children's Services.

Statistical analysis

This study used a non-randomised but controlled between-groups design. The data were analysed by univariate modelling.

Chi-squared analyses were utilised to compare demographic data. Two-way analysis of variance (ANOVA) was used to compare children in specialist behavioural programmes to those in mainstream schools. Group status was used as the independent variable and sleep variable responses as dependent variables. As this was a preliminary community-based field study and the first of its kind to compare these populations, power calculations were not performed before the study was conducted. However, collected results were used to estimate retrospectively what power the given sample size afforded to detect significant group differences of the magnitude suggested by the findings.

Because of the wide age range of the sample (6–15 years), age was used as a covariate in analyses, as were other potential confounds (gender, maternal education). More mothers reported education levels compared with fathers (66 mothers vs. 58 fathers). Therefore, mother's education was used, where possible as a surrogate measure of socio-economic status. Logistic regression models were used to test for associations between sleep problems and poor behaviour. Relationships between sleep, behaviour and academic variables were investigated by Pearson correlations with Fischer r-z transformations in the total sample ($n = 80$, mean (SD) = 9 years 11 months (0.11 months). To control for the number of comparisons tested, Bonferroni corrections suggested use of a significance value of 0.001. Data were analysed with Statview 1992–1998 and SAS version 8.01.

Results

Returned questionnaires totalled 85 (15 index and 70 controls), which reflected a return rate of 37.5% for the specialist behavioural units, 12.9% for the mainstream schools and 14.6% overall. Five control children with incomplete data were excluded. The final sample consisted of 15 index and 65 control children with mean (SD) age = 9 years 11 months (0.11 months). The sample included 41 girls.

Results of ANOVA models used to compare SDSC sleep subscale T-scores between index and control children are summarised in Table 1. All sleep problem factor scores were quantitatively higher in the index group; those differences that reached statistical significance included arousal problems, excessive daytime sleepiness and total sleep problems. A trend emerged for behavioural sleep problems ($P = 0.07$). Retrospective power calculations for variables that did not show statistically significant relationships suggested that more subjects would have been necessary to show significant results for other variables (see Table 1). Considerable variability in sleep scores (elevated SDs) and significant levels of comorbid sleep problems (a high Total Sleep Problem score) were evident in the index group. In short, children in specialist behavioural programmes reported significantly poorer sleep than children in mainstream schools.

Academic performance

Two parents (index = 1) and five teachers (index = 5) did not estimate school performance. Teachers for the five index children expressed the impossibility of grading these students on the arbitrary grading system against other children given their special schooling circumstances, despite approving the arbitrary scale prior to the study. A moderate correlation of 0.53 ($P < 0.001$) was shown between available parents' and teachers' grade point scores.

Parents reported significantly worse school performance in index children compared with controls (see Table 2). In contrast, teachers did not report statistically significant differences.

Behaviour

As the index group was separated from mainstream schooling because of behavioural problems, this group was expected to present with increased problematic behaviour. Analyses (ANOVA) confirmed this with increased problematic behaviour for index children on all CBCL subscales compared with mainstream students ($P < 0.005$).

In summary, children in specialist behavioural programmes, in comparison to matched mainstream schoolchildren, had worse sleep, academic performance and behaviour.

Relationships between sleep, behaviour and academic performance in the entire sample

Investigations with Pearson correlation and Fischer r–z transformations in the entire sample ($n = 80$) showed significant

Table 1 Comparison of sleep problems for index versus controls (ANOVA)

Sleep problem	Mean T-score (index)	Mean T-score (control)	*F*-value	*P*-value	Power (sample size needed)
Behavioural sleep problems of initiating and maintaining sleep	74.0 (19.0)	62.8 (13.4)	3.4	0.07	44% (94)
Sleep disordered breathing	57.2 (15.9)	55.6 (9.7)	0.1	0.75	5% (3027)
Arousal problems	70.2 (22.1)	54.6 (14.4)	5.2	0.03	58% (65)
Sleep–wake transition problems	65.4 (17.4)	57.2 (12.6)	2.1	0.15	30% (148)
Excessive daytime sleepiness	66.5 (17.2)	54.2 (9.4)	5.8	0.02	64% (57)
Hyperhydrosis	54.1 (12.9)	48.9 (8.7)	1.6	0.20	25% (187)
Total sleep problems	73.7 (19.4)	59.4 (13.4)	5.3	0.02	64% (57)

Table 2 Comparison of school performance for index versus controls (ANOVA)

	Mean (SD) index	Mean (SD) control	*F*-value	*P*-value
Parent reported CBCL school T-score†	28.8 (6.3)	47.7 (7.2)	65.3	<0.0001
Teacher reported overall school grade‡	3.7 (1.4)	2.6 (1.3)	3.2	0.08

†The lower the T-score the worse the performance. Parent T score calculated from four items on CBCL (subject performance + repeat grades + special class + school problems). ‡Grades were transformed into numerical values = A = 1, A– = 2, B = 3, B– = 4, C = 5, D = 6, E = 7, F = 8). CBCL, Child Behaviour Checklist.

Table 3 Pearson correlation coefficients for sleep, behaviour and academic variables within for the entire sample ($n = 80$)

Sleep problem	ADHD	Competence	Internalised behaviour	Externalised behaviour	Total behaviour	Teacher school grades	Parent school T-score
Behavioural sleep problems	0.65***	–0.44***	0.73***	0.69***	0.73***	0.19	–0.51***
Sleep breathing	0.33	–0.24	0.24	0.28	0.30	0.22	–0.19
Arousal	0.64***	–0.39	0.57***	0.48***	0.59***	0.20	–0.51***
Sleep–wake transition disorders	0.49***	–0.29	0.38**	0.38**	0.45***	0.08	–0.39**
Excessive daytime sleepiness	0.46***	–0.39*	0.58***	0.56***	0.65***	0.24	–0.54***
Hyperhydrosis	0.45***	–0.14	0.28	0.24	0.30	0.19	–0.21
Total sleep problems	0.66***	–0.43***	0.71***	0.62***	0.72***	0.23	–0.54***

*P = 0.001; **P ≤ 0.0005; ***P ≤ 0.0001. ADHD, attention deficit hyperactivity disorder.

correlations between the putative sleep risk factors that were assessed – problems with initiating and maintaining sleep, arousal, sleep–wake transition, excessive daytime sleepiness and Total Sleep Problems – and several outcomes, including reduced competency, impaired attention, lower parent-rated school grades (CBCL T-scores), increased hyperactivity, more prominent internalised behaviour and externalised behaviour ($P < 0.05$, Table 3). In short, poor sleep was significantly associated with poor academic performance and problematic daytime behaviour (Figs 1,2).

Logistic regression models in the total sample ($n = 80$), controlling for age, gender and maternal education, showed an increased likelihood of sleep disturbance in children with challenging behaviour. Specifically, children with CBCL behaviour T-scores 67–70 (borderline) or >70 (clinical) were five times more likely than remaining children to have SDSC Total Sleep Problem T-scores one SD above the mean (>60), (OR = 5.14, 95% CI (2.07–12.77), $P = 0.0004$). Exclusion of the data from one child, an index subject whose age (6.1 years) was less than the range for which the SDSC had been validated (6.5–15.3 years), did not change the results appreciably.

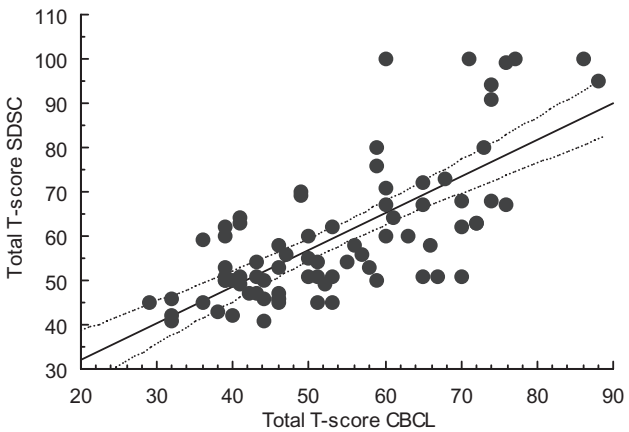

Fig. 1 Scatterplot and 95% confidence intervals for a linear relationship between sleep and behaviour problems. CBCL, Child Behaviour Checklist; SDSC, Sleep Disturbance Scale for Children.

Discussion

This preliminary study compared Australian children attending specialist behavioural programmes with demographically matched students in mainstream schools and found that the former have significantly increased problems with sleep. Children with problematic daytime behaviour, as measured by the CBCL, were five times more likely to report sleep disturbance. Additional specific neurobehavioural concerns, ranging from inattention and hyperactivity to mood and school performance, showed associations with insomnia, nocturnal arousal, sleep–wake transition problems and excessive daytime sleepiness.

To our knowledge, this is the first school-based study to investigate sleep patterns in children withdrawn from mainstream

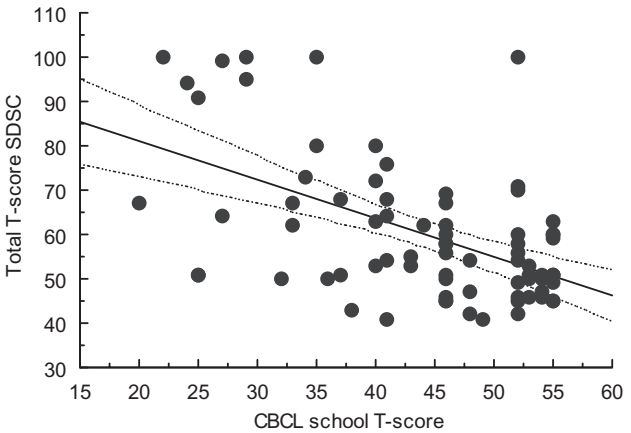

Fig. 2 Scatterplot and 95% confidence intervals for a linear association between sleep problems and parent rated school grades. CBCL, Child Behaviour Checklist; SDSC, Sleep Disturbance Scale for Children.

schooling because of behavioural and academic problems and placed in remedial academic classrooms. These findings concur with a previous report of higher frequencies of sleep problems in children separated from mainstream school because of learning difficulties[14] and with other studies that have shown sleep problems in children with conduct behavioural problems,[12] in children with poorer school performance;[9] and in children with impaired daytime functioning.[7,19,20] They do not concur with studies reporting increased sleep-disordered breathing in children with poor school performance or problematic behaviour.[3–6,8,9,21–23]

The positive associations between sleep and behaviour that emerged in our sample are consistent with growing evidence that disruption of sleep from diverse aetiologies may be detrimental to behaviour and academic performance. Several studies have reported that children with non-respiratory sleep problems[6,7,24,25] or experimental sleep restriction[26,27] show daytime cognitive and behavioural deficits. Comprehensive reviews[28,29] have proposed potential pathways by which sleep disruption alone may result in significant daytime deficits. Lack of sleep continuity, reduced sleep quantity, or poor sleep quality could affect the function of the prefrontal cortex, which regulates many of the behaviours that are sensitive to sleep disruption. Our study was correlational and cannot address cause and effect. However, our results and those of other recent studies[6,7,12,24,25] continue to provide mounting evidence that sleep disruption with or without respiratory compromise may impair daytime behaviour.

One of the aims of this study was to assess the relationship between sleep problems and academic performance. Excessive daytime sleepiness, behavioural sleep problems and night-time arousals showed the strongest associations with parentally reported school grades. This observation supports those of a previous study in which children and adolescents with daytime sleepiness performed more poorly in school.[20] Sleepiness may well have secondary effects on academic performance. However, teacher-reported school grades in our study were not associated with sleep problems. One possible explanation for the discrepancy may be a parental reporting bias because of the use of parental report for data collection in all three domains (sleep, behaviour and academic performance). The discrepancy could also have arisen in part because school grades from teachers were available for only 10/15 index students. The possibility that the arbitrary scale for the teachers did not measure constructs similar to those measured by the more comprehensive 4-item subscale of the parentally reported CBCL may also be a factor. As such, classification of school grades by teachers may not have captured the grading subtleties of the parental report, lacking sufficient sensitivity to detect potential relationships.

An additional limitation in this study is that the strong association between sleep problems, behaviour and school performance could have arisen in part from parental generalisation of both night-time and daytime behavioural problems in their children. Alternatively, behavioural problems in the index group may have arisen in part from parenting styles that reflect poor behaviour management both at night and during the day. However, daytime behavioural problems have been observed in association with non-behavioural sleep disorders that disrupt sleep, such as SBD,[4,8,12,30] periodic limb movement disorder[12,31,32] and parasomnias.[33] These reports suggest that the findings in the present study are not likely to be explained entirely by parental generalisation or parenting style. An additional limitation is the small sample size, with the poor return rate particularly in the mainstream sample. This increases the possibility of a type II error and reduces the external validity of the findings. A greater return rate and subsequent larger sample size may have improved the robustness of results and may have uncovered group differences in other sleep variables not found in the current study. However, the analysis of 15 index versus 15 matched controls allowed for a careful comparison, in turn complemented by results from the entire sample ($n = 80$). Finally, the risk of a small sample is predominately that associations of importance (such as one between sleep problems and behaviour) would not be found. However, we found several robust associations despite the limited sample size. Confirmation of these findings in larger sample sizes, with vigorous promotion or other strategies to maximise participation, seems warranted by our initial experience and findings.

Despite these limitations, our preliminary findings help to place previous reports of associations between childhood sleep disturbance and neurobehavioural problems into a new practical context. Virtually no classroom in Australia or elsewhere is free from some level of disruptive, oppositional behaviour. In such situations, negative classroom experiences influence both affected students and others. Transfer of some children to 'special schools' often provides only partial relief at significant expense. Our data should alert teaching and health professionals to the possibility that sleep problems may be frequent in remedial classes. If sleep disturbances do contribute to disruptive behaviour and poor academic performance in school children, then the magnitude of the associations apparent in our limited sample suggest a major impact and potentially important novel opportunities for behavioural intervention. Our findings raise the possibility that awareness of the sleep difficulties and attention to them could improve the quality of life and health of some children in special school programmes.

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