Journal of Paediatrics and Child Health

doi:10.1111/j.1440-1754.2009.01610.x

ORIGINAL ARTICLE

Sleep, performance and behaviour in Australian indigenous and non-indigenous children: An exploratory comparison

Sarah Blunden[1] and Ronald D Chervin[2]

[1]University of South Australia, Centre for Sleep Research, Adelaide, South Australia, Australia and [2]University of Michigan, Michael S. Aldrich Sleep Disorders Laboratory, Ann Arbor, Michigan, Illinois, United States

Aims: Sleep problems in Australian children are common and consequential but have not been investigated in Australian Aboriginal or Torres Strait Islander (indigenous) children. This study compares sleep in indigenous and non-indigenous children and investigates potential effects on school performance and daytime behaviour.

Methods: Subjects included 25 indigenous and 25 non-indigenous children (mean standard deviation (SD) age = 8.8 (1.4 years), range 7–11.11 years), in six Northern Territory primary schools. Parents completed the Sleep Disorders Scale for Children which produces a T-score (mean = 50 (SD = 10)) for behavioural sleep disorders, sleep disordered breathing, parasomnias, excessive daytime sleepiness and night sweating. Behaviour and school grades were assessed with the parent-reported Child Behaviour Checklist.

Results: Behavioural sleep problems of initiating and maintaining sleep, or parasomnias were commonly reported by both groups (24–40%), with indigenous children under 9 years reporting the most problems. No between-group differences were found in school performance. Significant relationships between sleep quality and behaviours were found, particularly for indigenous children.

Conclusions: These data suggest that substantial numbers of Australian children – more than one third in this pilot sample – may suffer from significant sleep problems. To the extent that sleep problems may impair prefrontal cortical function, emotional regulation, and control of behaviour, confirmation of current findings could have particular import for indigenous children.

Key words: Aboriginal or Torres Strait Islander; children's development; indigenous; problematic behaviour; school performance; sleep problems.

International prevalence estimates of sleep problems that reduce sleep duration in children range from 10% to 45%.[1–3] In Australia, these estimates are approximately 16% for sleep breathing disorders (SDB) such as snoring and sleep apnoea[4], and 35% for non-respiratory sleep disorders such as behavioural sleep problems, difficulties with sleep onset and maintenance, night waking and parasominias (comprising of problems with arousal and problems with sleep wake transition).[5]

However, these estimates are made principally in populations of non-indigenous children. Only two studies to date have published data on sleep in indigenous children. Valery *et al.*[6] reported a prevalence of SDB in indigenous children from the Torres Strait and the Northern Peninsula Area of 14.2 % with 6% reporting 'restless sleep', while Poulos *et al.*[7] reported sleep problems in children secondary to asthma. Much remains to be learned about the sleeping patterns of indigenous children.

Key Points

1. Up to 30% of urban indigenous and non-indigenous children have sleep problems.
2. Sleep problems can have significant and negative daytime consequences in children.
3. Associations between behaviour problems and sleep disturbance may be of particular import for indigenous children.

Correspondence: Dr Sarah Blunden, University of South Australia, Centre for Sleep Research, 7th floor, Playford Building, Adelaide, Frome Rd, Adelaide, SA 5000, Australia. Fax: +61 8 8302 6623; Email: sarah.blunden@unisa.edu.au

Accepted for publication 25 May 2009.

The importance of understanding sleep patterns in these children stems in part from evidence that inadequate sleep can impair childhood behaviour and cognition. A strong relationship exists between neurocognitive deficits, emotional lability, problematic behaviours and decreased school performance in both clinical[8–12] and non-clinical studies.[3,5,13,14] These data have emerged from children with both respiratory[8,11,15,16] and non-respiratory sleep disorders,[5,17–19] and children subjected to sleep restriction.[20] Sleep loss more generally has been associated with stress, increased locomotive activity, alterations in hormonal activity and body temperature, and changes in cytokines and tumour necrosis factor.[21] Children with reduced sleep duration are more likely than other children to be overweight or obese,[22,23] and to have changes in appetite regulation and insulin and glucose utilisation, both associated with metabolic syndrome.[24]

Despite the significant impact of sleep problems on children's development, investigation of the frequency of reported sleep problems in Australian indigenous children has been scant. Furthermore, assessment of any possible detrimental effects of poor sleep on school performance and behaviour in these children

has not been undertaken. Given that indigenous Australian children show poorer academic performance than their non-indigenous Australian counterparts,[25] the potential role of sleep merits investigation.

We therefore present preliminary frequency estimates of sleep problems reported in Australian indigenous children compared with their non-indigenous peers, and investigate relationships between sleep and performance.

Methods

Subjects

All schools listed in metropolitan Darwin, Northern Territory (NT) and Palmerston (an urban area 1 h from Darwin) were invited to participate between February and April 2005 (NT wet and beginning of the dry season). Representatives from eight schools accepted invitations to information sessions, two withdrawing before study commencement. A total of 135 questionnaires were returned from 442 distributed, giving a return rate of 30.6%. From this sample, 25 indigenous Aboriginal or Torres Strait Islander (indigenous) children of mean age (standard deviation (SD)) = 8.9 (1.4), range 7–11 years were matched as closely as possible to 25 non-Aboriginal or Torres Strait Islander (non-indigenous) children of mean age = 9.0 (1.5), range 7–12 years, who also had the most complete data sets. Children were matched for age, gender, postcode and parental education (based on Australian Bureau of Statistics categories – 1 = primary school completion; 2 = did not complete high school; 3 = completed year 12; 4 = TAFE/trades; 5 = tertiary). There were no statistical differences between groups (despite a tendency for paternal education, $P = 0.06$) in these matched variables. Subject characteristics are presented in Table 1.

Sleep

Sleep was assessed with the Sleep Disturbance Scale for Children (SDSC).[26] This well-validated instrument has been used in numerous previous studies of sleep in children around the world.[19,26–28] Parents are instructed to consider their child's sleep during the previous 6 months when the child has been well. The SDSC then provides six sleep problems factors grouped from 26 items:

1 Behavioural sleep problems of initiating and maintaining sleep
2 Sleep breathing
3 Parasomnias:
   - arousal disorders, for example, nightmares and night terrors
   - sleep–wake transition disorders, for example, sleep walking, sleep talking and bruxism
4 Excessive daytime somnolence
5 Sleep hyperhydrosis – night sweating
6 Total sleep problem score (sum of all individual sleep problem scores)

All sleep factor scores were transformed into age-specific T-scores with a mean (SD) of 50 (10). The T–scores for all ages in this sample were based on standardised norms for ages 6.5–15.3 years.[26] Sleep problems were identified in this study by T-scores one SD above the mean (i.e. >60).

Behaviour and school performance

Behaviour was assessed using the parental report version of the Child Behaviour Checklist (CBCL).[29] Based on responses to 20 competency items and 118 problematic items, the CBCL measures several subscales of behaviour and performance. For this study, we extrapolated school performance and behaviour. School performance was measured with three questions. Parents were asked whether their child was receiving remedial teaching or learning assistance (yes = 1, no = 0), whether they had ever repeated a grade (yes = 1, no = 0) and whether they had any other academic problems at school (yes = 1, no = 0). Parents' ratings of their child's performance in specific school subjects (failing = 0, below average = 1, average = 2 or above

Table 1 Sample characteristics

Variable	Whole sample	Indigenous ($n = 25$)	Non-indigenous ($n = 25$)	P value
Mean (SD) age (years, months)	8.9 (1.7)	8.9 (1.4)	9.0 (1.5)	ns
Range	7.01–11.11 years	7.01–11.06 years	7.01–12.00 years	
Age distribution (n)				
7–7.11 months	8	3	5	
8–8.11 months	18	11	7	
9–9.11 months	7	3	4	
10–10.11 months	4	2	2	
11–11.11 months	13	6	7	
Males	27	14	13	ns
Females	23	11	12	ns
Mean (SD)	2.9 (1.3)	3.00 (1.3)	2.9 (1.3)	ns
Mother's education† ($n = 40$)				
Mean (SD)	3.3 (1.0)	2.5 (0.5)	3.5 (1.0)	0.06
Father's education† ($n = 34$)				

†Education rated 1 = primary school completion; 2 = did not complete high school; 3 = completed year 12; 4 = TAFE/trades; 5 = tertiary. SD, standard deviation.

Table 2 Percentage of total sample (*n*) with T scores > 60

Sleep problem	Total sample (*n*)	Indigenous (%)	Non-indigenous (%)
Behavioural sleep problems	36 (18)	32 (8)	40 (10)
Sleep-disordered breathing problems	10 (5)	12 (3)	8 (2)
Arousal problems	12 (6)	12 (3)	12 (3)
Sleep wake transition problems	24 (12)	20 (5)	28 (7)
Excessive daytime sleepiness	18 (9)	20 (5)	16 (4)
Hyperhydrosis	4 (2)	4 (1)	4 (1)
Total combined sleep problems	35.4 (17)	32 (8)	39 (9)

average = 3) were averaged. Scores were summed and transferred to T-scores according to Achenbach.[29] Low scores indicate better academic performance.

Parents reported on three types of behaviour: internalised behaviour (including withdrawn behaviour, somatic complaints and anxious/depressed), externalised behaviour (including rule breaking behaviour and aggression), and a total problem behaviour (including social problems, thought problems such as 'hears things', 'strange ideas' and attention problems). The CBCL includes a measure of frequency (0 = not true, 1 = somewhat true, 2 = very true) that aids in establishing the clinical significance of a certain behaviour and can be compared with a large normative sample to identify the presence of pathological behaviours.[29] Behaviour scores were transformed into T-scores with a mean (SD) = 50 (10). High scores indicate more problematic behaviour.

Statistical analyses

All data presented are cross-sectional. Demographic differences were explored with χ^2 and age differences in sleep problems between indigenous and non-indigenous children were explored with *t*-tests. Similarly, between-group differences in sleep, behaviour and academic performance were conducted with unpaired *t*-tests using sleep problems as the dependent variables and school performance and behaviour as independent variables. Relationships between variables were investigated with Pearson correlations (r-z transformations). Significance was set at <0.05 given the exploratory nature of the study. The study was approved by the University of South Australia Human Ethics Committee and Northern Territory Department of Education. Indigenous parents were assisted in questionnaire completion by indigenous teacher's aides where necessary.

Results

Sleep problems

The most frequent sleep issue (T-score > 60) for the whole sample was behavioural sleep problems, reported by 36% of parents, followed by sleep wake transition problems in (24%). Behavioural sleep problems were reported in 32% of indigenous children followed by problems with sleep wake transition (20%) and excessive daytime sleepiness (20%). Similarly, behavioural sleep problems were the most reported sleep problems for non-indigenous children followed by sleep wake transition and excessive daytime sleepiness (40%, 28% and 16%, respectively) (See Table 2). Between-group mean comparisons showed only one sleep problem differed between groups, with excessive daytime sleepiness significantly higher in non-indigenous children ($P = 0.03$). Results revealed a considerable amount of variation in scores, as shown by high SDs. Total sleep time and level of 'refreshment' on awakening, as reported in the sleep diaries, did not reveal differences between groups. Results are summarised in Table 3.

Age and gender distribution of sleep problems

t-Tests were conducted to ascertain if the most reported sleep problems were specific to age groups, both for the whole sample, and separately for indigenous and non-indigenous children. Because of the uneven sample size of each age group that restricted comparisons between age groupings (e.g. 7–8-year-olds, 8–9-year-olds etc.) (see Table 1), participants were grouped as either <9 years of age ($n = 26$) or ≥9 years of age ($n = 24$). For the whole sample, although sleep problems were most common in children <9 years of age, none reached significance. There was a tendency for increased sleep wake transition problems in children <9 ($P = 0.08$). When separated, indigenous children <9 years reported significantly increased sleep wake transition ($P = 0.03$), and total sleep problems ($P = 0.04$) and a tendency for increased excessive daytime sleepiness ($P = 0.07$). For the non-indigenous children, no significant differences were found.

No significant sex differences emerged in reported symptoms of sleep disorders, in the total sample or between groups (χ^2 all $P > 0.05$), although a trend was noted for increased reports of behavioural sleep problems within non-indigenous females ($\chi^2 = 3.2$, $P = 0.06$).

Behaviour and school performance

Only three behaviour T-scores were significantly different between groups. Indigenous children displayed more externalised behaviour in general ($t = 2.1$, $P = 0.03$), specifically more aggression ($t = 3.0$, $P = 0.004$) and also more withdrawn behaviours ($t = 2.0$, $P = 004$). Trends emerged for thought problems

Table 3 Mean (SD) and between group differences (ANOVA)

Variable	Means (SD)		*P* value
	Indigenous	Non-indigenous	
Sleep Disorders Scale for Children	*n* = 25	*n* = 25	
Behavioural sleep problems	56.6 (14.9)	61.3 (13.4)	ns
Sleep disordered breathing problems	48.8 (12.4)	50.7 (9.2)	ns
Arousal problems	57.1 (18.4)	53.7 (10.5)	ns
Sleep–wake transition problems	56.7 (17.5)	57.2 (14.0)	ns
Excessive daytime sleepiness	51.5 (10.9)	59.4 (13.8)	0.03
Hyperhydrosis	45.3 (6.3)	47.4 (4.8)	ns
Total combined sleep problems	56.4 (15.2)	60.2 (13.3)	ns
Sleep diary	*n* = 21†	*n* = 22†	
TST sleep diary – h, min, (SD – h, min)	10.10 (0.45)	10.09 (1.09)	ns
Sleep refreshment‡	1.50 (0.26)	1.37 (0.46)	ns
Child Behaviour Checklist	*n* = 24†	*n* = 23†	
School performance T-score§	42.7 (7.6)	44.6 (8.2)	ns
Anxiety¶	56.5 (7.2)	49.1 (16.2)	ns
Withdrawn¶	58.2 (7.2)	54.4 (5.2)	0.04
Somatic behaviours¶	59.4 (7.4)	57.3 (10.0)	ns
Social behaviours¶	58.6 (7.0)	55.4 (6.8)	ns
Thought behaviours¶	58.2 (8.5)	54.4 (5.1)	0.07
Attention¶	57.7 (7.7)	55.3 (5.7)	ns
Rule breaking¶	57.2 (7.5)	55.1 (6.5)	ns
Aggression¶	58.8 (8.4)	52.6 (4.8)	0.004
Internalised behaviour¶	57.8 (9.1)	52.2 (10.9)	0.06
Externalised behaviour¶	57.1 (10.1)	51.3 (7.8)	0.03
Total behaviour problems¶	57.0 (9.5)	51.3 (9.3)	0.04

†Data not available for some subjects. ‡Scale where 1 = very refreshed – 5 = not refreshed at all. §Normal range = T-score 40–55. ¶Normal range = T-score < 60. ANOVA, analysis of variance; ns, not significant; SD, standard deviation; TST, total sleep time.

(t = 1.8, $P = 0.07$) and internalised behaviours ($t = 1.9$, $P = 0.06$). Total sleep problems were also significantly different ($t = 2.0$, $P = 0.04$). No significant between-group differences were found in school performance, as reported by parents ($P > 0.05$).

Relationships between sleep variables and behaviour were investigated with Pearson correlations and r-z transformations but were restricted to behaviours that showed significant between-group differences. For the whole sample, arousal problems were positively correlated with externalised behaviours ($r = 0.32$, $P = 0.02$), specifically aggression ($r = 0.37$, $P = 0.009$), withdrawn behaviour ($r = 0.31$, $P = 0.02$) and total behaviours ($r = 0.43$, $P = 0.001$). Total sleep problems correlated positively with total behaviour problems ($r = 0.31$, $P = 0.01$).

These relationships were explored separately for indigenous and non-indigenous children. Results are presented in Table 4. Among indigenous children, several moderate positive associations were found between withdrawn behaviour and total behaviours with sleep problems (total sleep problems, arousal problems, excessive daytime sleepiness and hyperhydrosis). Among non-indigenous children, sleep wake transition problems were related to aggression and total sleep problems. In summary, associations observed in the entire sample ($n = 50$) between behaviour problems and sleep problems emerged in large part from the indigenous children.

Discussion

This preliminary study is the first to examine the frequency of sleep problems in Australian indigenous children and compare them with a group of non-indigenous matched controls. While the findings are preliminary, they suggest that sleep problems, and particularly behavioural sleep problems of initiating and maintaining sleep, parasomnias and excessive daytime sleepiness, are common in both groups of children with up to 30% of this sample reporting these symptoms more than 3–5 times per week. Sleep problems were most common in children under 9 years of age, particularly in indigenous children. Non-indigenous parents reported more sleep problems but with excessive daytime sleepiness the only one to reach significance. School performance was not significantly different between groups but parents of indigenous children reported higher, withdrawn, externalised and total behaviour problems compared with non-indigenous children. In fact, the associations between total behaviour problems and sleep disturbance were stronger for indigenous children than non-indigenous children. If these findings can be confirmed, efforts in the future to address sleep problems in these children could possibly benefit not only sleep health but also daytime behaviour.

Table 4 Correlation coefficients for significant sleep and behaviour variables

Sleep variable	Aggression		Externalised behaviour		Withdrawn behaviour		Total behaviour	
	Indigenous $n = 24$	Non-indigenous $n = 23$	Indigenous $n = 24$	Non-indigenous $n = 23$	Indigenous $n = 24$	Non-indigenous $n = 23$	Indigenous $n = 24$	Non-indigenous $n = 23$
Arousal problems	ns	ns	ns	ns	ns	ns	0.46*	ns
Sleep wake transition problems	ns	0.43*	ns	ns	ns	ns	ns	0.48*
Excessive daytime sleepiness	ns	ns	ns	ns	0.39*	ns	ns	ns
Hyperhydrosis	ns	ns	ns	ns	0.56***	ns	0.49*	ns
Total sleep problems	ns	ns	ns	ns	ns	ns	0.41*	ns

*$P < 0.05$; ***$P < 0.005$. One indigenous and two non-indigenous families did not complete the CBCL. CBCL, Child Behaviour Checklist; ns, not significant.

The frequency estimates for these NT metropolitan school children were similar to those reported elsewhere in Australian and international samples.[5,30–33] Interestingly, all these children reported sufficient sleep quantity (10–12 h per night) although parent-reported sleep quality was compromised in many cases.

Findings also increase the awareness of the specific type of sleep problems that are reported by children of different ages and for the first time in indigenous children. Indigenous children reported significantly worse sleep problems in the younger age groups (specifically sleep–wake transition) compared with non-indigenous children, whose sleep problems appeared to be consistent across age groups. Many previous studies have reported an overrepresentation of sleep problems in younger age groups[14,34,35] and these data in indigenous children are consistent with previous findings. Similarly, these data concur with previous reports suggesting no significant gender differences in sleep problems between males and females.[5,36–38] Only two published studies have previously reported sleep problems in Australian indigenous children. In a study primarily of respiratory sleep disorders and asthma, using face-to-face semi-structured interviewing in indigenous communities, Valery *et al.*[6] found 6% of 1650 children (aged 0–17 years) reported 'restless sleep'. Similarly Poulos *et al.*,[7] report that more than one-third of both remote and urban indigenous children (aged 0–5 years) were reported with sleep disturbance as a result of asthma. The current study now serves to expand investigation in these children to include non-respiratory sleep problems and their potential consequences.

It is of interest that in this study, no relationship was found between sleep and school performance. Several previous studies in non-indigenous children have shown significant relationships[13,14,39,40] between these two factors. No studies in Australia have investigated this relationship in indigenous children although elsewhere race (African–American) and sleep disorders have shown positive relationships.[41] NT Government reports have made reference to 'poor sleep' as a contributing factor in poor outcomes in literacy and numeracy when comparing indigenous academic performance with national benchmarks[25] but to date no data have been published to either support or refute these concerns. Whether there is no relationship in this sample or whether a relationship was not detected because of insufficient numbers or parental report bias is unclear. Larger Australian studies utilising more objective measures of sleep and school performance are needed to clarify this issue.

One main finding of this study is the association between sleep problems and behaviour. It is of note that symptoms of sleep-disordered breathing, long found to be associated with problematic behaviour and decreased academic performance in children,[42–44] neither differ between groups nor was related to behaviour or school performance. Instead, it was the non-respiratory sleep disorders that were of importance. Non-respiratory sleep disorders such as restless legs syndrome,[17,42] behavioural sleep disorders[5,18] and parasomnias[13,33,43] have previously been related to problematic behaviour in several paediatric studies. These preliminary results support evidence of a relationship between non-respiratory sleep problems and problematic daytime behaviour. In this study, we also found a relationship between night sweating and daytime behaviour in indigenous children. One previous Australian study has found a relationship between night sweating and cognitive performance in non-indigenous children that may have been related to SDB[8] but the relationship between night sweating and behaviour in this group still remains unclear.

These data suggest that the relationship between sleep and behaviour may be stronger for indigenous children than for non-indigenous children. Reasons for this may be multifactorial. It is possible that the results arose in part from parental report bias and that parental characterisation that both behaviour and sleep are problematic is more likely in indigenous families, although this must be speculative given the limited parental report studies undertaken in this population. It may be that indigenous children have more behavioural problems than non-indigenous children *per se*, as suggested by the higher behaviour scores for indigenous children. It has been noted that indigenous children, because of disproportionate disadvantage[44] are at higher risk of clinically significant emotional and behavioural difficulties.[45] It is possible that the behaviour problems displayed in this sample of indigenous children has more to do with their social disadvantage than their sleep, particularly given that sleep patterns were similar between groups. However, it is worth noting that parents often underreport sleep

problems[46] and that if indigenous children have reduced parental supervision, as has been suggested in one study,[44] reduced monitoring of sleep is likely to be more common. If sleep problems are under-detected, then the strength of relationships between sleep and behaviour may be underestimated. Finally, it may be that either indigenous children are more susceptible to the effects of poor sleep on daytime behaviour or alternatively, that there is an unknown factor that affects behaviour in indigenous children. Additional studies in larger samples would clarify these questions.

Some limitations of this pilot study deserve mention. Self selection for the study, although unavoidable in a community-based study, may have skewed results. Despite best efforts, return rates were low, though similar to those obtained in previous Australian community-based studies[47,48] (42%; 36% respectively). Return rates and sample size were primarily dictated by operational constraints common in cross-sectional studies and were reliant on non-research personnel for recruitment. While retrospective power analyses suggested that this study was moderately powered to detect differences between groups (d = 0.63) in sleep and behaviour, a larger sample size may have improved the robustness of the results. Data were collected by self-report which introduces the risk of rater bias or a recall bias. However, higher report biases in indigenous families compared with non-indigenous children remains speculative. In addition, there was an indication that paternal education was higher in non-indigenous children but income data were not collected so further assessment was not undertaken. Normative data for both the SDSC and the CBCL are not available for indigenous children and this may have affected responses, although use of indigenous teacher's aides aimed to reduce this confounder. Finally, this study focussed on symptoms of sleep problems as defined by the SDSC, not on sleep disorders diagnosed by clinical interviews, examination or sleep studies.

Conclusion

Despite the said limitations, this is the first study to provide preliminary frequencies of sleep problems in Australian indigenous children and compare them with better-known sleep patterns in non-indigenous children. These results motivate further study. It is apparent from these estimates that sleep problems are common in these children with one child in three reporting significant sleep problems. With evidence to suggest that sleep problems are under-recognised and under-diagnosed in children at the primary health care level,[4,38] and increasing numbers of studies indicating amelioration of daytime deficits with treatment of sleep problems,[15,49–52] it is time that the high prevalence of paediatric sleep problems be acknowledged because of their effects on children's development. Any amelioration of behavioural problems with improved sleep would be welcome. In addition, as for many minority ethnic groups in affluent countries, the health of indigenous Australian children is poorer than their non-indigenous counterparts[53] and sleep health may be no exception. Despite an observable link between sleep and daytime performance in non-indigenous populations, we have little understanding of this relationship among indigenous children. Increased recognition and treatment of sleep problems in indigenous children could translate into a substantial public health impact.

Acknowledgements

This study was undertaken with the financial support of the Channel 7 Children's Research Foundation, South Australia Inc. The authors acknowledge the assistance and contributions of the Department of Education in the Northern Territory and the participating schools and students.

References

1 Kahn A, Van de Merckt C, Rebuffat E *et al.* Sleep problems in healthy preadolescents. *Pediatrics* 1989; **84**: 542–6.
2 Liu X, Sun Z, Uchiyama M, Shibui K, Kim K, Okawa M. Prevalence and correlates of sleep problems in Chinese schoolchildren. *Sleep* 2000; **23**: 1053–62.
3 Smedje H, Broman J, Hetta J. Associations between disturbed sleep and behavioural difficulties in 635 children aged six to eight years: a study based on parents' perceptions. *Eur. Child Adolesc. Psychiatry* 2001; **10**: 1–9.
4 Blunden S, Lushington K, Lorenzen B, Wong J, Balendran R, Kennedy D. Symptoms of sleep breathing disorders in children are underreported by parents at general practice visits. *Sleep Breath* 2003; **7**: 167–76.
5 Blunden SL, Lushington K, Lorenzen B, Martin J, Kennedy D. Neuropsychological and psychosocial function in children with a history of snoring or behavioral sleep problems. *J. Pediatr*. 2005; **146**: 780–6.
6 Valery P, Masters IB, Chang AB. Snoring and its association with asthma in Indigenous children living in the Torres Strait and Northern Peninsula Area. *J. Paediatr. Child Health* 2004; **40**: 461–5.
7 Poulos L, Toelle BG, Marks GB. The burden of asthma in children: an Australian perspective. *Paediatr. Respir. Rev*. 2005; **6**: 20–7.
8 Blunden S, Lushington K, Kennedy D, Martin J, Dawson D. Behavior and neurocognitive performance in children aged 5–10 years who snore compared to controls. *J. Clin. Exp. Neuropsychol*. 2000; **22**: 554–68.
9 Chervin RD, Archbold KH, Dillon JE *et al.* Inattention, hyperactivity, and symptoms of sleep-disordered breathing. *Pediatrics* 2002; **109**: 449–56.
10 Urschitz MS, Guenther A, Eggebrecht E *et al.* Snoring, intermittent hypoxia and academic performance in primary school children. *Am. J. Respir. Crit. Care Med*. 2003; **168**: 464–8.
11 Beebe DW, Wells CT, Jeffries J, Chini B, Kalra M, Amin M. Neuropsychological effects of pediatric obstructive sleep apnea. *J. Int. Neuropsychol. Soc*. 2004; **10**: 962–75.
12 O'Brien LM, Mervis CB, Holbrook CR *et al.* Neurobehavioral correlates of sleep-disordered breathing in children. *J. Sleep Res*. 2004; **13**: 165–72.
13 Stein MA, Mendelsohn J, Obermeyer WH, Amromin J, Benca R. Sleep and behavior problems in school-aged children. *Pediatrics* 2001; **107**: E60.
14 Sadeh A, Gruber R, Raviv A. Sleep, neurobehavioral functioning, and behavior problems in school-age children. *Child Dev*. 2002; **73**: 405–17.
15 Gozal D. Sleep-disordered breathing and social performance in children. *Pediatrics* 1998; **102**: 616–20.
16 Beebe DW, Groesz L, Jeffries J, Chini B, Amin R. Executive dysfunction in children referred for obstructive sleep apnea (OSA) evaluation. *Sleep* 2002; **25**: A225–6.

17 Chervin R, Archbold K, Dillon J *et al.* Associations between symptoms of inattention, hyperactivity, restless legs, and periodic leg movements. *Sleep* 2002; **25**: 213–8.
18 Owens J, Opipari L, Nobile C, Spirito A. Sleep and daytime behavior in children with obstructive sleep apnea and behavioral sleep disorders. *Pediatrics* 1998; **102**: 1178–84.
19 Blunden S, Chervin R. Sleep problems are associated with poor outcomes in remedial teaching programs: a preliminary study. *J. Paediatr. Child Health* 2007; **44**: 237–42.
20 Fallone G, Acebo C, Arnedt J, Seifer R, Carskadon M. Effects of acute sleep restriction on behavior, sustained attention, and response inhibition in children. *Percept. Mot. Skills* 2001; **93**: 213–29.
21 Kryger MH, Roth T, Dement WC (Eds). *Principles and Practices of Sleep Medicine*, 2nd edn. Philadelphia, PA: W.B. Saunders Company, 1994.
22 Gupta N, Mueller WH, Chan W, Meininger JC. Is obesity associated with poor sleep quality in adolescents? *Am. J. Hum. Biol*. 2002; **14**: 762–8.
23 Sugimori H, Yoshida K, Izuno T *et al.* Analysis of factors that influence body mass index from ages 3 to 6 years: a study based on the Toyama cohort study. Kagamimori S. *Pediatr. Int*. 2004; **46**: 302–10.
24 Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. *Lancet* 1999; **354**: 1435–39.
25 Power C. *National Assessment in Australia: An Evaluation of the Australian Studies in Student Performance Project*. In Australian Government Publishing Service (AGPS). Canberra: Australian Government, 2002.
26 Bruni O, Ottaviano S, Guidetti V *et al.* The Sleep Disturbance Scale for Children (SDSC). Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. *J. Sleep Res*. 1996; **5**: 251–61.
27 Ferreira V, Carvalho L, Ruotolo F, de Morais J, Prado L, Prado G. Sleep Disturbance Scale for Children: translation, cultural adaptation, and validation. *Sleep Med*. 2009; **10**: 457–63.
28 Nixon GM. Short sleep duration in middle childhood: risk factors and consequences. *Sleep* 2008; **31**: 71–8.
29 Achenbach TM. *Manual for Child Behaviour Checklist 4–18 years and 1991 Profile*. Burlington, VT: University of Vermont, Department of Psychiatry, 1991.
30 BaHammam A, Bin Saeed A, Al-Faris E, Shaikh S. Sleep duration and its correlates in a sample of Saudi elementary school children. *Singapore Med. J*. 2006; **47**: 875–81.
31 Laberge L, Tremblay RE, Vitaro F, Montplaisir J. Development of parasomnias from childhood to early adolescence. *Pediatrics* 2000; **106**: 67–74.
32 Owens J, Maxim R, Nobile C, McGuinn M, Msall M. Parental and self-report of sleep in children with attention-deficit/hyperactivity disorder. *Arch. Pediatr. Adolesc. Med*. 2000; **154**: 549–55.
33 Quine L. Sleep problems in primary school children: comparison between mainstream and special school children. *Child Care Health Dev*. 2001; **27**: 201–21.
34 Blader J, Koplewicz H, Abikoff H, Foley C. Sleep problems of elementary school children. A community survey. *Arch. Pediatr. Adolesc. Med*. 1997; **151**: 473–80.
35 Sadeh A, Raviv A, Gruber R. Sleep patterns and sleep disruptions in school-age children. *Dev. Psychol*. 2000; **36**: 291–301.
36 Owen G, Canter R, Robinson A. Snoring, apnoea and ENT symptoms in the paediatric community. *Clin. Otolaryngol. Allied Sci*. 1996; **21**: 130–4.
37 Ferreira AM, Clemente V, Gozal D *et al.* Snoring in Portuguese primary school children. *Pediatrics* 2000; **106**: e64.
38 Chervin RD, Archbold KH, Panahi P, Pituch KJ. Sleep problems seldom addressed at two general pediatric clinics. *Pediatrics* 2001; **107**: 1375–80.
39 Eliasson A, Eliasson A, King J, Gould B, Eliasson A. Association of sleep and academic performance. *Sleep Breath*. 2002; **6**: 45–8.
40 Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. *Sleep Med. Rev*. 2006; **10**: 323–7.
41 Chervin R, Clarke D, Huffman J *et al.* School performance, race, and other correlates of sleep-disordered breathing in children. *Sleep Med*. 2003; **4**: 21–7.
42 Picchietti D, Allen R, Walters A, Davidson J, Myers A, Ferini-Strambi L. Restless legs syndrome: prevalence and impact in children and adolescents – the Peds REST study. *Pediatrics* 2007; **120**: 253–66.
43 Pearl P, Efron L, Stein M. Children, sleep and behaviour: a complex association. *Minerva Pediatr*. 2002; **54**: 79–91.
44 Turner K, Richards M, Sanders M. Randomised clinical trial of a group parent education programme for Australian indigenous families. *J. Paediatr. Child Health* 2007; **43**: 201–2.
45 Zubrick S, Lawrence D, Silburn S. *The Western Australian Aboriginal Child Health Survey: the social and emotional wellbeing of aboriginal children and young people*. Telethon Institute for Child Health Research, 2004.
46 Bauer K, Blunden S. How accurate is subjective reporting of childhood sleep patterns: a review of the literature and implications for practice. *Curr. Pediatr. Rev*. 2008; **4**: 132–42.
47 Clark L, Tiggemann M. Sociocultural influences and body image in 9- to 12-year-old girls: the role of appearance schemas. *J. Clin. Child Adolesc. Psychol*. 2007; **36**: 76–86.
48 Evans AM, Scutter SD. Prevalence of 'growing pains' in young children. *J. Pediatr*. 2004; **145**: 255–8.
49 Minde K. Treatment of sleep problems in small children. *Acta. Paediatr*. 2002; **91**: 866–7.
50 Dahl RE, El-Sheikh M. Considering sleep in a family context: introduction to the special issue. *J. Fam. Psychol*. 2007; **21**: 1–3.
51 Chervin RD, Ruzicka DL, Giordani BJ *et al.* Sleep-disordered breathing, behavior, and cognition in children before and after adenotonsillectomy. *Pediatrics* 2006; **117**: 769–78.
52 Owens J, Palermo TM, Rosen CL. Overview of current management of sleep disturbances in children: II – behavioral interventions. *Curr. Ther. Res*. 2001; **63** (Suppl. B): B38–52.
53 Trewen D, Madden R. *The Healh and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples*. Canberra: Australian Bureau of Statistics and Australian Institute of Health and Welfare, 2003.