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The contribution of sleep to 'Closing the Gap' in the health of Indigenous children: a commentary Camfferman D¹, Blunden S²

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Abstract

Objective: While the socio-economic and environmental factors impinging on the health and daytime functioning of Indigenous children are complex, it is suggested that poor sleep quality may also be a significant contributing factor.

Results: The overall sleep quality of Australian Indigenous children is likely to be affected by their higher prevalence rates of asthma, sleep disordered breathing, diabetes and obesity. Australian Indigenous children are further reported to have a higher prevalence of emotional regulation problems, behavioural problems and lower academic performance, all of which are common indicators of impaired sleep.

Conclusions: Further research in the area of Indigenous children's sleep quality is likely to play a significant part in 'Closing the Gap' between Indigenous and non-Indigenous children's health, academic performance and social outcomes.

Keywords: Indigenous, Children, Sleep, Health, Behaviour.

Introduction

The wellbeing of Australian Indigenous children has long been an issue of concern, primarily due to the high prevalence of health problems and poor academic outcomes compared with non-Indigenous children. Recent findings on the sleep of Indigenous children suggest that this group may also be encumbered with a higher prevalence of sleep problems. A growing body of literature on physiological (with a physical aetiology) and behavioural (with a non-physical aetiology) sleep problems in children demonstrate strong associations with secondary deficits in academic performance, attention, emotional regulation and behaviour. However, the number of studies on the sleep of Indigenous children and possible secondary performance measures is limited to only a few.

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Summary of sleep data on Indigenous children

Asthma and sleep

In general, childhood asthma is common among Australian children with reported prevalence rates of between 14% to 16% [1]. Indigenous children experience a greater prevalence of asthma with 14% to 28% reported in different regional areas [2]. Although the populations of Indigenous and non-Indigenous children differ in their regional distribution, not all of the disparity in the rates of asthma can be attributed to location. Specifically, asthma has been reported to be more common among Indigenous children than non-Indigenous children even in the same urban environment (24% vs. 15% respectively) [3]. In non-Indigenous children with asthma, secondary sleep disturbance is a commonly reported complaint. Within a 1-month period, 48% of sufferers reported sleep disturbance due to asthma, and of these, almost a third reported sleep disturbance at least three or more nights per week [4, 5]. However, with only a few studies to review, the possible relationship between asthma and sleep disturbance in Indigenous children is yet to be fully explored.

Sleep disordered breathing

Asthma has similar features to a range of conditions known under the umbrella term of 'sleep disordered breathing'. Sleep disordered breathing ranges from primary snoring to obstructive sleep apnoea, and can be accompanied by nocturnal hypoxaemia [6]. Childhood sleep disordered breathing is associated with not only physiological and general health effects, but also neuropsychological and psychosocial effects on development, behaviour, mood and learning [7, 8]. Asthma and sleep disordered breathing are linked because of common risk factors that promote airway inflammation and/or disturbed neuromuscular control of breathing [9]. Valery et al. (2004), who examined the prevalence of comorbid sleep disordered breathing and asthma among 1650 Indigenous children (0-17 years), reported a prevalence rate of 14.2% [10] compared with 10.5% in non-Indigenous pre-school children [11] and 15.2% in non-Indigenous primary school aged children [12]. Valery et al. further reports that 6% of Indigenous children had restless sleep occurring two or more nights per week during the last 6 months, although the cause of sleep disturbance was not examined further [10]. It can be assumed that some degree of sleep disturbance would be associated with both asthma or sleep disordered breathing, as reported in the non-Indigenous paediatric population [2, 3, 10], however, the association between these conditions and their impact on sleep remain to be explored in Indigenous children.

Obesity and sleep

The increasing incidence of obesity among the Indigenous population of Australia is of concern [13, 14], particularly the increasing rates of obesity among Indigenous children [15, 16]. Indigenous children (aged 6-11 years) are 1.4 times more likely to be obese than their non-Indigenous peers, whilst in Indigenous 15-19 year olds, the likelihood of obesity increases to 2.6 times [17, 18]. A recent study on Indigenous children in remote communities found that approximately 20% were overweight with approximately 5% were defined as obese [15]. Even among this population, there are sub-groups where the prevalence rates of obesity are outstanding. For example, 46% of youths residing in the remote Torres Strait region are obese [19].

Obesity is also a risk factor for sleep disordered breathing due to the structural changes that fat deposits produce in the mechanisms of the upper airway [9]. In a study on adult subjects, Horner et al. (1989) reports that fatty infiltration of upper airway structures caused upper airway narrowing, while subcutaneous fat deposits in the anterior neck region and other cervical structures exert forces that promote pharyngeal collapse [20]. Among obese children, there is also strong evidence to suggest that structural differences in upper airway dimension in combination with large tonsils and adenoids can make airway obstruction a significant concern [21].

While obesity is known to promote sleep disordered breathing, reduced sleep duration independent of breathing problems has also been reported to contribute to excessive increases in body weight. Gupta, Mueller, Chan et al. (2002) study found that obese adolescents experienced less sleep than non-obese adolescents and that for each hour of lost sleep, the odds of obesity increased by 80% [22]. Taheri (2006) reported associations between short sleep duration and excess body weight in all age groups and that this association was more pronounced in children [23]. Van Cauter and Knutson's (2008) review of evidence from laboratory and epidemiological studies on children and young adults indicate that chronic partial sleep loss may increase the risk of obesity and weight gain [24]. Finally, Mamum, Lawlor, Cramb et al's (2007) study, using birth cohort data of children born between 1981 and 1983, found that children who had sleeping problems at ages 2-4 years were more likely to have a greater BMI and a higher prevalence of obesity compared to those who had not had sleeping problems [25]. In summary, sleep appears to be strongly associated with non-Indigenous child and adolescent obesity, and may to contribute to the rates of obesity among Indigenous children.

Diabetes and sleep

Indigenous Australians experience a disproportionately high rate of diabetes when compared to the non-Indigenous communities [26], with recent reports showing an increasing incidence of type



2 diabetes among Indigenous children and adolescents [27-29]. The determinants of type 2 diabetes are complex, though obesity, physical inactivity, genetic predisposition and socioeconomic status have been noted [30]. Similarly, Indigenous children with type 2 diabetes typically have a family history of diabetes and are overweight or obese, and may have indicators of hyperinsulinism such as 'acanthosis nigricans' which is a hyperpigmentation of the skin usually found in body folds [28].

There is a growing body of research demonstrating associations between diabetes and sleep quality. In adults, findings show that reduced slow wave sleep (EEG defined high amplitude-low frequency waveform) is associated with poor glucose maintenance and lower insulin sensitivity [31, 32]. In fact, according to Perfect (2010), inadequate sleep quantity, anomalies in sleep architecture, sleepiness and sleep disordered breathing all contribute to morbidity in individuals with diabetes [33]. In a later study by Perfect et al. (2010) on non-Indigenous diabetic adolescents, greater sleep disturbance was related to higher glucose levels with diabetic adolescents experiencing a lower percentage of slow wave sleep than non-diabetic adolescents [34]. Further, sleepiness and poor sleep habits in diabetic adolescents were related to lower quality of life scores, depressed mood, poor academic performance and lower reading scores. Consequently, Perfect et al. suggests that sleep be routinely assessed as part of a diabetes management program.

Mental health and sleep

At present, there is a lack of literature examining the relationships between mental health and sleep behaviour in Indigenous children. In studies on non-Indigenous children, disruptions in the organisation of the sleep-wake cycle may represent possible early markers of emerging psychopathology [35]. Among 5 to 12 year olds, measures of anxiety were found to be related to sleep problems such as sleep-onset delay, enuresis, and subjective daytime sleepiness [36]. Equally, children and adolescents who report sleep difficulties were also more likely to report symptoms of anxiety [37] showing a bi-directionality between the two conditions. In a study of children and adolescents with anxiety disorders (i.e., generalised, separation, and social anxiety), 88% were found to have at least one sleep problem, whereas the majority (55%) demonstrated having at least three or more sleep problems. The total number of sleep problems were also found to be positively associated with the severity of the anxiety and further, the degree of interference in the child's family functioning [38].

Among non-Indigenous children and adolescents, there are also strong relationships found between sleep problems and depression. Two thirds of depressed children suffered from sleep-onset and sleep maintenance insomnia, and half of the children with endogenous-type depression report insomnia [37]. Adolescents who report sleep difficulties are significantly more likely to report symptoms of depression, anxiety, tension, lethargy, irritability, poor self-esteem, daytime stress, worry, negative thoughts, and emotional lability and are more likely to consume nicotine, caffeine and alcohol as adults [39-42]. Furthermore, sleep dysregulation is the most prevalent symptom of major depression in adolescents [13], [43-45] particularly in adolescent males [46, 47] with adolescent males also more likely to report symptoms of depression [48-50]. While it is unclear whether sleep deficits induce depression or vice versa, what is clear is that the mental health status reported by young people is significantly worse under conditions of sleep loss, and furthermore, have been reported to improve after their sleep problems have been resolved [51]. Therefore, the contribution to the mental health of young people through amelioration of sleep disturbance should not be discounted [52], and in fact should be actively pursued.

Research studies focused on the sleep of Indigenous children

As noted above, sleep disorders with a physiological aetiology are common in Indigenous children. Sleep disorders with a nonphysiological aetiology have also been implicated with daytime consequences in Indigenous children. Blunden and Chervin (2010) investigated parental report data on the sleep of 25 Indigenous and 25 non-Indigenous children (aged 7-11 yrs) from six Northern Territory primary schools. Sleep duration was similar between groups, but in terms of sleep quality, 32% of Indigenous children report behavioural sleep problems (poor sleep habits and poor sleep hygiene), 20% had sleep wake transitional problems and 20% report having excessive daytime sleepiness that reached clinical cut-off scores on the Sleep Disturbance Scale for Children [53, 54]. Whilst behavioural sleep problems of initiating and maintaining sleep, and/or parasomnias were commonly reported in both groups, Indigenous children under 9 years old reported the most problems with significantly higher scores on sleep-wake transition problems, total sleep problems and a tendency for increased excessive daytime sleepiness. In addition, this study measured the potential impact of reduced sleep guality on behavioural deficits and academic performance. Significant relationships were detected between sleep quality and externalised behaviours such as aggression, and internalised behaviours such as withdrawn behaviours and thought problems, particularly among Indigenous children [53]. Despite this trend of interest, no between group differences were found in parental reports of academic performance. Given the lack of difference in sleep duration between Indigenous and non-Indigenous children, the authors suggest that differences in sleep quality rather than sleep duration merit further examination.

In a later study, Blunden and Camfferman (2012) used self-report questionnaires to examine sleep quantity, sleep quality and related health data from 19 Indigenous children and 49 non Indigenous

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children, (age range 9-15 years) from a remote rural South Australian area school at Cooper Pedy [55]. This study reports that Indigenous children had significantly (p <0.05) less Total Sleep Time (M = 9hrs:36mins, SD = (2hrs: 05mins) before a school day compared to non-Indigenous children (M = 9hrs:52mins, SD = (1hr: 22mins). Furthermore, Indigenous children reported poorer sleep quality. One component of poor sleep quality is the variability in bedtimes and wake-up times [56] which has been assessed in non-Indigenous children. Biggs et al. (2011) used parental report in a community sample of 1622 non-Indigenous Australian children (aged 5-10 years) and found that inconsistent sleep schedules, particularly changes to bedtimes and wake times, were associated with daytime performance deficits in non-Indigenous Australian children [56]. They found that children who had a bedtime and wake-up time variability of > 60min during the week, significantly increased the risk of problematic behaviour, notably, Internalising, Hyperactive and Total Problem scale scores on the Child Behaviour Checklist [57]. Indeed, Blunden and Camfferman's (2012) study with Indigenous children reported similar findings. They recorded the variability in Indigenous and non-Indigenous bedtimes in 30 minutes increments, up to 3 hours. The higher the rating, the more variability in bedtimes and wake-up times (range 1-5). Indigenous children had significantly more variability in wake-up times during the school week, with greater incremental differences in their wake times compared to non-Indigenous children, [4.8(3.6) vs. 2.69 (2.5), F(1,52)=4.88, p =.032], respectively. Interestingly, among Indigenous children, less total sleep time before a school day was related to less stable bedtimes before a school day (r2 = .85, p = .00) [55]. Whilst, it is important to note that subjective, questionnairebased studies, such as these, are subject to self-report bias, they begin to assist us in understanding sleep wake patterns in Indigenous children.

Indeed, all of the above studies were undertaken using subjective measures, either through the children themselves or parental report. However, Cooper, Kohler and Blunden (2012) assessed the sleep of 21 Indigenous children (aged 6-13 years) from a remote community near Katherine, in the Australian Northern Territory, utilising an objective sleep measure, (an Actiwatch, a watch like device than can estimate sleep duration). In addition neurocognitive testing was undertaken using the Wechsler Individual Achievement Test and the NEuroloPSYcological Assessment-I & II (NEPSY & NEPSY II) [58] which measured domains of learning, and literacy. Poor sleep quality, as shown by lower sleep efficiency (actual time asleep while in bed) and greater nocturnal movement, were both found to be associated with reduced reading ability (r2 = .50 and r2 = -.52respectively). Sleep fragmentation was also found to be strongly associated with reduced reading ability and numerical skills (r2 = -.62 and $r^2 = -.47$, respectively). Interestingly, no significant associations were found between Total Sleep Time and academic and executive performance measures, but the association between reduced sleep quality and neurocognitive deficits were prominent features of concern.

Conclusion

In conclusion, Australian Indigenous children experience a higher prevalence of asthma, sleep disordered breathing, obesity and diabetes. All of these conditions are known to either reduce sleep quality or be exacerbated by poor sleep. Sleep quality is also reported to have a strong relationship with common mental health problems in non-Indigenous youth, and is also likely to play a part in the mental health of Indigenous children. The few studies undertaken on Indigenous children's sleep suggest that rather than the amount of sleep, the broad concept of sleep quality (e.g. sleep scheduling, sleep fragmentation) is more of an issue for these children than their non-Indigenous peers, and further, that it impacts on their daytime performance and behaviour.

If future studies are to evaluate sleep in these children in order to understand how better sleep health can contribute to overall health and wellbeing, we need to consider what factors need to be taken into account. Accordingly, the authors of this commentary will provide a companion paper outlining relevant issues and methodological considerations to measure the sleep behaviour of Australian Indigenous children.

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able 1: A list a publications on the sleep and related academic and behavioural performance in Australian Indigenous children.
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Title	Year & Author	Aim	Method	Subjects and age mean	Sleep results	Behaviour & academic
				(S.D)		performance results
Snoring and its association with asthma in Indigenous children living in the Torres Strait and Northern Peninsula Area [4]	(2004) Valery P.C., Masters I.B. & Chang A.B.	To examine the prevalence of snoring among Indigenous children and adolescents with asthma symptoms and relate its association to sleep disordered breathing.	Parental report through structured interview based on a standardized questionnaire	1650 children, aged 0-17, were included in the study from five randomly selected communities in the Torres Strait region.	Overall, the prevalence of snoring was 14.2% (95 Cl 12.5-15.9); snorting was 3.6% (Cl 2.7-4.6), and 6% (Cl 4.9-7.2) reported restless sleep. Snoring was higher in males than females (17.1% vs. 10.8%, p=0.005)	N/A
The burden of asthma in children: an Australian perspective. [3]	(2005) Poulos L.M., Toelle B.G. and Marks G.B.	To review the incidence and outcomes of asthma in Australian children	Review of meta data.		Urban Indigenous children were found to experience a greater burden of asthma than other children. More than one third of children with asthma have sleep disturbance due to the illness.	60% have missed school and/or experienced other restrictions in their activities due to the disease
Sleep, performance and behaviour in Australian Indigenous and non-Indigenous children: An exploratory comparison.[15]	(2009) Blunden S. & Chervin R.D.	To investigate sleep in Indigenous children and potential associated deficits in behaviour and academic performance.	Parental report via Questionnaire; The Sleep Disordered Scale for Children, Child Behaviour Checklist	25 Indigenous children aged 8.8yrs (1.4) compared to 25 non-Indigenous children aged 9.0yrs(1.5) from urban primary schools in the N.T.	Among Indigenous children behavioural sleep problems 32%, sleep wake transitional problems 20% and excessive daytime sleepiness 20%.	Behavioural sleep problems of initiating and maintaining sleep, or parasomnias were commonly reported in both groups (24-40%), with Indigenous children under 9yrs old 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. Such as more externalised behaviour, specifically, more aggression, and more withdrawn behaviours, thought problems and internalised behaviours

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Sleep and	(2012) Cooper	To assess the	Actigraphy for	21 children	Average time in bed	Reduced academic
academic	P, Kohler M. &	sleep of remote	two consecutive	from a remote	9.6hrs (59.2min).	performance and auditory
performance	Blunden S.	Indigenous	nights, reported,	Australian	Average sleep time	attention compared to
in Indigenous		children and	Wechsler Individual	Indigenous	8.78hrs (49.6min)	non-Indigenous norms.
Australian		examine the	Achievement Test,	community,		Sleep duration was
children from		relationship	NEuroloPSYcological	(aged 6-13 yrs)		not associated with
a remote		between sleep	Assessment-II)			performance measures.
community: an		disruption and				Sleep fragmentation was
exploratory study.		both academic				associated with reduced
[16]		performance				reading and numerical
		and executive				skills.
		function.				
Sleep patterns	(2012) Blunden S.	To compare	Self-report	19 Indigenous	Less sleep on a school	Wake time stability was
of Indigenous vs.	& Camfferman D.	the sleep of	Questionnaire	children and 49	day for Indigenous	related to reduced leisure
no Indigenous		Indigenous and		non-Indigenous	children compared	activity.
children in a rural		non-Indigenous		children, (age	to non-Indigenous	
setting. [9]		children in		11.6 (2.1yrs)	children which could	
		a remote		range 9-15yrs	potentially equate	
		community		from a remote	to 100 minutes	
				South Australia	less TST per week.	
				school at Cooper	Indigenous children	
				Pedy.	had significantly less	
					stable wake up times	
					on school days with a	
					larger distribution of	
					wake times before a	
					school day. Less TST was	
					related to less stable	
					sleep times.	







The Australian Indigenous Health*Bulletin* (ISSN 1445-7253) is the electronic journal of the Australian Indigenous Health*InfoNet*.

The purpose of the Australian Indigenous Health*Bulletin* is to facilitate access to information of relevance to Australian Indigenous health. Reflecting the wide range of users – policy makers, service providers, researchers, students and the general community – the Health*Bulletin* aims to keep people informed of current events of relevance, as well as recent research. Research information is provided in two ways – the publication of original research and the presentation of abstracts of research published or presented elsewhere.

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