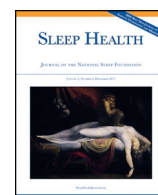




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Sleep schedules and school performance in Indigenous Australian children

Sarah Blunden, PhD^{a,*}, Chris Magee, PhD^b, Kelly Attard, BA (Hons)^a, Larissa Clarkson, PhD^c, Peter Caputi, PhD^d, Timothy Skinner, PhD^e

^a Central Queensland University, 44 Greenhill Rd, Wayville, Adelaide, South Australia, 5087, Australia

^b University of Wollongong, South Western Sydney Campus, 33 Moore St, Liverpool, New South Wales, 2170, Australia

^c Australian College of Applied Psychology, Level 10 123 Lonsdale St, Melbourne, Victoria, 3000, Australia

^d School of Psychology, University of Wollongong, Wollongong, New South Wales, 2522, Australia

^e Charles Darwin University, Ellengowan Dr, Casuarina, Northern Territory, 0810, Australia

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ABSTRACT

Background: Sleep duration and sleep schedule variability have been related to negative health and well-being outcomes in children, but little is known about Australian Indigenous children.

Methods: Data for children aged 7–9 years came from the Australian Longitudinal Study of Indigenous Children and the National Assessment Program–Literacy and Numeracy (NAPLAN). Latent class analysis determined sleep classes taking into account sleep duration, bedtimes, waketimes, and variability in bedtimes from weekdays to weekends. Regression models tested whether the sleep classes were cross-sectionally associated with grade 3 NAPLAN scores. Latent change score modeling then examined whether the sleep classes predicted changes in NAPLAN performance from grades 3 to 5.

Results: Five sleep schedule classes were identified: normative sleep, early risers, long sleep, variable sleep, and short sleep. Overall, long sleepers performed best, with those with reduced sleep (short sleepers and early risers) performing the worse on grammar, numeracy, and writing performance. Latent change score results also showed that long sleepers performed best in spelling and writing and short sleepers and typical sleepers performed the worst over time.

Conclusions: In this sample of Australian Indigenous children, short sleep was associated with poorer school performance compared with long sleep, with this performance worsening over time for some performance indicators. Other sleep schedules (eg, early wake times and variable sleep) also had some relationships with school performance. As sleep scheduling is modifiable, this offers opportunity for improvement in sleep and thus performance outcomes for these and potentially all children.

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Background

Australian Indigenous children have poorer health than non-Indigenous Australian children.¹ For example, the incidence of diabetes,² obesity,³ asthma, and sleep disordered breathing^{4,5} is greater in Indigenous than in non-Indigenous children. Secondary deficits including sleep disturbance often occur concurrently with these health conditions.^{6–10}

Indigenous children also have poorer academic outcomes compared with non-Indigenous children. A number of contextual and socioeconomic factors may underlie the differences in educational

outcomes for Indigenous Australian children, including English not being the primary language in remote communities,¹¹ low school attendance rates,¹² lack of culturally appropriate learning environments, and lack of educational resources.¹¹

Sleep quality—which encompasses sleep continuity, how rested an individual feels upon waking, and how alert they are during the day¹³—could have important implications for educational outcomes in Indigenous children. Existing research has indicated that various indicators of poor sleep quality are associated with cognitive outcomes in children. For example, Astill et al conducted a meta-analysis of 96 studies encompassing 35,936 children and found that sleep duration was significantly associated with cognitive performance. Dewald et al (2010) conducted a meta-analysis of 26 studies and found that sleep duration ($r = .07$), perceived sleep quality ($r = .10$), and sleepiness ($r = -.13$) were significantly associated with

* Corresponding author at: Central Queensland University, 44 Greenhill Rd, Wayville, South Australia, 5034, Australia.

E-mail address: s.blunden@cqu.edu.au (S. Blunden).

school performance. Other studies report that other components of sleep quality (eg, late bedtimes, irregular sleep patterns) predict poorer cognitive functioning and school performance, and behavioral problems in children.^{14,15–17,18}

There is a paucity of literature reporting the state of sleep health and frequency of sleep problems in Australian Indigenous children and even less on potential relationships between sleep and educational outcomes in Indigenous children. Available studies show that Indigenous children with fragmented and less efficient objectively measured sleep have reduced reading ability and numerical skills.¹⁹ Furthermore, poorer self-report sleep quality is associated with increased aggression, whereas later bedtimes are negatively associated with school attendance.^{20,21} A major limitation of these studies is they included only a small number of Indigenous children (eg, $N = 25$). In addition, studies have not investigated whether other components of sleep quality, such as variable bedtimes, have implications for daytime functioning in Indigenous children.

The present article investigated whether sleep quality is associated with educational and learning outcomes in Indigenous Australian children. This represents an important area of research given the urgent need to address the educational disparities facing Indigenous Australians.²² The Footprints in Time data from the Longitudinal Study of Indigenous Children provide the unique opportunity to examine whether sleep quality is related to educational and academic outcomes. We focused specifically on sleep schedules (bedtimes, waketimes, bedtime regularity, and sleep duration) given their potential importance to school outcomes and available evidence indicating that Indigenous children have more disrupted sleep schedules compared with non-Indigenous children. Rather than investigating these variables independently, we used a person-centered approach (latent class analysis) to investigate (1) whether there were distinct sleep schedule subtypes (subsequently referred to as *classes*) and (2) whether these classes had differing associations with school performance. Person-centered approaches have rarely been applied in the context of sleep, although a recent study of non-Indigenous Australian children indicated 6 distinct sleep quality classes that were associated with health-related quality of life.^{23–26} A person-centered approach could provide important insights into the nature of sleep schedules in Indigenous children and their implications for school performance.

Participants and method

Participants

This article utilized data from the Longitudinal Study of Indigenous Children (LSIC), a longitudinal cohort study in Australia that is conducted by the Department of Social Services. This study commenced in 2008 and follows a cohort of children aged 6–18 months at baseline (B cohort) and a cohort of children aged 3.5–5 years at baseline (K cohort). These cohorts were recruited using a 2-stage clustered sampling design. First, 11 sites across Australia (3 in New South Wales, 2 in Victoria, 3 in Queensland, 1 in South Australia, 2 in Northern Territory) covering remote, regional, and urban locations were selected. Second, purposive sampling was used to recruit participants within each site from lists provided by Centrelink and Medicare Australia.

The first wave of data occurred in 2008, and follow-up data have been collected annually. In this article, we restricted the sample to the older K cohort because children in the B cohort were too young to have data on school performance (see details on National Assessment Program–Literacy and Numeracy [NAPLAN] below). We examined sleep schedule and school performance data from Wave 5 when the children were in grade 3, and grade 5 school performance data from Wave 8. The retention rate between Waves 4 and 5 was 85.5%, with 71.8% of the sample having been retained between Waves 1 and

5. Ethics clearance for the LSIC was obtained from the Australian Government Department of Health Departmental Ethics Committee.

Measures

Sleep schedules

Parents reported the time their child normally went to bed on a school night (school night bedtime), the time they normally woke up (school night waketime), and their sleep duration (school night sleep duration). This sleep duration estimate from parents and caregivers was used for analyses. For most children, there was no difference between reported sleep duration and sleep duration extracted from waketime–bedtime. For some sleep classes reported below, the bedtimes and waketimes do not align perfectly with estimated sleep duration, although these differences were only minor (eg, within 5 minutes). This is important for interpreting Table 2. Parents also indicated the time their child normally went to bed on a weekend night (nonschool bedtime). All of the sleep schedule variables were assessed on an interval scale. The exception was nonschool bedtime whereby parents could respond on an interval scale or indicate that their child's weekend bedtime “depends on time/length of daytime nap” or that they had “no regular bedtime.”

We estimated variability in bedtimes between a school night and nonschool night. For children who provided relevant data, we estimated variability by subtracting nonschool night bedtimes from school night bedtimes. These data were split at the median to create 2 bedtime variability categories (<60 minutes and ≥60 minutes) that are consistent with previous studies in non-Indigenous children.²⁷ For the remaining children (ie, those who indicated that their bedtimes varied on a nonschool night), we created an additional, third category: irregular bedtimes.

National Assessment Program–Literacy and Numeracy

In May each year, all Australian children in grades 3, 5, 7, and 9 undertake standardized tests (NAPLAN) that assess 4 domains of literacy and numeracy: reading, writing, language conventions (spelling; grammar, and punctuation), and numeracy. The NAPLAN tests are developed collaboratively by the Australian Curriculum, Assessment and Reporting Authority, Australian state and territory governments, the nongovernment school sector, and the Australian government.²⁸

Wave 5 of the LSIC includes grade 3 NAPLAN scores (K cohort only), whereas Wave 8 includes grade 5 NAPLAN scores. In these NAPLAN tests, reading was assessed by asking students to read a series of passages (eg, magazine articles) and answer a series of multiple-choice questions relating to the content and meaning of those passages. Language is assessed by showing students a series of sentences with incorrectly spelled words or words missing, and either providing correct spelling of the word or selecting an appropriate word to fill the gap. Numeracy is assessed via a series of multiple-choice questions involving arithmetic and numerical problem solving. Finally, writing is assessed by providing students with a prompt (eg, a statement) and requiring them to write a response that expresses and justifies a position, and draws an appropriate conclusion on each NAPLAN test. NAPLAN tests are scored so that a given score reflects the same level of achievement over time.

Covariates

Covariates included child sex, number of people living in a household (household size), family type (coded as single parent/guardian vs dual parent/guardian), maternal work status (coded as employed or not employed), and maternal education (coded as <high school, high school, or tertiary qualification). The presence of child sleep problems (yes vs no) was derived from a question asking parents whether their child experienced any difficulties sleeping. We examined neighborhood socioeconomic status using the Socio-Economic

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