Sleep problems in the first year of elementary school: The role of sleep hygiene, gender and socioeconomic status

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ABSTRACT

Objectives: To determine (1) the relationship between sleep hygiene practices and parent-reported child sleep problems in students in the first year of elementary school, (2) whether the relationship differed by (a) gender and (b) SES and (3) in a multivariate explanatory model.

Design: Cross-sectional survey of a population-based sample.

Setting: Forty-five elementary schools in metropolitan Melbourne, Australia.

Participants: Families of children aged 4–6 years in the first year of elementary school in Melbourne, Australia.

Measurements: Exposures: Parent-reported child sleep hygiene, gender and data linkage to community-based disadvantage. Outcome: Parent-reported child sleep problems. Analyses: Logistic regression models were used to examine each aim.

Results: Of 6635 approached parents, 4901 (74.30%) participated. In the final model, using audio devices at bedtime was associated with increased risk of child sleep problems (OR 2.12, 95% CI 1.60, 2.81) as was an inconsistent bedtime routine on school nights (OR 2.52, 95% CI 1.76, 3.60) and non-school nights (OR 1.66, 95% CI 1.09, 2.55). Boys with an inconsistent bedtime routine on non-school nights had a higher risk (OR 2.07, 95% CI 1.49, 2.88) than girls (OR 1.61, 95% CI 1.15, 2.28). SES was not associated with sleep problems.

Conclusion: Inconsistent bedtime routines and audio device use were each associated with an increased risk of parent-reported sleep problems. Associations did not differ based on SES but did for boys and girls in terms of inconsistent bedtimes on weekends. Behavioral sleep interventions targeting sleep hygiene could have similar benefits for all children, regardless of socio-economic status.

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Introduction

Up to 40% of Australian children transitioning from preschool to elementary school experience a parent-reported sleep problems,[1] which can negatively affect their subsequent academic, behavioral and health trajectories.[1–3] Therefore, understanding the etiology of sleep problems during this period could inform whom and what aspects sleep interventions during the early years of school should target.

Research suggests that sleep hygiene practices, such as consistent bedtimes, bedtime routine and use of electronic devices, are associated with sleep problems in school-aged children.[4–9] However, some inconsistencies in findings remain which may be related to small sample sizes but also studies only focusing on select aspects of sleep hygiene, as opposed to all key components which are often targeted in clinical practice and sleep health messages. For instance, there is limited research, which has been able to concurrently examine whether the presence of electronics in the bedroom or its use before bedtime are associated with increased child sleep problems. In addition, a recent review by Carter et al[10] highlighted that it is not known how different types of media (i.e. TV, video games, audio devices) may be differentially associated with child sleep problems. Furthermore, although it is accepted that sleeproutines and timing may vary between school and non-school nights,[11] little research has examined the extent to which sleep timing on school and non-school nights is associated with increased sleep problems. For instance, parents may be less likely to report a child sleep problem if the child's weekend sleep patterns do not impact on the parent's sleep or the family's planned activity. It could also reflect parental differing expectations between school and non-school nights, with regular bedtime

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routines present on school nights but not on non-school nights. In contrast, parents may be more likely to report their child has a sleep problem if the sleep pattern on school night impacts on the parent's outcomes, such as their ability to arrive at work on time.[12]

Another important consideration when examining aspects of daily habits that may impact on child sleep problems is whether there are any differences by gender or socio-economic status (SES). For instance, boys are more likely to experience sleep problems and poor sleep hygiene practices than girls[13–15] along with poorer sleep hygiene practices and sleep problems being more prevalent in children from lower SES backgrounds.[16–18] However, evidence for the associations between sleep problems and gender and SES are inconclusive due to different measures of sleep problems and sleep hygiene practices and wide age range sampling. There is a paucity of research sampling children in the early years of school when poor sleep may adversely impact on a successful school transition. In particular, how well children transition to school has been shown to be predictive of later school achievement, engagement and well-being outcomes.

Despite research showing associations between different aspects of sleep hygiene and child sleep problems, there are few population level findings that have evaluated the association between gender, SES, and sleep hygiene practices with the sleep problems in a single model. This is despite etiological models suggesting that sleep problems in young children arise due to interactions between multiple factors such as gender, SES, and sleep hygiene. This study addresses this gap using a community-based sample of Melbourne children in their first year of school to examine:

1. The relationship between sleep hygiene practices (consistency of bedtime, consistency of pre-bedtime routine, electronics in the bedroom, and use of electronics at bedtime) and child sleep problems;
2. Whether the relationship between sleep hygiene practices and sleep problems differ by (a) child gender or (b) SES; and
3. The relationship between sleep hygiene practices, gender, SES and child sleep problems in a single explanatory model.

Method

Study design

This study uses baseline data from the Sleep Well - Be Well study conducted at the Murdoch Childrens Research Institute.[19] Participants were recruited from the first year of elementary school in Victoria, Australia during 2013 and 2014. The first year of school is commonly known as Grade Prep. All schools were from the Southern Region of Metropolitan Melbourne, as defined by the Victorian Department of Education and Training. This region is the largest of four in metropolitan Melbourne, servicing more than 14,000 new school entrants annually from diverse socio-economic and cultural backgrounds.

Schools were invited to participate in 2013 using a randomly ordered list generated by an independent statistician in the Clinical Epidemiology and Biostatistics Unit at the Royal Children's Hospital, Melbourne. This list was stratified by school type i.e. Government or Catholic. Parents of each child at the participating schools were approached to complete the study. Overall, 47 primary schools (Government n = 36, Catholic n = 11) agreed to participate, with 32 schools participating in both 2013 and 2014, with one schools only participating in 2013 and 14 in 2014. The schools participating only in 2014 were recruited due to ensure the required sample size for the main trial was still achieved. In 2013, there were 26 Government and 7 Catholic schools whilst there were 36 Government and 10 Catholic schools in 2014.

Research measures

Sleep problem (outcome)

Child sleep problems were defined using the parent-report question: *"How much is your child's sleeping pattern or habits a problem for you? (i.e. problems going to sleep or waking overnight)".*[20] Parents were required to indicate whether their child's sleep was a *large problem*, a *moderate problem*, a *small problem*, *no problem at all* or *not sure/don't know*. Responses were dichotomized with a sleep problem defined as those who had a large/moderate problem, and no sleep problem defined as those who responded small/no. Not sure/don't know responses were coded as missing. This approach aligns with previous longitudinal and intervention research,[1,21,22] which has demonstrated differences in child and parent well-being outcomes based on these categories.

Consistent bedtime routine and bedtimes

Bedtime routine on school nights and non-school nights was assessed using the question: *"On school nights and non-school nights, does your child follow a set routine in the hour before bedtime (e.g., bathe, brush teeth, read/listen to a story, go to bed)?"* Likewise, consistency of bedtime on school nights and non-school nights was assessed using the question: *"On school nights and non-school nights, does your child go to bed around the same time (within 10 minutes each night) each night?"*

For both questions, parents were required to respond using a 5-point Likert Scale from *almost never* to *nearly always* for school nights and non-school nights separately. Responses were dichotomized into "inconsistent routine" (almost never and occasionally) and "consistent routine" (half the time, often, and nearly always). This dichotomy aligns with current research approaches which define a consistent routine as being sleep behaviors as occurring for the majority of the week.

Bedtime electronics to fall asleep

Bedtime electronic use was measured by parent-report, with possible responses being their child falls asleep (i) watching television, (ii) playing a computer game, (iii) playing a game system (i.e., Xbox, Wii, Nintendo DS), (iv) using a mobile phone or (v) listening to an audio device (music or audio book); by marking all that apply or indicating *none of the above* or specifying an alternative activity. In the 2013 screening survey, which applied to 42% of responses, the response to the audio device (music or audio book) category was derived from the free text responses specified in the alternative activity option. Three research assistants independently categorized the free text responses. In 2014, the audio device option (v) was added to the screening survey. Sensitivity analyses found no evidence for a difference in the association between sleep problem and listening to an audio device in each survey year and therefore data from both years were combined.

Presence of electronics in the bedroom

Parents indicated whether their child had a television, computer, game system (i.e., Xbox, Wii, Nintendo DS), mobile phone and/or audio device (radio, CD player, iPod) in the bedroom by marking all that apply or indicating *none of the above* or specifying an alternative activity.[20] Three research assistants independently categorized these alternative activities across the predefined categories where appropriate. The response to the 'audio device in the bedroom' option was derived from free text responses using the same approach as above for "Bedtime electronics to fall asleep". Fifty-eight percent of the data was obtained directly from an item in the survey and 42% was determined from classification of free text.

Socio-economic status

Residential postcode was assigned a score ($M = 1000, SD = 100$) according to the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) from the Australian Bureau of Statistics'

census-based Socio-Economic Indexes for Areas (SEIFA).[23] The IRSAD summarizes information about the economic and social conditions of people and households within an area, including both relative advantage and disadvantage measures. Lower scores represent greater disadvantage. Consistent with the Australian Government Department of Industry classification system,[24] IRSAD scores in the bottom 25% quartile were classified as *low*, scores in the middle two quartiles were classified as *medium*, and scores in the top 25% quartile were classified as *high* SES.

Data analysis

To address Aims 1 and 2, Odds Ratios (*OR*), 95% Confidence Intervals (95% CI), and associated *P*-values were estimated from separate univariable logistic regression models fitted between sleep problem and each sleep hygiene variable. To assess whether the association between sleep problem and each sleep hygiene variable differed by gender (Aim 2a), or SES (Aim 2b), an interaction between sleep hygiene variable and either gender or SES was included in the logistic regression model. The *OR*, (95% CI), and associated *P*-values for the association between sleep problem and sleep hygiene variable for each level of gender or SES, were estimated from this model. To evaluate Aim 3, a multivariable logistic regression model was constructed using the Hosmer-Lemeshow, and Sturdivant Seven Step Purposeful Selection Method.[25] Model fit was assessed with a likelihood ratio test between the constant only model and final model, and manually through inspection of the Pearson residuals for each covariate pattern. Statistical analyses were conducted using Stata version 14.[19]

Results

Sample characteristics and missing data

From a total of 6635 parents, 4901 (74.30%) returned surveys (see Fig. 1). Sample characteristics for each study variable are included in Table 1. Sleep problem was missing in 54 (1.1%) children. Children were aged 4 to 8 years (*M age* = 5.7, *SD* = 0.39, *n* = 4862), with 2463 (51%) male (*M age* = 5.7, *SD* = 0.39) and 2409 (49%) female children (*M age* = 5.6, *SD* = 0.38). Age was missing in 39 children and gender in 29 children. In 6.4% of children (*n* = 312), parents
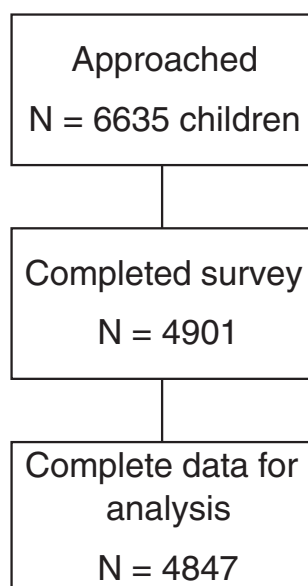
Table 1
Study variable characteristics and missing data

Variable	N (%) N = 4901	Missing *n* (%)
Sleep problem	621 (12.8%)	54 (1.1%)
Electronics in bedroom		
Television or DVD	566 (11.6%)	-
Computer or game system	297 (6.1%)	-
Mobile	78 (1.6%)	-
Audio device	665 (13.6%)	-
Bedtime electronics		
Watching television or DVD	869 (17.7%)	-
Playing computer or game system	92 (6.9%)	-
Mobile	53 (1.1%)	-
Listening to audio device	340 (6.9%)	-
Inconsistent bedtime		
School nights	238 (4.9%)	36 (0.73%)
Non-school nights	586 (12.4)	159 (3.24%)
Inconsistent bedtime routine		
School nights	208 (4.3%)	26 (0.53%)
Non-school nights	513 (10.8%)	148 (3.02%)
Gender (male)	2463 (51%)	29 (0.59%)
ISRAD score		11 (0.22%)
Low	375 (7.7%)	
Medium	2206 (45.0%)	
High	2309 (47.0%)	

reported that their child had previously been diagnosed with a major medical or developmental/behavioral problem.

There was no evidence of a difference between children with and without complete sleep problem data, except children falling asleep with a computer or game may have more missing data (OR = 3.1, 95% CI: 1.0-10.3, *P* = .06).

The relationship between sleep problems and sleep hygiene practices for girls and boys and levels of IRSAD

There was at least moderate evidence of an association between sleep problem and 8 of the 12 sleep hygiene practices (Table 2). The odds of having a sleep problem was highest for children with an inconsistent bedtime on school nights, *OR* = 4.15, 95% CI [3.13 to

Approached

N = 6635 children

Completed survey

N = 4901

Complete data for analysis

N = 4847

Fig. 1. Study cohort.

Table 2
Univariate Logistic Regression Models for Child Sleep Problem

Variable	*OR* [95% CI] N = 4847	*P*
Electronics in bedroom		
Television or DVD	1.37 [1.08, 1.75]	.010
Computer or game system	0.89 [0.61, 1.28]	.524
Mobile	0.79 [0.38, 1.64]	.522
Audio device	1.21 [0.96, 1.53]	.104
Bedtime electronics		
Watching television or DVD	1.55 [1.27, 1.90]	<.001
Playing computer or game system	0.96 [0.51, 1.81]	.897
Mobile	2.01 [1.05, 3.85]	.035
Listening to audio device	2.17 [1.66, 2.84]	<.001
Inconsistent bedtime		
School nights	4.15 [3.13, 5.51]	<.001
Non-school nights	2.98 [2.42, 3.67]	<.001
Inconsistent bedtime routine		
School nights	2.88 [2.11, 3.95]	<.001
Non-school nights	2.13 [1.69, 2.68]	<.001
Gender (male)	0.84 [0.71, 1.00]	.045
ISRAD score		
Low [a]		
Medium	0.98 [0.70, 1.37]	.910
High	1.06 [0.77, 1.48]	.710

Note. Only non-missing data included in analysis. OR = Odds Ratio; CI = confidence Interval; IRSAD = Index of Relative Socio-economic Advantage and Disadvantage[a] comparison group.

Table 3
Logistic Regression Models for Child Sleep Problem for Boys and Girls

Variable	Females		Males		Interaction	
	OR [95% CI]	P	OR [95% CI]	P	OR [95% CI]	P
Electronics in bedroom						
Television or DVD	1.31 [0.93, 1.85]	.12	1.47 [1.04, 2.07]	.03	1.12 [0.69, 1.82]	.65
Computer or game system	1.02 [0.60, 1.73]	.94	0.80 [0.48, 1.34]	.40	0.79 [0.38, 1.64]	.52
Mobile	0.73 [0.26, 2.07]	.55	0.87 [0.31, 2.47]	.79	1.19 [0.27, 5.21]	.82
Audio device	1.24 [0.92, 1.68]	.16	1.14 [0.78, 1.65]	.50	0.92 [0.57, 1.48]	.73
Bedtime electronics						
Watching television or DVD	1.26 [0.95, 1.68]	.11	1.93 [1.45, 2.57]	<.001	1.53 [1.02, 2.29]	.04
Playing computer or game system	1.22 [0.54, 2.76]	.64	0.74 [0.26, 2.08]	.56	0.61 [0.16, 2.27]	.46
Using Mobile	1.80 [0.72, 4.48]	.21	2.25 [0.90, 5.65]	.08	1.25 [0.34, 4.59]	.73
Listening to audio device	2.25 [1.58, 3.19]	<.001	2.00 [1.31, 3.07]	.001	0.89 [0.51, 1.55]	.68
Inconsistent bedtime						
School nights	3.95 [2.65, 5.89]	<.001	4.42 [2.96, 6.61]	<.001	1.12 [0.64, 1.97]	.70
Non-school nights	2.31 [1.71, 3.12]	<.001	3.87 [2.90, 5.18]	<.001	1.68 [1.10, 2.55]	.02
Inconsistent bedtime routine						
School nights	2.86 [1.83, 4.47]	<.001	2.95 [1.89, 4.61]	<.001	1.03 [0.55, 1.93]	.93
Non-school nights	1.82 [1.31, 2.53]	<.001	2.52 [1.83, 3.48]	<.001	1.39 [0.88, 2.20]	.16

Note. Interaction provides a measure of difference in effect of sleep hygiene variable between genders; OR = Odds Ratio, CI = Confidence Interval. Only non-missing data included in analysis.

5.51], $P < .001$. There was weak evidence that males had lower odds of a sleep problem compared to females, $OR = 0.84$, 95% CI [0.71, 1.00], $P = .05$. There was no evidence for an association between sleep problem and SES, as defined by IRSAD.

There was weak evidence that the strength of the association between sleep problems and watching television or a DVD while falling asleep (interaction $P = .04$), and having an inconsistent bedtime on non-school nights (interaction $P = .02$) differed by gender (Table 3). There was little evidence that the association between sleep problems and the sleep hygiene practices differed by level of IRSAD score (interaction $P > .05$ for each factor) (Table 4).

Multivariable model of the relationship between sleep problem and sleep hygiene practices

The adjusted associations between sleep hygiene practices and sleep problem are shown in Table 5. Three sleep hygiene practices were independently associated with sleep problems: use of an audio device while falling asleep and inconsistent bedtime on school and non-school nights. There was evidence that boys were more likely to have inconsistent bedtime on non-school nights than girls. A likelihood ratio test of the full model against the constant only model provided strong evidence ($P < .0001$) that the sleep hygiene practices were associated with sleep problem.

Discussion

Overall, our findings demonstrate that inconsistent bedtime, both on school nights and non-school nights, as well as audio device use, are associated with an increased risk of a parent-reported sleep problem in the first year of elementary school. Interestingly, we found that the associations do not differ based on SES, but there is evidence that boys are more likely to have inconsistent bedtimes on weekends than girls. These findings build upon current research by demonstrating that at a population level, the importance of consistent bedtimes on both school and non-school nights and the limiting of audio devices at bedtime for child sleep problems during the first year of elementary schooling.

Our findings that use of audio devices whilst falling asleep is associated with sleep problems are consistent with findings in adolescents,[26] but not in children of similar age.[27] These differences may be related to the type of music children are listening to, as research suggests that classical music is associated with lower sleep problems while rock music can delay sleep.[28] It is also plausible

Table 4
Logistic Regression Models for Child Sleep Problem for Low, Medium, and High IRSAD

Variable	Low		Medium		High		Interaction
	OR [95% CI]	P	OR [95% CI]	P	OR [95% CI]	P	P
Electronics in bedroom							
Television or DVD	2.01 [1.26, 3.19]	.003	1.23 [0.88, 1.72]	.23	1.22 [0.65, 2.30]	.54	.22
Computer or game system	0.95 [0.46, 1.97]	.88	0.85 [0.50, 1.42]	.53	0.93 [0.44, 1.99]	.86	.96
Mobile	1.00 [0.29, 3.41]	.99	0.74 [0.26, 2.09]	.57	0.59 [0.08, 4.62]	.62	.89
Audio device	0.96 [0.50, 1.83]	.89	1.38 [1.01, 1.89]	.04	1.08 [0.71, 1.65]	.73	.47
Bedtime electronics							
Watching television or DVD	2.30 [1.47, 3.60]	<.001	1.41 [1.07, 1.85]	.01	1.57 [1.01, 2.43]	.04	.18
Playing computer or game system	0.69 [0.16, 3.01]	.62	1.08 [0.51, 2.30]	.84	0.93 [0.11, 7.64]	.95	.86
Mobile	2.13 [0.58, 7.88]	.26	1.92 [0.87, 4.24]	.11	3.28 [0.30, 36.37]	.33	.92
Listening to audio device	2.58 [1.37, 4.83]	.003	2.29 [1.58, 3.32]	<.001	1.78 [1.07, 2.94]	.03	.61
Inconsistent bedtime							
School nights	4.27 [2.23, 8.18]	<.001	4.34 [2.95, 6.38]	<.001	3.80 [2.21, 6.52]	<.001	.92
Non-school nights	3.40 [2.07, 5.59]	<.001	2.75 [2.06, 3.66]	<.001	3.35 [2.27, 4.93]	<.001	.64
Inconsistent bedtime routine							
School nights	1.86 [0.93, 3.75]	.08	3.11 [2.05, 4.73]	<.001	4.02 [2.04, 7.90]	<.001	.27
Non-school nights	1.95 [1.15, 3.30]	.01	2.13 [1.56, 2.89]	<.001	2.46 [1.55, 3.89]	<.001	.79

Note. Interaction = likelihood ratio test comparing model with and without interaction term; OR = Odds Ratio, CI = Confidence Interval; Only non-missing data included in analysis.

Table 5
Multivariable Logistic Regression Model for Child Sleep Problem

Variable	OR [95% CI] N = 4664	P
Listening to audio device at bedtime	2.12 [1.60, 2.81]	<.001
Inconsistent bedtime on school night	2.52 [1.76, 3.60]	<.001
Inconsistent bedtime on non-school night		
Interaction with gender	1.66 [1.09, 2.55]	.02
Girls	1.61 [1.15, 2.28]	.006
Boys	2.07 [1.49, 2.88]	<.001

Note. OR = Odds Ratio, CI = Confidence Interval.

that children with sleep problems are more likely to have an audio device as parents believe this an effective sleep aide by promoting relaxation and reducing anxiety.[29] Therefore, the presence of an audio device may be a marker of sleep problems rather than a cause per se.

Our findings extend previous research which has highlighted the importance of consistent sleep scheduling,[8,30,31] by understanding the concurrent contributions of a broader range of sleep hygiene parameters, such as media use. For example, Biggs et al[8] found that those children whose bedtime varied by more than 60 minutes within a week had poorer behavior and mental health. A similar study by Kelly et al. also highlighted that consistent bedtimes are associated with cognitive ability in 7-year-old children.[31] Our findings demonstrate that inconsistent bedtimes on school and non-school nights are associated with increased risk of having a sleep problem. Interestingly, our results also indicate that having an inconsistent bedtime on non-school nights was associated with greater odds of sleep problems in boys compared with girls. This differential effect may be due to variations in leisure activities, with boys previously shown to be more likely to engage in higher usage of electronic media, which can lead to inconsistent bedtimes.[32] Another mechanism could be that boys are more likely to have sleep problems that manifest in difficulties in having a consistent bedtime, such as bedtime resistance. However, our findings are cross-sectional and therefore unable to infer causality.

This study has several strengths. It is the first population-based study of students in the first year of school to explore a broad range of sleep hygiene factors and their relationship with sleep problems within the same population. The sample was demographically diverse, which enhances the generalizability of our findings. Other studies have predominantly recruited selective samples, focusing on children either exclusively with sleep problems or recruited through sleep clinics. Our findings are consistent across several domains of sleep, which are commonly used in research. We therefore can examine the association based on the child's overall sleep problem, the regularity of their bedtime, and also sleep duration on school and non-school nights.

The main limitation of our study is the use of parent-reported measures, which may lead to an underestimation of child sleep problems.[33] However, parent report of sleep problems is an important predictor of parent motivation for health seeking behavior for the child's sleep problem. In addition, it takes into consideration parental expectations and cultural norms as to what constitutes a sleep problem as opposed to adhering to diagnostic criteria.[34] However, future research could examine whether similar findings are also evidence when using objective measures, such as actigraphy, in a population-based sample. However, there is currently a lack of population-based studies that have used objective measures due to the increased resources required for such studies. Another limitation of our findings is that SES was defined using a community measured derived at the suburb level, as opposed to individual family SES factors which may differ. Finally, the cross-sectional nature of our study is unable to determine causal precedence, which future research could address via longitudinal studies.

Our overall findings highlight the importance of consistent bedtimes on school and non-school nights as well as limiting media use before bedtime to reduce the risk of sleep problems in children starting school. However, it is also important to acknowledge that listening to music has been used clinically as a way to help children relax before bedtime, so further research is required to examine how different types of music may influence children's sleep. Another important gap is how such information is not only communicated to both parents and children, but instigates behavior change where required. Current sleep interventions in elementary school aged children have focused on addressing child sleep problems,[21,35] including those where sleep is a co-morbidity.[22,36] One area where research remains limited is the effectiveness of universal programs that aim to increase parent and student knowledge about what aspects of daily routine and habits can place young children at greater risk of sleep problems. Such programs could help to reduce sleep problems. Given that our findings did not suggest any differences based on family SES, a universal approach may have benefits for a wide population of children. Schools are well-placed to deliver such universal sleep hygiene messages, and have been described as 'a missed public health opportunity'.[37] A universal intervention could include having positive sleep hygiene messages as part of health and well-being classes, or as part of interactions between schools and families. Although such universal interventions have shown promise when targeting adolescents,[38–40] such an approach has not been rigorously tested in younger school-aged populations. Challenges for schools implementing such interventions include feasibility (time, cost) given other curricular requirements and sustainability. Further, such interventions may lead to increased knowledge but whether they also lead to sufficient improvements in sleep hygiene to reduce child sleep problems in the community is not known.

In conclusion, sleep hygiene practices are central to understanding sleep problems in Australian Grade Prep children. These findings could be used to inform the development of intervention and prevention programs, potentially delivered through schools, such that children may have better physical, social, emotional, and cognitive developmental outcomes.

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