

# A Brief Sleep Intervention Improves Outcomes in the School Entry Year: A Randomized Controlled Trial



**WHAT'S KNOWN ON THIS SUBJECT:** Sleep problems are common in school-aged children and might compromise the function of children and parents and contribute to a poor transition to school, which can result in later academic difficulties. Improvement of child sleep through brief behavioral strategies might improve the school transition.



**WHAT THIS STUDY ADDS:** Large-scale screening of new school entrants for sleep problems, followed by a targeted behavioral intervention, was demonstrated to be feasible and was beneficial for short- to medium-term child psychosocial outcomes. Larger effectiveness trials are needed to confirm the public health benefits of these interventions.

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## KEY WORDS

randomized controlled trial, sleep disturbances, school-based program, social-emotional problems, school health

## ABBREVIATION

CI—confidence interval

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## abstract

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**OBJECTIVE:** To determine the feasibility of screening for child sleep problems and the efficacy of a behavioral sleep intervention in improving child and parent outcomes in the first year of schooling.

**METHODS:** A randomized controlled trial was nested in a population survey performed at 22 elementary schools in Melbourne, Australia. Intervention involved 2 to 3 consultations that covered behavioral sleep strategies for children whose screening results were positive for a moderate/severe sleep problem. Outcomes were parent-reported child sleep problem (primary outcome), sleep habits, psychosocial health-related quality of life, behavior, and parent mental health (all at 3, 6, and 12 months) and blinded, face-to-face learning assessment (at 6 months).

**RESULTS:** The screening survey was completed by 1512 parents; 161 (10.8%) reported a moderate/severe child sleep problem, and 108 of 136 (79.2% of those eligible) entered the trial. Sleep problems tended to resolve more rapidly in intervention children. Sleep problems affected 33% of 54 intervention children versus 43% of 54 control children at 3 months ( $P = .3$ ), 25.5% vs 46.8% at 6 months ( $P = .03$ ), and 32% vs 33% at 12 months ( $P = .8$ ). Sustained sleep-habit improvements were evident at 3, 6, and 12 months (effect sizes: 0.33 [ $P = .03$ ]; 0.51 [ $P = .003$ ]; and 0.40 [ $P = .02$ ]; respectively), and there were initial marked improvements in psychosocial scores that diminished over time (effect sizes: 0.47 [ $P = .02$ ]; 0.41 [ $P = .09$ ]; and 0.26 [ $P = .3$ ]; respectively). Better prosocial behavior was evident at 12 months (effect size: 0.35;  $P = .03$ ), and learning and parent outcomes were similar between groups.

**CONCLUSIONS:** School-based screening for sleep problems followed by a targeted, brief behavioral sleep intervention is feasible and has benefits relevant to school transition. *Pediatrics* 2011;128:692–701

Poor sleep (ie, insufficient or fragmented sleep) affects more than one-third of school-aged children<sup>1</sup> and is associated with poorer child and parent outcomes.<sup>2–7</sup> In this age group, the majority of sleep problems are behavioral in nature. For example, in a population sample of 4000 Australian children aged 6 to 7 years, sleep problems such as bedtime resistance and night waking occurred in 16% to 21% of children and were associated with poorer child behavior, health-related quality of life, and learning.<sup>3</sup>

Poor sleep might affect a child's transition to formal schooling because of its effects on all 5 of the core school readiness attributes: (1) child physical health and well-being; (2) social competence; (3) emotional maturity; (4) language and cognitive skills; and (5) approach to learning. School readiness, a concept recognized in many countries including the United States, Canada, and Australia,<sup>8–11</sup> reflects the sum of a child's biology and environmental exposures through the infant and preschool years. Results of longitudinal research suggest that poorer function in these domains can adversely affect later academic and social-emotional outcomes<sup>8</sup> and that both academic and social-emotional trajectories are relatively stable in children from as young as 8 years.<sup>12,13</sup> Nevertheless, nearly a quarter of all Australian children enter school with limitations in their school readiness.<sup>14</sup> The expression of certain attributes, such as child social and emotional skills and approach to learning, can also be affected by immediate factors that have an impact on the child's day-to-day well-being and/or family functioning (including parent mental health). Identification of factors that are readily remediable could optimize children's daily functioning, which might lead to a better transition to formal education. One promising approach is better management of child

sleep problems, because of their very high population prevalence as well as their association with school readiness domains. For example, children with behavioral sleep problems are 2 times more likely to have poor social relationships and 3 times more likely to have emotional problems<sup>15,16</sup> and deficits in scores that reflect language, literacy, and mathematical thinking.<sup>3</sup> In addition, poor sleep is associated with poor parent mental health,<sup>17</sup> which impairs a parent's ability to provide a supportive environment during the school transition period.<sup>18</sup> Moreover, effective treatment might be achieved with the use of brief, parent-oriented behavioral interventions. Behavioral strategies for child sleep problems are accepted by clinicians,<sup>19</sup> and the effectiveness of these strategies in community settings has previously been reported for infants<sup>20,21</sup> and in small clinic-based trials in school-aged children.<sup>22–25</sup>

No trials have examined the benefits of the delivery of such interventions in a targeted population of children who have undergone screening to identify sleep problems.<sup>26,27</sup> We therefore conducted a randomized controlled efficacy trial of a brief behavioral sleep intervention within a population-based framework, which targeted all children in participating schools who had positive screening results for sleep problems in their first year of school. We hypothesized that, compared with control families, intervention families would report fewer child sleep problems; better child health-related quality of life, behavior, and learning; and better caregiver mental health at follow-up assessments performed 3, 6, and 12 months after random assignment to the intervention group.

## METHODS

### Design and Setting

This randomized controlled trial was nested within a population-based sur-

vey used to screen for child sleep problems in children who were new primary school entrants. Ethics approval was obtained from the human research ethics committee at the Royal Children's Hospital, Melbourne, Australia (HREC 27132). Research approval was obtained from the Victorian state department of education and early childhood development, Melbourne, Australia (SOS003739). The components of the study are shown in Fig 1.<sup>28</sup>

### Baseline Screening Survey

Twenty-two government primary schools in metropolitan Melbourne participated. These schools were drawn from 3 local government areas selected for low proportions of students with non-English-speaking backgrounds and an intake of >55 school-entry children. In February through June 2008 and February through March 2009, written questionnaires designed to screen for sleep problems were distributed by school teachers to all parents of children in all new entrant ("prep") classes at these schools.

### Trial Eligibility and Recruitment

Parents were eligible for the trial if they reported that their child had a moderate or severe sleep problem (see "Measures" below). We excluded families with insufficient English to complete the survey and children with likely obstructive sleep apnea, as follows. If the parent chose any of these statements: "Child snores loudly at night," "Child seems to stop breathing during sleep," and/or "Child snorts and/or gasps during sleep," Dr Hiscock (a pediatrician with experience in child sleep problems) called the parents to obtain additional information regarding the symptoms and, if referral to a sleep clinic was deemed necessary, excluded the child from the study

Time point	Intervention	Control
School survey ( <i>n</i> = 1523)		A
RCT recruitment		
RCT enrolment ( <i>n</i> = 108)		B
Randomization		
Intervention week 1	C	
Intervention week 2	D	
Intervention week 3	E	
3-mo postrandomization follow-up	F G	F
6-mo postrandomization follow-up	F H	F H
12-mo postrandomization follow-up	F	F

A	<b>School survey:</b> Sent through schools to caregivers of children in Grade Prep in first 5 mo of academic school year. Measured caregiver report of sleep problems, sleep hygiene and patterns, behavior and health related quality-of-life, primary caregiver mental health, and family demographics.
B	<b>RCT enrollment survey:</b> Sent directly to eligible and interested caregivers from the school survey after contacting via telephone. Measured child attention and hyperactivity behavior problems and child sleep.
C	<b>Individual intervention session (45 min):</b> Held with caregiver at child's school by trained research assistant. Discussed normal sleep requirements for children in this age group. Discussed and provided information about suitable behavioral strategies specific to the child's sleep problem. Caregiver created sleep management plan during the session of suitable strategies discussed (maximum of 3) to improve their child's sleep.
D	<b>Intervention phone call (20 min):</b> Research assistant called caregivers at a prearranged time ~2 wk after individual intervention session to reinforce information provided. Original sleep management plan was reviewed and, if required, minor changes were discussed.
E	<b>Optional second individual session (30 min):</b> Held at child's school with caregivers who requested a more detailed review and revision of their original sleep problem management plan than could be offered during the phone call.
F	<b>Study follow-up survey:</b> Sent directly to randomly assigned caregivers to assess primary and secondary outcomes.
G	<b>Intervention feedback survey:</b> Sent to all intervention families to assess the usefulness and acceptability of the intervention and its components.
H	<b>Child face-to-face assessment (30 min):</b> Conducted with the child at their school during school hours. Assessment consisted of 2 measures of child academic achievement and health related quality-of-life.

**FIGURE 1**  
Graphical representation of the study design. RCT indicates randomized controlled trial.

before random assignment to a study group.

We called eligible families to explain the trial and ascertain interest in the trial. We then mailed a package to the primary caregiver that included detailed study information, consent forms, a more detailed enrollment questionnaire, and a postage-paid reply envelope.

### Randomization and Blinding

An independent statistician produced a computer-generated randomization

sequence to randomly assign the families by using randomly permuted block sizes of 2 and 4 in a nonsystematic sequence. Allocation to the intervention or control trial arm occurred on receipt of a signed consent form and was performed by a researcher not otherwise involved in the study, which ensured allocation concealment. All direct assessment outcomes were collected by researchers who were blind to the trial-arm status. Parents, who reported the questionnaire outcome data, could not be blinded.

### Interventions

Intervention families received a private consultation at their child's school followed by a telephone-based consultation a fortnight later, with a second private consultation after an additional week if requested by the parent. Three research assistants (1 registered psychologist, 1 registered nurse, and 1 trainee psychologist) were trained by Drs Quach and Hiscock for three 2-hour sessions to conduct the intervention. Figure 1 provides details of the intervention program, which involved eliciting a description of the parent's perception of the child's sleep problem and the parent's goals for the child's sleep. Flexible yet standardized behavioral strategies tailored to the child's sleep problem were presented to parents. In addition to being presented with information about age-appropriate normal sleep cycles and given the opportunity to discuss this information, parents were taught about good sleep hygiene practices (eg, providing a good sleep environment, limiting caffeine consumption after school), the importance of consistent bedtime routines on all nights of the week, and behavioral strategies specific to the child's sleep problem, such as bedtime fading with set morning wake times for delayed sleep phase, graduated extinction for limit-setting disorders, and relaxation strategies for anxiety leading to insomnia. Behavioral strategies were based on recommendations from the American Academy of Sleep Medicine and review of current research literature.<sup>29</sup> Parents were provided with a sleep management plan for which they were encouraged to write down up to 3 strategies during the consultation that they were planning to implement to improve their child's sleep. The plan was reviewed during the telephone-based consultation and, if required, was revised at the second face-to-face con-

**TABLE 1** Secondary Child and Parent Outcomes

Construct	Measure	Additional Information	Baseline	Follow-up, mo		
				3	6	12
<b>Child</b>						
Sleep difficulties	Child Sleep Habits Questionnaire	Validated 33-item questionnaire (Cronbach's $\alpha = 0.68$ ) covering dyssomnias, parasomnias, and sleep-disordered breathing problems of >2 wk duration in 4- to 12-y-olds. <sup>47</sup> Items scored 1, 2, or 3; total score possible range 33–99. Scores >41 are indicative of clinical sleep problems	●	●	●	●
HRQoL	Pediatric Quality of Life Inventory 4.0 (parent-proxy report)	Validated 23-item questionnaire ( $\alpha = 91$ ) of HRQoL over 1 mo in 2- to 18-y-olds yielding Physical Health and Psychosocial Health summary scales and total score with a possible range of 0–100. Higher scores represent better quality of life <sup>48</sup>	●	●	●	●
	Pediatric Quality of Life Inventory SF12 (child self-report)	Validated 15-item child self-report measure ( $\alpha = 87$ ) of HRQoL over 1 mo for 5- to 7-y-olds. <sup>49</sup> Yields Physical Health and Psychosocial Health summary scores with a possible range of 0 to 100			●	
Behavior	Strengths and Difficulties Questionnaire	Validated 25-item measure ( $\alpha = 0.76$ ) of behavioral and emotional problems over 6 mo for 3- to 16-y-olds. <sup>50</sup> Items scored 0, 1, or 2. Total Difficulties score consists of 20 items and has a possible range of 0 to 40 with higher scores representing more behavior problems. Prosocial behavior score consists of 5 items and has a possible range of 0 to 10 with higher scores representing better prosocial behavior	●		●	●
Learning	Wechsler Individual Achievement Test, Australian Abbreviated	Validated face-to-face measure ( $\alpha = 0.88$ ) of academic achievement for 4- to 19-y-olds. Yields standardized scores for word functioning, mathematical functioning, and spelling. Standard score mean of 100 (SD 15)			●	
<b>Parent</b>						
Mental health	Depression Anxiety Stress Scale-21	Validated 21-item self-report ( $\alpha = 0.89$ ) of depression, anxiety, and stress for >1 mo for individuals aged $\geq 17$ y. <sup>51</sup> Each scale has 7 items scored 0, 1, 2, or 3, with a possible range of 0–21, with higher scores indicative of poorer mental health	●	●	●	●

HRQoL indicates health-related quality of life.

sultation. Clinicians provided study-designed information sheets as part of the intervention, which included information on normal sleep in children, common sleep problems, and possible strategies for managing each problem. All intervention sessions were conducted by using a standardized consultation sheet in which the consultant recorded key components of the intervention, discussion areas, and information sheets provided.

We did not offer control families assistance for their child's sleep, but they were free to seek help elsewhere, in line with care currently available in the community for such children.

### Follow-up

We mailed participating families a survey at 3, 6, and 12 months after random assignment. At 6 months, a researcher

directly assessed the child's learning at school, for which 2 researchers were trained to perform assessments by an experienced clinical psychologist.

### Measures

#### Primary Outcome Measure

As the primary outcome measure, we used the primary caregiver's report from the screening survey as to their child's sleep (no, mild, moderate, or severe problem; dichotomized into no/mild versus moderate/severe). Report of a moderate/severe sleep problem determined the child's trial eligibility. We used caregiver report because (1) parent perception of a sleep problem is a key driver of help-seeking behavior, (2) the definition of what constitutes a sleep problem from a research

perspective remains a hotly debated topic,<sup>50</sup> (3) subjective measures are more cost-effective and feasible to use than objective measures for determination of child sleep problems in large population-based settings,<sup>51</sup> and (4) parent report captures behavioral bedtime problems better than actigraphy.

#### Secondary Outcome Measures

The secondary outcome measures, summarized in Table 1, comprised measures reported by children and parents as well as direct assessment.

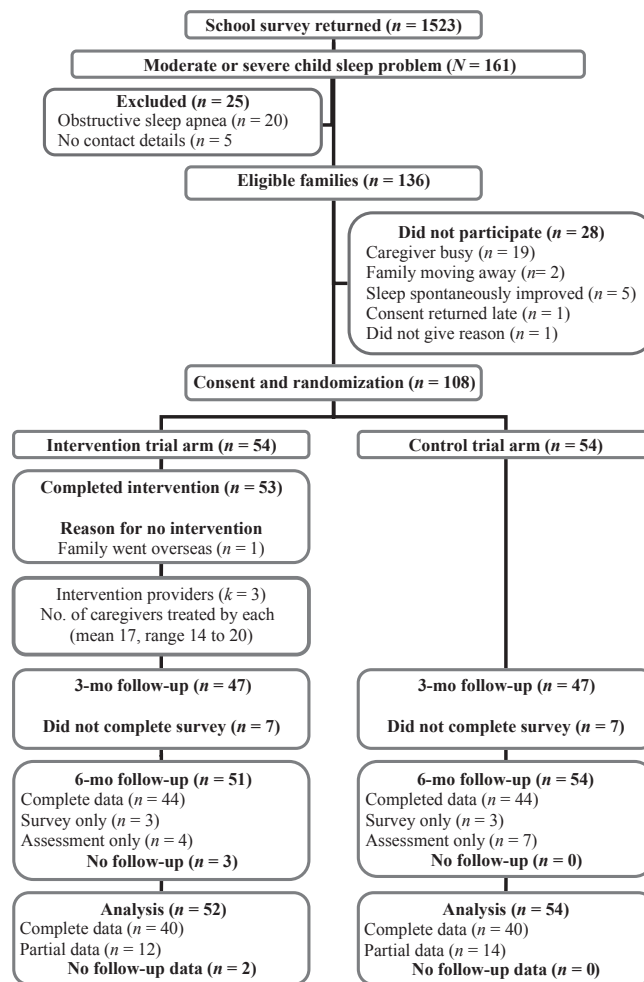
#### Sample Size

The primary outcome was sleep problem status at follow-up. We assumed that child sleep problems would persist for 60% of children without intervention,<sup>3</sup> and that halving this to 30% would be a

meaningful public health result. A simple 2-arm study would therefore require 49 children with sleep problems in each arm to have 80% power at the 5% level of significance to detect this effect.

### Statistical Analysis

Intention-to-treat comparisons of the trial arms were conducted for each of the 3 follow-ups, at 3, 6, and 12 months. Linear regression models were fitted to estimate mean differences between trial arms for continuous outcomes, and logistic regression was used to estimate odds ratios to compare binary outcomes between trial arms. All models were adjusted for the baseline score for that outcome,<sup>52</sup> except analyses of child learning and self-reported health-related quality of life, because face-to-face assessments were not conducted with children at baseline. These assessments were not made at baseline because of the need to minimize the period between recruitment and receipt of the intervention to avoid the identification of potential control children by teachers. Because of the random assignment to trial arms, however, baseline equivalence with respect to these factors was likely. We conducted analyses both with and without adjustment for potential confounders chosen a priori through review of the current literature. These potential confounders included child gender,<sup>17,33</sup> parent marital status,<sup>34</sup> and family socioeconomic status.<sup>35</sup> The unadjusted and adjusted analyses of the binary outcomes provided similar results, and we summarized the intervention effect as the difference between the 2 proportions and the unadjusted risk ratio. Confidence intervals (CIs) for the mean differences between trial arms for continuous outcomes were validated by using the bias-corrected accelerated bootstrap method, but the standard model-based CIs are presented.<sup>36</sup>



**FIGURE 2** Sleep intervention CONSORT (Consolidated Standards of Reporting Trials) flowchart.

Effect sizes for continuous variables were calculated as the mean difference between trial arms divided by the SD in the control arm.<sup>37</sup> Traditionally, effect sizes are interpreted as small, moderate, and large (~0.20, 0.50, and 0.8 SD, respectively)<sup>38</sup>; however, in population-based research, effect sizes as small as 0.25 might have great public health significance.<sup>39</sup>

All analyses were implemented by using Stata 10.1 (Stata Corp, College Station, TX).

## RESULTS

### Screening Sample

Participant flow for the screening survey and the targeted intervention is shown in

Fig 2. A total of 1512 parents (response rate: 71.0%) completed the survey, and there was no marked difference in child gender or demographic characteristics between those who did and did not complete the survey; 10.8% (95% CI: 9.1–12.3) of parents reported moderate or severe sleep problems, which were associated with poorer child psychosocial health and behavior and parent mental health (all  $P < .001$ ).

### Baseline Characteristics of the Children in the Trial Sample

Of the 161 children with a moderate/severe sleep problem, 136 were eligible for the trial and 108 (79.2%) chose to take part (54 intervention,



**TABLE 2** Child Characteristics and Outcome Measure Scores at Randomization

Variable	Intervention (N = 54)	Control (N = 54)
<b>Child characteristics</b>		
Age, mean (SD), y	5.7 (0.3)	5.7 (0.5)
Gender, male, %	50	50
Bedtime, mean (SD)	7:57 PM (0:46)	7:54 PM (0:31)
Total sleep duration, mean (SD), h:min	11:06 (0:48)	11:12 (0:42)
Same bedtime each night, %	74	67
Asleep within 20 min, %	33	20
CSHQ total score, mean (SD)	52.6 (6.6)	52.0 (8.2)
SDQ prosocial behavior, mean (SD)	7.5 (1.7)	7.2 (2.2)
SDQ total difficulties, mean (SD)	9.4 (4.9)	10.2 (4.7)
PedsQL psychosocial health, mean (SD)	72.1 (12.0)	73.3 (10.2)
PedsQL physical summary, mean (SD)	76.4 (16.0)	71.8 (17.6)
<b>Primary caregiver</b>		
Age, mean (SD), y	39.4 (4.2)	39.6 (5.0)
Employed, %	63	57
Biological parent, %	96	100
Married/de facto, %	89	89
English is main language at home, %	96	98
University degree, %	54	59
Household Income per annum, %		
<A\$60 000	21	24
A\$60 001–A\$90 000	31	20
>A\$90 000	48	57
DASS-21 Depression, median (IQR)	4.2 (2.1–8.4)	4.2 (2.1–6.3)
DASS-21 Anxiety, median (IQR)	2.0 (0.0–6.1)	2.0 (0.0–4.1)
DASS-21 Stress, median (IQR)	13.8 (7.9–19.7)	9.9 (5.9–15.8)
DASS-21 Total score, median (IQR)	20.1 (9.9–32.1)	17.1 (10.0–28.3)

CHSQ indicates Child Sleep Habits Questionnaire; SDQ, Strengths and Difficulties Questionnaire; PedsQL, Pediatric Quality of Life Inventory; DASS, Depression Anxiety Stress Scale; IQR, interquartile range.

54 control). One family did not receive the intervention because of absence. However, their data are presented. Table 2 shows baseline characteristics. Scores for child health-related quality of life and behavior were similar to those in a recent nationally representative Australian sample.<sup>3</sup> A total of 36 (33%) of 108 families did not complete all components of the study (all surveys and the face-to-face assessment), and 2 of these families did not complete any follow-up components. Those who did and did not complete all study components had similar baseline characteristics.

## Outcomes

### Primary Outcome: Parent-Reported Sleep Problems

Sleep problems tended to resolve in both groups, but they resolved more rapidly in the children who received interventions. Thus at 3 months, 33%

of intervention caregivers, compared with 43% of control caregivers, reported moderate/severe child sleep problems (percentage difference: 9.9% [95% CI: -9.6 to 29.5];  $P = .3$ ; unadjusted risk ratio: 0.76), falling by 6 months to 25.5% in the intervention versus 46.8% in the control children (percentage difference: 21.3% [95% CI: 23.3–40.2];  $P = .03$ ; unadjusted risk ratio: 0.54). By 12 months control sleep problems had also fallen markedly (32% vs 33%; percentage difference: 1.5 [95% CI: -18.0 to 21.0];  $P = .8$ ; unadjusted risk ratio: 0.95). Thus, although the evidence clearly supports an intervention effect at 6 months, the wide CIs at 3 and 12 months indicate uncertainty about the true effects at 3 and 12 months.

Intervention children whose sleep problem improved had better baseline scores on the Strengths and Difficulties Questionnaire total difficulties

score (mean difference: 2.8 [95% CI: -0.1 to 5.9];  $P = .06$ ), and caregivers had less baseline anxiety symptoms (mean difference: 3.8 [95% CI: 0.4–7.2];  $P = .03$ ), but were otherwise similar to those whose sleep problem did not improve.

### Secondary Outcomes

Results for secondary outcomes are shown in Table 3. At all follow-up time points, total scores on the Child Sleep Habits Questionnaire were better for intervention than control children. These better scores were driven initially by lower bedtime resistance at 3 (effect size: 0.31;  $P = .03$ ) and 6 (effect size: 0.38;  $P = .007$ ) months, which translated into less bedtime delay at 6 (effect size: 0.50;  $P = .01$ ) and 12 (effect size: 0.39;  $P = .01$ ) months and, by 12 months, longer sleep duration (effect size: 0.42;  $P = .02$ ). There was fair-to-weak evidence of benefit to children's psychosocial health summary scores for the Pediatric Quality of Life Inventory (effect sizes at 3, 6, and 12 months: 0.47 [ $P = .03$ ], 0.35 [ $P = .07$ ], and 0.33 [ $P = .1$ ], respectively). These benefits largely reflected improved emotional and social functioning subscale scores. On the Strengths and Difficulties Questionnaire, despite similar total difficulties behavior scores throughout, intervention children developed better prosocial behavior scores by 12 months (effect size: 0.35;  $P = .03$ ). We completed academic achievement assessments for 48 of 54 (88.9%) intervention and 51 of 54 (94.4%) control children and found little evidence of a difference between groups ( $P = .5$ – $.8$ ).

There was little evidence of a marked improvement in parent mental health (effect sizes for total scores on the Depression Anxiety Stress Scale: 0.25 [ $P = .09$ ]; 0.22 [ $P = .3$ ]; and 0.08 [ $P = .6$ ] at 3, 6, and 12 months, respectively). An initial marked benefit to the depres-

**TABLE 3** Adjusted Regression for Child and Parent Secondary Outcomes at 3, 6 and 12 Months After Randomization

Outcome	Intervention, Mean (SD)	Control, Mean (SD)	Mean Difference, Intervention – Control (95% CI)	Effect Size	<i>P</i>
<b>3 mo</b>					
CSHQ total score	46.0 (6.5)	48.0 (7.3)	–2.4 (–4.6 to –0.2)	0.33	.03
PedsQL parent proxy					
Psychosocial health	80.1 (12.8)	74.8 (11.8)	5.5 (0.7 to 10.3)	0.47	.02
Physical health	82.6 (15.7)	77.4 (16.1)	2.7 (–3.7 to 9.1)	0.17	0.4
DASS-21					
Depression	5.6 (9.7)	5.6 (6.5)	–2.0 (–4.0 to 0)	0.31	.04
Anxiety	3.5 (5.5)	3.2 (4.0)	–0.5 (–1.9 to 0.8)	0.13	0.4
Stress	10.0 (8.0)	9.2 (7.1)	–0.8 (–3.2 to 1.6)	0.11	0.5
Total score	19.1 (21.3)	18.0 (15.6)	–3.9 (–8.5 to 0.7)	0.25	.09
<b>6 mo</b>					
CSHQ total score	45.6 (6.1)	49.0 (7.8)	–4.0 (–6.5 to –1.4)	0.51	.003
PedsQL parent proxy					
Psychosocial health	78.1 (13.3)	73.7 (12.3)	4.3 (–0.4 to 9.1)	0.35	.07
Physical health	81.2 (16.6)	73.7 (18.3)	3.8 (–2.9 to 10.5)	0.21	.3
PedsQL child self-report					
Psychosocial health	71.6 (14.2)	68.5 (14.4)	3.3 (–2.4 to 9.0)	0.23	.3
Physical health	75.6 (20.2)	80.0 (20.2)	–4.0 (–12.3 to 4.4)	0.20	.3
SDQ behavior					
Total difficulties	8.2 (4.2)	9.9 (4.4)	–0.7 (–2.1 to 0.6)	0.16	.3
Prosocial behavior	8.1 (1.8)	7.9 (1.7)	–0.1 (–0.7 to 0.5)	0.06	.7
WIAT-II					
Word	114.5 (13.1)	114.4 (14.9)	0.6 (–5.2 to 6.3)	0.04	.8
Numerical	102.9 (12.0)	101.5 (13.0)	1.7 (3.3 to 6.7)	0.13	.5
Spelling	117.5 (17.6)	115.9 (17.7)	2.4 (–4.7 to 9.5)	0.14	.5
DASS-21					
Depression	5.3 (7.9)	4.7 (4.9)	–0.6 (–2.8 to 1.5)	0.12	.6
Anxiety	2.8 (4.8)	3.1 (3.3)	–0.9 (–2.2 to 0.5)	0.27	.2
Stress	9.8 (8.5)	9.6 (6.6)	–1.0 (–3.8 to 1.8)	0.15	.5
Total score	17.8 (19.5)	17.5 (12.4)	–2.8 (–8.2 to 2.6)	0.22	.3
<b>12 mo</b>					
CSHQ total score	45.2 (6.3)	48.1 (8.6)	–3.3 (–6.1 to –0.4)	0.40	.02
PedsQL parent proxy					
Psychosocial health	76.8 (14.8)	73.4 (12.1)	4.1 (–0.9 to 9.1)	0.33	.1
Physical health	77.6 (22.2)	73.0 (19.8)	2.9 (–5.5 to 11.3)	0.15	.5
SDQ behavior					
Total difficulties	8.6 (5.2)	9.9 (5.5)	–0.5 (–2.3 to 1.2)	0.10	.5
Prosocial behavior	8.5 (1.5)	7.6 (2.0)	0.7 (0.0 to 1.3)	0.35	.03
DASS-21					
Depression	5.2 (6.8)	3.6 (4.3)	0.5 (–1.3 to 2.4)	0.12	.6
Anxiety	3.9 (5.8)	2.9 (4.1)	0.0 (–1.7 to 1.8)	0.00	.9
Stress	10.0 (8.8)	10.1 (6.8)	–1.3 (–3.9 to 1.3)	0.19	.3
Total score	19.1 (20.0)	16.7 (13.0)	–1.1 (–6.4 to 4.2)	0.08	.6

CHSQ indicates Child Sleep Habits Questionnaire; PedsQL, Pediatric Quality of Life Inventory; DASS, Depression Anxiety Stress Scale; SDQ, Strengths and Difficulties Questionnaire; WIAT, Wechsler Individual Achievement Test IQ.

sion scale (effect size: 0.31; *P* = .04) was not sustained by 6 months or beyond.

## DISCUSSION

### Principal Findings

In this randomized controlled trial we evaluated the efficacy of a behavioral sleep intervention to treat child sleep problems identified through

population-based screening in the first 6 months of formal school. Both the screening and the intervention were feasible and acceptable. Benefits included evidence of more rapid resolution of child sleep problems (primary outcome) and sustained and clinically important improvements in child sleep habits. For secondary outcomes, improvements in child psychosocial func-

tion decreased somewhat over the year of follow-up, but the effect sizes that were still evident by 12 months would certainly be important if confirmed. Intervention and control children had similar learning outcomes at 6 months.

### Comparison With Other Studies

In this trial our investigation went beyond those of previous studies because we focused on sleep problems of school-aged children at a population level, measured important adverse outcomes related to sleep disturbance, and extended the follow-up period beyond 4 months.<sup>22–25</sup> The observed benefits, however, were in keeping with the successful outcomes of population-based brief behavioral sleep interventions delivered for infants with sleep problems.<sup>20,21</sup> In addition, improvements in children’s psychosocial health and prosocial behavior suggest the intervention might be favorable for the transition to formal schooling because these areas contribute to school readiness. School readiness, however, was not measured in this trial.

In contrast to previous studies of child sleep and learning,<sup>16,40,41</sup> intervention children in our trial did not have better learning at 6 months. This result might indicate that the improvement of sleep problems does not lead to improved learning. Alternatively, our measures might have been insufficiently sensitive to detect change, unlike those used in previous studies, in which investigators focused on skills such as working memory and use of lengthier assessments that might have been more sensitive to change.<sup>42</sup> We focused, however, on policy-relevant domains of reading, mathematics, and spelling and used a relatively brief and simple measure in keeping with our population aims. A third possibility is that learning improvements might lag

behind those of sleep; unfortunately, we lacked the resources for an additional 12-month assessment.

### Strengths and Limitations

This trial was rigorously conducted and reported in accordance with the CONSORT (Consolidated Standards of Reporting Trials) statement.<sup>45</sup> Strengths of the study included its population basis, high recruitment and retention rates, validated outcome measures, blinded assessment of learning, and follow-up to 12 months after randomization. Although this investigation was an efficacy trial, it was delivered to, and found to be feasible and acceptable for, all children in the participating schools, which makes us optimistic that it could be extended readily to an effectiveness (pragmatic) trial. Additional evidence of generalizability can be inferred from data for the nationally representative Longitudinal Study of Australian Children,<sup>3</sup> which showed rates of moderate-severe sleep problems in children aged 4 to 7 years that were similar to those in our sample at baseline, and rates of spontaneous improvement over 2 years that were similar to those in our control group.

The main limitation of the study was that of power; in this small efficacy trial, only 47 children contributed follow-up data in each of the intervention and control groups. Thus, the study had low power to detect benefits with respect to child psychosocial health. The point estimates for these outcomes, if true, would be important at the population level. The study had a

number of other potential limitations. The use of parent-reported child sleep problems might have resulted in response bias if parents in the intervention group were predisposed to report better sleep at outcome and/or a placebo effect existed. However, we note that not all parent-reported outcomes favored the intervention group, which suggests that any placebo effect, if positive, operated differentially. In addition, several of our trials in which we used similar designs (eg<sup>44,45</sup>) have yielded null parent-reported outcomes despite very positive parent evaluations, which argues against any expectation of placebo effects. Parent report, however, is the most cost-effective and feasible option for a population-based screening measure compared with objective measures such as overnight polysomnography. Parent report reflects parent concern about a child's sleep, which in turn is likely to be the motivator for parents who seek help from a program such as this.<sup>31,46</sup> Parents were the main source of outcomes data and could not be blinded, so bias could explain our positive findings; as noted above, we were not able to objectively reassess learning at 12 months because of our limited resources. It is not known whether existing school-based health professionals, such as school nurses in Australia, can effectively deliver this intervention with at least the same efficacy. We are optimistic about this method of delivery, because our interventionists were not sleep experts and received only brief training designed to be replicated on a larger scale. Finally, the

relatively advantaged suburbs in which this trial was conducted might limit generalizability of the findings to more disadvantaged children.

### CONCLUSIONS AND IMPLICATIONS

This targeted, brief, school-based sleep intervention improved child sleep problems and sleep habits and showed some evidence of leading to improved child psychosocial functioning after successful school-based screening for child sleep problems. This study should now be replicated in a larger effectiveness trial in which the intervention is offered to a population of children with a broader socioeconomic range, is implemented by a school-based health workforce, and is evaluated for its longer-term outcomes and cost-effectiveness.

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**AN “A” BY ANY OTHER NAME:** *The other day, my eldest son shared with me his most recent college grades. He was quite happy that he had all A's and B's. Although proud of his accomplishments, I was a little perplexed. I knew he worked hard in Japanese, but how in the world had he gotten such a high grade in his mathematics course? After all, math classes had been his Achilles heel since middle school. Moreover, my wife, who is a mathematician, had trouble getting A's in mathematics courses while in college. One explanation could be that my son benefited from college grade inflation. According to an article in The New York Times (Economix Blogs: July 14, 2011), over the past few decades, the percentage of A grades awarded at colleges has dramatically increased. Reviewing data from 200 four-year colleges and universities, researchers found that the percentage of A grades increased from 15% to 30% between 1940 and 1980 and in 2008 stood at 43%. The percentage of B grades has held steady at ~35%. However, the percentage of C's and D's has fallen precipitously. Currently, only ~10% of all grades are D's and F's. It is interesting that public schools tend to be stingier than similarly selective private schools; only 73% of grades at public schools are A's and B's compared with 86% at private schools. Science and engineering schools tend to grade harder than liberal arts schools. Why the grade inflation? Initially, back in the 1960s professors may have not wanted to fail students, because failing students could be sent to Vietnam. The recent dramatic increase is more likely due to an incentive-driven approach to education. Courses with more lenient grading curves tend to get better instructor reviews. Moreover, many schools want to maximize the success of graduating students competing for jobs or graduate school programs. Of course, with so many students all reporting A's and B's, the challenge for employers or graduate schools to identify truly superior students is made only more difficult. As for my son, I opted to not discuss with him grade inflation or how in my wife's mathematics program the average student, regardless of the difficulty of the course, was awarded a C. We simply enjoyed the moment and the fact that he had worked quite hard and to the best of his ability.*

Noted by WVR, MD

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