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Original Article

School-based sleep education program improves sleep and academic performance of school-age children

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ABSTRACT

Study objective: The objective of this study was to develop and evaluate the effectiveness of a school-based sleep education program aimed at improving the sleep and academic performance of school-age children.
Methods: Using a community-based participatory research approach, we created a school-based sleep education program, "Sleep for Success"™ (SFS), composed of four distinct modules that addressed the children, their family and community, the school staff, and decision makers within the school setting. Implementation was carried out in three elementary schools. Seventy-one students participated in the evaluation of the program. The effectiveness of the SFS program was evaluated using non-randomized controlled before-and-after study groups (intervention and control) assessed over two time points (pre- and post-program implementation). Before (baseline) and after implementation, sleep and academic performance were measured using actigraphy and report card marks, respectively.
Results: In the intervention group, true sleep was extended by 18.2 min per night, sleep efficiency improved by 2.3%, and sleep latency was shortened by 2.3 min, and report card grades in mathematics and English improved significantly. No changes were noted in the control group.
Conclusion: Participation in the sleep education program was associated with significant improvements in children's sleep and academic performance.

1. Introduction

Low academic achievement in children is a common and serious problem that affects a large number of students [1,2]. School outcomes largely determine long-term social and economic success and a successful start to formal learning in school is formative to these outcomes [3,4]. Insufficient or poor quality sleep is a significant risk factor for poor academic performance [5–9], as they affect cognitive processes that underlie academic performance [10–16], such as executive functions [17,18], memory [19], and attention [9].

Previous research efforts have sought to promote good sleep habits and extend sleep durations among adolescents in light of the delayed circadian timing associated with the onset of puberty and the bedtime-delaying psychosocial factors observed in this age group [20]. However, a sizeable proportion of elementary school children sleep on average 8 h [21], which is significantly less than the recommended 10 h per night [22,23]. In a large survey, 27% of school-age children were reported to obtain fewer hours of sleep than their parents/caregivers thought they needed [24], and a recent objective study using wrist actigraphy showed that children aged 4–10 years slept less than the recommended amount of sleep per night [21].

Our work seeking to promote good sleep habits and extend sleep duration has focused on younger children for several reasons, as follows: 1) sleep deprivation in prepubertal children is likely to be caused by lifestyle habits and culturally normative bedtimes and thus may be addressed by sleep education programs that target lifestyle choices; 2) school-age children can suffer from significant sleep deprivation and will therefore benefit from acquiring healthier sleep habits as well as increased and improved sleep; 3) school-age children are more receptive to guidance from adult figures (eg, parents and teachers) and are therefore more likely than adolescents to internalize the healthier sleep habits promoted by a school-based sleep education program; and 4) developing healthy habits at a young age has been shown to create a foundation for integrating these habits into daily life in later years, suggesting that early education on the importance of sleep could set the stage for an easier transition to adolescence.

Schools are ideal venues for prevention and intervention programs as they reach large segments of the youth population, provide

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a platform for health education and promotion [25], and can play an active role in encouraging children to adopt and maintain a healthy lifestyle. It has been shown that using the preexisting infrastructure of the educational system can offer a cost-effective route for delivering health-promoting programs [26,27]. Despite the critical importance of sleep in the daytime functioning and health of elementary school students, and the high prevalence of sleep deprivation among school-age children, the topic of sleep is not addressed in most school health curricula. Only one school-based sleep intervention for elementary school has been reported [28], but there is no information regarding its effectiveness as the study did not use objective sleep measures or outcome measures pertaining to the potential impact of the program on daytime functioning. The other reported efforts in sleep education/promotion have focused on school-based interventions for adolescents [29–39], and have suffered from multiple limitations, including the use of knowledge (not actual sleep behavior) as an outcome measure [36–39], the lack of objective measures of sleep [30–37,39–41], and the lack of relevant secondary measures, such as academic performance [29,30,32,35–37,41] (and see [40,42,43]).

To address the problem of insufficient sleep in school-age children, we developed and evaluated a school-based intervention designed to increase children's total sleep time. This program, "Sleep for Success™" (SFS), was developed through a partnership between a team of researchers from McGill University and a team of educators and communities served by the Riverside School Board (RSB), Quebec. The educational program involved a 6-week classroom curriculum for children, plus tools aimed at eliciting the involvement of parents and teachers. This report describes the results stemming from the implementation of SFS.

The primary goal of this study was to evaluate the impact of SFS on objective measures of sleep duration, efficiency, and latency in healthy, typically developing school-age children. The secondary goal was to examine changes in report-card grades following students' participation in this sleep promotion program. We hypothesized that the sleep and academic performance of children in the intervention group would improve compared to baseline following the implementation of SFS, whereas children of the control group would show no change over the study period.

2. Methods

2.1. Participants

A total of 192 students participated in the program activities. Of them, 74 (33 boys and 41 girls, aged 7–11 years (mean = 8.46, standard deviation (SD) = 1.8) agreed to participate in the study and completed all measures at both time points. A participant was excluded if he/she 1) had a history of psychiatric illness, developmental disorder, learning disability, or psychosis that might affect academic performance; 2) reported a sleep disorder; or 3) had a medical or psychiatric condition that might interfere with sleep. Based on these criteria, three children were excluded: two with attention-deficit hyperactivity disorder (ADHD) and one with asthma. Of the 71 remaining participants, 46 children (23 boys and 23 girls) participated in the intervention and 25 (eight boys and 17 girls) comprised the control group.

The participants were recruited from three elementary schools of the RSB, which governs the public education of the English-speaking population of Montreal's south shore. These schools use the same educational curricula, apply the same grading systems, and work under the same educational requirements of the Ministry of Education of Quebec. Two schools agreed to participate in the sleep intervention program, and the third school agreed to act as a control. Teachers invited parents to participate in the study via flyers that described the sleep promotion program (SFS). Parents who responded to these flyers were contacted for further screening. The study was approved by the Research Ethics Board of Douglas Mental Health University Institute (Montreal, Canada) and the Research Ethics Board of the Riverside School Board. Informed consent was obtained from the parents of all participants.

Most of the participants were Caucasian (71.4%), with the remainder classified as Mixed Ethnicity (14.3%), Asian (7.2%), Hispanic, or African American (7.1%). All participants spoke English as their first language. The majority of children (93%) came from families in which the parents were married. Of the remaining children, 4.3% came from families in which the parents were separated or divorced, and 2.74% came from families with a single mother. In terms of education, 66% of the mothers and 43% of the fathers were post-graduates, 20.56% of the mothers and 34.28% of the fathers had college-level education, and 13.44% of the mothers and 22.72% of the fathers had high-school education. Regarding income, 6.2% of the households had an annual combined income <$25,000, 23.3% had an annual income of $25,000–$65,000, 22.4% had $65,000–$95,000, and 48.1% had >$95,000.

2.2. Design

The study aimed to test the effectiveness of "SFS"™ using non-randomized controlled before-and-after study groups (intervention and control) assessed over two time points (pre- and postprogram). The primary outcome measures were actigraphic sleep measures, and the secondary outcome measures were report card grades.

2.3. Procedure

In the present study, we used a collaborative approach known as Community-based Participatory Research (CBPR) to develop our sleep education program [44]. Our partnership included researchers, school board administrators, teachers, educators, parents, and students. Following the principles of CBPR, we built on the strengths and resources within the community, facilitated a collaborative, equitable partnership in all phases of the research, and fostered co-learning and capacity building amongst all partners [45]. Using CBPR to develop "SFS'™ program, we were able to enhance the relevance of the data and its application by all partners involved; bring together partners with excellent skills, knowledge, and expertise to address the importance of sleep in youth; and enhance the quality, validity, sensitivity, and practicality of our sleep.

The programs included the following four modules: *Sleep Knowledge and Education*, which empowers students to make healthier choices; *Family and Community Involvement*, which encourages parents and children to discuss sleep in the context of a balanced lifestyle; *Sleep Promotion for Staff*, which empowers staff to practice balanced and healthy lifestyles, and thus lead by example; and *Sleep-friendly School Environment*, which encourages school principals to assess their school's policies, curricula, workload, and activity schedules in order to identify modifiable factors that could be targeted in order to support student's healthy sleep.

2.3.1. Sleep knowledge and education module

The topics covered in the program included the barriers to proper sleep, good bedtime routines, proper sleep hygiene, the consequences of poor sleep, the benefits of proper sleep, and the importance of sleep as a critical part of a healthy lifestyle. To ensure that the program was developmentally appropriate, three parallel versions of the "SFS"™ program were developed: first and second graders were introduced to a character named Sleepy Steven; third and fourth graders were introduced to superheroes; and fifth and sixth graders were introduced to the Critical Sleep Investigators. These versions of the program were similar in content and