

## Original Article

# The Effects of Education through Short Message Service for Mothers on Sleep Duration among School-Aged Children: A Randomized Trial

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### ABSTRACT

**Background:** Children's sleep problems can negatively affect their daily functioning at home and school, their behaviors, and their health status. Education through short message service (SMS) is among the techniques with potential positive effects. However, no study is available on the effects of SMS-based sleep education on sleep among children. **Objectives:** This study aimed to examine the effects of SMS-based education for mothers on sleep duration among their 7–12-year-old children who had sleep inadequacy. **Methods:** This randomized controlled trial was conducted on 206 elementary students and their mothers. Students with sleep inadequacy who were selected from thirteen elementary schools in Tabriz, Iran, were randomly allocated to a control ( $n = 103$ ) and an intervention ( $n = 103$ ) group. In the intervention group, students' mothers were provided with sleep education through thirty nightly messages sent at 20:00 for 1 month. Mothers in both groups completed the 2-week sleep record before, 1 week, and 3 months after the intervention. The data were analyzed using the independent samples  $t$ - and the Chi-square tests, the repeated-measures analysis of variance, and the analysis of covariance. **Results:** The mean of sleep duration in the intervention group significantly increased from  $533.28 \pm 29.35$  min at baseline to  $551.26 \pm 37.93$  at the first posttest and  $568.25 \pm 35.44$  at the second posttest ( $P < 0.05$ ). In the control group, the mean of sleep duration significantly increased from  $523.13 \pm 33.69$  min at the pretest to  $539.98 \pm 49.03$  at the first posttest ( $P < 0.05$ ) and insignificantly decreased to  $528.96 \pm 52.20$  at the second posttest ( $P > 0.05$ ). Between-group difference respecting the mean of sleep duration was statistically significant only at the second posttest ( $P < 0.001$ ). **Conclusion:** SMS-based sleep education for mothers is effective in significantly increasing sleep duration among school-aged children.

**KEYWORDS:** Child, Education, Message, Mothers, Sleep

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## INTRODUCTION

Sleep is among the most basic needs of human beings. It greatly affects physical and mental health, quality of life,<sup>[1]</sup> emotional development, cognitive function, learning, and concentration.<sup>[2]</sup> Children with inadequate sleep are more aggressive, have more absence from school, and are more prone to academic failure than their peers.<sup>[3]</sup> Sleep inadequacy is associated with different health problems such as hyperlipidemia, obesity, and high blood pressure.<sup>[4]</sup>

Despite the importance of sleep to children's growth and development, studies show that many children suffer from sleep problems. For instance, a study in Tehran, Iran, found that students aged 6–9 years had unhealthy sleeping habits.<sup>[5]</sup> Two other studies on the sleeping habits of 6–11-year-old Iranian children also reported the high prevalence of sleep inadequacy among them.<sup>[5,6]</sup> Other studies also showed that sleep problems and unhealthy sleeping habits were prevalent among children.<sup>[7,8]</sup> Yet, children's sleep problems are usually ignored. Such ignorance negatively affects their daily functioning at home and school, their behaviors, and their health status.<sup>[7]</sup>

Children do not accurately understand their need for sleep. Therefore, their sleep patterns are largely determined by their parents and their family plans.<sup>[4,9]</sup> Family lifestyle, activities, and preferences such as television watching, shopping, and entertainment can result in delayed sleeping and sleep problems. A study reported that children's sleep problems were related to their parents' sleep patterns.<sup>[10]</sup> Accordingly, the success of any intervention for the management of children's sleep problems largely depends on parental involvement in the intervention.<sup>[11]</sup>

Nurses have important roles in promoting public health<sup>[12]</sup> and providing health-related public education.<sup>[13]</sup> They have critical role in improving public knowledge about healthy sleeping habits and improving public health.<sup>[14]</sup> They can use different methods for public and patient education about sleep. Short message service (SMS) is one of these methods. SMS is a simple, easy-to-use, and inexpensive technology with widespread use.<sup>[15]</sup> Studies showed that SMS-based education was welcomed by learners.<sup>[16,17]</sup>

The results of studies into the effects of education on sleep are contradictory. For instance, a study on Italian teenagers aged 17–19-year-old found the effectiveness of school-based education in improving their knowledge about sleep.<sup>[18]</sup> However, a study on 14–17-year-old teenagers reported that although education about sleep improved their sleep-related knowledge, it had no

significant effects on their sleep behaviors.<sup>[19]</sup> Another study found that a school-based educational program for teenagers increased their sleep duration on the weekends for a short period of time, but had no significant effects on their sleep-related knowledge.<sup>[20]</sup> Studies also investigated the effects of parent-based sleep education and reported various results. A study showed that parent-based group versus individualized education did not affect the children's sleep outcome.<sup>[21]</sup> However, another study reported that parent-based behavioral sleep workshops were effective in improving subjective and objective measures of sleep and sleep habits in children with autism spectrum disorders.<sup>[22]</sup> These methods may be less applicable for parents who are at job during the day or their child are healthy. However, no study had yet evaluated the effects of SMS-based sleep education for parents on sleep duration among children. Hence, the question still remains whether SMS-based education for mothers is effective in improving sleep duration among their children.

## Objectives

This study aimed to examine the effects of SMS-based education for mothers on sleep duration among their 7–12-year-old children with sleep inadequacy.

## METHODS

### Study design and participants

This randomized controlled trial was conducted in 2015–2016 on 7–12-year-old students with sleep inadequacy and their mothers. They were selected through random sampling from elementary schools in Tabriz, Iran. Inclusion criteria for students were education in elementary school, sleep inadequacy, and having no physical and mental health problems. Inclusion criteria for mothers were agreement for participation in the study, access to a mobile phone, no employment in health-care settings, basic literacy skills, and having no known physical and mental health problems.

Sleep inadequacy was determined based on age using the following method: 7-year-old, <585 min in 24 h; 8-year-old, <570 min; 9-year-old, <555 min; 10-year-old, <540 min; 11-year-old, <530 min; and 12-year-old, <510 min in 24 h.<sup>[23]</sup> The only exclusion criterion was moving from the current living place or school.

Sample size was calculated based on the results of a pilot study on 30 participants. The baseline mean  $\pm$  standard deviation (SD) of the sleep duration score of the children was  $530.27 \pm 29.35$  and increased to  $565.26 \pm 35.44$  at the week after the intervention. Then, with a Type I and II errors of 0.01 and 0.1, respectively, and considering  $S_1 = 29.35$  and  $S_2 = 35.44$  and  $\mu_1 = 530.27$  and  $\mu_2 = 565.26$ , the needed sample for each group was estimated at

26. However, we recruited all the available samples to compensate the possible attrition.

### Data collection instruments

Instruments were a personal characteristic questionnaire, the child symptom inventory-4 (CSI-4) and 2-week sleep record (2-WSR). The items of the personal characteristic questionnaire were on child's and mother's age, child's gender and birth rank, child's or other family members' affliction by physical or mental health problems, as well as mother's education level, occupation, and mobile phone number. CSI-4 parent version<sup>[24]</sup> is a parent-specific form developed based on the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> Edition for the diagnosis of mental health problems among students. This scale contains 110 multiple-choice or dichotomous items. The multiple-choice items are responded as "Never," "Sometimes," "Often," or "Always" and dichotomous questions responded "Yes" or "No." In the present study, responses "Never," "Sometimes," and "No" were scored zero and responses "Often," "Always," and "Yes" were scored 1. The results of this inventory were interpreted by a psychologist. A former study reported that the test-retest correlation coefficient of this inventory was 0.46–0.87 and its Cronbach's alpha was 0.74–0.94.<sup>[25]</sup>

The other study instrument was 2-WSR -a table with 14 rows and 24 columns to measure sleep duration in 24 hours.<sup>[26]</sup> Each mother was trained to fill the boxes of this record with black when her child was asleep and to leave the boxes blank when the child was awake. Moreover, she had to use downward arrow whenever her child went to sleep and use upward arrow whenever her child woke up. Finally, the mean of sleep duration was calculated for each child.

Both CSI-4 and 2-WSR were translated from English into Persian and their content validity was confirmed by twelve nursing and pediatric faculty members of Tabriz University of Medical Sciences, Tabriz, Iran. For reliability assessment, CSI-4 was twice completed by the same thirty mothers in the pilot study. The test-retest intraclass correlation coefficient and the Cronbach's alpha of the inventory were 0.87 and 0.79, respectively.

### Procedures

Participants were selected through cluster sampling. Initially, thirteen public schools (including six boys' and seven girls' schools) in Tabriz, Iran, were selected and then all 7–12-year-old students in these schools were approached. They were provided with the personal characteristics questionnaire to be completed by their mothers at home. One week later, they were asked to bring the completed questionnaire to the school. All eligible mothers were invited to attend a session at school, where they were

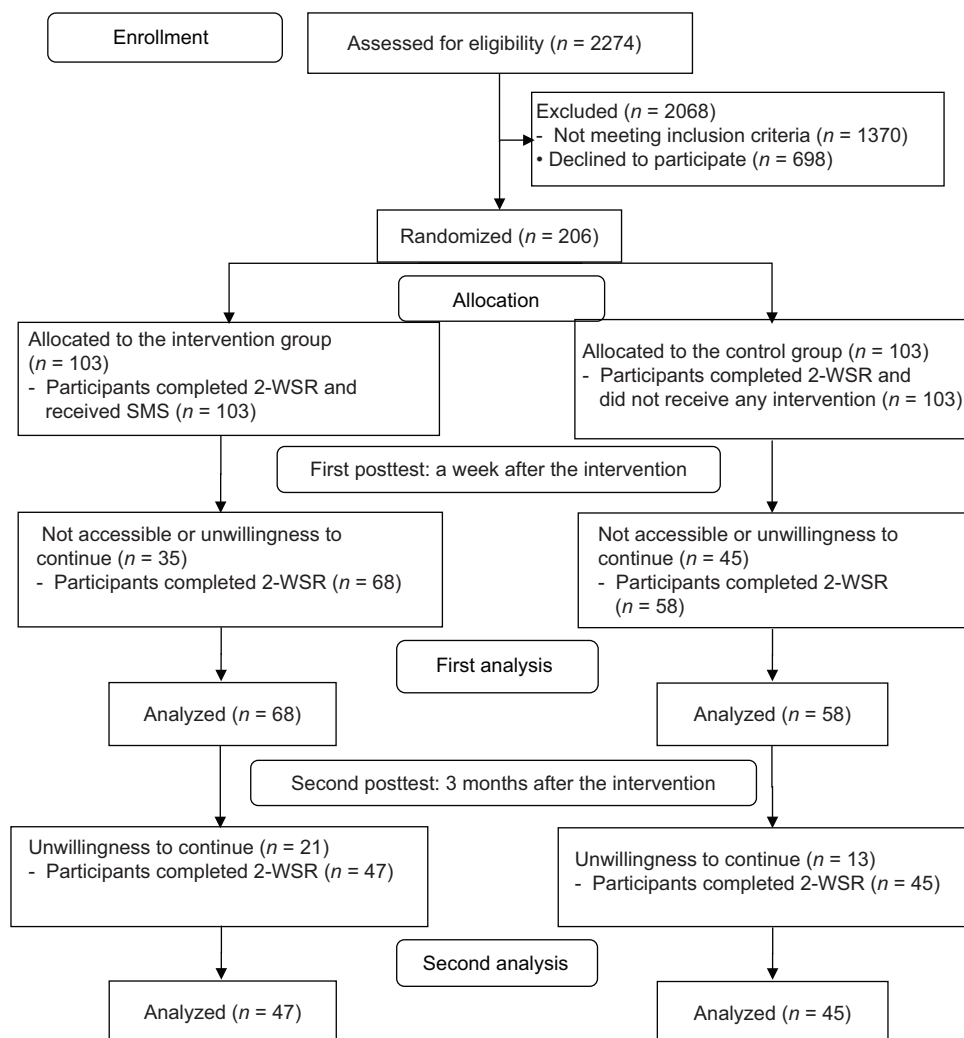
provided with information about the study and were asked to complete CSI-4 under the supervision of a psychologist. At the end of the session, 2-WSR was given to all mothers and they were asked to complete it for 2 weeks (as the pretest). One week after the session, a short message was sent to all mothers through SMS to remind them of completing 2-WSR. Another short message was sent to them 2 weeks after the session in order to remind them of returning the 2-WSR to school. Based on the collected data, children with sleep inadequacy and without physical and mental health problems were identified ( $n = 206$ ). As the study course was lengthy and the study intervention was not in-person, there was a high potential of participant withdrawal from the study. Thus, all 206 eligible students were recruited to the study and were equally allocated to a control ( $n = 103$ ) and an intervention ( $n = 103$ ) group. Randomization was done using an on-line Random Allocation Software (<https://www.sealedenvelope.com/simple-randomiser/v1/lists>) and with a block size of 2 and an allocation ratio of 1:1. Students and mothers were blind to the study groups.

### Intervention

The study intervention was SMS-based education about sleep. Educational materials were prepared through reviewing the existing literature and were approved by twelve nursing and pediatric faculty members of Tabriz University of Medical Sciences, Tabriz, Iran. Each night during the 1-month course of the intervention, a short educational message about sleep was sent to mothers in the intervention group at 20:00 via SMS. Examples of short messages were "Prevent child-stimulating activities after dinner (e.g., computer games, video and TV watching and video games)," "Set the bedtime at a specific time and make sure the child is tired enough while sleeping. Children will not sleep at night and wake up frequently if they sleep long during the day or wake up too late in the morning." The mothers were asked to avoid sharing messages with others. Moreover, to ensure that they received each message, they were asked to make a missed call to the first author immediately after receiving the message. A reminder message was sent to mothers who did not make the missed call for half of the messages to ensure that they had received the messages. Mothers who did not answer this reminder message were excluded from the study. One week and 3 months after the intervention, the 2-WSR was completed for 2 weeks by the mothers as the first and the second posttests. Mothers in the control group did not receive any short message and completed the 2-WSR 1 week and 3 months after the intervention.

### Ethical considerations

The study obtained ethical approval from the Ethics Committee of Tabriz University of Medical Sciences,



**Figure 1:** The flow of participants in the study

Tabriz, Iran (code: TBZMED.REC.1394.18) and was registered in the Iranian Registry of Clinical Trials (code: IRCT201404088315N10). All participants were informed about the study aims and advantages and were ensured of confidential data management and voluntary participation in the study. Written informed consent was obtained from all participants. All steps of the study were taken in accordance with the principles of the latest update of the Helsinki declaration. Some gifts were also given to the participating students. At the end of the study, the educational materials were provided to participants in the control group.

### Data analysis

The data were analyzed using the SPSS software v. 13.0 (SPSS Inc, Chicago, IL, USA). The Kolmogorov–Smirnov test showed that all quantitative variables had normal distribution. The data were summarized using the measures of descriptive statistics, including absolute frequency, relative frequency, mean, and SD. The independent samples *t*- and the Chi-square tests

were used for between-group comparisons respecting baseline sleep duration and personal characteristics. Moreover, the repeated-measures analysis of variance was conducted to compare the within-group variations of sleep duration across the three measurement time-points. The analysis of covariance was also performed to compare the groups respecting sleep duration at the first and the second posttests. Significance level was set at  $<0.05$ .

### RESULTS

At the first posttest, 58 participants in the control group and 68 participants in the intervention group completed 2-WSR. These numbers at the second posttest were 45 and 47, respectively [Figure 1]. There were no statistically significant difference between the intervention and the control groups respecting the demographic characteristics of the participants who were excluded. The same findings were observed for the participants who completed the study [ $P < 0.05$ ; Table 1].

The results of the repeated-measures analysis of variance illustrated significant increase in sleep duration in the intervention group across the three measurement time-points. The Sidak *post hoc* test for pairwise comparisons revealed significant differences between the first and the second ( $P = 0.002$ ), the first and the third ( $P < 0.001$ ), and the second and the third ( $P < 0.001$ ) time-points. The repeated-measures analysis of variance also showed at least one significant change in the mean of sleep duration in the control group. *Post hoc* analysis revealed that only the difference between the first and the second time-points was statistically significant [ $P = 0.016$ ; Table 2].

At the first posttest, the between-group mean difference of sleep duration was 1.13 min and the between-group

difference was not statistically significant ( $P = 0.879$ ). At the second posttest, this value was 29.14 min and the between-group difference was statistically significant ( $P < 0.001$ ). Based on covariance analysis the between-group pretest-first posttest difference was not statistically significant ( $P = 0.726$ ), and the between-group pretest-second posttest difference was statistically significant [ $P = 0.001$ ; Table 2].

## DISCUSSION

The study results illustrated that SMS-based education for mothers was effective in significantly improving sleep duration among their school-aged children. Studies are conflicting about the effect of SMS-based education on people's behavior.<sup>[27]</sup> In line with our findings, a former study found that a school-based intervention significantly broadened sleep-related knowledge and reduced sleep problems among teenagers.<sup>[28]</sup> Another study reported that on-campus education significantly improved teenagers' sleep-related knowledge and sleep duration and concluded that improving sleep-related knowledge positively affects sleep behaviors and sleep duration.<sup>[29]</sup> SMS-based education for parents was also reported in another study to be effective in improving sleep-related knowledge.<sup>[30]</sup>

Contrary to our findings, a study on teenagers aged 12–18-year-old showed that although school-based education was effective in improving their sleep-related knowledge and behavioral and mental health, it had no significant effects on sleep duration.<sup>[31]</sup> Another study on 58 teenagers with an age mean of 15.98 found that school-based education reduced problems such as sleep irregularity and sleep latency, while it did not significantly affect sleep duration and sleep quality.<sup>[32]</sup> The contradiction between the results of our study and the results of these two studies can be attributed to the fact that our intervention was family based, while their interventions were school based. Sleep problems among children are greatly affected by family plans<sup>[9]</sup> and parental awareness.<sup>[10]</sup> Therefore, sleep-related

**Table 1: Participants' personal characteristics**

Characteristics	Groups <sup>a</sup>		P
	Intervention	Control	
Child's gender			
Male	35 (51.5)	28 (48.3)	0.518 <sup>b</sup>
Female	33 (48.5)	30 (51.7)	
Child's birth rank			
First	41 (60.3)	31 (53.4)	0.415 <sup>b</sup>
Second	23 (33.8)	24 (41.4)	
Third	4 (5.9)	3 (5.2)	
Child's age (years)	9.1 ± 1.65	9.2 ± 1.45	0.589 <sup>c</sup>
Mother's age (years)	35.2 ± 5.74	35.5 ± 4.10	0.335 <sup>c</sup>
Mother's employment status			
Employed	13 (19.1)	10 (17.2)	0.716 <sup>b</sup>
Housewife	55 (80.9)	48 (82.8)	
Mother's education level			
Secondary school	10 (14.7)	5 (8.6)	0.314 <sup>b</sup>
High school	5 (7.4)	3 (5.2)	
Diploma	36 (52.9)	35 (60.3)	
Associate degree	3 (4.4)	1 (1.7)	
Bachelor's degree	13 (19.1)	11 (19)	
Master's degree	1 (1.5)	3 (5.2)	

<sup>a</sup>Data are presented as *n* (%) or mean±SD, <sup>b</sup>The results of the Chi-square test, <sup>c</sup>The results of the independent samples *t*-test. SD: Standard deviation

**Table 2: Within- and between-group comparisons of the mean ± standard deviation of the two groups respecting children's sleep duration (min)**

Group	Time			P <sup>a</sup>		
	Pretest	First posttest	Second posttest	Time	Group	Time*Group
Intervention	533.28±29.35	551.26±37.93	568.25±35.44	< 0.001	< 0.001	0.022
Control	523.13±33.69	539.98±49.03	528.96±52.20			
P value <sup>b</sup>	0.238	0.817	< 0.001			
Between-group comparison	-	1.58(-11.95, 15.12) <sup>c</sup>	35.90 (19.44, 52.35) <sup>c</sup>			
		1.13(-13.71, 15.99) <sup>d</sup>	29.14 (12.59, 45.69) <sup>d</sup>			
P value <sup>e</sup>		0.879	< 0.001			

<sup>a</sup>The results of the repeated-measure analysis of variance, <sup>b</sup>The results of the independent-sample *t* test, <sup>c</sup>difference mean (lower limit upper limit) for intervention group, <sup>d</sup>difference mean (lower limit, upper limit) for control group, <sup>e</sup>The results of the analysis of covariance adjusted for baseline values and potential confounders (namely educational level, birth rank, and age)

interventions for children need to involve families, particularly parents.

The results of the present study also showed that the between-group difference regarding sleep duration was not statistically significant at the first posttest (mean difference was 1.13 min), but was statistically significant at the second posttest (mean difference was 29.14 min). This study was conducted from Autumn 2015 to Spring 2016. The pretest was conducted at the end of the autumn and the first and the second posttests were conducted in winter and spring, respectively. Short day length and snowfall-related school closures in the winter might have caused increase in sleep duration in the control group at the first posttest.

This study was conducted only in public elementary schools, and hence, its findings may have limited generalizability. Moreover, some participants left the study during the intervention because they considered short messages as intrusion on their privacy. Attrition rate in the study was also high (9%) due to the 3-month follow-up (second posttest) and that some mothers were reluctant to continue their participation, though we attempted to eliminate this limitation by increasing the sample size. Future studies are recommended to compare the effects of internet-based and SMS-based interventions on sleep duration and quality. Furthermore, children's daily sleep episodes at school, family sleep pattern, illiterate mother, or mother without mobile phone were not considered in the current study. However, considering the possible effects of these variables, further studies with considering these variables are suggested.

## CONCLUSION

This study concludes that SMS-based sleep education for mothers can be effective in significantly increasing sleep duration among school-aged children. Nurses and school health instructors can use SMS to increase parents' awareness of the importance of healthy sleeping and thereby prevent sleep inadequacy and its complications among children.

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## Conflicts of interest

There are no conflicts of interest.

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