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Educating Adolescents About Healthy Sleep: Experimental Study of Effectiveness of Educational Leaflet

Marija Bakotić, Biserka Radošević-Vidaček, Adrijana Košćec

Institute for Medical Research and Occupational Health, Zagreb, Croatia

Aim To evaluate how exposure to educational leaflet about healthy sleep affects knowledge about sleep in adolescents.

Methods The study included students aged 15-18 years from 12 high schools (1209 participants; 85% of eligible study population). Multistage sampling was used and the selected schools were randomly assigned into two intervention groups and two control groups, according to the Solomon experimental design. Intervention groups received educational leaflets and control groups did not. In one of the intervention groups and one of the control groups, pre-testing of knowledge about sleep was performed. Students answered the Sleep Knowledge Test, which was constructed in accordance with the information on the leaflet. Data were analyzed by four-way ANOVA and additional analyses of simple main effects were performed.

Results Positive effect of educational leaflet was found in students aged 15 ($F=28.46$; $P<0.001$), 16 ($F=5.74$; $P=0.017$), and 17 ($F=17.17$; $P<0.001$), but there was no effect in students aged 18 ($P=0.467$). In male students, positive effect of the leaflet was found only in the group that had not been pre-tested ($F=6.29$; $P=0.012$), while in female students, it was found in both pre-tested ($F=26.24$; $P<0.001$) and not pre-tested group ($F=17.36$; $P<0.001$), with greater effect in pre-tested group ($F=5.70$; $P=0.017$). Female students generally showed better knowledge about sleep than male students ($F=95.95$; $P<0.001$).

Conclusion Educational leaflets can be an effective first step in educating younger high school students about healthy sleep, with the method being more effective in female adolescents.

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Correspondence to:
Biserka Radošević-Vidaček
Institute for Medical Research and Occupational Health
Ksaverska c. 2. PO BOX 291
HR-10001 Zagreb, Croatia
bvidacek@imi.hr

Sleep education has been used as a method of primary and secondary prevention of sleep problems in all age groups (1-3). An especially vulnerable age group are adolescents who frequently have poor sleep habits and suffer from sleep deprivation (4-6). In adolescents, insufficient sleep, inadequate sleep quality, and irregular sleep patterns are associated with daytime sleepiness, negative moods, increased likelihood of stimulant use, higher levels of risk-taking behavior, poor school performance, and increased risk of unintentional injuries (7-10). As an US study has shown, sleepiness was the major causal factor in many traffic accidents and more than 50% of sleep-related crashes involved drivers aged 25 or younger (11).

Having in mind that adolescence is not only a period when sleep problems arise, but also a period when many life habits are established, adolescent education about healthy sleep becomes an important task. Different educational programs and public educational campaigns have been organized to increase the knowledge about healthy sleep and consequences of sleepiness in adolescents and their parents and teachers (12-14). The effects of such educational programs on adolescents' sleep knowledge and characteristics have been described by several studies (2,12).

Another way to increase knowledge about sleep and to foster positive behavioral changes regarding sleep in adolescents are public education campaigns. In order to achieve these goals, effective educational methods need to be developed and a systematic evaluation of their effectiveness performed. In this study, we evaluated the effect of our educational effort to increase adolescents' knowledge about sleep. The method we used was exposure to leaflets, which is a commonly used method in public health campaigns. Since some studies have shown sex differences in school performance (15,16), we expected that sleep education would have a different effect on knowledge about sleep in boys than in girls. The effect of age on sleep education may also be expected because of possible differences in the basic knowledge about sleep in students of different age.

METHODS

Participants

From 55 public general-education and vocational schools in Zagreb, all 4-year schools (n = 50) were selected and divided into 3 groups according to their educational program: general-education schools (n = 20), vocational schools in the area of engineering (n = 12), and vocational schools of other types (n = 18). For the selection of participants, multistage sampling was used, consisting of 2 stages. In the first stage, 4 schools of each type were randomly selected, making it a total number of 12 schools. In the second stage, 4 classes from each of these 12 schools were randomly selected, one for each grade (first to fourth). A total of 48 classes were selected. The participation of students was voluntary. School principals obtained approvals for participation from students and from both of their parents. Out of 1430 potential participants, 32 (2%) did not have parents' approval or did not want to participate and 189 students (13%) were absent from school on the days when the study was performed. The final sample was composed of 1209 participants (85% of the eligible study population), 54% of which were girls. Modal age of students in the first grade was 15 years, in the second grade 16 years, in the third grade 17 years, and in the fourth grade 18 years.

Study design and procedure

The study was performed according to the Solomon 4-group experimental design (17). There were 4 study groups, each comprising 1 randomly assigned general-education school, 1 vocational school in the area of technical engineering, and 1 vocational school of other type. These 4 study groups underwent different procedures, which are presented in Figure 1.

Students from all groups answered the Sleep Knowledge Test as a part of a larger anonymous survey study in which adolescents' sleep habits and daytime functioning were examined. Sleep education leaflets were distributed to all students in experimental groups on the day they were delivered to schools. School psychologists or educators distributed the leaflets in each class. Before handing the leaflet to each student they read the following instruction to the class: "The Institute for Medical Research and Occupational Health is conducting a study on sleep characteristics of adolescents. As a part of the study you will now receive a leaflet about sleep. The researchers invite you to read everything what is written on the leaflet." The students from control groups also received the leaflets, but at the end of the study.

With the agreement of school principals, the examination was organized during school lessons. Students from pretested groups were informed that the testing would be repeated in a month's time. We used the same test

for pre-testing and testing of sleep knowledge. To eliminate the impact of different answering strategies on the final test result, the participants were instructed to answer all the questions in the test, no matter if they knew the correct answers. The anonymity of the participants who had been pre-tested was assured by using a code system.

Material

The content of sleep education leaflet was determined by sleep experts on the basis of a literature review about adolescents' sleep needs, importance of sleep, and sleep hygiene practices. It contained representative information regarding adolescents' sleep and healthy practices of sleep in general, as well as recommendations about sleep duration for teenagers, recommendations about temporal organization of sleep, information about different behaviors and environmental factors that can influence sleep quality, and about the importance of sleep and consequences of sleepiness. The leaflet also contained an example of sleep-wake diary and explanation for its use. It was designed by professional graphic designers on a single unfolded sheet of paper, printed on both sides. The dimensions of the leaflet were 21×21 cm.

To assess students' knowledge about sleep the Sleep Knowledge Test was used (web extra material). It was constructed according to the information presented on the leaflet, with 20 true or false statements about sleep. Correct answers were scored as 1 and incorrect as 0 points. The test score was a sum of all correct answers, ranging from 0 to 20, with higher scores indicating better sleep knowledge. The readability of the Sleep Knowledge Test was checked by 10 adolescents. The analysis of readability was qualitative, based on adolescents' estimates. No readability score was calculated. Adolescents' comments and remarks about how easily they could read and understand each question were taken into consideration during construction of the final version of the test. Psychometric evaluation of the Sleep Knowledge Test was performed on the results of 611 students. Mean score on the Sleep Knowledge Test was 13.66±2.59. Calculations for skewness (Skewness=-0.50, SE=0.099) revealed negative asymmetry of test results, showing that there were more individuals above the mean score. Items of the Sleep Knowledge Test ranged in difficulty from 25.9% to 96.2% and the average item difficulty of the test was 68.1%. All correlations between test items and total score were significant, ranging from 0.23 to 0.41. Cronbach α coefficient was 0.55, indicating moderate internal consistency of the test.

Statistical analysis

We compared test scores between 4 groups obtained during week 5 of the study (Figure 1), disregarding pre-test results, according to Campbell and Stanley's approach to analysis of data in the Solomon design (18).

The percentages of correct answers to each question of the Sleep Knowledge Test were calculated separately for boys and girls in each study group. The χ^2 tests were performed to test sex differences in the percentage of correct answers to each question.

Four-way ANOVA was performed with Sleep Knowledge Test scores as dependent variable, and educational leaflet (yes/no), knowledge pre-testing (yes/no), sex, and grade (4 levels) as between-subjects factors. Since we had an unequal n design, we used ANOVA with sums of squares type III, which is a preferred method for such a design, testing the hypothesis about unweighted means. Therefore the Sleep Knowledge Test scores were presented as unweighted means, ie, estimated marginal means±standard errors. In case of significant interaction effect, simple main effects analysis was planned with Bonferroni adjustment method.

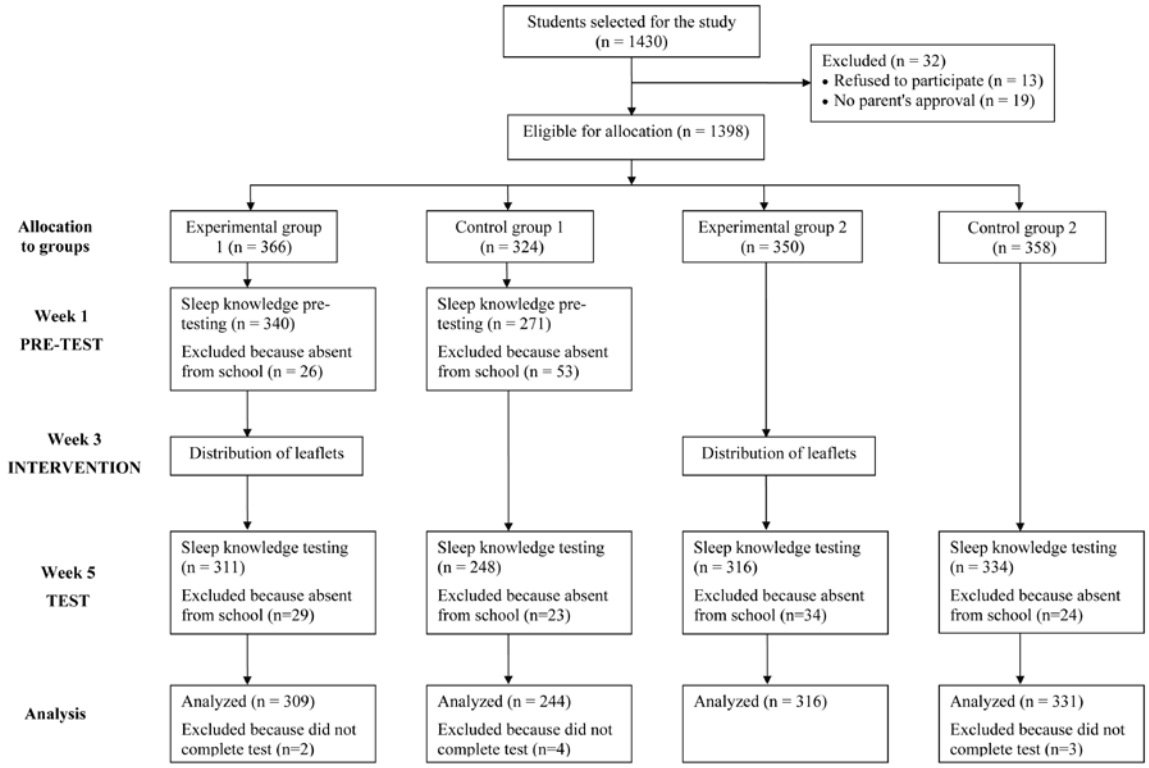
Before we tested differences in the Sleep Knowledge Test scores by means of ANOVA, we tested homogeneity of variances and normality of distributions in 32 cells of the design (2×2×2×4). Leven test of homogeneity of variances was performed. It indicated that variances in the 32 cells of ANOVA design were homogeneous ($F_{(31,1168)}=1.31$, $P=0.119$). Kolmogorov-Smirnov tests were significant for 16 cells. Problems with normality were found in 7 cells, using 95% confidence intervals for the skewness and kurtosis. The observed deviations indicated negative skewness and/or leptokurtic distribution. We performed ANOVA since deviations from normality were not extreme and were observed only in some cells, and ANOVA is usually not seriously affected by lack of normality if sample sizes are large enough.

Probability values of $P\leq0.05$ were considered statistically significant. Data were analyzed using SPSS for Windows, version 9.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The average item difficulty indexes for the whole test ranged across the study groups from 69.4% to 80.2% for girls and from 65.0% to 69.2% for boys. In all 4 study

Figure 1.



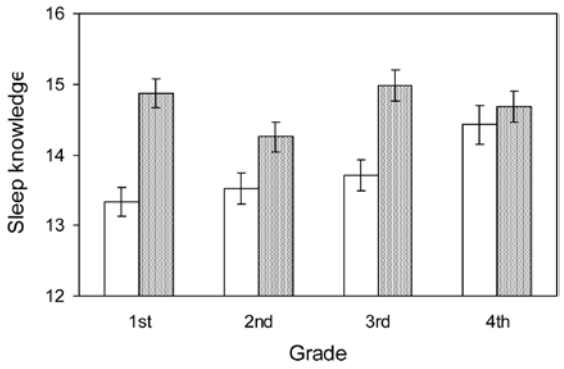
Phases of the study and the experimental design.

groups, female students more often answered correctly the question number 13, regarding the negative effect of a big meal before bedtime on sleep (experimental group 1: 94.0% girls vs 75.2% boys, $\chi^2 = 21.94$, $P < 0.001$; experimental group 2: 94.6% girls vs 73.7% boys, $\chi^2 = 28.11$, $P < 0.001$; control group 1: 88.2% girls vs 76.1% boys, $\chi^2 = 5.84$, $P = 0.016$; control group 2: 93.6% girls vs 68.8% boys, $\chi^2 = 33.87$, $P < 0.001$). In 3 out of 4 study groups, female students more often answered correctly additional three questions. One was the question number 1, on the importance of sleep in comparison with other biological needs (experimental group 1: 84.5% of correct answers in girls vs 65.2% in boys, $\chi^2 = 15.50$, $P < 0.001$; experimental group 2: 76.2% girls vs 62.3% boys, $\chi^2 = 6.92$, $P = 0.009$; control group 2: 75.4% girls vs 63.7% boys, $\chi^2 = 5.36$, $P = 0.021$). The other was the question number 10, on the impact of alcoholic beverages on sleep (experimental group 1: 67.9% of correct answers in girls vs 50.4% in boys, $\chi^2 = 9.78$, $P = 0.002$; experimental group 2: 60.4% girls vs 39.6% boys, $\chi^2 = 9.81$, $P = 0.002$; control group 2: 56.1% girls vs 38.8% boys, $\chi^2 = 10.02$, $P = 0.002$). The third was the question number 12, on the impact on sleep of caffeinated beverages taken in the evening (experimental group 1: 76.8% of correct answers in girls vs 51.1% in boys, $\chi^2 = 22.31$, $P < 0.001$; control group 1: 60.0% girls vs 47.0% boys, $\chi^2 = 4.09$, $P = 0.043$; control group 2: 55.6% girls vs 40.0% boys, $\chi^2 = 8.01$, $P = 0.005$). Sex differences in the frequency of correct answers to other questions were either found only in fewer than 3 study groups or were not found at all.

Four-way ANOVA yielded significant main effects of educational intervention ($F_{(1,1168)} = 36.60$, $P < 0.001$). It indicated that students who had received educational leaflets two weeks before completing the Sleep Knowledge Test achieved on average better score on the test (14.70 ± 0.11) than students who had not received leaflets (13.75 ± 0.11). Further, a significant main effect of grade ($F_{(3,1168)} = 3.21$, $P = 0.022$) showed that scores on the Sleep Knowledge Test varied across grades, from an average score of 14.10 ± 0.14 in the first grade to 13.89 ± 0.15 in the second grade, 14.34 ± 0.15 in the third grade, and 14.55 ± 0.18 in the fourth grade. The main effects

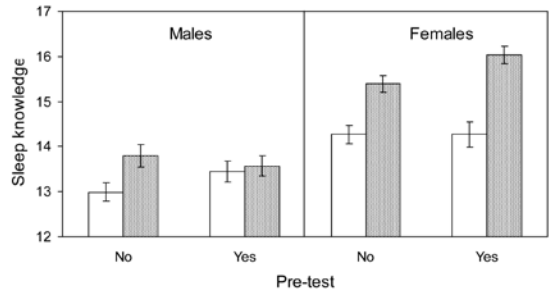
of educational leaflet and grade need to be discussed in the light of significant interaction between grade and educational intervention ($F_{(3,1168)}=3.18$, $P=0.023$) (Figure 2). Analysis of simple main effects of educational leaflet within each grade showed a positive effect of educational leaflet in the first grade ($F_{(1, 1168)}=28.46$, $P<0.001$), second grade ($F_{(1, 1168)}=5.74$, $P=0.017$), and third grade students ($F_{(1, 1168)}=17.17$, $P<0.001$). This effect was not found in the fourth grade students ($P=0.467$). Analysis of simple main effects of grade within each category of educational intervention (whether the students got the leaflet or not) showed that there were no differences in sleep knowledge between students of different grades who received educational leaflet ($P=0.075$). Grade differences in sleep knowledge were found in groups of students who did not receive the leaflet ($F_{(3, 1168)}=3.61$, $P=0.013$).

Figure 2.



Sleep knowledge by grade and educational intervention. Open bars – control groups that did not receive educational leaflet; gray bars – experimental groups that received educational leaflet. Number of participants: control groups – n=156 for the 1st grade, n=146 for the 2nd grade, n=153 for the 3rd grade, and n=120 for the 4th grade; experimental groups – n=166 for the 1st grade, n=151 for the 2nd grade, n=162 for the 3rd grade, and n=146 for the 4th grade.

Figure 3.



Sleep knowledge by pre-testing and educational intervention in male and female adolescents. Open bars – control groups that did not receive educational leaflet; gray bars – experimental groups that received educational leaflet. Number of subjects: male – n=160 for not pre-tested control group, n=114 for not pre-tested experimental group, n=134 for pre-tested control group, and n=141 for pre-tested experimental group; female – n=202 for not pre-tested control group, n=171 for not pre-tested experimental group, n=168 for pre-tested control group, n=110 for pre-tested experimental group.

The ANOVA also yielded significant main effect of sex ($F_{(1, 1168)}=95.95$, $P<0.001$), indicating generally better sleep knowledge in female students, who achieved an average score of 14.99±0.11 on the Sleep Knowledge Test, in comparison with male students who achieved and average score of 13.45±0.11. We also observed significant interaction between sex and educational leaflet ($F_{(1, 1168)}=9.75$, $P=0.002$). This two-way interaction was modified by pre-testing and needs to be interpreted in the light of higher order interaction between pre-testing, educational leaflet, and sex ($F_{(1, 1168)}=4.55$, $P=0.033$) (Figure 3). Analyses of simple main effects of educational leaflet within each combination of sex and pre-testing were performed. In the group of male students, positive effect of leaflet was observed only in students who had not been pre-tested ($F_{(1, 1168)}=6.29$, $P=0.012$), while there was no effect of educational leaflet in those who had been ($P=0.720$). In the group of female students, positive effect of leaflet was observed both in those who had been pre-tested ($F_{(1, 1168)}=26.24$, $P<0.001$) and in those who had not been ($F_{(1, 1168)}=17.36$, $P<0.001$). In addition, the effect was greater in pre-tested girls than in those who had not been not pre-tested ($F_{(1, 1168)}=5.70$, $P=0.017$).

DISCUSSION

Our study showed that distribution of educational leaflets had a positive effect on knowledge about sleep in younger high school students, especially in girls. Educational leaflets enable dissemination of health-related information to many people in a relatively short time. Also, they have been shown to have beneficial effects on knowledge and awareness of different health-related problems, such as arthritis, oral cancer, and diabetes (19-21), and to affect changes in people's health-related behavior (22,23).

Cortesi et al (12) found that Italian adolescents had had poor knowledge about sleep before involvement in sleep education program, but made a significant improvement afterwards. In our study, the difference in knowledge about

sleep between those who received educational leaflet and those who did not was relatively small. Such small difference could be explained by the fact that Sleep Knowledge Test was rather easy for the majority of participants, regardless of whether they got the leaflet or not.

We found that the effect of the leaflet on adolescents' sleep knowledge depended on the age of participants. A positive effect of the leaflet was found in adolescents aged from 15 to 17, but not in adolescents aged 18. It is possible that older adolescents had already been familiar with information presented on the leaflet.

We also found that the effect of the leaflet depended on the sex. Female students in our study showed significantly better sleep knowledge than male students. In contrast, Cortesi et al (12) did not find sex differences in the sleep knowledge of Italian adolescents. We also found that more female than male students in most study groups correctly answered the test questions that can be considered as health-related, such as those about the importance of sleep in general, food intake, and drinking alcoholic and caffeine beverages before bedtime. Such finding is in accordance with the studies which found better knowledge in women than in men for various areas of health (24-26). Better scores in girls may be associated with the fact that girls have different approach to academic achievement than boys. Girls had significantly better grades than boys, which was confirmed by other studies (15,16). Higher achievement in girls than in boys has not yet been fully understood, but one explanation may lie in different student roles that are assumed by girls and boys (16). According to this explanation, girls usually accept the role of a hard-working, dedicated, and focused student, while for boys success in sport and socializing are more important than their academic achievement. A different educational effect in boys and girls may also be related to sex differences in learning styles. High school girls are more self-motivated, persistent, responsible, and conforming in learning than boys (27), which may have affected their better results on the test.

An advantage of Solomon design is that it can be used to determine the effect not only of educational leaflets but also of interaction between the pre-test and education. Our results indicated that girls who were exposed to leaflets generally had better knowledge about sleep. Additionally, girls who had been pre-tested were more sensitive to sleep education and were more responsive to education than those who had not been pre-tested. Male students who were exposed to educational leaflets showed somewhat better knowledge about sleep than those who were not exposed, but only if their knowledge had not been previously tested. Therefore, it seems that either the pre-test or leaflets about sleep slightly sensitized male adolescents to the importance of sleep and principles of healthy sleep. They had a positive effect on their sleep knowledge, but their interest in sleep did not go beyond that and their knowledge about sleep remained at the lower level than it was the case with female adolescents.

The relatively low difficulty of the Sleep Knowledge Test can be considered a drawback of the study, since the test had low sensitivity in discriminating study groups according to their knowledge about sleep. The items of the Sleep Knowledge Test corresponded to the information presented in the leaflet and were selected to achieve two goals. One was to represent the information about sleep and sleep hygiene practices which are of crucial importance for adolescents (28). The other was to match the quantity and complexity of presented information to type of educational method used (leaflets). Relatively high percentage of students who answered at least some items correctly indicated that adolescents had already been acquainted with some information about sleep and sleep hygiene. Yet again, perhaps the difficulty of the Sleep Knowledge Test could have been enhanced by a different response format (ie, recall instead of recognition), which would allow insight into a deeper level of memory process. Another limitation of our study was that we did not analyze the effect of educational leaflet on adolescents' behavior and sleep characteristics. Different knowledge about sleep in different groups of students does not necessarily lead to differences in sleep hygiene practices and sleep characteristics. However, some previous studies (29,30) indicate that in general population there is a positive association between knowledge about sleep hygiene principles and sleep hygiene practice, and that better sleep hygiene practice is associated with better sleep quality. Nevertheless, it is important to note that change of any health behavior is a long-lasting process requiring increasing awareness and knowledge about the health problem (31). Therefore, only limited effects might be expected from such a simple educational method such as leaflet distribution.

From the point of view of primary prevention of sleep problems, it would be important for future studies to include adolescents from primary schools, since education should begin in young children, before prob-

lems related to sleepiness and other consequences of insufficient sleep emerge.

The leaflet method has several advantages over other educational methods, but also some disadvantages. Simplicity may be viewed as both. Leaflets usually do not require great effort from participants except to read the material and follow the instructions. On the other hand, there is no personal interaction with participants, which means that some information from the leaflets can be hard to understand, left unnoticed, or interpreted as irrelevant. This can result in inefficacy of leaflets in increasing knowledge and/or changing people's behavior. Also, we must keep in mind that people acquire health information in different ways, that some graphic designs are more appealing than others, and that not everyone would read leaflets to find out about health-related topics.

In summary, this study experimentally evaluated the effectiveness of one of the most commonly used methods in public health campaigns – distribution of educational leaflets – in a group of high school students. It showed that distribution of educational leaflets could be considered an effective method in public educational campaigns about sleep among high school students.

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