

Effect of Brief Sleep Hygiene Education for Workers of an Information Technology Company

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Abstract: To investigate the effects of sleep hygiene education for workers of an information technology (IT) company, we conducted a controlled clinical trial providing 581 workers one-hour sleep hygiene education. The contents of the sleep hygiene education program were a review of sleep habits, provide sleep hygiene education, and the establishment of sleep habit goals. A self-report questionnaire was used to measure outcomes including the Pittsburgh Sleep Quality Index (PSQI), Karolinska Sleepiness Scale (KSS), Checklist Individual Strength (CIS), Center for Epidemiologic Studies for Depression (CES-D), and mean sleep duration on week-days before and 4 wk after the intervention. A total of 391 participants were included in the analysis, with 214 participants in the sleep hygiene education group and 177 in the waiting list group. KSS score at 2 P.M. decreased by 0.42 points in the sleep hygiene education group, but increased by 0.08 points in the waiting list group, showing a significant effect size of 0.50 (95% CI, –0.97 to –0.04, $p < 0.05$). PSQI score also improved, but the inter-group difference was not statistically significant. The present study provides preliminary evidence that brief sleep hygiene education may improve afternoon sleepiness at work, but not sleep at night for IT workers.

Key words: Sleep hygiene education, Workers, Information technology company, Sleepiness, Controlled clinical trial

Introduction

Insomnia is a significant social issue, with high prevalence rates across the world. The prevalence of insomnia has been shown to range from approximately 9 to 50% in population surveys in the United States (US) and Europe¹⁾. The prevalence of insomnia in Japan was reported to be 21.4% in a population survey²⁾.

Insomnia is known to be common among the working population, with 20% to 30% of workers in Japan reporting disturbed sleep^{3–5)}. Chronic sleep disturbance is reported to lead to fatigue, impaired mood, and behavioral disorders, resulting in reduced performance at work and negative health effects^{6, 7)}. Furthermore,

insomnia leads to work accidents and associated economic losses. Workers experiencing daytime sleepiness due to disturbed sleep were reported to be drowsier during breaks and fall asleep during work more often than other workers, and were also reported to be less satisfied with their work and to have higher rates of absence from work and work accidents⁸⁾. Leger reported that the total cost of work accidents from sleepiness in the US in 1988 was \$24.7 billion⁹⁾. Virginie *et al.* reported that workers with insomnia in France in 2006 missed 5.8 d per year of work, whereas good sleepers missed only 2.4 d¹⁰⁾. A prospective Swedish study also demonstrated a similar association of insomnia with a higher rate of absence from work¹¹⁾. In addition, the annual cost of work absenteeism per employee was reported to be 2,511 euros for insomniacs compared to 1,038 euros for workers with good sleep habits in 2006¹⁰⁾.

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Intervention for and prevention of insomnia are becoming increasingly important. As an intervention for workers with insomnia, sleep medication is often used to treat sleep disturbances, and while short-term use of such medication may be effective for acute or transient sleep disturbances, long-term use is controversial due to the risks of development of tolerance and dependence¹²). Recent studies have concluded that non-pharmacological interventions are clinically effective for sleep disturbance^{13–16}). Non-pharmacological methods for sleep disturbance include sleep hygiene education, bright light therapy and cognitive and behavioral therapies¹⁷). The efficacy of light therapy and behavioral and cognitive therapies for sleep disturbances has been demonstrated in a number of studies, including randomized trials^{18–20}). However, few studies have investigated sleep hygiene education for sleep disturbance, and there is insufficient evidence for its efficacy available at present^{21, 22}). Sleep hygiene education concerns various aspects of lifestyle and behaviors as well as environmental factors such as light, noise, and temperature for the intervention and prevention of insomnia¹³). Sleep hygiene education is suitable for group education in the workplace and is expected to serve a preventive role for those without overt sleep disturbances, allowing it to be profitably incorporated into occupational preventive health education.

In the present study, we provided workers with an one-hour sleep hygiene education program, and then examined the effects of the session on sleep quality, daytime sleepiness, fatigue, depression and mean sleep duration on weekdays.

Subjects and Methods

Participants and procedure

We conducted a controlled clinical trial to evaluate the effect of brief sleep hygiene education for workers of an information technology company in Tokyo.

The methods of the study were reviewed by the health and safety committee of the company. The committee, decided that workers would be assigned to either the intervention group or a waiting list by department groups prior to our obtaining workers' consent, and workers would be informed of the scheduled date of the education session as far in advance as possible. This was because the workers, mostly system engineers with busy schedules, were performing their jobs together in a group. In addition, workers in the waiting list group and workers not participating in the study would also receive the same education as those in the intervention group at a later date.

An industrial hygienist not directly involved in the

study randomly assigned workers to the groups, using a tabular list of departments. All of the 581 workers were assigned to the sleep hygiene education group (307 subjects) or the waiting list group (274 subjects) by department group. Eight shift workers whose schedule included night shifts were excluded. No other exclusion criteria were used. Based on the data reported from the personnel department, the workers worked an average of approximately 200 h per month.

The workers were provided with a written explanation of the objectives and methods of the study in advance. Workers were informed that participation in the study was voluntary and that refusal to participate in the study would not result in any loss of benefits, then they were asked to complete a self-report questionnaire prior to the education session if they chose to participate. Workers were informed that final consent to participate in the present study would be confirmed by returning the self-report questionnaire to the investigator.

Sleep hygiene education was provided to the sleep hygiene education group during June 2007. Four weeks after the education intervention, all participants were asked to complete the self-report questionnaire again. The efficacy of the sleep hygiene education was evaluated through analysis of the changes from the pre-education baseline data.

The study was approved by the Health and Safety Committee at the workplace and the Epidemiology Ethics Committee of Kitasato University.

Contents of sleep hygiene education

The sleep hygiene education consisted of a one-hour program that could be readily implemented at the workplace. The contents of sleep hygiene education were to review current sleep habits, provide information on sleep hygiene in a lecture format, and establish sleep habit goals for the future. A check sheet was used to examine sleep habits. The content of the sleep habits check sheet and the sleep lecture was drawn from a combination of the Therapeutic Guidelines for Treating Sleep Disturbances published by a Japanese Ministry of Health, Labour and Welfare study group²³), a manual prepared by the US National Institutes of Health²⁴), and the 16 tips prepared for the general public by the American Academy of Sleep Medicine²⁵). The aim was to produce a program that would be easy for the workers of the company to put into practice. The following 13 items were listed on the sleep habits check sheet: get up at the same time every day, be exposed to morning sunlight on awakening, eat regular meals, avoid hard exercise 2 h before bedtime, take a warm and relaxing bath, avoid caffeine after dinner, avoid alcohol before going to bed, avoid using the computer before going to

bed, use incandescent lighting at night, listen to relaxing music before going to bed, use aromatherapy, breathe from the abdomen, and go to bed only when sleepy.

Workers were instructed to complete the check sheet regarding their current sleep habits 10 min prior to the lecture. An occupational health physician then lectured on sleep hygiene for 40 min. The lecture focused on the role and mechanism of sleep, the proper sleep environment for promotion of good sleep (including proper light level, noise level, and temperature), relaxation therapies (including proper bathing, exercise, music, aromatherapy, and abdominal breathing), and sleep stimulation control therapy procedures (including going to bed only when sleepy, as well as caffeine restriction and autonomic balance control). The lecture was followed by a 10-min question-and-answer session. In this session, workers were instructed to use the sleep habits check sheet to select approximately three sleep habits that they were going to try to adopt to ensure good sleep in the future. To increase the efficacy of the education, e-mail follow-up was conducted by the occupational health physician 2 wk after the session. At the follow-up session, the occupational health physician inquired as to whether the employee had been able to put the self-selected sleep-related behaviors into practice and encouraged continued compliance. The waiting list group was instructed to continue to lead an ordinary lifestyle.

Measurements

The self-report questionnaire completed before and 4 wk after the intervention period included questions on sleep quality, daytime sleepiness, fatigue, depression and mean sleep duration on weekdays. To investigate the difference in potential confounding factors, the questionnaire before intervention included questions on age, sex, mean sleep duration on weekdays, caffeine intake before going to bed, smoking habit, habitual alcohol drinking, and exercise habits.

Sleep quality

The Japanese version of the Pittsburgh Sleep Quality Index (PSQI) was used in the study. PSQI is a standard index for assessing sleep quality and is widely used in both clinical settings and public health practice²⁶. The Japanese version of this index has been demonstrated to be reliable and valid²⁷. This self-report questionnaire combines seven components for evaluating sleep quality and quantity over the previous month, namely sleep quality, sleep-onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction, the score of which are totaled

to yield a global sleep quality score (ranging from 0 to 21). Higher score indicate worse sleep quality, and a global PSQI score of 6 points or higher indicates poor quality sleep.

Daytime sleepiness

The Japanese version of the Karolinska Sleepiness Scale (KSS) was used to assess daytime sleepiness. The Japanese version of the scale has been demonstrated to be reliable and valid²⁸. The KSS evaluates sleepiness on a 9-point scale, with evaluations ranging from “very alert” (score=1) to “very sleepy, fighting sleep” (score=9). KSS has been used to evaluate sleepiness in a number of studies, and KSS results have been shown to be significantly correlated with performance and various physical indicators²⁹. In the study, subjects were questioned about sleepiness at 10 A.M. and 2 P.M. on the day the self-report questionnaire was completed.

Fatigue

The Japanese version of the Checklist Individual Strength (CIS) was used to evaluate fatigue. The Japanese version of the checklist has been shown to be satisfactorily reliable and valid for assessing fatigue among a Japanese population^{30, 31}. The CIS is a questionnaire about fatigue developed by Vercoulen *et al.* that is widely used all over the world. The CIS consists of 20 questions that evaluate fatigue over the previous two weeks on a 7-point scale. The CIS is composed of four subscales: subjective fatigue (8 items), reduced motivation (4 items), reduced activity (3 items), and reduced concentration (5 items). A high total CIS score indicates a high level of fatigue and low motivation, concentration, and levels of activity³¹.

Depression

The Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D) was used to evaluate depression. The Japanese version of the scale has been shown to be reliable and valid³². The CES-D is a 20-item questionnaire developed to assess depressive symptoms in the general population and is used to screen for depressive symptoms developing in the past week. Higher score indicate higher levels of depression.

Statistical Analysis

Analysis included subjects who completely answered all of the age, sex, mean sleep duration on weekdays, PSQI, KSS, CIS, and CES-D score. Student's *t*-test and the χ^2 test were performed on the baseline data to assess differences between the sleep hygiene education

Table 1. Baseline characteristics of the participants

Variables	Total (n=391)	Intervention group (n=214)	Waiting list group (n=177)	<i>p</i> value
PSQI score	6.4 (2.5)	6.4 (2.4)	6.4 (2.5)	0.85
KSS score at 10 A.M.	3.5 (2.1)	3.4 (2.1)	3.6 (2.1)	0.61
KSS score at 2 P.M.	4.9 (2.3)	4.9 (2.4)	4.8 (2.3)	0.70
CES-D score	15.5 (7.3)	15.0 (6.8)	16.0 (7.8)	0.16
CIS score	75.6 (18.9)	75.0 (18.2)	76.3 (19.7)	0.51
Sex, males, n	316 (80.8)	176 (82.2)	140 (79.1)	0.25
Age, years	33.8 (9.3)	34.9 (9.0)	32.5 (9.5)	0.01
Mean sleep duration on weekdays, hours/day	5.8 (1.1)	5.8 (1.2)	5.8 (1.1)	0.79
Caffeine intake before going to bed, n	179 (45.8)	104 (48.6)	75 (42.4)	0.16
Smoking habit, n	77 (20.0)	46 (21.5)	31 (17.5)	0.24
Habitual alcohol drinking, n	236 (60.4)	126 (58.9)	110 (62.1)	0.22
Exercise habits, n	142 (36.3)	80 (37.4)	62 (35.0)	0.29

PSQI, Pittsburgh Sleep Quality Index; KSS, Karolinska Sleepiness Scale; CES-D, Center for Epidemiologic Studies Depression Scale; CIS, Checklist Individual Strength; Intervention group, Sleep hygiene education group.

PSQI, KSS, CES-D, CIS, Mean sleep duration and age are presented as mean (SD). Others are presented as number (%). Analyses were performed using the χ^2 test and *t*-test.

group and the waiting list group with regard to age, sex, mean sleep duration on weekdays, caffeine intake before going to bed, smoking habit, habitual alcohol drinking, exercise habits, PSQI score, KSS at 10 A.M. and 2 P.M. score, CES-D score, and CIS score. The efficacy of sleep hygiene education was determined by comparing the two groups for changes in outcomes 4 weeks after education. Analysis of covariance (ANCOVA), adjusted for covariates which were significantly different between the education group and waiting list group at baseline, was used to compare the change between the two groups. SPSS 11.5J software for Windows was used for the statistical analysis software, and the level of significance was set at $p < 0.05$.

Results

Of the 307 subjects in the departments pre-assigned to the education group, 270 (87.9%) consented to participate in the study, and 194 (70.8%) of the 274 subjects in the departments pre-assigned to the waiting list group consented to participate. For the 270 participants, the same sleep hygiene education was repeated four times, with approximately 70 participants per session. Two hundred and fourteen (79.3%) of the 270 participants who had attended the education session answered the post-education self-report questionnaire, and 177 (91.2%) of the 194 participants in the waiting list group returned the questionnaire. Reasons for refusal to consent to participate in the study and failure to complete the post-education questionnaire were not inquired.

A total of 391 subjects were ultimately included in

the analysis, with 214 subjects in the sleep hygiene education group (176 males and 38 females) and 177 in the waiting list group (140 males and 37 females). Three hundred seventy-one (95%) of 391 participants were system engineers. No significant differences were noted between the 73 subjects who did not complete the post-education questionnaire and the 391 ultimately included in the analysis with regard to mean age, sex, mean sleep duration on weekdays, PSQI score, KSS score, CIS score, and CES-D score.

Table 1 shows the results of the comparison of the baseline data between the sleep hygiene education group and the waiting list group prior to intervention. A significant difference in mean age was noted between the sleep hygiene education group (mean age [SD] was 34.9 [9.0] yr) and the waiting list group (32.5 [9.5] yr) ($p = 0.01$), but no significant inter-group differences were noted for any of the other parameters. The average PSQI score of all participants was high at 6.4 (2.5), and the average per-day mean sleep duration on weekdays on weekdays of all participants was 5.8 (1.1) h. The CES-D and CIS score were also high, indicating that the workplace tended to foster depression and fatigue.

The sleep habits most commonly selected as future goals in the sleep hygiene education group were exposure to morning sunlight (selected by 122 subjects [45%]), abdominal breathing before bed (selected by 113 [41%]), listening to music before bed (selected by 80 [29%]), taking a relaxing bath (selected by 77 [28%]), and going to bed only when sleepy (selected by 63 [23%]).

Inter-group differences between the sleep hygiene education group and the waiting list group with regard

Table 2. Effect of sleep education on PSQI, Mean sleep duration on weekdays, KSS, CES-D, and CIS adjusting for age

Variables	Intervention group		Waiting list group		Inter-group difference		
	mean change	SE	mean change	SE	Difference	95%CI	<i>p</i> value
Global PSQI score	-0.67	0.13	-0.41	0.14	-0.26	(-0.64, 0.12)	0.17
KSS score at 10 A.M.	0.03	0.15	0.28	0.16	-0.25	(-0.68, 0.19)	0.27
KSS score at 2 P.M.	-0.42	0.16	0.08	0.18	-0.50	(-0.97, -0.04)	0.04
CES-D score	-0.20	0.39	-0.22	0.42	0.02	(-1.11, 1.15)	0.97
CIS score	-1.00	0.89	-0.61	0.98	-0.39	(-2.99, 2.22)	0.77
Mean sleep duration on weekdays, hours/day	0.03	0.07	0.07	0.08	-0.04	(-0.24, 0.16)	0.69

PSQI, Pittsburgh Sleep Quality Index; KSS, Karolinska Sleepiness Scale; CES-D, Center for Epidemiologic Studies Depression Scale; CIS, Checklist Individual Strength; Intervention group, Sleep hygiene education group.

to change in measurements 4 wk after the intervention are described in Table 2. The sleep hygiene education group exhibited greater improvement in global PSQI score (0.67-point decrease) than the waiting list group (0.41-point decrease), but the inter-group difference was not statistically significant (effect size was -0.26 points [95%CI, -0.64 to 0.12]), $p=0.17$). The KSS at 2 P.M. score differed significantly between groups, with the sleep hygiene education group showing a 0.42-point decrease and the waiting list group a 0.08-point increase (effect size was -0.50 points [95%CI, -0.97 to -0.04]), $p=0.04$). The changes in KSS score at 10 A.M., CES-D score, CIS score and mean sleep duration on weekdays did not differ significantly between the two groups. The participants sustained short sleep (5.8 h per day on weekdays) during the study period. Additional analysis of the 219 subjects classified as having poor quality sleep at baseline, indicated by a global PSQI score of 6 points or higher, showed greater improvement in global PSQI score in the sleep hygiene education group (1.18-point decrease) than in the waiting list group (0.70-point decrease), although not to a significant degree (effect size was -0.48 points [95%CI, -1.02 to 0.06]), $p=0.08$). Additional analysis of the 180 subjects classified as having poor quality sleep, and severe depression excluded at baseline, indicated by a global PSQI score of 6 points or higher and CES-D score of 24 points or lower at baseline, showed greater improvement in global PSQI score in the sleep hygiene education group (1.29-point decrease) than in the waiting list group (0.71-point decrease), although not to a significant degree (effect size was -0.58 points [95%CI, -1.18 to 0.02]), $p=0.06$).

Discussion

In the present study, a one-hour session of sleep hygiene education resulted in a significant decrease in daytime sleepiness at 2 P.M. 4 wk after the session for 391 information technology workers. The effects of

this intervention were not statistically significant for the other outcomes, but perceived sleep quality as measured by PSQI appeared to improve. These findings provide empirical evidence that a single, brief opportunity of sleep hygiene education may be useful for preventing afternoon sleepiness in the workplace. Lavie P. and Dement W.C. showed that insufficient sleep increases daytime sleepiness^{8, 33}). In addition, Bes F. *et al.* reported that sleep propensity increases slightly and reaches its highest value in the early afternoon, at 2 P.M.³⁴). We suggest that daytime sleepiness at 2 P.M. is the outcome most susceptible to improvement of night sleep. Improvement of daytime sleepiness has high significance from the perspective of safety and performance in the workplace.

In the education session, workers established goals for improved sleep habits using a sleep habits check sheet and were encouraged to continue to work to establish good sleep habits in a follow-up session conducted by an occupational health physician. These aspects of the education are considered to have contributed to the overall efficacy of the program.

The most commonly selected sleep habit goal among participants was obtaining exposure to morning sunlight. In the education, it was emphasized that the tendency of many system engineers to sleep late at night and wake up late in the morning is detrimental to good sleep and stressed the importance of waking up early in the morning and obtaining light exposure. This focus is considered to have contributed to the large number of engineers choosing to make an effort to obtain exposure to morning sunlight. Morning sunlight has been reported to effectively advance the sleep phase and synchronize the circadian rhythm with the sleep-wake cycle^{17, 35}), possibly resulting in improved sleep and reduction in daytime sleepiness.

The sleep hygiene education also prompted a number of participants to attempt to adopt lifestyle habits to promote relaxation, including abdominal breathing, listening to music, and taking a relaxing, warm bath.

Relaxation therapies have been proven to be effective against patient-specific insomnia symptoms in a number of studies³⁶). In particular, music therapy has been reported to reduce anxiety and improve quality of sleep in several studies^{37, 38}). Relaxation techniques may be self-implemented at one's convenience and can result in improved sleep³⁹). The ease with which these techniques may be adopted facilitates sleep habit modification and may in fact be responsible for the positive results of the present study.

The education session in the present study also covered sleep stimulus control therapy procedures, such as going to bed only when sleepy. Several studies have shown that sleep stimulus control therapy is more effective than relaxation therapies in reducing the symptoms of insomnia³⁶). Sleep stimulus control therapy has been shown to effectively reduce sleep-onset latency³⁹) and to effectively help maintain sleep¹⁷). Adachi *et al.* found that individual sessions of behavioral therapy including sleep stimulus control resulted in increased mean sleep duration on weekdays, reduced sleep-onset latency, and improved sleep efficiency⁴⁰). The results of the present study did not demonstrate that our sleep hygiene education is significantly effective at improving sleep quality, fatigue, depression or mean sleep duration on weekdays. Previous studies have reported that fatigue and depression are significantly associated with sleep duration^{41, 42}). In the present study, the participants sustained shortage of sleep during the study period. Therefore, these outcomes were not significantly improved. A recent internet-based interventional study of insomniacs showed reduced sleep disturbance and arousal during sleep, and improved sleep efficiency⁴³). A study using internet-based sleep hygiene education (combining elements of sleep hygiene, sleep stimulus control, and relaxation therapies) for workers having a desire to improve sleep quality improved subjective sleep, although the global PSQI score was not improved significantly⁴⁴). Our study included not only insomniacs, but also healthy participants who were not necessarily motivated to participate in the education program, which might have weakened the effect of the intervention. Most of the previous studies examining the efficacy of sleep hygiene education were conducted for sleep-disturbed patients who were highly motivated to participate. Further studies are required to learn how to enhance the motivation of participants without immediate symptoms²⁰).

Compared to non-pharmacological therapies such as relaxation therapies, sleep restriction therapy is reported to take less time to implement⁴⁵), and to be more effective among chronic insomniacs⁴⁶). However we didn't include about sleep restriction therapy procedure in our

education, because the participants didn't have much time for sleep.

Several limitations of the present study warrant mention. First, allocation was not fully random. Study participants were not allocated individually at the registration center or by a computer-generated randomization chart, but were allocated in groups using an incomplete randomization method in which an industrial hygienist not directly involved in the study assigned groups consecutively, using a tabular list of departments. Additionally, in accordance with the company's request, assignment to the two groups was performed before obtaining consent from the participants. Such methodology was advantageous to the participants working in a group from a scheduling perspective because potential participants were made aware of the date of the education session in advance. However, some workers may have refused to participate because they knew in advance that they had been assigned to the waiting list group. Second, the response rate for the questionnaires was relatively low. Although the reasons for these factors were not examined, work demands may be assumed to have played a large role. Third, only subjective measures, not objective evaluation indices, were used in the evaluation. Fourth, the observation period was relatively short at 4 wk. To evaluate the effect of the sleep hygiene education more appropriately, a long-term observation is needed. Fifth, the sleep habits check sheet was unsigned and administered only to the sleep hygiene education group, and the relationship between the effects and change in sleep habits could not be investigated. Sixth, we did not investigate the working hours.

Although the short mean sleep duration on weekdays was probably a result of the long working hours of the participants, it hampered the demonstration of the efficacy of sleep hygiene education intervention; however, afternoon sleepiness did improve among study participants. Seventh, smoking before going to bed was not investigated. We only questioned whether or not workers had a smoking habit in the additional analysis, no significant differences between habitual smokers and non-smokers were noted for any of the outcomes. Improvement of sleepiness in the workplace can not only prevent work accidents, but can also improve workers' quality of life. Instruction in good sleep hygiene can help workers achieve quality sleep despite limited mean sleep duration on weekdays as well as achieve improvement in sleep disturbances without the use of drugs. Further studies providing sleep hygiene education to workers in a wide range of occupations including shift work are needed.

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