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Original Article

Effects of Sleep Hygiene Education and Behavioral Therapy on Sleep Quality of White-collar Workers: A Randomized Controlled Trial

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Abstract: Because poor sleep quality can reduce quality of life and increase prevalence of illness in workers, interventions are becoming increasingly important for businesses. To evaluate how sleep quality is affected by one-on-one behavioral modification when combined with group education, we conducted a randomized, controlled trial among day-shift white-collar employees working for an information-technology service company in Japan. Participants were randomly allocated to groups receiving either sleep hygiene group education (control group), or education combined with individual sleep modification training (one-on-one group). Occupational health professionals carried out both procedures, and sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). PSQI scores were obtained before and after the intervention period, and changes in scores were compared across groups after adjustments for age, gender, job title, smoking and drinking habits, body-mass index, and mental health as assessed using K6 scores. The average PSQI score for the control group decreased by 0.8, whereas that of the one-on-one group decreased by 1.8 (difference of 1), resulting in a significantly greater decrease in score for the one-on-one group (95% confidence interval: 0.02 to 2.0). These results show that, compared to sleep hygiene group education alone, the addition of individual behavioral training significantly improved the sleep quality of workers after only three months.

Key words: Behavioral approach, Relaxation training, Stimulus control, Seep restriction, Randomized controlled trial, Seep hygiene education, Worker

Introduction

Poor sleep quality, including insomnia, can reduce the quality of life (QOL)[1, 2]. A large-scale survey of day-shift white-collar employees in Japan revealed that poor sleep quality, regardless of meeting the diagnostic criteria for insomnia, can result in great monetary costs to their employers[3]. The study reported that, among these workers, the one-month point prevalence of poor sleep quality evaluated using the Pittsburgh Sleep Quality Index (PSQI) was approximately 30 to 45% across all ages and genders, significantly higher than that in the general population of Japanese adults[3]. Further, poor sleepers were more likely to take sick leave, suffered from worse physical and psychological health, and had more problems with both

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job-related activities and personal relationships than those with relatively normal sleep. Well-designed occupational interventions will be highly beneficial to companies by ensuring good sleep and health of employees[4].

Sleep hygiene education includes aspects of lifestyle and behavior as well as environmental factors such as light and noise[5] and is expected to serve a preventative role in those without overt sleep disturbances, allowing it to be profitably incorporated into occupational health education[6]. However, such education has been reported to be less effective when applied as the sole measure taken to improve sleep habits[7]. Engle-Friedman *et al.* conducted a randomized controlled trial to evaluate the effect of sleep hygiene education among the elderly, with results showing that unless additional interventions such as stimulus control were added, sleep education was of limited therapeutic value[8]. As a workplace example, Kakinuma *et al.* provided workers with a one-hour sleep hygiene education program focused on significantly decreasing daytime sleepiness at 2 P.M; however, that study failed to find a significant change in the PSQI score[6].

Several studies have reported that a program combining sleep hygiene education with cognitive behavioral exercises such as relaxation training, sleep restriction, and stimulus control is an effective method of non-pharmacological intervention for patients with insomnia[5, 9]. In the workplace, Suzuki *et al*. evaluated the effect of an Internet-based self-help program (including sleep hygiene and cognitive behavioral therapy) on sleep quality. However, they noted no significant change in PSQI score[10]. Given that relevant lifestyle patterns vary by individual, face-to-face intervention should be included to provide each worker with the most appropriate knowledge for their specific needs with regards to better sleep quality.

Japanese companies employ health professionals (physicians or nurses) to provide workers with health services such as in-house group education and individualized health guidance. Recently, several companies have started to provide sleep hygiene group education, despite the evidence described above showing that this alone does little to improve sleep quality. Here, we conducted an RCT with white-color workers to assess whether or not intervention using both sleep hygiene group education as well as individually based behavioral modification is a more effective means to improve sleep quality than education alone.

Methods

Participants and procedures

Participants were white-collar, day-shift employees at an information technology (IT) service company in Japan that regularly provides workers with in-house mental health education. The Safety and Health Committee approved the incorporation of sleep hygiene into the in-house education program in 2009 and allowed our team to conduct the present RCT. Of note: despite the education having been approved since 2009, this was the first time this IT company provided workers with sleep hygiene education.

Study participation was voluntary, and informed consent was obtained from workers prior to sleep hygiene education after explaining the purpose, procedures, and details of the intervention. Workers who had been treated for psychiatric disorders or sleep disorders (as reported on a self-administered questionnaire) were not included in the study. We established no other exclusion criteria. Due to corporate compliance policy prohibiting the removal of employees' private information from the company, data were not entered into the clinical trial registry.

Participants were randomly allocated to groups receiving either sleep hygiene education alone (control group) or a combination of group education with individually based behavioral training (one-on-one group). Employees who did not consent to this study also received the requisite sleep hygiene education with study participants. After completion of the study, control group participants also received one-on-one behavioral assistance for ethical reasons. This study was approved by the ethics committee of Kitasato University.

Administration of intervention

Sleep hygiene education was provided by the physician employed by the IT company, and the individual behavioral training was carried out by two occupational health nurses in addition to the physician. Prior to the study, professionals completed a three-hour training program covering both procedures using educational materials prepared by a sleep specialist. Intervention was conducted during working hours.

Control condition: Group-based sleep hygiene education

The group-based sleep hygiene education was a 40-min program consisting of a 30-min lecture followed by a ten-min question-and-answer session. Group sessions were repeated five times with approximately 20 to 30 participants

Table 1. Contents of sleep hygiene group education

Health education

1. Sleep structure.
2. Number of sleeping hours needed and individual variations.
3. Sleep as a reflection of daytime functioning and vice-versa.
4. The importance of bedroom conditioning.

Sleep hygiene education

Endeavor to…

1. Get up every day at the same time, including weekends.
2. Avoid taking daytime naps. If you have to take them, make sure you do so before 3:00 pm and that the total time napping does not exceed one hour.
3. Avoid the use of caffeinated products, nicotine, and alcohol, especially later in the day.
4. Avoid heavy meals within 2 h before going to sleep.
5. Maintain appropriate environmental conditions for sleep.
6. Avoid stressful activities in the hours before going to sleep (i.e. avoid noisy environments).
7. Pursue regular physical activity, such as walking or gardening, but avoid vigorous exercise within a few hours before going to sleep.
8. Take a bath in body-temperature water to relax.
9. Do breathing-control exercises to relax.

per session between April and September 2011.

Educational resources were prepared with references to the "Guidelines for diagnosis and treatment of sleep disorders[11]", "Sleep, Sleep Disorders, and Biological Rhythms[12]" and "Sleep Hygiene – The Healthy Habits of Good Sleep[13]". Contents of the program are described in Table 1. At the end of sleep hygiene education, the participants were asked to choose a feasible approach for improving sleep quality or any of the habitual behaviors presented in the program and were subsequently instructed to adopt it into their daily routine.

Intervention condition: individually based behavioral training combined with group-based sleep hygiene education

Within a week of completing the sleep hygiene education, participants received individual behavioral training that consisted of a single 30-min session. After being interviewed regarding current sleep habits, participants were asked to choose any of the following three behavioral modifications adapted specifically to them: relaxation training, stimulus control, or sleep restriction. After selecting a method, participants were instructed how to practice it in their everyday lives. Behavioral approach particulars are described in detail in Table 2. Instructors were always available to answer questions from participants via e-mail. The extent to which the participants maintained the new behavior was not investigated.

Outcome measures

Sleep quality was assessed using the PSQI, a test that has enjoyed widespread use in the field of public hygiene, and the Japanese version of which has been confirmed as reliable and valid[14, 15]. The PSQI rates aspects of sleep, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the previous month, and calculates a total PSQI score (0–21 points) that quantifies sleep quality. A score of 6 or more indicates poor-quality sleep[16].

We obtained PSQI scores before the start of the study and compared them to scores obtained three months after completion of intervention. The main outcome measurement was the change in PSQI scores for each experimental group. We also compared the proportion of workers with PSQI scores ≥ 6 across each group before and after training.

Adjustment factors known to be associated with sleep quality—including age, gender, job title, smoking and drinking habits, body-mass index, and mental health[17–20]—were assessed in all participants using the K6 screening scale via a self-administered questionnaire before the group education session. The K6 screening scale is a six-item self-administered screening tool designed to detect mood disturbance and anxiety disorder. The scale is used to rate the severity of anxiety and depression symptoms on a five-point rating scale, quantifying a subject's mental health with a score ranging from 6 to 30 points; the higher the score, the higher the prevalence of mood disturbance and anxiety disorder[21]. The Japanese version of the K6 has been validated for screening mental disorders by Furukawa *et al*[22].

Table 2. Contents of the individual behavioral approach

Stimulus control
Participants were encouraged to adhere to the following advice:
1. Do not use the bedroom for activities other than sleep. Do not read, watch TV, or talk on the phone.
2. If it takes a while to fall sleep (more than 10–15 min), get up and go into another room. Do something until you start to feel sleepy, and then go back into the bedroom to sleep.
3. Get up at about the same time every morning, on both weekdays and weekends, regardless of the time you have gone to bed.
4. Do not nap during the day.
5. Do not use the computer before going to bed [within X hours before going to bed?]
Sleep restriction
The participants were encouraged to adhere to the following advice:
1. Stay in bed 15 min longer than the average sleep duration over the last 2 wk. Time in bed should not be less than 5 h.
2. Subtract the amount of time spent sleeping from the time for awakening, and set this as the subjective bedtime.
3. Increase total time in bed by 15 min when sleep efficiency exceeds 90% for 5 consecutive nights. Adjust the total time in bed until the ideal sleep duration is obtained.
Relaxation
The participants were asked to choose a feasible approach from one of the following:
1. Breathing control: Do breathing-control exercises to relax.
2. Music therapy: Listen to music (health professionals provided soothing music to subjects who requested it)
3. Aromatherapy: Participants chose their favorite scent from sleep-inducing essential oils (lavender, ylang-ylang, etc.), and these were provided for 2 wk. Participants were instructed to wet a tissue with a drop of essential oil and to then place the tissue by the bedside. If they believed the aromatherapy was beneficial, they were advised to purchase the oils themselves to continue.

Sample size

The sample size required to achieve the main outcome was calculated using a two-tailed *t*-test (α=0.05). We assumed a mean difference of 1.0 PSQI points between the control and one-on-one groups and a standard deviation (SD) of 2.0 PSQI points for each group, based on previous studies[6]. Taking these assumptions into account, we calculated that a sample size of 63 for each group would be required to ensure a statistical power of 80%. For this reason, we sought to recruit at least 126 subjects.

Randomization

Random assignment was performed using a permuted block method with a block size of six and no stratification. A research assistant who had no direct contact with participants was responsible for generating the random numbers.

Statistical analysis

Intent-to-treat analysis was performed using the last-observation-carried-forward method (data from one month after the end of the group session was used for participants for whom no three-month follow-up data were available).

A generalized linear model was used to evaluate differences between the changes in PSQI score across groups after the three-month period. Effect size was calculated after adjusting for the factors mentioned above (*outcome measures*). Seven subscale scores of the PSQI were not analyzed because the small sample size would have increased the likelihood of Type II errors, as well as Type I errors from multiple testing. All tests were two-tailed with significance set at 0.05 and were conducted with SPSS ver. 12 (SPSS Inc., Chicago, IL, USA).

Results

A flow diagram of this study is shown in Fig. 1. Of 136 who received regular in-house education, 129 (94.9%) agreed to participate in the study, and all completed sleep hygiene group education. After excluding 2 men who had been treated for psychiatric or sleep disorders, 127 participants were allocated to the intervention (62; 51 male [82.3%]) or control (65; 58 male [89.2%]) groups.

Baseline demographic characteristics of the study participants are described in Table 3. The mean ages of the one-on-one and control groups were 31.3 (SD=7.1) and 31.3 (SD=7.2) yr, respectively. No significant differences in age, gender make-up, job title, BMI, smoking and drinking, sleep duration, K6 score, or PSQI score were noted between groups.

Of the 62 participants in the one-on-one group, 61 completed all individual behavioral sessions. One participant missed a single session due to work but still received the three-month follow-up questionnaire, and was therefore

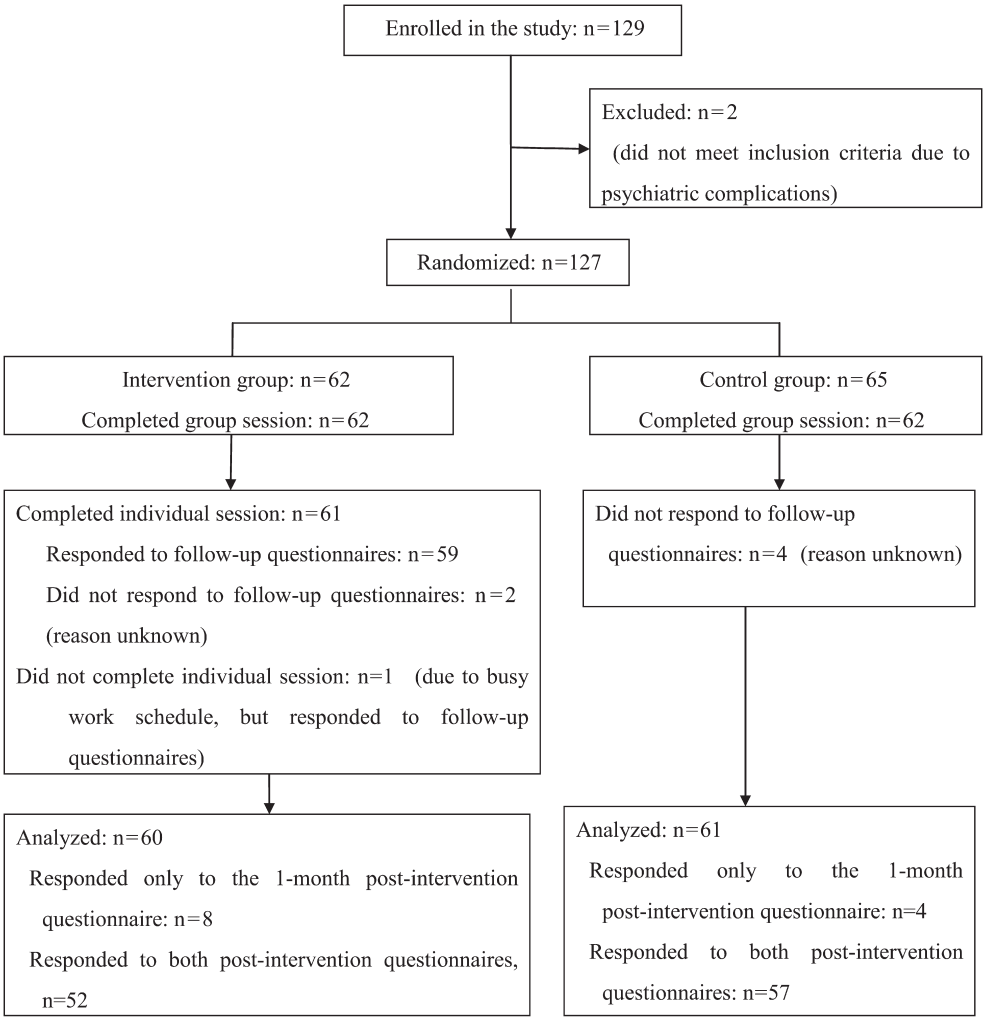

Fig. 1. Flowchart of participant allocation and outcome assessment.

Table 3. Baseline demographic characteristics of participants

	Total (N=127)	Intervention (N=62)	Control (N=65)	*p*
Number of males, n (%)	109 (85.8)	51 (82.3)	58 (89.2)	0.31
Age in years, mean (SD)	31.3 (7.1)	31.3 (7.0)	31.3 (7.2)	0.98
Managerial position, yes, n (%)	34 (26.8)	16 (25.8)	18 (27.7)	0.84
BMI, kg/m^2, mean (SD)	22.4 (3.5)	22.4 (4.0)	22.3 (3.1)	0.80
Mean sleeping hours on weekdays, mean (SD)	5.6 (0.8)	5.6 (0.9)	5.6 (0.84)	0.99
Smoking habit, n (%)	28 (22.0)	14 (22.6)	14 (21.5)	0.71
Nighttime drinking, n (%)	8 (6.7)	4 (6.8)	4 (6.6)	1.00
Missing, n (%)	7 (5.5)	3 (5.0)	4 (6.2)	
K6 score, mean (SD)	2.4 (3.0)	2.2 (3.0)	2.6 (3.0)	0.47
PSQI score, mean (SD)	6.6 (3.1)	6.9 (3.0)	6.3 (3.1)	0.27
≥6	79 (62.2)	41 (68.3)	37 (60.7)	0.46

SD, standard deviation; BMI, body mass index; PSQI, Pittsburgh Sleep Quality Index. Categorical variables were analyzed using Fisher's exact tests, and continuous variables were analyzed using *t*-tests.

Table 4. Difference in changes of PSQI scores between the intervention and control groups

	Mean change (SE)[1]		Difference (95%CI)[1]	*p* value
	Intervention group	Controls		
PSQI score	−1.7 (0.4)	−0.3 (0.4)	1.4 (0.3, 2.4)	0.01
	Mean change (SE)[2]		Difference (95%CI)[2]	*p* value
	Intervention group	Controls		
PSQI score	−1.8 (0.8)	−0.8 (0.8)	1.0 (0.02, 2.0)	0.047

SE, standard error of mean; CI, confidence interval; PSQI, Pittsburgh Sleep Quality Index. [1]Unadjusted, [2]After adjustment for age, gender, job title, smoking and nightcap habits, BMI, K6 scores, and baseline PSQI scores.

Table 5. Difference in the change in proportion of poor-sleep quality workers between the experimental groups

	Change in proportion		Difference	*p* value[1]
	Intervention group	Controls		
Proportion of those with poor sleep quality (PSQI ≥ 6)	−23.3%	−11.5%	11.8%	0.08

PSQI, Pittsburgh Sleep Quality Index. [1]Fisher's exact tests.

included in the analysis. Of the 61 participants who completed all individual sessions, two were excluded from analysis because they did not respond to one of the follow-up questionnaires. In total, 60 participants were included in the final analysis, including eight participants who did not respond to the three-month follow-up questionnaire but whose responses to the one-month follow-up questionnaire were used as the final outcome. Of the 65 participants in the control group, four were excluded from analysis because they did not respond to one of the follow-up questionnaires. A total of 61 participants from this group were therefore included in the final analysis, including four subjects who did not respond to the three-month follow-up questionnaire but whose responses to the one-month follow-up questionnaire were used as the final outcome. No significant differences were observed between excluded and included individuals with respect to age or gender.

Table 4 shows the variation between the baseline PSQI score and that obtained three months after intervention, and the results of comparisons between groups. In unadjusted analysis, the average PSQI score of both groups significantly decreased after the three-month period, with the one-on-one group decreasing significantly more than the control group (one-on-one group: decrease of 1.7; control group: decrease of 0.3; difference between groups, 1.4; 95% confidence interval [CI]: 0.3 to 2.4). After adjusted analysis, the decrease in PSQI score remained significantly higher for the one-on-one group (one-on-one group: decrease of 1.8; control group: decrease of 0.8; difference between the groups, 1.0; 95%CI: 0.02 to 2.0).

The change in the proportion of workers with PSQI scores ≥ 6 (poor sleep quality) is shown in Table 5. In the one-on-one group, this proportion decreased by 23.3% (from 68.3% [41/60] to 45.0 % [27/60]), while that in the control group decreased by only 11.5% (from 60.7% [37/61] to 49.2% [30/61]). The difference (11.8%) between the two groups was significant (p=0.08). Additionally, after adjusting the confounding factors in the one-on-one group, the PSQI score decreased by 2.3 (95%CI: –3.2 to –1.5) in the poor sleep group and by 0.3 (95%CI: –1.1 to 0.5) in the good sleep group (PSQI score<6), showing a significant difference of 2.0 (95%CI: –1.0 to –3.0) between the two groups.

Harmful events likely related to the intervention

No participants reported harmful events associated with the intervention in the present study.

Discussion

Here we found that by adding individual behavioral modification to sleep hygiene group education, sleep quality improved significantly compared to group education alone. Further, the combined intervention reduced the proportion of participants reporting poor sleep quality. In the one-on-one group, the PSQI score was decreased by 1.8 and the ratio of poor sleeper was decreased by 23.3%. Considering that poor sleep quality is closely related to

QOL and absence from work, these results are particularly meaningful from the perspective of preventative medicine in the workplace.

Our results are consistent with those found in previous multi-component therapies that included sleep hygiene education, stimulus control, sleep restriction, or relaxation training given by a sleep specialist. The magnitude of the changes was similar to previous studies examining non-insomniac populations[23]. However, our study can be differentiated from others in the following respects: the participants were all healthy workers, group and individual interventions were carried out by occupational health professionals who were not sleep specialists, and the group and individual interventions took only 40 and 30 min, respectively.

Most previous studies have involved patients already suffering from sleep disturbances, with relatively few reporting findings in healthy workers who have not been previously treated for psychiatric disorders or sleep disturbances. Kakinuma *et al*. conducted an intervention study in healthy workers involving one hour of sleep hygiene group education, with the participants themselves establishing behavioral goal of achieving good sleep. Participants in the intervention group reported a significant improvement in daytime sleepiness at 2 PM, and displayed greater improvement in PSQI scores compared to the control group, but with no statistical significance[6]. Suzuki *et al*. conducted a randomized controlled trial to evaluate the effect of an Internet-based self-help program on improving quality of sleep among adult workers, with results showing the program to be effective but not significantly so[10]. Because the target points to improve sleep vary by individual, face-to-face individual-based lifestyle intervention should be conducted to strongly motivate healthy workers to educate themselves on poor-sleep prevention.

In previous studies involving patients with insomnia, interventions averaged 5.7 sessions over 6.5 wk[24]. However, securing sufficient time for health education and guidance is often difficult in workers' daily lives, particularly for repeated sessions during working hours. The intervention employed here, using 40-min group education and 30-min individual sessions, may therefore be a more feasible approach than that currently used for the majority of workers in Japan. In our study, occupational health professionals conducted both group education and individual sessions, a facet to the study considered essential to providing continual education and guidance within a company. Although the health professionals involved were trained by a sleep specialist, they were not sleep specialists themselves. Intensive guidance was given to the health professionals regarding the behavior modifications (relaxation training, stimulus control, and sleep restriction), including ways to respond to potential questions workers might pose. Cognitive approaches have also been widely employed as non-pharmacological intervention for insomnia[25–27]; however, adopting a cognitive restructuring approach to treat dysfunctional thinking processes related to sleep is often difficult for non-sleep specialists. Because we only included workers without a history of sleep disturbances, all of the behavioral approaches used here were easily learned and safely conducted by non-sleep specialists.

The current study suggests combining sleep hygiene education with a behavioral therapy approach such as relaxation training, stimulus control, sleep restriction, or cognitive therapy[24, 26, 28, 29]. Relaxation training can be used at any time as a self-help approach and is considered to improve sleep quality[29, 30]. Given that music therapy reportedly reduces anxiety and has also been shown effective in improving sleep quality[30, 31], we allowed participants access to soothing music and essential oils. This service subsequently motivated the subjects to listen to music and engage in aromatherapy in their private lives, which we believe contributed to the effects of the study. Previous studies have reported that stimulus control and sleep restriction are more effective in treating insomnia than relaxation training[28, 29, 32–34]. However, the individual guidance of 30 min in the present study can be insufficient to understand and adopt stimulus control and sleep restriction into their everyday lives. Intervention employing stimulus control or sleep restriction through more frequent individual guidance sessions, as well as developing a measure for securing sufficient sleep duration, is expected to be significantly more beneficial than the present intervention.

Limitations

Several aspects of our findings limit generalization and therefore warrant mention. First, all of the participants were white-collar employees working in the software research and management department of a single company. Different results may have been obtained if the study had involved other types of businesses or shift workers. In addition, the mean baseline PSQI score was relatively high among all participant, and slightly higher in the one-on-one group than in the control group. Although statistical analysis was performed after adjustment for baseline PSQI scores, this stratification may have affected the study results. Second, our study used only subjective evaluation of sleep quality. While polysomnography seems an unre-

alistic way to perform an analysis, our results might have benefitted from support provided by actigraphy. Third, to reduce respondent burden, we limited the number of questionnaire items about outcome and adjustment factors as much as possible. Several potential relevant factors such as number of working hours, caffeine intake, amount of exercise, and sleep diary contents were not examined. Our study was also limited by the relatively short follow-up period of three months; future studies should include a longer follow-up duration.

Generalizability

In the workplace, time constraints and a limited number of occupational health professionals trained in sleep disorders require that any intervention be short and simple to administer. Our minimal intervention sessions are practical and therefore likely to be adopted by the industry. In addition, professional support is not always available in the workplace. Using our methods, even occupational health professionals who are not sleep specialists can promptly and safely administer both group education and individual sessions.

Conclusion

Here, we conducted an RCT using white-collar workers to confirm our hypothesis that combining an individual-based behavioral approach with sleep hygiene group education significantly improves the quality of sleep. Results on comparing changes in sleep quality indicated that after 3 months of combined intervention improved the sleep quality of workers significantly more than group education alone. Given that disturbed sleep is strongly associated with workers' health, safety, and productivity, intervention is an extremely important method of prevention. Indeed, a number of companies have recently begun conducting somewhat effective sleep hygiene group education. Our findings here suggest that even more improvement can be obtained with an additional intervention focused on individual behavioral modification.

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