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Original Article

Verification of effect of sleep health education program in workplace: a quasi-randomized controlled trial

Yukari NAKADA[1]*, Aya SUGIMOTO[2], Hiroshi KADOTANI[3] and Naoto YAMADA[4]

[1]Department of Nursing, Kanazawa Medical University, Japan
[2]Santen Pharmaceutical Co., Ltd., Japan
[3]Department of Sleep and Behavioral Sciences, Shiga University of Medical Science, Japan
[4]Department of Psychiatry, Shiga University of Medical Science, Japan

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Abstract: Short sleep duration is a serious problem that not only enhances the risk of various mental and physical disorders, but also affects the productivity in the workplace. However, in terms of studies focused on workers, there are few reports that evaluated sleeping conditions in an objective way. The purpose of this study is to implement sleep health education in the workplace in terms of primary prevention of mental health disorder and then to investigate the subjective and objective effectiveness of the education using self-administered questionnaires (sleep duration, ESS, AIS, PHQ-9, SF-8) and an activity monitor (MTN-210). Study design is a quasi-randomized controlled trial. Sleep health education was provided through three 50-min lectures (total 150 min) as a single cycle for five months in the Intervention group. We obtained baseline data and then six months later. The study analyzed 70 subjects (36 Intervention group, 34 Control group). The weekday sleep duration for the Control group decreased by 12.9 min, whereas that of the Intervention group increased by 14.3 min (difference of 27.2 min), resulting in a significantly increase in score for the Intervention group. The present study suggests that sleep health education may be beneficial for good sleep habits in workers.

Key words: Sleep health education, Workplace, Primary prevention, Activity monitor, Mental health

Introduction

Japanese sleep duration has decreased gradually in the last half century. The National Survey on Daily Time Use of NHK (2015) showed that a weekday mean sleep duration is 7 h and 15 min[1)]. In addition, according to the survey of the Organization for Economic Co-operation and Development (OECD) in 2011, the Japanese daily mean sleep duration is 7 h and 43 min[2)]. These surveys imply the second shortest sleep duration next to Korea among 18 countries. It is obvious that a short sleep duration not only presents with physical and mental symptoms, such as daytime sleepiness[3)], fatigue[4)], headache[5,6)], and irritation[6)], but also enhances the risk of metabolic syndrome[7)], depression[8,9)], cardiovascular diseases[10)], and cerebrovascular diseases[11)], as well. Furthermore, the 'National Health and Nutrition Examination Survey' by the Ministry of Health, Labour and Welfare reveals that the percentage of individuals who cannot take enough rest by sleeping is 20%[12)]. Sleep disorders are closely associated with depression. In the workplace, lack of sleep is also associated with the occurrence of accident[13)], which is a serious problem that affects pro-

*To whom correspondence should be addressed.
E-mail: ynakada0329@gmail.com

ductivity. In Japan, sleep deprivation has become more and more serious. Physical and mental health may be impaired. Good sleep habit is important because it affects an individual's future health. For this reason, the importance of sleep health education that aims to disseminate correct sleep knowledge has become recognized even in the workplace. The investigation by Kakinuma *et al.*, on the effect of sleep hygiene education on insomnia in information technology workers revealed the partially effective results of this approach, as it led to decline in daily napping in the participants[14]. Furthermore, Nishinoue *et al*. reported the effectiveness of sleep hygiene education and behavioural therapy in information technology workers as confirmed by the analysis of sleep quality by Pittsburgh Sleep Quality Index (PSQI). When combined with behavioural therapy, sleep hygiene education was discovered to be more effective[15]. However, the studies reported the effects after a session only for a short period of time, and few studied the effect of sleep health education for several months.

In this study, we hypothesized that the improvement and maintenance of mental health based on sleep may be achieved by practicing sleep health education over a long period of time. If this is proved true, our study can contribute to the reduction of the onset of mental health disorders. Most previous studies measured subjective changes by questionnaires, while few measured sleeping conditions objectively. We performed a quasi-randomized controlled trial to test the effectiveness of sleep health education in the workplace for about half a year in terms of primary prevention of mental health and then to investigate sleep changes both subjectively and objectively using self-administered questionnaires and activity monitor (MTN-210; Kissei Comtec's, Nagano, Japan) ("MTN-210").

Subjects and Methods

Research design and subjects

This study was designed to allocate the subjects into two groups, namely, the Intervention group (employee number: odd) and Control group (employee number: even), using quasi-randomized controlled trial. The sleep health education was carried out not only for the subjects in this research but also for all the employees as a primary prevention of mental health disorder in the workplace. Therefore, the employees were classified by even or odd numbers to avoid confusion at the workplace. The subjects were recruited through the company's email network. As of April 2015, 418 office-based employees (43.0 ± 7.5 yr, male 76.8%) of a certain pharmaceutical company were included in this study. Only 77 employees provided informed consent and were divided into the two groups (41 Intervention, 36 Control). However, the final groupings included 70 subjects (42 males, 28 females: mean age 43.1 ± 8.3 yr) divided into the Intervention group (36) and Control group (34) because of dropouts from personal transfers (Fig. 1). Among them, there were 16 shift workers (8 Intervention, 8 Control). Upon commencement, this study was registered in the University Hospital Medical Information Network (UMIN; 000026650).

Sleep health education program

The sleep health education program consists of three 50-min lectures (total 150 min) as a single cycle for all the employees during office hours as part of mental health education (Table 1). For five months between May and September 2015, the program was implemented for the employees with odd numbers together with the 36 subjects of the Intervention group. On the other hand, employees with even numbers including the 34 subjects of the Control group attended the program for five months between October 2015 and February 2016.

The sleep health education was conducted about 20 times with each lecture. Each subject took the classes with no obstacle to the work or business. Practical program combined with lectures were implemented. Sleep health education protocol was developed by the researcher and supervisor with reference to reliable literature[12, 16–19].

Two specialists were in charge of the lectures. One is a researcher of this study (18-yr career as occupational health nurse) and a member of the Japanese Society of Sleep Research, who had attended the 'seminar for sleep health treatment' hosted by the Japan Family Planning Association under the mentorship of some influential board members of the Japanese Society of Sleep Research. The other lecturer is an occupational health nurse (9-yr career), who underwent practical coaching by the researchers of this health education sufficiently.

The first lecture was entitled 'Basic knowledge of sleep' with the following topics: 1) sleep duration in Japanese, 2) circadian rhythm, 3) role, mechanism, and types of sleep, 4) overnight sleeping process, 5) prevalence of sleep disorders, 6) relation between sleep duration and mortality rate, 7) influence of lack of sleep and sleep disorders on risk of diseases and accidents and performance. The second lecture was about 'Sleep disorders and interventions for a good sleep.' The topics included: 1) types of sleep disorder, 2) types of insomnia, 3) factors that cause insomnia, 4) methods for sound sleep habits, 5) lifestyles to overcome

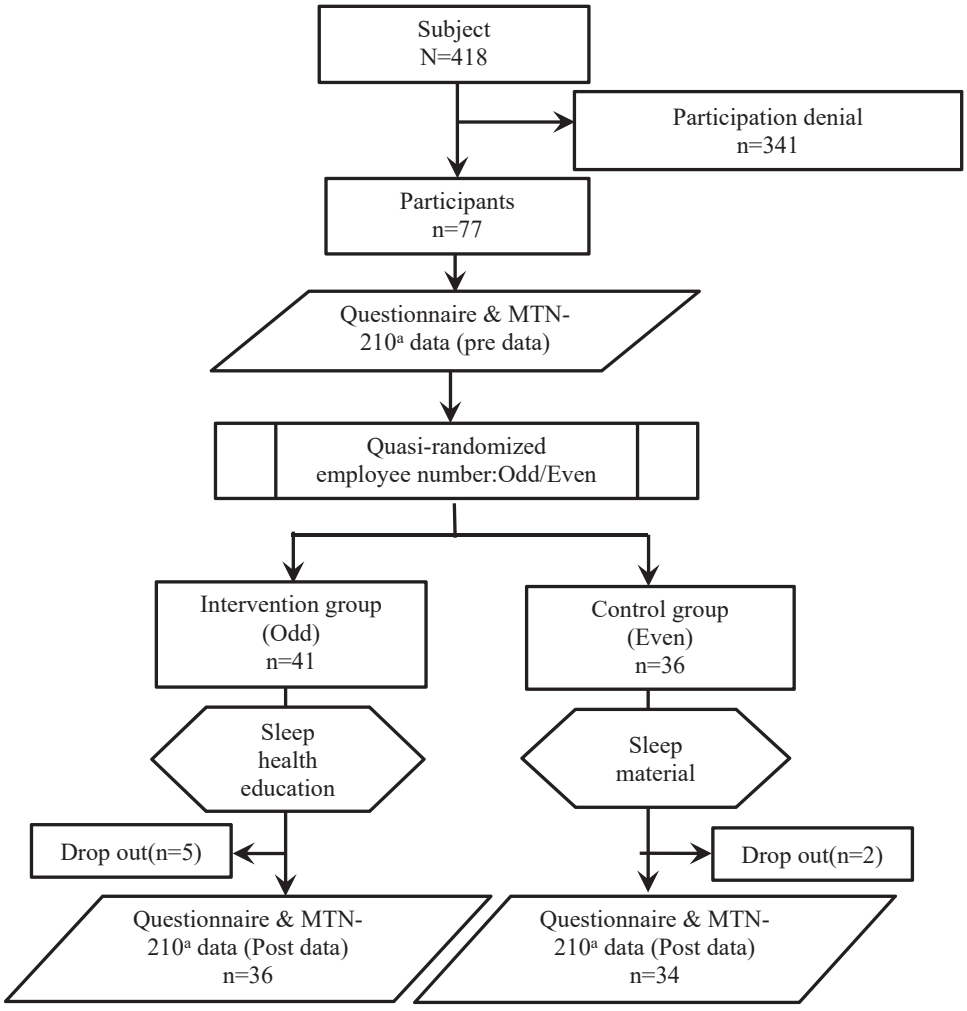

Fig. 1. Study design.

shift work disorder, 6) behavior therapy according to the types of insomnia. The third lecture is a summary of the program and confirmation of skill situation. In addition, a sleep diary was imposed as homework before initiation of the second lecture. Daily habit checklist[20] and cognitive behavioral therapy of the expected effect on insomnia were used as course materials. Daily habit checklist consisted of 18 items including alcohol, smoking, bathing, exercise, bedroom environment, and ideas that are closely related to sleep. Cognitive behavioral therapy on the effects expected of insomnia used sleep restriction[21] and stimulation control[21].

As for the subjects of the Control group, they were provided with 'the guidelines for consultation and teaching for sound sleep' (pages 3–30) and 'Oita Counselling and Support Center, 2012'[22].

Research method

The MTN-210, which was already validated[23], and self-administered questionnaires that consisted of 46 items were used for the survey of data. The MTN-210 was used for activity-based sleep recordings. The data was collected before (April 2015) and after (October 2015) the sleep health education. The data before the sleep health education were set as baseline data. The MTN-210 was provided for the subjects in April and October 2015. The subjects attached the MTN-210 daylong to the precordium or abdomen beneath the underwear for 7–10 d. Data were extracted from the MTN-210 devices through an NFC interface (PaSoRi, RC-S380, Sony Corporation, Japan)

Table 1. Contents of sleep health education

First lecture (May – June 2015)	Time (min)
Basic knowledge of sleep	50
Sleep duration in Japanese	
Circadian rhythm	
Role of sleep	
Mechanism of sleep	
Types of sleep: REM/nonREM	
Overnight sleeping process	
Prevalence of sleep disorders	
Relation between sleep duration and mortality rate	
Influence of lack of sleep and sleep disorders on risk of lifestyle-related diseases, depression, accidents, and performance	
Homework: sleep diary	
Second lecture (June – August 2015)	
Sleep disorders and interventions for a good sleep	50
Types of sleep disorders according to International Classification of Sleep Disorders Second Edition	
Types of insomnia: Sleep-onset insomnia, Sleep maintenance insomnia, Sleep offset insomnia, Nonrestorative sleep	
Factors that cause insomnia: Environmental factor, Physical factor, Mental factor, Lifestyle habit factor	
Methods for sound sleep habits: Drinking and caffeine consumption, smoking, use of media at bedtime, exercise and bath	
Lifestyles to overcome shift work disorder	
Behavior therapy according to the types of insomnia: Sleep restriction and stimulation control	
Third lecture (August – September 2015)	
Summary and confirmation of skill situation	50

using SleepSign Act software (Kissei Comtec, Nagano, Japan). For sleep/wake detection from the MTN-210 data, default settings in SleepSign Act were used, in which sleep detection followed the previously reported algorithm[24]. Data items extracted from the MTN-210 were set as sleep duration (weekday/holiday), sleep efficiency (weekday/holiday), and sleep latency (weekday/holiday). The Survey items from the self-administered questionnaire were as follows: age, sex, sleep duration (weekday/holiday), Japanese version of the Epworth Sleepiness Scale (ESS)[25], Japanese version of the Athens Insomnia Scale (AIS)[26], Patient Health Questionnaire-9 with Japanese language version (PHQ-9)[27], and Health-related QOL score-standard version ("SF-8")[28].

The ESS is a questionnaire used to assess 'sleepiness during the day.' It consists of 8 items ($\alpha = 0.88$[29]). Responses with four levels (a score of 0 to 3) are rated on a score of 0 to 24. More than 11 is assessed as 'excessive sleepiness during the day.'

The AIS is a global common scale for the assessment of insomnia developed by the World Health Organization (WHO). Responses with four levels (a score of 0 to 3) to eight questions are rated on a score of 0 to 24. More than 6 is assessed as 'suspected of insomnia.' In this study, insomnia was measured using the AIS because it is based on the ICD-10 criteria (nonorganic sleep disorder). AIS consists of eight items ($\alpha = 0.78 - 0.88$[26]). The first five items assess difficulty with sleep induction, awakening during the night, early morning awakening, total sleep time, and overall sleep quality. The last three items evaluate the daytime consequences of insomnia (problems with sense of well-being, functioning, and sleepiness during the day). Each item is rated on a scale of 0 (no problem at all) to 3 (very serious problem), and the total AIS score ranges from 0 to 24. The subjects were requested to rate a sleep difficulty as positive if they had experienced it at least three times a week during the last month. In the AIS, the optimum cutoff score is set as 6 for individuals suspected of being insomniacs based on the sensitivity and specificity derived by comparison with the ICD-10 diagnosis of "nonorganic insomnia" by a medical interview.

The PHQ-9 consists of 9 items on the assessment of depression ($\alpha = 0.88 - 0.91$[30]). On evaluation of the past two-week symptoms, responses with four levels (a score of 0 to 3) are rated on a score of 0 to 27 with severity of depression as follows: score of 0 to 4 (no depression), 5 to 9 (low to mild), 10 to 14 (moderate), 15 to 19 (moderate to severe), and 20 to 27 (severe).

We used SF-8 to assess the quality of life. The SF-8 is a scale which measures eight domains of health. The questionnaire consists of 8 items, which have eight subscale scores, such as physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. The question to each item is

designed to answer with options that consist of 5–6 steps. The response to each item is scored by norm-based scoring (NBS) based on national standard value (mean 50, SD 10), which is calculated by using score distribution of the public, and then converted into subscale score. In addition, Physical Component Summary and Mental Component Summary, which indicate physical QOL and mental QOL, respectively, are calculated by regression equation based on each scored item.

Statistical analysis

Together with comparison of the changes by intervention in the two groups using ANOVA, the significance of changes was assessed by group. Regarding the quantitative data, Student's *t*-test was used between the two groups while paired *t*-test for within-group comparison. Regarding the category data, χ^2 test, McNemar test, and Fisher's exact test were applied between the two groups. Overall significance level was set at 5%. All analyses were done with IBM SPSS version 21.0 (IBM SPSS Statistics, IBM Corporation, Armonk, NY).

Ethical consideration

The researchers explained the intent and purpose of this study to the directors of the business offices involved and assured confidentiality. Informed consent for the implementation of this study was obtained. The subjects were provided verbal explanation about the intent and outline, with emphasis on respecting the freewill of the subjects to participate in this study, measures for privacy protection, data management, and publication of the results. Individual informed consent was also obtained from them. Personal information obtained was managed by the researchers under strict restriction on access and control to the data. Whenever any subject experiences mental and physical disorders during participation in this study, it is determined to call at once for intervention of an employment medical advisor. The study protocol was reviewed and approved by the ethics committee of the Shiga University of Medical Science (No. 26-174: 12/22/2014).

Results

Baseline analysis

Table 2 shows the characteristics of the two groups before the intervention. The 70 subjects were divided into Intervention group (36: men- 22; women - 14) and Control group (34: men - 20; women - 14). The mean age of all subjects was 43.1 ± 8.3 yr (Intervention group - 43.4 ± 8.3; Control group - 42.9 ± 8.4 yr). The distributions of the age ranges were 20–29 yr (4: Intervention - 1; Control - 3), 30–39 yr (20: Intervention - 11; Control - 9), 40–49 yr (30: Intervention - 17; Control - 13), and more than 50 yr (16: Intervention - 7; Control - 9). The job types were clerical (24: Intervention - 14; Control - 10), operator (23: Intervention - 14; Control - 9), technical (18: Intervention - 5; Control - 13), and others (5: Intervention - 3; Control - 2). The mean BMI was 22.6 ± 3.6 (Intervention - 22.9 ± 3.2; Control - 22.3 ± 4.1). The distribution indicated a higher ratio of aged 40–49 yr in the Intervention group and technical staff in terms of the job type in the Control group. However, there was no between-group difference in terms of distribution by sex, age, and job types, as well as BMI.

The results on sleep duration (weekday/holiday), sleep efficiency (weekday/holiday), and sleep latency (weekday/holiday) from the MTN-210 data and the data from self-administered questionnaires, including sleep duration (weekday/holiday), ESS, AIS, PHQ-9, and SF-8 (Physical Component Summary/Mental Component Summary), revealed no between-group differences.

Change in data of activity monitor after intervention

Sleep index data extracted from the MTN-210 were sleep duration (weekday/holiday), sleep efficiency (weekday/holiday), and sleep latency (weekday/holiday). Table 3 shows the pre- and post-intervention data of the two groups.

The weekday sleep durations increased significantly to 14.3 (306.3–292.0) min in the Intervention group but decreased to -12.9 (276.9–289.8) min in the Control group before and after the education (Table 3).

There was no between-group difference in the results of the sleep duration (holiday), sleep efficiency (weekday/holiday), and sleep latency (weekday/holiday) before and after the education.

Changes in data of self-administered questionnaire after intervention

The data on the self-administered questionnaire were as follows: sleep duration (weekday/holiday), ESS, AIS, PHQ-9, and SF-8 standard version. Table 3 shows the data of both groups before and after intervention. There was no between-group difference in the results of the sleep duration (weekday/holiday), ESS, AIS, PHQ-9, and SF-8 before and after the education.

Table 2. Participants' characteristics

	n (%)	Intervention group n (%)	Control group n (%)	*p*-value
Sex				
Males	42 (60.0)	22 (61.1)	20 (58.8)	0.519[a]
Females	28 (40.0)	14 (38.9)	14 (41.2)	
Age, yr (mean ± SD)	43.1 ± 8.3	43.4 ± 8.3	42.9 ± 8.4	0.800[b]
Age				
20–29 yr	4 (5.7)	1 (2.8)	3 (8.8)	0.588[c]
30–39 yr	20 (28.6)	11 (30.6)	9 (26.5)	
40–49 yr	30 (42.9)	17 (47.2)	13 (38.2)	
≥50 yr	16 (22.8)	7 (19.4)	9 (26.5)	
Job type				
Clerical staff	24 (34.3)	14 (38.9)	10 (29.4)	0.141[c]
Operator	23 (32.9)	14 (38.9)	9 (26.5)	
Technical staff	18 (25.7)	5 (13.9)	13 (38.2)	
Other	5 (7.1)	3 (8.3)	2 (5.9)	
BMI (mean±SD)	22.6 ± 3.6	22.9 ± 3.2	22.3 ± 4.1	0.524[b]
	Mean (SD)	Mean (SD)	Mean (SD)	*p*-value
MTN-210				
Sleep duration (Weekday), minutes	290.9 (62.7)	292.0 (50.9)	289.8 (73.9)	0.890[b]
Sleep duration (Holiday), minutes	304.0 (64.1)	308.0 (63.0)	299.8 (66.0)	0.597[b]
Sleep efficiency (Weekday), %	72.4 (10.4)	72.3 (8.7)	72.7 (12.2)	0.876[b]
Sleep efficiency (Holiday), %	71.5 (11.8)	72.8 (9.9)	70.2 (13.5)	0.358[b]
Sleep latency (Weekday), minutes	6.7 (6.4)	6.8 (7.2)	6.5 (5.7)	0.854[b]
Sleep latency (Holiday), minutes	6.7 (7.9)	5.7 (4.5)	7.6 (10.4)	0.330[b]
Self-administered questionnaire				
Sleep duration (Weekday), hour	6.6 (0.9)	6.8 (0.8)	6.5 (1.0)	0.229[b]
Sleep duration (Holiday), hour	7.5 (1.1)	7.7 (1.1)	7.4 (1.2)	0.293[b]
ESS	8.4 (4.5)	8.2 (4.9)	8.6 (4.1)	0.679[b]
AIS	5.5 (3.3)	5.4 (3.2)	5.6 (3.4)	0.720[b]
PHQ-9	5.2 (4.6)	4.9 (4.4)	5.6 (4.9)	0.546[b]
SF-8				
Physical Component Summary	48.5 (6.7)	47.9 (6.6)	49.6 (6.9)	0.451[b]
Mental Component Summary	47.4 (8.2)	47.7 (8.6)	49.0 (7.9)	0.796[b]

MTN-210: activity monitor, ESS: Epworth Sleepiness Scale, AIS: Athens Insomnia Scale, PHQ-9: Patient Health Questionnaire-9, SF-8: 8-item Short-Form Health Survey

[a] χ^2 test [b] Student's *t* test [c] Fisher's exact test

Discussion

The purpose of this study is to evaluate the effectiveness using the MTN-210 and self-administered questionnaires after implementing an intervention study of sleep health education in the workplace. A comparative study was conducted on office-based employees divided into the Intervention group and Control group by quasi-randomized controlled trial. The comparison was based on the objective sleep data from the MTN-210 and the changes in responses from the questionnaires. The results indicated a significant increase in the weekday sleep duration in the Intervention group using the MTN-210 compared with the Control group. Some studies reported stronger evidence than ours[31, 32], but we used objective data by activity monitors as well as subjective data by questionnaires.

Subjects

According to the Basic Survey on Wage Structure in 2015[33], the mean age of workers is 42.3 yr. The mean age of the subjects in this study is 43.1 yr. There is no significant disparity in age between the survey and our study.

To encourage as many participants as possible in this study, we emphasized the importance of sleep by communicating fully with the safety and health committee of the two business offices and by sending email to all the

Table 3. Changes before and after intervention

	Intervention group (n=36)			Control group (n=34)			*p*-value[c]
	mean	SD	*p*-value[b]	mean	SD	*p*-value[b]	
MTN-210[a]							
Sleep duration (Weekday), minutes							
pre	292.0	50.9	0.113	289.8	73.9	0.170	0.036
post	306.3	66.9		276.9	62.5		
Sleep duration (Holiday), minutes							
pre	308.0	63.0	0.179	299.8	66.0	0.872	0.341
post	318.4	74.4		298.1	66.4		
Sleep efficiency (Weekday), %							
pre	72.3	8.7	0.892	72.7	12.2	0.396	0.520
post	72.5	10.8		71.5	11.7		
Sleep efficiency (Holiday), %							
pre	72.8	9.9	0.730	70.2	13.5	0.248	0.249
post	72.3	11.5		72.3	11.7		
Sleep latency (Weekday), minutes							
pre	6.8	7.2	0.641	6.5	5.7	0.559	0.974
post	7.4	4.2		7.1	2.9		
Sleep latency (Holiday), minutes							
pre	5.7	4.5	0.285	7.6	10.4	0.478	0.906
post	6.8	5.0		9.0	6.4		
Self-administered questionnaire							
Sleep duration (Weekday), hours							
pre	6.8	0.8	0.331	6.5	1.0	0.129	0.458
post	6.9	0.9		6.8	1.2		
Sleep duration (Holiday), hours							
pre	7.7	1.1	0.942	7.4	1.2	0.006	0.286
post	7.7	1.2		7.9	1.4		
ESS							
pre	8.2	4.9	0.732	8.6	4.1	0.453	0.747
post	8.4	4.6		9.2	5.3		
AIS							
pre	5.4	3.2	0.011	5.6	3.4	0.213	0.277
post	4.0	2.6		5.1	3.9		
PHQ-9							
pre	4.9	4.4	0.385	5.6	4.9	0.036	0.812
post	4.4	4.3		4.9	4.4		
SF-8							
Physical Component Summary							
pre	47.9	6.6	0.325	49.1	6.9	0.736	0.654
post	49.2	6.8		49.6	6.5		
Mental Component Summary							
pre	47.7	8.6	0.170	47.2	7.9	0.139	0.979
post	49.6	6.6		49.0	7.6		

SD: standard deviation; ESS: Epworth Sleepiness Scale; AIS: Athens Insomnia Scale; PHQ-9: Patient Health Questionnaire-9; SF-8: 8-item Short-Form Health Survey

[a] activity monitor [b] *p*-values; between pre and post [c] *p*-values; between two groups

employees. The analysis of this study was based on the data obtained on April and October 2015. However, we asked the subjects to wear the MTN-210 for 7 to 10 d every two months after April 2015. It was pointed out that non-participants experienced inconvenience in frequent wearing of the MTN-210 at a factor of less than 20% of the participation level.

Research data

The weekday sleep durations increased significantly in the Intervention group compared with the Control group before and after the education. Schutte-Rodin *et al.*[34] reported that "Simple education regarding sleep hygiene alone does not have a proven efficacy for the treatment of chronic insomnia". Zacrone[35] reported the same point of view. As described above, sleep health education that aims at spreading knowledge on correct sleep habit cannot be expected to be effective alone. Contrariwise, there is a report that recognized the effectiveness[14, 15, 36, 37]. Kakinuma *et al.*[14] reported that "Sleep hygiene education is significantly effective at improving sleep quality," and Chen[37] reported that "Sleep hygiene education program being delivered by a nurse can improve sleep quality in working women". In this study, sleep health education was shown to be effective with regard to the weekday sleep duration (+14.3 min). In previous studies, sleep duration was extended to +22.3 min[38] and to +12 min (after 4 wk)[39] by sleep health education. We concluded sleep health education, which had reasonable improvements in sleep habit. Although, in relation to sleep efficiency and the items on sleepiness and mental health aspect of the questionnaires, the efficacy of the program was not seen.

Our subjects had higher ESS scores than those in Edahiro *et al.*[40] and Taniyama *et al.*[41]. Our PHQ-9 results had similar scores as in Harvey *et al.*[42] There are few data on sleep using objective index with activity monitors in the field of occupational health. Although more than 85% of sleep efficiency rate is expected[43–45], the data using the MTN-210 in this study indicates approximately 70%. This suggests that our population may have some sleep-related problems.

Relevance of sleep health education program

While many previous studies evaluate one-time sleep health education[14, 15], the sleep health education program that we implemented consists of three 50-min lectures (total 150 min) as a single cycle over a period of five months. Sleep diary as a homework is highly reliable[46]. Our study subjects did not report serious sleep disorders in the baseline, thus we thought it difficult to ask writing down detailed sleep diarys. In the field of occupational health that involves shiftworks, this must be an appropriate program. The reasons why the significant effectiveness in this study is not obtained include the following. 1) The education period was a five-month-long period. 2) Changes in sleep may be difficult to be observed because, in general, the baseline health performance of workers is high. Nonetheless, the program is probably effective as primary prevention because we observed the elongation of the weekday sleep duration data extracted from the MTN-210 in the Intervention group.

This is a study that investigated only the changes in the MTN-210 and self-administered questionnaires. Upon consideration of a tool to measure the validity of a sleep health education program, rebuilding a more practical program in the workplace will be necessary. We can probably attribute such programs to subjects with other populations with lower physical and/or mental burden, as this program was conducted as a health service of the entire business office where its headquater approved the program.

Limitations of this study

The limitations of this study are as follows. 1) This is a quasi-randomized controlled trial with the subjects allocated by employees' numbers instead of a plain randomized controlled trial. 2) The subjects are potentially health-minded because the trial was conducted at a certain pharmaceutical company. 3) The participants may have had poor sleep quality based on the characteristics of this study. 4) There is impossibility of generalization because of the small sample size analyzed.

The specific aspects of this study are as follows. First, this trial was conducted as a health program in the workplace. Second, the sleep health education program was conducted in terms of primary prevention as a group approach that utilized cognitive behavioral therapy. Individualized approach to workers with sleep disorders using cognitive behavioral therapy can be effective as well. In terms of occupational safety and health, an intervention method is desirable in which there are more participants who can accomplish the program including the realization of the significance of prevention. For this reason, we allocated odd and even numbers so that it would be easy for employees to remember when to learn sleep health education and for equality in each workplace. In future studies, we would like to examine not only the enhancement of training contents suitable for subjects by age, kind of business, and job, but also an evaluation method for sleep health education. In addition, improvement of education programs including a systematical approach by the entire organization should be necessary because a collaboration with industrial physicians, health administrators, and directors of business offices is required to promote the primary prevention aspects of the workers' sleep habits.

In this study, we compared the outcomes of the Control group using only document-based self-education to those

of the Intervention group in the workplace by implementing the sleep health education program using the MTN-210 and self-administered questionnaires. The results indicated a significant increase in the weekday sleep duration through the MTN-210. This is a breakthrough study that analyzed the effectiveness of sleep health education program in the workplace based on the results of the questionnaires and objective sleep index data.

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Conflict of Interest

The authors declare no conflict of interest.

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