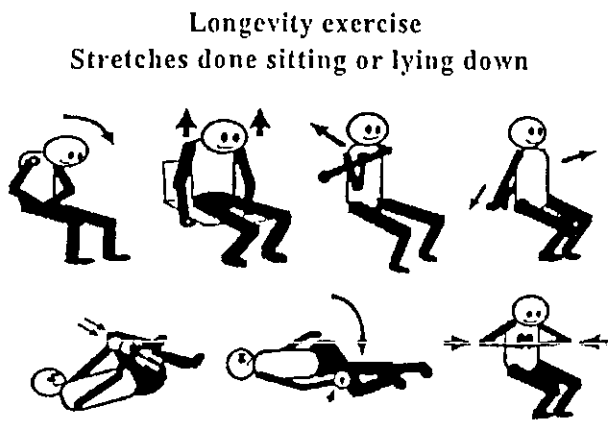

Fig. 9. Longevity exercises.

the fact that many elderly with a motivated lifestyle take regular naps, it would seem possible that short naps at the proper times can delay the advance of aging not only physically but mentally as well.

Improving effects of short daytime naps and slight exercise in the evening on sleep

Recently, several nonpharmacological treatments have been shown to improve sleep in the elderly [2]: sleep restriction therapy [25], cognitive behavior therapy [26,27], appropriately timed bright light [28], exercise [29,30] and passive body heating [31].

Four years ago, we began a joint university–community project that included a field validation study and sleep-health classes. The aim was to both assist the elderly in obtaining quality sleep and create a lifestyle for an aging society. The subjects were elderly people suffering from insomnia, with whom we conducted a 4-week interventional guidance in short naps after the lunch and light evening exercise (exercises that can be readily incorporated into a routine, such as easy-to-remember light stretches done sitting or lying down and abdominal breathing; Fig. 9, longevity exercises).

The subjects of this study [32] were 11 elderly people (73.8±5.4 years) who gave informed consent for their participation. "Intervention" by a short nap after lunch (30 min between 1300 and 1500 h) and exercise with moderate intensity including stretching and flexibility in the evening (30 min from 1700 h) was carried out for 4 weeks in winter. All subjects were able to lead a normal life at home, and screening tests before the "intervention" were used to exclude those who experienced sleep problem due to illness. Their physical activities were recorded using actigraphs for 1 week pre- and postintervention. Actigraph data were analyzed to determine "sleep" and "wake" periods by applying a Cole's validated algorithm [33] to the portions of the records identified as sleep periods by the combination of sleep logs. Mental health was assessed using the General Health Questionnaire (GHQ) [34]. Furthermore, a questionnaire mainly about their volition and physical health was performed only after intervention.

After the intervention (Figs. 9 and 10), sleep efficiency significantly increased, showing that sleep quality was improved. Furthermore, nodding in the evening significantly decreased after the "intervention." Their GHQ score also significantly decreased, showing that their mental health was also improved. After the "intervention," many elderly answered that volition and physical health also improved (volition: 63.6%; physical health: 90.9% of all subjects).

The key points in the mechanism for improved sleep are maintaining proper wakefulness during the day, and

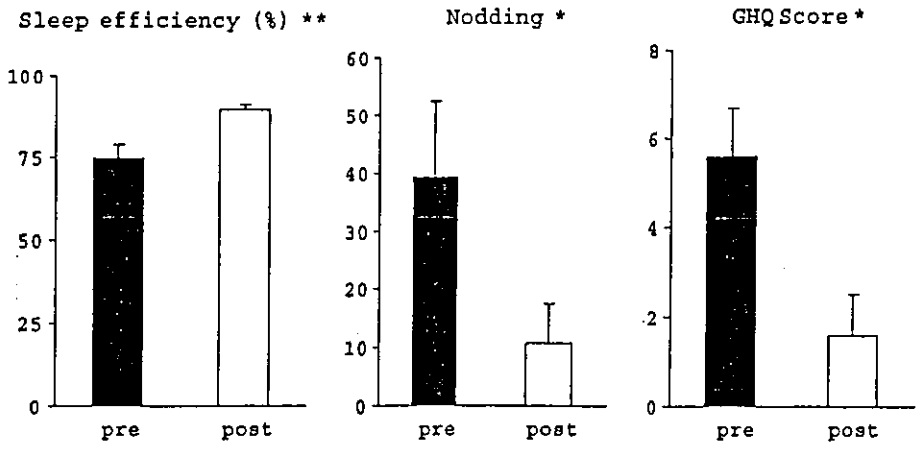

Fig. 10. Comparison of pre- and postintervention results for sleep quality, nodding and mental health in the elderly. * $P<.05$; ** $P<.01$.

preventing dozing off from the late afternoon until bedtime. Present results demonstrated that the proper awakening maintenance during evening was effective in improving sleep quality. Until recently, it was considered that taking a nap has a negative effect on the nocturnal sleep. However, a short nap of 30 min between 1300 and 1500 h has little quantitative effect on nocturnal sleep. Moreover, a short nap is effective for recovery of attention, concentration and brain function [15,23]. The present results reconfirmed that habitually taking a short nap is effective in maintaining sleep quality [14,15,23], and indicated that napping is an effective way for elderly people to maintain the sleep. The body temperature phase of elderly people is advanced 2–3 h ahead of that of young people [35]. Moreover, the existence of a "forbidden zone" was demonstrated [36]. This "forbidden zone" is the time period in the vicinity of the highest value of body temperature, and it corresponds to the peak of muscle and exercise capacity [37]. It is considered that this time zone occurs around 1700 h, and that exercise around this time is effective for improving sleep quality of elderly people. It is also considered that exercise in the evening increases the activity of the arousal system in the "forbidden zone." It is considered that arousal maintenance in the afternoon may be recovered by the short nap, and that the quality of the daytime arousal of the elderly people in this study was improved by exercise in the evening. As a result, the frequency of nodding before going to sleep decreased, and the quality of nocturnal sleep was improved. After the "intervention," mental health also improved with improving sleep quality. Furthermore, volition and physical health also improved with improving sleep quality. A short nap of 30 min and light evening exercise promote good quality sleep at night and a high level of motivation on waking the following day, forming a positive cycle.

Brain function, physical health and developing the habit of taking short naps and doing longevity exercises

As part of a commissioned survey project on health promotion (Health and Physical Strength Promotion Foundation), in 2001 we conducted a study on establishing lifestyle guidance intervention on field assessment techniques for sleep improvements related to mental and physical health and brain function in the elderly. Elderly people selected on the basis of regular medical checkups and health survey results gathered at a community center, and public health nurses and instructors, with some community health promotion committee members and students of the clinical psychology course at Hiroshima International University, participated as staff. With this group, sleep-health classes were conducted as a health promotion activity and verification study through the cooperation of the university and community (one class consisted of about 20 people, and met 3 days a week for 4 weeks). Health management and guidance, development of habits, interview surveys, measurements, analyses, assessments of effect and feedback were conducted in mutual cooperation. Furthermore, visual detection task and tests of physical strength and fitness (the muscular power of a leg, pliability, balance, etc.) were performed pre- and postintervention.

The subjects of this study were 15 elderly people (73.1±5.2 years) who gave informed consent for their participation. "Intervention" by a short nap after lunch (30 min between 1300 and 1500) and exercise with moderate intensity including stretching and flexibility in the evening (30 min from 1700) were carried out for 4 weeks in winter. All subjects were able to lead a normal life at home, and screening tests before the "intervention" were used to exclude those who experienced sleep problem due to illness. Their physical activities were recorded using actigraphs for 1 week pre- and postintervention.

After the intervention, wake time after sleep onset significantly decreased, showing that sleep quality was improved. Their GHQ score also significantly decreased, showing that their mental health also improved.

After the intervention, in addition to improvements in sleep, the elderly participants were found to have significantly better results on a computer cognitive task as well as improved brain function (Fig. 11). The results of visual detection task were also improved after the "intervention." After the intervention, there was a significant reduction in evening naps and drowsiness and the classes were recognized to be effective in ensuring the maintenance of proper wakefulness before bedtime, including during the day. The reduction in daytime drowsiness is thought to have contributed to improved brain function. As for tests of physical strength and fitness, the muscular power of a leg, pliability, the sense of balance significantly increased. Improvements were also seen in measurements of physical strength (Fig. 12). Alertness, motivation, physical fatigue, concentration ability, appetite, level of confidence and other parameters (Table 1) also showed significant

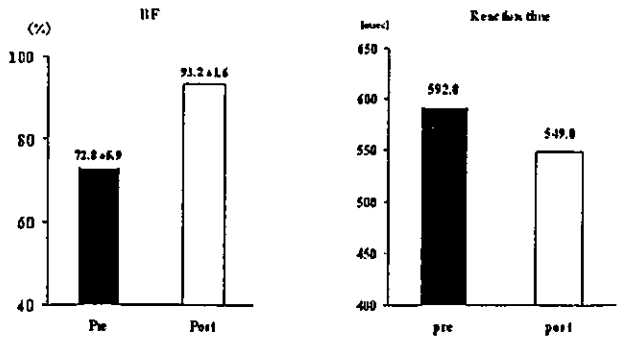

Fig. 11. Comparison of pre- and postintervention results for brain function. ** $P<0.01$.

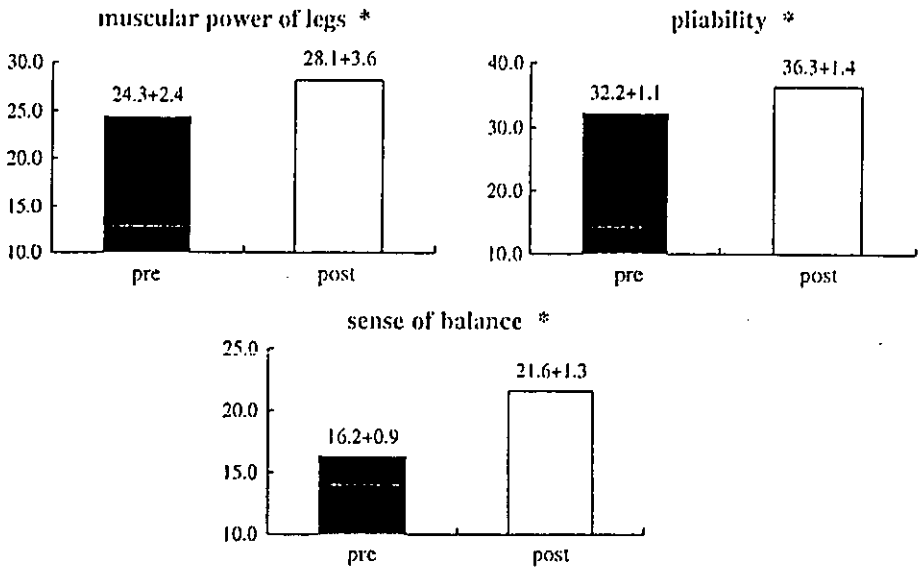

Fig. 12. Comparison of pre- and postintervention results for physical strength measurements.

improvements. After the "intervention," many elderly answered that mental, physical health were also improved.

To evaluate and confirm the effects of the health guidance classes, we developed a subjective mental and physical state assessment sheet to be used mainly on-site by the public health nurses, and investigated the distribution of degree of improvement in health and sleep status (Table 2). About 80% of the elderly reported improvements in state of sleep and falling asleep (Fig. 13). The majority of subjects also reported improvements in their general physical condition and motivation, and felt that food tasted better. These results demonstrated that developing the habits of taking short daytime naps and doing longevity exercises as a result of lifestyle guidance led to improvements in sleep and physical condition and increased motivation. Thus, on both the subjective mental and physical condition assessment sheet and in postinstruction objective indicators such as actigram and physical strength measurements and computer tasks improvements were seen in sleep, motivation, daytime mood and physical condition. Effective field activities are promising as simple evaluation methods in the future. To help establish the habits of taking short daytime naps and doing longevity exercises, regular sleep-health classes are now being held as one means to create a lifestyle for an aged society and prevent dementia and bed confinement. One very interesting result has appeared: in towns that have energetically launched health education and health promotion activities for the elderly, medical fees that were running about 1,000,000 yen per elderly resident 4 years ago have currently been reduced to less than 700,000 yen. In short, the cost of medical care has been reduced to 70%.

Table 1
Psychological improvements (using the visual analogue scale) by intervention

	Pre	Post	t	P
Alertness	48.0 (14.6)	78.4 (19.9)	4.38	<.01
Motivation	50.1 (12.3)	76.5 (24.4)	3.43	<.01
Fatigue recovery	45.4 (10.9)	77.3 (21.6)	4.09	<.01
Concentration	46.1 (11.1)	65.8 (20.0)	2.69	<.05
Appetite	52.4 (16.5)	77.5 (20.3)	3.79	<.01

Values are expressed as mean (S.E.).

Table 2
Questionnaire of subjective appraisal of mental and physical health

Please respond to the following questions about your state of mental and physical health over the past several weeks

1) How is your overall condition?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
2) How are your shoulders/neck?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
3) Your waist/ lower back?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
4) Your knees?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
5) Sleep?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
6) Falling asleep?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
7) Waking up?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
8) Motivation/drive?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
9) Going out, meeting people (activeness)?	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	
10) Taste of meal	1. Much better	2. A little better	3. Unchanged
	4. A little worse	5. Much worse	

Better sleep and health by assuring proper wakefulness during the day

In the Hiroshima Prefecture, health promotion activities to ensure proper daytime wakefulness and nighttime sleep are spreading under the "Mental and Physical Wellness Program." A new mini day service plan has also been proposed and implemented. This plan combines short naps, which are effective in preventing lifestyle-related diseases, and laughter and evening longevity exercises, which promote motivation and vitality.

Ensuring comfortable wakefulness with short daytime naps, laughter therapy and light evening exercise

In addition to helping people acquire habits of the short naps and longevity exercises mentioned above, this program offered brain activation exercises including laughter and group work in the time between the end of the nap and the evening longevity exercises. This helped to rest the brain and give sharpness to activities, to better ensure maintenance of wakefulness in the afternoon after 3:00

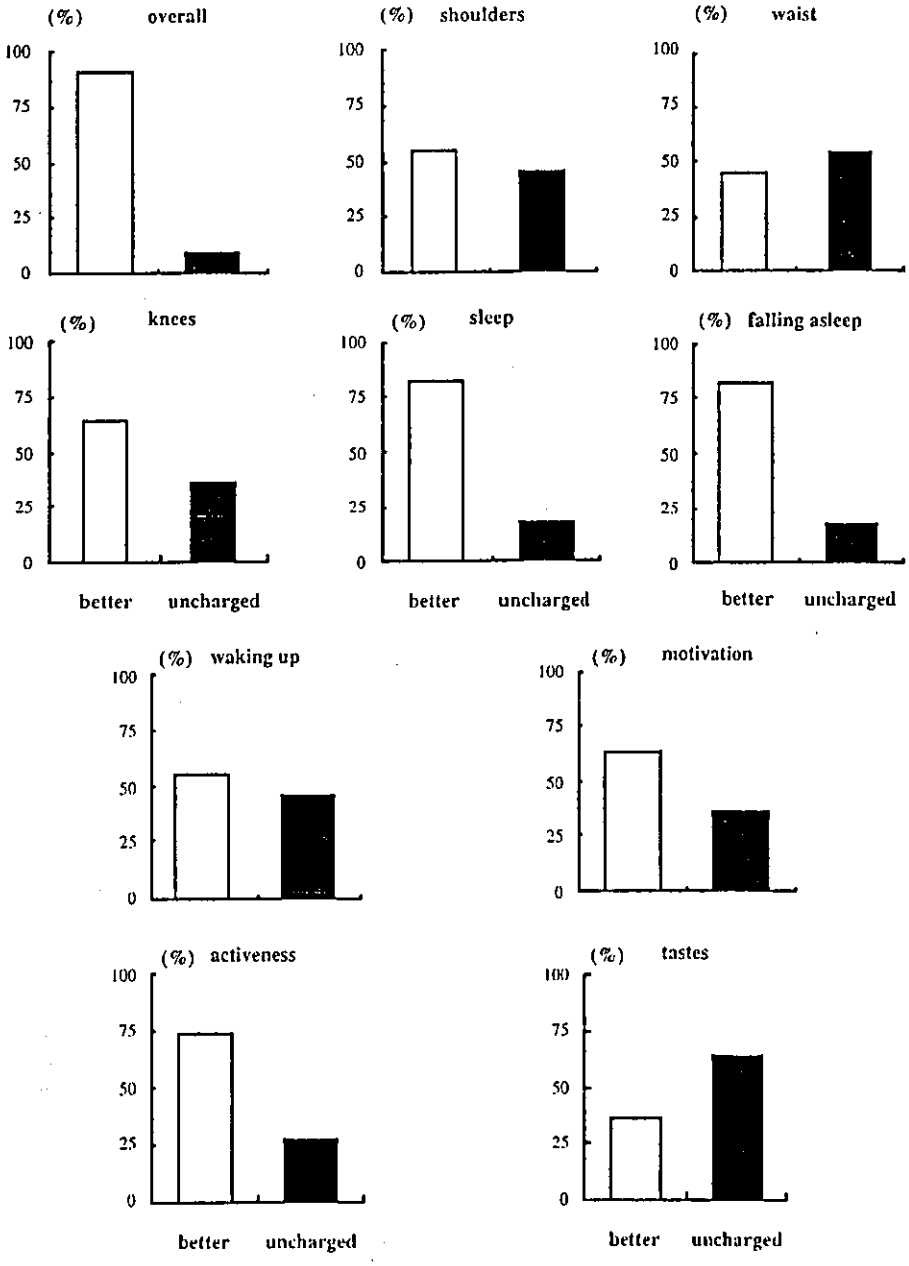

Fig. 13. Level of improvement using the subjective physical condition assessment sheet.

o'clock, a time that strongly affects nighttime sleep. Elderly people with few acquaintances gathered at a city welfare center twice a week for 2 months, napped together in the early afternoon, enjoyed group activities and learned a lifestyle and daily activities to be used in building a good environment for sleep and wakefulness. A good environment for sleep and wakefulness was formed with the aim of improving mental and physical health and brain function.

The subjects of this study were 23 elderly people who gave informed consent for their participation. The effects of the class were compared before and after participation in the Wellness Program (Table 3). The level of sound sleep was significantly improved, and subjective symptoms of fatigue were significantly reduced from 6.9 to 4.2. Moreover, there was a significant reduction in the percentage of people who complained of disorientation, apprehension and a loss of patience. After the class, there was also a significant increase in rise in the results of a test of the *kana* syllabary, which was a simple measure of brain function. Thus, the development of good habits from participation in the class was found to improve sleep state, mental and physical health and brain function. By living a life in which there is a clear distinction between activity and rest, in which the brain and body are rested with short naps, the brain is activated with laughter, group work and recreation, and the brain and body are activated with exercise, the elderly can maintain proper wakefulness throughout the day (from waking until going to bed), and nighttime sleep can be improved. The creation of a good cycle between sleep and wakefulness can give rise to a positive synergistic effect in the improvement of mental and physical health and brain function.

Spread of health promotion activities for the brain and mind in the community

These results are beginning to spread in trials to support efforts for the prevention of dementia, lifestyle-related diseases, and bed confinement, and improve QOL and ADL of the elderly . Through middle-aged leader training and the formation of clubs that accompany the classes, motivation and the awareness of one's role among the elderly are increased, leading to more active seniors. In addition, with regular rounds by specialized staff including public health nurses, exercise instructors and psychologists, and proper living guidance and encouragement, we may look forward to these clubs continuing and taking root. Strengthening social support systems focused on community residents themselves, which support health promotion of the brain and spirit, will become increasingly important in the future. In the coming age, sleep will no longer be a simple life maintenance phenomenon in which people sleep because they are tired. Rather, the time has come for us to change our understanding so that measures to prevent insomnia are regarded as essential in health promotion for both the brain and the spirit, and the community as a whole addresses this issue in earnest.

Table 3
Comparison of sleep, mental and physical fatigue, and brain function between pre- and post-intervention in the Wellness Program

	Pre	Post	t/χ^2 value	P
Subjective symptoms of fatigue	6.9 (4.2)	4.2 (2.8)	2.49	<.05
Complains of disorientation	29.4%	5.9%	3.24	<.10
Complains of apprehension	52.9%	17.6%	4.64	<.05
Loss of patience	41.2%	5.9%	5.88	<.05
Score of the kana syllabary	27.2 (9.3)	38.4 (14.8)	4.00	<.05

Appendix

Sleep Health Risk Index (five sleep-health risk factors)

Question 1. **Intermittent waking**

How many times during the night (during sleep) do you wake up?

(1) None (2) About___times per night

If you do not wake up during the night, score 0 points. Score 1 point for each time you wake up until 4 times. Score 4 points if you wake up 4 times or more. Multiply your total score by 3/4 so that all questions are evenly weighted. The maximum score is thus 3.

Question 2. **Feeling of sound sleep**

How deep is your usual sleep?

(1) Sound (2) Generally sound (3) Neither

(4) Generally poor (5) Poor

Score 0 points for a response of "Sound" and 4 points for a response of "Poor." Multiply your total score by 3/4 so that all questions are evenly weighted.

Question 3. **Frequency of nocturnal urination**

About how many times do you go to the toilet during the night?

(1) Do not go (2) Go about___times per night

As with mid-sleep arousal, score 0 points for 0 times, and 4 points for 4 or more trips to the toilet. Multiply your total score by 3/4 so that all questions are evenly weighted.

Question 4. **Early morning awakening**

Do you awake too early in the morning?

(1) Frequently (2) Sometimes (3) Occasionally

(4) Never

Score 0 points if you answered "Never" and 3 points if you answered "Frequently." The maximum score is 3. Score each of the following questions (5–14) in the same manner.

Question 5. **Nocturnal partial arousals**
Are you told you are groggy at night?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 6. **Kanashibari**
When sleeping at night are you struck with a feeling of being tied down (Kanashibari)?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 7. **Vivid nightmare during falling asleep**
Do you have vivid, frightening dreams as you are about to fall asleep at night?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 8. **Restless legs, abnormal limb movements**
Are you told your legs twitch or kick during the night, or do your legs become restless and uncomfortable when you get sleepy?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 9. **Hypnotics**
Do you take sleeping medicine or tranquilizers to sleep?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 10. **Snoring**
Do you snore?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 11. **Sleep breathings**
Are you told that you stop breathing during your sleep?
(1) Frequently (2) Sometimes (3) Occasionally
(4) Never

Question 12. **Difficulty arising**
Can you get out of bed when it is time to get up?
(1) I can get up easily (2) I can get up with a little effort
(3) I can get up with considerable effort
(4) I cannot get up no matter how hard I try

Question 13. **Sleep latency**
How long does it normally take you to fall asleep after getting into bed?
Generally about___minutes
Score 0 points if sleep latency is less than 10 minutes, 1 point if 10–20 minutes, 2 points if 20–30 minutes, and 3 points if more than 30 minutes.

Question 14. **Getting out of bed**
About how long does it take you get up after waking in the morning?
Generally about___minutes
Score 0 points if the time until getting up is less than 10 minutes, 1 point if 10–20 minutes, 2 points if 20–30 minutes, and 3 points if more than 30 minutes.

Five sleep-health risk factors
(1) sleep maintenance problems, Question 1, 2, 3, 4
(2) parasomnia-like problems, Question 5, 6, 7, 8
(3) sleep apnea, Questions 10, 11
(4) difficulty waking up, Question 12, 14
(5) difficulty initiating sleep, Questions 9, 13

From the questionnaire involving life habits and sleep health [23,24], five sleep-health risk factors were determined by factor analysis, and these were scored as follows: (1) sleep maintenance problems, (2) parasomnia-like problems, (3) sleep apnea, (4) difficulty waking up and (5) difficulty initiating sleep. Furthermore, the total score of each factor score was calculated as the Sleep-Health Risk Index.

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