An Epidemiological Study on Relationship between the Hours of Sleep and Life Style Factors in Japanese Factory Workers

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Abstract To prevent “life style-related diseases”, it is necessary to evaluate not only the factors directly related to sleep but also the relationship between sleep and other life style-related factors (such as smoking, alcohol drinking, food habits, and exercise routines). There have been no extensive studies conducted on these relationships. A survey was conducted on 2,000 employees of a large plant over a 6-year period to provide data that would allow one to analyze correlation between hours of sleep and other life style factors, such as smoking, alcohol drinking, dietary habit, and exercise. It focused on a serial evaluation, with special reference to the correlation between sleep and smoking and drinking habits, exercise, and food habits. In relation to smoking or an alcohol drinking habit, no significant correlation was found between those who did not get enough sleep and those who got adequate sleep. For the dietary habits, the group with insufficient hours of sleep was related to a less than satisfactory frequency of meal taking, irregularity of eating, snacking habits, excessive seasoning of food, and consumption of insufficient quantities of vegetables. Conversely, it was recognized that those who have satisfactory food habits are more likely to enjoy an appropriate amount of sleep. Those who fail to get sufficient sleep engage in food habits that are more likely to cause life style-related diseases. J Physiol Anthropol 21 (2): 115-120, 2002  http://www.jstage.jst.go.jp/en/

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Introduction

“Nutrition”, “exercise”, and “rest” are 3 major elements for the promotion of health. Many have reported that “nutrition”, in particular, is closely related to disease entities such as hypertension and hyperlipemia and that it has a significant effect on the development of “life style-related diseases”. It has also been reported that “exercise” and “rest” have an effect on the development and recovery from diseases. It may be that these 3 elements are interrelated to induce diseases (Hara et al., 2000; Fukuda and Morimoto, 2001; Morimoto, 1991).

Although the largest portion of one’s time is spent in sleep, a significant part of “rest”, relatively little attention has been paid to this subject. Most studies have been limited to topics on sleep itself (e.g., the mechanism of sleep, with reference to cerebral physiology and changes in sleep time) and sleep disorders (e.g., those caused by work shifts, sleep apnea syndromes and disruption of life activities, REM sleep disturbances and social activities, sleep disorders among the aged, and drug-induced sleep disturbances and their management) (Bliwise et al., 1994; Hoffstein, 1994; Hopton and Dlugoleka, 1995). These studies referred mostly to factors that independently affect the development of sleep disorders. Their results appear to indicate that sleep is under the complex effects of diverse factors; age, societal conditions, physical and psychological state, and life style (Gall et al, 1993; Spiegel et al, 1999; Campbell, 1995; American Academy of Sleep Medicine, 1999).

To prevent “life style-related diseases”, it is necessary to evaluate not only the factors directly related to sleep but also the relationship between sleep and other life style-related factors (such as smoking, alcohol drinking, dietary habits, and exercise routines). There have been no extensive studies conducted on these relationships. Therefore in this study, a survey was conducted on 2,000 employees of a large plant over a 6-year period to provide data that would allow one to analyze correlation between sleeping and other life style factors, such as smoking, alcohol drinking, diet, and exercise.
Methods

Subjects

They were employees of a chemical plant located in Sakai, Osaka, Japan. Among the employees who received routine health examinations between 1992 and 1998, those who satisfied conditions 1) through 5) were selected: 1) Men between the ages of 20 to 59 years; 2) Those who did not require more detailed examinations other than a routine health examination; 3) Those who were not given a diagnosis of chronic diseases at the routine examination (such as cardiac disease or diabetes mellitus); 4) Those who did not report an abnormality, such as fatigue or a common cold on the day of the routine health examination; 5) Those who were not workers on the 3 shifts on the production line.

Most operated the computer-controlled equipment and were not at risk of being exposed to toxic chemicals. The number of individuals ultimately selected were: 1,687 in 1992; 1,810, 1993; 1,860, 1994; 1,782, 1995; 1,747, 1996; 1,795, 1997; 1,652, 1998.

Fig. 1 shows the age distribution of the subjects during the survey period. Between 1992 and 1998, there were no outstanding changes in the distribution of the age groups (20 to 29, 30 to 39, 40 to 49, and 50 to 59) or the mean age.

Informed consent and maintaining privacy for subjects

To protect the human rights of the participants, informed consent was obtained. On the same occasion, the purpose of the study was clearly described. They were also advised that the results would only be used to protect the health of the employees of the plant and the method, particulars of the questions posed, and risks were thoroughly explained. The prospective respondents were urged to participate and told that their participation was completely voluntary, their privacy would be thoroughly respected, and the organizers of the study were prepared to answer any questions they might have about the survey.

To maintain the privacy of the respondents, a code was assigned to each individual for the statistical analysis. This would prevent identification of individuals when restrictions on the data evaluation were lifted or the results were published.

Survey method for subjects

Prior to the health examination, question sheets were distributed to the test subjects so that they could report on their hours of sleep, smoking and alcohol drinking history, exercise and dietary habits. The completed forms were collected on the day of the health examination. The rate of recovery was 99.9%. The same form was used throughout the entire study period.

A multiple choice format was adopted for the questionnaire that was designed to be filled out by each respondent. The questions were on: “hours of sleep” (1, less than 6; 2, 6.1 to 8.9; 3, 9 or more); “cigarette smoking” (1, non-smoking; 2, quit smoking; 3, smoking); “alcohol drinking” (1, do not drink; 2, quit drinking; 3, drinking); “frequency of physical exercise” (1, never; 2, sometimes; 3, once or twice a week; 4, almost every day); and “dietary habits” subdivided into 7 items: (1) number of meals per day (1, 3 times; 2, twice; 3, irregular); (2) snack between meals (1, yes; 2, no); (3) eating out (1, frequently; 2, rarely); (4) daily diet pattern (1, regular; 2, irregular); (5) intake of vegetables in the diet (1, ample; 2, none); (6) seasoning of food (1, strongly salty; 2, conventional; 3, lightly seasoned); (7) oily food items (1, preferred; 2, not desired much).

Statistical analysis

The association between the hours of sleep and various factors involved in one’s life style was analyzed for each year between 1992 and 1998 by employing χ² tests. Subjects were divided into 2 groups according to their hours of sleep (less than 6, 6.1 to 8.9), and their life style items were smoking and drinking habits, exercise, and taste in food for each group from 1992 to 1998. The comparison between age by the hours of sleep was analyzed for each year between 1992 and 1998 by employing t-tests.

For statistical analysis, the Macintosh Statview Ver. 5.0 Computer Program was used (SAS Institute Inc., Berkeley, USA). The significance level was set at p<0.05.

Results

Changes in hours of sleep

Fig. 2 shows change of percentage for 3 groups.
classified by hours of sleep between 1992 and 1998. Throughout the period, the group with sleep hours between 6.1 and 8.9 was the largest (around 83%), followed by the group with sleep hours of 6.0 or less (around 16%). The percentage for those sleeping 9 hours or more was within 1% for each year.

Table 1 shows the mean ± standard deviation of age by hours of sleep in each year between 1992 and 1998. No statistically significant difference in age was noted between the groups sleeping 6 hours or less and that sleeping 6.1 to 8.9 hours in all survey periods. However, a statistically significant increase in age was noted for those sleeping 9.0 hours or more in comparison with those in the other 2 groups in all survey periods.

The relationship between hours of sleep and dietary habits

Figs. 3-A to -F show sequential percentage changes for factors related to food habits in the 2 groups classified by hours of sleep. Fig. 3-A shows the percentage of those with no regular frequency of eating meals each day for the 2 groups classified by hours of sleep. Compared with those sleeping 6.1 to 8.9 hours, a higher proportion of those sleeping 6.0 hours or less ate their meals at irregular frequencies. A statistical significance was noted between these two groups in all survey periods.

The percentages for those who frequently ate out in each of the 2 groups with different sleep hours are shown in Fig. 3-C. Compared with those sleeping 6.1 to 8.9 hours, those who dined out often slept 6 hours or less in all experimental periods. However, beginning in 1992, the percentage for the latter group, 32.5%, came down in each subsequent year, eventually to 20.3% in 1998.

The relationship between hours of sleep and smoking, drinking, or physical exercise

Compared with those sleeping 6 hours or less, smoking was slightly more frequent for those in the group sleeping 6.1 to 8.9 hours for each year; but the difference between the two groups was not significant. For alcohol drinking habits, there was no significant difference between those two groups. As for exercising habits, the percentage of those who hardly exercise tended to increase annually for those sleeping 6.0 hours or less when compared to those sleeping 6.1 to 8.9 hours; but the change was not significant. It showed that there was no significant association between hours of sleep and smoking, alcohol drinking, or exercise.

Since less than 1% of the participants slept 9 hours or more, they were excluded from this analysis.

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Fig. 3  Sequential percentage for those with irregular eating of meals per day (A), those with consumed snack between meals (B), those who frequently ate out (C), those with irregular daily diet pattern (D), those who did not consume sufficient amount of vegetable (E), those who preferred very salty food (F), in the 2 groups (less than 6, 6.1 to 8.9) classified by hours of sleep between 1992 and 1998.
Discussion

"Nutrition", "exercise", and "rest", which had been the basis for health promotion, are now regarded as important elements in preventing these lifestyle-related diseases (Ballor and Keesey, 1991; Breslow and Enstrom, 1980). In particular, it is expected that sleep, which occupies a large part of rest, plays an important role in the prevention of disease and recovery from it. Yet relatively little attention has been paid to this important physiological process (Kim et al., 2000; Ohida et al., 2001; Palomaki et al., 1989; Seki, 2001).

According to the results of a survey conducted on the hours that Japanese citizens spend, on average, the time spent in sleeping was 8 hours and 13 minutes in the 1960s, 7 hours and 57 minutes in the 1970s, and 7 hours and 32 minutes in 1995 (NHK, 1996). In this study, during the 6-year period between 1992 and 1998, about 16% were sleeping 6 hours or less, about 83%, 6.1 to 8.9 hours, and about 1%, 9.0 hours or more. Little change was observed during the study period, with no tendency for a decline in hours of sleep, such as that cited above.

Compared with studies on the relationship between morbidity and smoking and alcohol drinking, there are only a few epidemiological studies on the correlation between sleep and morbidity. Among these, in a 6-year follow-up study conducted by the American Cancer Society, a high mortality was noted for those sleeping 4 hours or less or 10 hours or more (in comparison with those sleeping 7 to 8 hours), regardless of sex, age, or history of cardiac diseases or diabetes mellitus. It has been recognized that when the hours of sleep are extremely short or long, the incidence of heart diseases, cerebrovascular diseases, malignant neoplasms, and suicide rise with statistical significance (Hammond, 1964). It has been said that the relationship between the hours of sleep and one's average health status can be expressed by a curve that forms a peak: based on mortality, sleeping 7 to 8 hours is ideal for both men and women (Hammond and Garfinkel, 1969). Below this range is associated with the lowest health status; but sleeping over 8 hours also has a negative effect on one's health status. In other words, sleeping too much or too little will have a negative effect on one's health (Kripke et al., 1979).

In Japan, Morimoto (2000) studied the relationship between 8 items related to health (including hours of sleep) and biological indicators such as NK cell activity and chromosome aberrations. Sleeping 6 hours or less or 9 hours or more was considered to be a poor health habit (Kusaka et al. 1996; Bello and Breslow, 1972). It was proven that a group with poor health habits also exhibited poor biological indices; and that a poor lifestyle (including hours of sleep) is associated with a high probability for developing diseases.

The present study was not conducted to evaluate the direct effect of sleep on the body: rather, it focused on a serial evaluation, with special reference to the association between sleep and smoking and drinking habits, exercise, and dietary habits. In relation to smoking or an alcohol drinking habit, no significant correlation was found between those who did not get enough sleep and those who got adequate sleep. For the food habits, the group with insufficient hours of sleep was related to a less than satisfactory frequency of meal taking, irregularity of eating, snacking habits, excessive flavoring of food, and consumption of insufficient quantities of vegetables. Conversely, it was recognized that those who have satisfactory food habits are more likely to enjoy an appropriate amount of sleep (Ohida et al., 2001). Those who fail to get sufficient sleep engage in food habits that are more likely to cause lifestyle-related diseases, such as hypertension and hyperlipemia (Guyton, 1987).

These results may be interpreted to prove indirectly that there is a relationship between hours of sleep and mortality or incidence of diseases as stated above (Hammond, 1964; Hammond and Garfinkel, 1969; Kripke et al., 1979). Those who do not allow themselves enough time to sleep not only suffer from a lack of sleep: their lifestyle, especially their eating habits, will be less than satisfactory. A busy lifestyle that necessarily curtails one's hours of sleep also forces that person to dine out or rely on snacks between meals; and the frequency or pattern of eating meals is disturbed. In other words, the rise in mortality or morbidity for those who sleep fewer hours is not caused only by a lack of sleep: the culprit is also an inappropriate lifestyle that includes irregular food habits.

It should be added that the questionnaire used in this study was designed to be responded to individually. There is a possibility that some responses to questions on food habits may have been biased by subjective interpretation. Many individual differences will occur or may be expected in the regularity of meals, frequency of dining out, and consumption of vegetables, which may...
present some problems. Improvements will be made in future studies.

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