Prevalence of Insomnia and its Relationship to the Health Habits or Status of Women Living along a City Road

Part 1. Epidemiologic Study

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Abstract

The prevalence rate of insomnia among 424 married women and its associated factors were surveyed. Insomnia is defined as having one of the following symptoms one or more times per week: difficulty inducing sleep (F1), difficulty maintaining sleep (F2), early morning awakening (F3), light sleep (F4), or worry about poor sleep quality (F5). Poor sleep as a whole in the past one month (F6) was also inquired about. Percentages of F1, F2, F3 and F5 among the subjects in their sixties were 21.3%, 13.3%, 6.7% and 10.7%, respectively, relatively higher than those of subjects in their thirties or forties. There was a significant difference in the percentage of F6 among four age categories ($p < 0.05$), and the percentage of F6 was highest (23.3%) in those in their thirties. Depressive state correlated with six insomnia items, F1 to F6 ($r_s = -0.195, -0.161, -0.117, -0.221, -0.176, 0.284$, respectively). Perceived health status correlated with F1 (-0.237), F4 (-0.213), F5 (-0.259), and F6 (0.373). Present medical condition correlated with F1 (-0.195), F3 (-0.146), and F5 (-0.220). The prevalence rates of insomnia for subjects in their thirties, forties, fifties and sixties were 16.7%, 17.7%, 25.7%, and 24.0%, respectively. Increases in the percentages of difficulty in inducing and maintaining sleep, early morning awakening and worry about poor sleep quality in the subjects in their sixties, and sleep dissatisfaction of those in their thirties were recognized.

Key words: Insomnia, Field survey, Depressive state, Subjective sleep inventory, Aging

Introduction

Insomnia is a common complaint relating to daily life¹⁾. The prevalence of insomnia has been reported in Western countries²⁻⁴⁾, though values have varied. In Japan, related information has been relatively lacking. The sources of insomnia criteria used in past epidemiologic studies were DSM-III-R, ICD-9CM, and DCSAD (Diagnostic Classification of Sleep and Arousal Disorders)²⁻⁴⁾. The DCSAD was revised and renamed the ICSD (International Classification of Sleep Disorders)⁵⁾. Operationally defined criteria of sleep disturbance in the ICSD were divided in detail, and the word "insomnia" was applied to many categories of sleep disturbance. Under these circumstances, the definition

of insomnia by its degree and frequency is tentatively made by the investigator, so that comparison of studies has become increasingly difficult and standardized insomnia criteria for epidemiologic surveys may thus be required^{6,7)}.

In the present study, the authors calculated the prevalence rate of insomnia among female inhabitants of a small city utilizing a sleep questionnaire, and also analyzed the association between subjective sleep parameters and perceived health status, depressive state, exercise and present medical condition.

Subjects and Methods

A cross-sectional study was conducted in December, 1994. We surveyed the zone along Route 17, or the Tobu bypass road from Route 50 to Route 17, located in the center of the city of Maebashi in Japan. The traffic volume from 22:00 to 4:00 decreased from 815/hour to 257/hour, and then gradually increased to 308/hour at 5:00 and 593/hour at 6:00. Of the vehicles, over 50% were trailers and trucks with diesel engines. This zone is a residential area, and we selected subjects dwelling from 0 to 150 m from the road.

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A large scale map of Maebashi, containing the name of each household (Zenrin, Co., Ltd., Kitakyushu), was used. Lines were drawn parallel to the roads at distances of 150 m from the roadside. The authors devised a plan to analyze the association between the distance of the residence from the roadside and the percentage of insomnia. After environmental monitoring of the indoor sound level had been completed, the inter-relationship could be clarified. Female adults who were 20 years of age and older were chosen as subjects. At the first visit, the author asked, "Are there female subjects not less than 20 years of age living here?" If not, the survey was discontinued. After collection of the questionnaire, we excluded subjects who were 70 years or older and under 30 years. Unmarried subjects were also excluded. Originally, 1,285 persons were chosen, of whom 648 replied (50.4%). Among them, the number of married females aged 30 to 69 years of age was 424. The authors made list-wise data deletion and the final number of subjects was 331.

Subjective sleep inquiries were made using a self-administered questionnaire, part of which is shown in the Appendix. In Japan, the OSA sleep questionnaire is widely used to assess the sleep quality of the previous night. There is, however, no standard questionnaire for estimating the prevalence of insomnia in Japan and other countries, so an original questionnaire must be devised to conduct a survey. An explanatory letter and questionnaire were handed to every participant. Within 24 hours, a field technician visited each subject's house and collected the questionnaire. Difficulty inducing sleep, difficulty maintaining sleep, early morning awakening, light sleep, and worry about poor sleep quality at least once per week were judged as positive symptoms of insomnia. The prevalence of insomnia was calculated as the rate of subjects who replied positively to at least one item out of five. If sleep as a whole was not good, integrated or perceived sleep feeling was judged as being poor. Present health status or perceived health was classified into five categories as good, fairly good, moderate, relatively poor, and poor, according to a survey conducted by the Ministry of Health and Welfare⁸⁾. Depressive state was judged by the Todai Health Index (THI)⁹⁾. There are no questions about sleep disturbance in the THI depressive state scale. A higher THI scale score reflects a more depressive state.

Exercise was reported in binary fashion according to the question "Have you exercised recently?" Present medical condition was also reported in the same fashion in response to the question "Are you now receiving treatment for a disease?" Statistical analyses were performed using Ryan's multiple comparison, which is a conservative method of reducing the alpha error, and Spearman's rank correlation coefficient utilizing NAP software¹⁰⁾.

Results

Although no significant difference was seen, percentages of difficulties inducing and maintaining sleep, early morning awakening and worry about poor sleep quality of subjects in their sixties were relatively higher than those of subjects in their thirties or forties. The prevalence of insomnia as judged by each item increased with aging, which also showed no significant difference. The prevalence was 16.7% in subjects in their thirties, and 24.0% in those in their sixties. In contrast, there was a significant difference in the percentage of a poor integrated (perceived) sleep feeling among the four age categories ($p < 0.05$), and the percentage in their thirties was the highest (23.3%). (Table 1)

Percentages of good, fairly good or moderate perceived health showed no significant differences in any age category. Although the percentage engaging in exercise among subjects in any age category showed no significant difference, the percentages in their fifties and sixties were about twofold higher than that of subjects in their thirties. The percentage with no present medical condition among subjects in their thirties was significantly higher than that of subjects in their fifties and sixties. The mean scale score value of the depressive state of subjects in their sixties was significantly lower than that of subjects in their thirties and forties. (Table 2)

For those in their thirties, associations of the perceived health status with integrated (perceived) sleep feeling and insomnia, as a representative indicator, were identified. The scale score of the depressive state was associated with light sleep. No other associations were recognized in this age category. For those in their forties, association of the perceived health status with difficulty in inducing sleep, worry about poor sleep quality, integrated

Table 1 Percentage of each item and insomnia prevalence rate

Age	DIS	DMS	Morning	Light	Worry	Integrated sleep#*	Prevalence rate##
30-39	8.9	6.7	2.2	6.7	3.3	23.3	16.7
n=90	(8)	(6)	(2)	(6)	(3)	(21)	(15)
40-49	14.6	6.3	2.1	4.2	6.3	10.4	17.7
n=96	(14)	(6)	(2)	(4)	(6)	(10)	(17)
50-59	17.1	10.0	5.7	11.4	10.0	11.4	25.7
n=70	(12)	(7)	(4)	(8)	(7)	(8)	(18)
60-69	21.3	13.3	6.7	6.7	10.7	10.7	24.0
n=75	(16)	(10)	(5)	(5)	(8)	(8)	(18)
Total	15.1	8.8	3.9	6.9	7.3	14.2	20.5
n=331	(50)	(29)	(13)	(23)	(24)	(47)	(68)

DIS: Difficulty inducing sleep, DMS: Difficulty maintaining sleep, Morning: Early morning awakening, Light: Light sleep, Worry: Worry about poor sleep quality

#: Integrated or perceived sleep feeling, ##: Insomnia prevalence rate

Numbers of subjects are given in parentheses.

There was a significant difference of integrated sleep (*) among the four age categories ($p < 0.05$), but there was no significant difference between the percentage of those in their 30s and 40s by Ryan's multiple comparison.

Table 2 Percentage or mean value of each item

Age	n=	Perceived health (good, fairly good or moderate)	Regular exercise	No present medical condition	THI scale score of depression
30-39	90	96.7 (87)	13.3 (13)	85.6 (77)	13.2±3.67*
40-49	96	89.6 (86)	21.9 (28)	75.0 (72)	13.4±3.65**
50-59	70	94.3 (66)	27.1 (19)	62.9 (44)**	12.2±2.55
60-69	75	88.0 (66)	26.7 (20)	57.3 (43)**	11.8±3.00
Total	331	92.1 (305)	21.8 (72)	71.3 (236)	12.7±3.36

Numbers of subjects are given in parentheses.

There is a statistically significant difference between * (**) and ____ by Ryan's multiple comparison.

*p < 0.05, **p < 0.01

Table 3 Spearman's rank correlation coefficient between each sleep disturbance item and other factors (n=331)

		DIS	DMS	Morning	Light	Worry	Intergrated sleep	Prevalence rate
30's n=90	Perceived health	-0.136	0.021	-0.075	-0.147	-0.109	0.339**	0.234*
	Depressive state	-0.132	-0.158	-0.073	-0.245*	-0.105	0.145	0.097
	Exercise	-0.017	0.080	0.022	-0.110	-0.061	-0.055	0.081
	Present condition	-0.098	-0.020	-0.202	-0.065	0.060	0.099	0.063
40's n=96	Perceived health	0.293**	-0.076	-0.147	-0.085	-0.322**	0.401**	0.349**
	Depressive state	-0.334**	-0.236*	-0.144	-0.268**	-0.256*	0.309**	0.363**
	Exercise	0.026	0.019	-0.049	0.127	-0.119	0.013	-0.076
	Present condition	-0.149	0.030	-0.121	0.136	-0.203*	0.116	0.121
50's n=70	Perceived health	-0.138	-0.328**	-0.163	-0.332**	-0.321**	0.419**	0.422**
	Depressive state	-0.103	-0.249*	-0.210	-0.205	-0.171	0.287*	0.276*
	Exercise	-0.012	0.059	-0.019	0.020	-0.124	0.058	0.045
	Present condition	-0.023	-0.092	-0.120	-0.164	-0.287*	0.141	0.089
60's n=75	Perceived health	-0.349**	-0.087	0.028	-0.341**	-0.247*	0.419**	0.300**
	Depressive state	-0.403**	-0.272*	-0.297**	-0.188	-0.288*	0.426**	0.401**
	Exercise	0.046	0.179	0.153	0.168	0.163	0.047	-0.027
	Present condition	-0.364**	0.026	0.002	-0.149	-0.258*	0.093	0.334**

Abbreviations are listed in Tables 1 and 2.

(perceived) sleep feeling and insomnia were identified. The scale score of the depressive state was associated with all items of sleep disturbance except early morning awakening. Present medical condition correlated with worry about poor sleep quality. For those in their fifties, associations of perceived health status with difficulties in maintaining sleep, light sleep, worry about poor sleep quality, integrated (perceived) sleep feeling and insomnia were identified. The score of the depressive state was associated with difficulty in maintaining sleep, integrated (perceived) sleep feeling and insomnia. Present medical condition correlated with worry about poor sleep quality. For those in their sixties, associations of perceived health status with difficulty in inducing sleep, light sleep, worry about poor sleep quality, integrated (perceived) sleep feeling and insomnia were identified. The depressive state was associated with all items of sleep disturbance except light sleep. Present medical condition correlated with difficulty in inducing sleep, worry about poor sleep quality and insomnia. (Table 3)

None of the five items of insomnia correlated with exercise. Present medical condition was clearly associated with each item of sleep disturbance, by age. Perceived health status was clearly associated with each item of sleep disturbance in those over 40 years of age. Depressive state was clearly associated with being in the forties and the sixties. (Table 3)

Discussion

The final recovery rate for this survey was 50.4%. There was a possibility of nonresponse bias which might have affected the percentage of those with insomnia. There are certain other epidemiological biases in the process of conducting a field questionnaire survey, and there exist certain some difficulties in fully excluding such bias.

The results of this study cannot be applied directly to the general female population. The target subjects along the road may have been living there for a relatively long time, because

housing land near the road is generally occupied by such inhabitants. Environmental nuisances such as noise are worse along the road. Adaptation to the environment should also be considered. The authors speculate that the estimation of the prevalence of insomnia in this research may be limited to married women living in an urban environment.

Liljenberg et al. reported the percentages of difficulty in inducing sleep (DIS) to be 0.5% and 1.1% (male and female, respectively) and that of difficulty in maintaining sleep (DMS) to be 1.1% (both male and female). They also defined DIMS as the percentage of DIS or DMS, which was 1.4% in males and 1.7% in females⁷⁾. Gislason et al. calculated the prevalence rate of habitual insomnia defined as DIS or DMS, for six episodes or more per week, utilizing a questionnaire. Target subjects were inhabitants of Iceland aged 65 and older, and the percentage of DIM in females was 11.4% while that of DMS was 29.6%¹¹⁾. Husby et al. conducted a survey involving over 10,000 inhabitants of Norway asking "Are you bothered by sleeplessness?" The percentage of yes responses was 41.5% among subjects aged from 30 to 34 years, 44.1% of those 35 to 39 years, 44.8% of those 40 to 44 years and 46.3% of those 45 to 49 years¹²⁾. The above three reports indicate that the prevalence rate of insomnia changes according to questionnaire content, including the frequency of insomnia and age.

A major survey on the prevalence of insomnia was conducted by interview by Hammond who targeted over one million males and females in the United States. The percentages of subjective symptoms of insomnia were 13.9% for subjects aged 30 to 34 years, 15.9% for those 35 to 39 years, 19.8% for those 40 to 44 years, 23.8% for those 45 to 49 years, 29.0% for those 50 to 54 years, 31.1% for those 55 to 59 years, 31.5% for those 60 to 64 years and 31.0% for those 65 to 69 years¹³⁾. Foley et al. interviewed over 9,000 males and females aged 65 and older with regard to insomnia, and the percentage among females was 25.4%¹⁴⁾. Mellinger reported that 20% of female subjects from 18 to 79 years of age complained of difficulty in inducing or maintaining sleep, or early morning awakening in the previous one year in a survey interview¹⁵⁾.

The grade of insomnia can be operationally classified according to the DSM-III-R. The prevalence rate of severe insomnia in female subjects aged 65 years or older, who perceived a disturbance in their daily activities, was 29.1% by this criterion⁴⁾. The same author reported the prevalences of insomnia in other generation; 21.9% in those 36 to 45 years, 28.7% in those 46 to 55 years and 32.6% in those 56 to 65 years³⁾. Weyerer et al. calculated the percentages with a clear pre-state sleep deficit in females according to the criteria of ICD-9, as being 9.0% for those in their thirties, 14.0% in the forties, 24.3% in the fifties and 29.4% in the sixties²⁾. The value for those in their fifties is in agreement with our result, but the gradient of the percentage against age category is steeper.

Henderson et al. compared mental and physical illness in two groups, divided according to complaints of insomnia, targeting subjects aged 70 and older¹⁶⁾. Recent perceived health among subjects who had complaints of insomnia was significantly worse than that of subjects who had none. The percentage reporting a lack of exercise among subjects who had complaints of insomnia was significantly higher than that of subjects who had no such complaints. Individuals with insomnia tended to have more medical problems and be more depressed. There was no associa-

tion between insomnia and exercise in our report, and this discrepancy was noteworthy. Foley et al. extracted certain factors related to insomnia by multiple regression analysis targeting subjects aged 65 and older. Perceived health, depressive score by CES-D and frequency of taking prescription medications were definitely related to insomnia. These authors mentioned that the cause-effect relationship between the depressive state and chronic insomnia was unclear¹⁷⁾.

The prevalence rate of insomnia increases with age^{2, 3, 12, 13, 15, 18)}. Gislason et al. reported a poor association between the two^{11, 19)}, but it seems certain that the prevalence rate of insomnia increases with age if younger and older generations are included in the analysis. In our report, the percentages of difficulty in inducing and maintaining sleep, early morning awakening and worry about poor sleep quality among subjects increased with age, which showed no significant difference.

In this report, the percentage of poor integrated (perceived) sleep, which was assumed to express sleep dissatisfaction, was increased in subjects in their thirties. We speculated that children waking the subject up during the night, and disturbed subjective satisfaction with sleep, which were not overtly revealed by the score of the five sleep questions, might have accounted for some part of this observation. The self-reported sleeping time of the subjects in their thirties was 7.35 ± 1.02 h; there was no significant difference from the mean value of 7.18 ± 0.96 h for those in their fifties, but it was significantly higher than the mean value of 6.91 ± 0.98 h for those in their forties.

The incidence of disease increases with age, but this study demonstrated that the change in incidence did not reflect perceived health. Perceived health was recognized, by the subject, via a comparison between the health target level and present health status. The depressive state improved in those 60 years of age and older, and this change partly related to the mechanism of determining perceived health.

For those in their thirties, there was a poor association between sleep disturbance and health status or habits. The association between perceived health status and sleep disturbance became increasingly clear with advancing age, however. The association between depressive state and sleep disturbance disappeared in those in their fifties, which was in part explained by hormonal change. For those in their sixties, present medical condition was broadly associated with sleep disturbance, and medication seemed to be an important daily life concern in this generation.

The test-retest reliability of the questionnaire should be assessed to obtain information on the reproducibility of this survey. The authors conducted a trial of the test-retest survey on sleep induction utilizing kappa statistics, and the κ value was 0.741, which was significant ($p < 0.01$). We plan to verify the reliability of other questionnaires in the future.

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Appendix. Six sleep questions with four possible answers each. A symptom frequency of at least once a week was judged to be positive.

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- 1) Have you had trouble sleeping because you could not get to sleep?
 ①: Three or more times a week ②: Once or twice a week
 3: Less than once a week 4: Not during the past month
 - 2) Have you had trouble sleeping because you woke up in the middle of the night and could not get to sleep again?
 ①: Three or more times a week ②: Once or twice a week
 3: Less than once a week 4: Not during the past month
 - 3) Have you had trouble sleeping because you woke up in the early morning?
 ①: Three or more times a week ②: Once or twice a week
 3: Less than once a week 4: Not during the past month
 - 4) Have you experienced light sleep for the entire night?
 ①: Three or more times a week ②: Once or twice a week
 3: Less than once a week 4: Not during the past month
 - 5) Have you worried about the poor quality of your sleep?
 ①: Three or more times a week ②: Once or twice a week
 3: Less than once a week 4: Not during the past month
 - 6) During the past month, how would you rate your sleep quality overall?
 1: Very good 2: fairly good ③: relatively poor ④: very poor
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For difficulty in inducing sleep (1), difficulty in maintaining sleep (2), early morning awakening (3), light sleep (4), and worry about poor sleep quality (5); one or more times per week, circled items were judged to be positive symptoms of insomnia. For an integrated or perceived feeling of poor sleep, encircled items were also judged to be positive symptoms.

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