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Original article

## Population study on the prevalence of insomnia and insomnia-related factors among Japanese women

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### Abstract

**Background:** To identify the effect of certain factors on insomnia in the general population.

**Methods:** A self-reported questionnaire survey was conducted among 648 Japanese women living in the residential area of a city. Age of participants ranged from 20 to 80 s.

**Results:** The crude prevalence of insomnia was 8.8%. Multivariate logistic regression analysis with control for many confounding variables revealed that experiencing a major life event (OR = 4.4, 95% CI = 1.7–11.4,  $P < 0.01$ ), depressive state (OR = 1.2, 95% CI = 1.1–1.3,  $P < 0.01$ ), and 'relatively poor or poor' self-rated health (OR = 3.2, 95% CI = 1.0–10.1,  $P < 0.05$ ) were risk factors for insomnia. By contrast, there was no dose–response relationship between the distance of our subjects from a major road and prevalence of insomnia.

**Conclusions:** The authors assume that depressive state by a major life event is closely associated with insomnia and that relatively poor self-rated health is also associated with stressful event and psychological distress. Although the noise from vehicles such as cars or motorcycles can affect the quality of sleep for subjects who live near a major road, in general the prevalence of insomnia did not increase significantly in this study.

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*Keywords:* Insomnia; Major life event; Depressive state; Self-rated health; Road traffic noise; Questionnaire; General inhabitants; Women

### 1. Introduction

Environmental factors, including noise, disturb sleep [1]. However, many other factors, such as sex, age, health status, and psychosocial stress caused by life events also cause sleep disorders [2]. Sleep disorders caused by environmental noise have been reported in the general population [3–7], but the definition of insomnia has never been established in population studies on environmental noise and sleep [8].

One of our authors previously reported the effect of road traffic noise on insomnia [9], selecting three different geographical areas including Maebashi, famous in Japan for its traffic, and Nagasaki, where the many slopes make it difficult to determine the distance from each house to the main road. We felt that a single setting (Maebashi) was

preferable, both to avoid the complexity of geographical characteristics and also for comparing several factors affecting sleep quality of the general inhabitants.

According to a recent report, night time exposure to noise may affect serum cortisol; lower cortisol levels after awakening were associated with subjective reports of lower sleep quality and mood [10]. Before addressing the question of insomnia caused by traffic noise, the authors conducted a quantitative field survey to make clear the general significance of noise on sleep.

Although contradictory results have been reported in regard to the gender differences in noise-induced sleep disorders [11], there is a reliable opinion that women are more sensitive to noise than men [8,12]. The present study was undertaken to identify risk factors, including environmental noise exposure, for insomnia in female subjects in a city.

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## 2. Materials and methods

### 2.1. Survey area and subjects

A self-administered questionnaire concerning demographic information and sleep-related items was distributed to women living in Maebashi City (population approximately 280,000). The target area included a major road. The nighttime traffic volume was 900 motor vehicles per hour. The residential area was divided into three zones according to distance from the road: zone A (the reference zone), more than 50 m; zone B, 20–50 m; zone C, 0–19.9 m. The speed limit on the major road is 50 km per hour. Buildings, such as apartment houses, form an almost unbroken line along the roadside. No sound barriers have been erected between the houses and road. The outdoor sound level measured at roadside for 24 h was 70.4 dBA, which was expressed by the equivalent sound level (*Leq*). *Leq* at distances of 20, 50, and 100 m from the major road was calculated. Sound levels were measured from 21:30 to 24:30 h on weekdays in January 2001; the mean values were 64.7, 57.1, and 54.8 dBA, respectively, indicating that the sound level decreased with the distance of residences from the road.

Subjects were selected based on a map of the residential area. The subjects were not identified prior to sending trained staff to the household, and all women were asked to complete the questionnaire for each household. Staff visited the subjects to request their participation in the study and made a return visit about 2 weeks later to collect the replies. Questionnaires were completed by 648 of the 1286 subjects (50.4%). Although this response rate was minimum, the authors concluded that the sample was valid because there was no difference in age between respondents and non-respondents. The subjects ranged in age from 20 to 80 s, and 302 of 619 subjects (48.8%) were employed.

### 2.2. Epidemiological definition of insomnia

A 12-page questionnaire was distributed, composed of seven sections. Eleven questions were devoted to insomnia; questions devoted to sleep disturbance caused by traffic noise were asked separately.

The prevalence of insomnia determined in a community survey depends on the definition of insomnia, which is related to the content of the questionnaire. The authors used the criteria of the International Statistical Classification of Diseases and Related Health Problems, 10th version (ICD-10) [13], and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [14] for the diagnosis of insomnia because of their simplicity and comprehensiveness. The first criterion is the presence of a subjective, sleep-related problem. The second is the presence of one or more of the following four symptoms, occurring one or more times per week and having persisted for at least 1 month: difficulty falling asleep, intermittent awakening, early morning awakening, and a feeling of light overnight sleep.

The third criterion is the presence of one or more of the following after-effects of sleep disturbance: 'lethargy', 'tardiness', 'inefficiency in work', 'dozing or napping', 'proneness to error, particularly in work' or 'overly sleepy'.

The reproducibility of diagnosis based on these criteria has been confirmed by the results of a test–retest study at a 1-month interval: 56 of the 79 insomniacs (71%) were re-diagnosed as insomniacs, and 85 of the 90 non-insomniacs (94%) were re-diagnosed as non-insomniacs [9].

Present self-rated health status or perceived health was classified into five categories: good, fairly good, moderate, relatively poor, and poor, as in a survey conducted by the Ministry of Health, Labor and Welfare [15]. Depressive state was rated on the basis of the Todai Health Index (THI), which consists of 10 questions [16], with higher scores reflecting a more depressed state. There are no questions about sleep disturbance in the THI depressive state scale.

### 2.3. Analytical procedure

Multiple logistic analysis was carried out to identify risk factors for insomnia. The degree of risk of insomnia was represented as an odds ratio (OR) adjusted for other variables. The independent variables, including the distance from the road (zone), were converted into three dummy variables for the analysis. Six choices concerning major life events were presented in the questionnaire: 'moving away from home', 'getting married or giving birth', 'getting or losing a job, or changing jobs', 'serious disease or injury', 'death in the family', and 'other stressful events'. Any one of the above, experienced within the previous 6 months, was counted as a major life event. To increase the stability of the results, the authors excluded from the logistic regression analysis all subjects older than 80 and all those with 'good' self-rated health. Statistical procedures were conducted using the SPSS 10.0J for Windows package.

## 3. Results

### 3.1. Description of the respondents

The subjects ranged in age from 20 to 80 s. The numbers of married and unmarried persons were 490 and 113, respectively. In addition, the numbers of full-time workers, part-time workers, and unemployed persons were 302, 24, and 293, respectively.

### 3.2. Sleeping habits

The mean bedtime and rising time on nights before weekdays were 23:11 and 06:35 h, respectively, and on nights before weekend days and holidays were 23:34 and 07:41 h, respectively. Of 630 respondents, 172 (27.3%)

were in the habit of taking naps one or more times a week, and 109 (17.5%) of 623 respondents complained of sleep-related problems. Among the subjects aged 80 years of age and older, 69.2% were in the habit of taking naps, which is higher than other age groups. The age group with the lowest percentage of sleep-related problems (9.0%) was the 30–39-year-old group.

### 3.3. Prevalence of insomnia

Fifty-seven subjects (8.8%) were classified as insomniacs, the most common type of insomnia being difficulty falling asleep (17.6%) (Table 1). The prevalence of insomnia was lowest among those in their 80s (6.3%), followed by those in their 40s (6.5%), although none of

Table 1  
Basic information on the prevalence of insomnia among the 648 participants in the study

Variables	Subgroup	Insomnia	S1	S2	S3	S4
Total		8.8 (57/648)	17.6	9.9	6.3	7.8
Age	20 s	10.8 (10/93)	18.5	3.2	4.3	7.5
	30 s	9.4 (12/127)	10.4	5.5	1.6	7.9
	40 s	6.5 (8/124)	15.3	6.5	3.3	5.7
	50 s	8.3 (10/121)	18.5	9.1	7.6	9.1
	60 s	9.6 (11/115)	21.1	16.8	12.3	7.1
	70 s	9.5 (4/ 42)	31.0	19.0	4.9	7.3
	80 s	6.3 (1/ 16)	13.3	26.7	20.0	14.3
Marital status	Married	8.4 (41/490)	17.1	10.5	6.8	7.6
	Not married	8.3 (11/133)	17.4	3.0	3.0	6.1
Job ( $\geq 3$ days/week)	Employed	8.6 (26/302)	15.1	6.3	5.0	7.3
	Other	8.8 (28/317)	20.1	12.7	6.7	8.0
	Unemployed	8.8 (28/317)	20.1	12.7	6.7	8.0
Live with a child ( $\leq 6$ years)	Yes	14.0 (18/129) *	16.7	11.7	5.5	11.6
	No	7.2 (33/457)	17.6	8.8	6.0	6.8
Self-rated health	Good	0.0 (0/146)	4.9	2.7	0.0	0.0
	Fairly good	6.3 (7/112)	16.1	9.9	8.9	5.4
	Moderate	10.5 (31/296)	20.2	8.5	5.2	9.9
	Relatively poor	23.2 (13/56)*	34.5	29.1	16.7	17.9
	Poor	20.0 (2/10)	30.0	40.0	20.0	30.0
Medical treatment	Yes	13.6 (27/199) **	25.9	11.2	8.6	9.6
	No	6.8 (28/412)	13.8	8.5	4.7	7.1
Smoking habit	Yes	10.2 (11/108)	22.4	9.3	6.5	9.3
	No	8.3 (43/515)	16.3	9.2	6.1	7.4
Alcohol intake	Yes	11.0 (15/136)	17.0	7.4	5.9	5.9
	No	8.0 (39/486)	17.7	9.9	6.3	8.3
Regular exercise	Yes	6.4 (9/140)	18.0	10.7	6.5	7.9
	No	9.3 (45/485)	17.3	9.1	6.1	7.3
Regular Breakfast	Yes	7.2 (35/488)	15.1	9.5	5.8	6.2
	No	13.0 (19/146)*	25.5	10.3	6.2	11.0
Tasting tea (caffeine)	Yes	8.9 (47/531)	17.7	8.7	5.5	8.0
	No	8.1 (8/99)	17.5	14.4	10.4	6.3
Residence period	– 2.9 years	10.8 (12/111)	19.3	9.9	8.2	6.3
	3–9.9 years	10.9 (14/129)	15.0	6.2	2.3	9.3
	10 years	7.3 (29/398)	17.5	10.1	6.6	7.4
Distance from a big road	> 50 m	8.5 (17/200)	15.2	10.1	6.1	7.1
	20–50 m	6.5 (14/217)	15.9	6.5	3.7	6.5
	0–19.9 m	11.0 (17/154)	20.1	11.0	6.6	10.5
House material	Reinforced	11.4 (21/184)	16.6	10.9	5.5	9.3
	Mortared	7.1 (11/154)	16.9	7.2	7.3	6.6
	Wooded	7.7 (21/274)	18.9	10.6	5.6	7.7
House	Detached	8.2 (40/490)	17.1	10.2	6.0	7.2
	Apartment	11.4 (17/149)	18.9	8.7	6.1	9.4
Major life event	Yes	14.5 (36/249) ***	24.1	10.4	7.7	10.8
	No	5.3 (21/399)	13.6	9.6	5.4	5.9

S1, difficulty in falling asleep; S2, intermittent awakening; S3, early morning awakening; S4, a feeling of light overnight sleep. These symptoms occur one or more times a week and has persisted for at least 1 month. Major life event refers to the six events listed in the questionnaire: 'moving away from home', 'getting married or giving birth', 'getting or losing a job, or changing jobs', 'serious disease or injury', 'death in the family', and 'other stressful events', which had been experienced within the last 6 months. Significant differences, partly against the underlined value, were marked as \* $P < 0.05$ ), \*\* $P < 0.01$ , and \*\*\* $P < 0.001$ .

the differences among the seven age groups were significant. Groups with a significantly higher prevalence of insomnia consisted of those living with a child aged six or younger ( $P < 0.05$ ), those undergoing medical treatment ( $P < 0.01$ ), those who did not regularly eat breakfast ( $P < 0.05$ ), and those who had experienced a major life event ( $P < 0.001$ ). Those with a 'relatively poor' self-rated health status had a significantly higher prevalence of insomnia than those who reported 'good', 'fairly good', or 'moderate' health. The prevalence of intermittent awakening was highest in the elderly. The rates ranged from 3.2 to 26.7%, with a significant trend of linearity with age ( $P < 0.001$ ), and no dissociation from the line.

There were no significant differences in the prevalence of insomnia among the three zones, nor in the percentage of subjects with sleep disorders in the previous month as a whole (C, 17.3%; B, 13.3%; and A, 20.3%), but when the source of the noise was specified, the percentages of sleep disorders—35.8% caused by cars and 53.2% by motorcycles—was higher among subjects living within 20 m of the road, compared to the control area (more than 50 m from the road), where the percentages were 13.5% (cars) and 26.2% (motorcycles).

Among the insomniacs, 17.3% were currently consulting a physician or a specialist for their sleep problems, and 22.9% were currently using a hypnotic prescribed by a physician.

#### 3.4. Factors related to insomnia (multiple logistic regression analysis)

Multiple logistic regression analysis revealed that insomnia was associated with experiencing one or more major life events within the previous 6 months (Table 2). The odds ratio for insomnia without a major life event was 4.4 (95% confidence interval: 1.7, 11.4,  $P < 0.01$ ) after controlling for several confounding variables. Other risk factors for insomnia were depressive state (OR = 1.2 by an increase of 1 score on the THI depression scale, 95% confidence interval: 1.1–1.3,  $P < 0.01$ ), and 'relatively poor or poor' self-rated health (OR = 3.2, 95% CI = 1.0–10.1,  $P < 0.05$ ) compared to 'good, fairly good or moderate'.

#### 4. Discussion

Although the present study had assumed road traffic noise to be an important cause of insomnia, the percentage of sleep disorders correlated with distance from the road only when the source of the noise, such as cars and motorcycles, was specified. The risk of insomnia estimated by distance from the major road was not significant according to the results of multivariate analysis.

The prevalence of insomnia in the general population differs [17,18], partly because there is no standard

Table 2  
Odds ratios of insomnia according to several related factors

Factors	Unadjusted odds		Adjusted odds	
	OR	95% CI	OR	95% CI
Age (under 50s)				
50 or older	1.0	0.6, 1.8	2.7	0.9, 7.9
Not get married	1.0	0.5, 2.0	1.2	0.4, 3.5
Having a job	1.0	0.6, 1.7	0.7	0.3, 1.8
Not living with a child ( $\leq 6$ years)	0.5*	0.3, 0.9	0.7	0.2, 2.0
Self-rated health				
(good, fairly good or moderate)				
relatively poor or poor	4.0**	2.1, 7.8	3.2*	1.0, 10.1
No medical treatment	0.5**	0.3, 0.8	0.7	0.3, 1.9
Smoking status	1.2	0.6, 2.5	0.5	0.2, 1.6
Alcohol intake	1.4	0.8, 2.7	2.0	0.7, 5.7
No regular exercise	2.6*	1.0, 6.8	3.1	0.9, 11.0
No regular breakfast	1.5	0.7, 3.1	1.2	0.4, 3.4
Tasting tea (caffeine)	1.1	0.5, 2.4	2.3	0.6, 10.0
Residence period (within 3 years)				
3–9.9 years	1.0	0.4, 2.3	2.6	0.7, 10.2
10 years	0.6	0.3, 1.3	1.1	0.3, 4.7
Distance from a big road (>50 m)				
20–50 m	0.7	0.4, 1.5	1.0	0.4, 2.6
0–19.9 m	1.3	0.7, 2.7	1.8	0.6, 5.3
House material (reinforced)				
Mortared house	0.6	0.3, 1.3	0.9	0.2, 3.4
Wooded house	0.6	0.3, 1.2	0.9	0.3, 3.1
Apartment building	1.4	0.8, 2.6	1.3	0.3, 5.2
Depressive state (THI)	1.2***	1.1, 1.3	1.2**	1.1, 1.3
Major life event	3.0***	1.7, 5.3	4.4**	1.7, 11.4

ns, not significant. Significant differences against control in parenthesis were marked as \* $P < 0.05$ ; \*\* $P < 0.01$ ; and \*\*\* $P < 0.001$ .

definition. The prevalence of insomnia in the present study, compared to that of previous studies using the same definition [9,19], was lower.

Difficulty in sleep maintenance, common among the elderly [20,21], can be explained by physiological aging [22]. In this study, insomnia characterized by intermittent awakening was more strongly associated with aging than insomnia characterized by the other sleep-related symptoms. Difficulty falling asleep was highest among the 30–39-year-old age group, a finding that agrees with a previous report [23]. This may be related to the frequently irregular sleep–wake cycle of those in their 30s who care for children.

Major life events, strongly associated with insomnia, can sometimes cause severe mental disorders [13]. Logistic regression analysis in our study showed that major life events, such as change of lifestyle, and depressive state were significantly associated with insomnia.

In conclusion, experience of a major life event, depressive state, and self-rated 'relatively poor or poor' health were selected as related factors to insomnia among adult women living in a Japanese city. Further field research should focus on actual exposure of insomniacs to noise.

The authors have a plan to conduct further survey considering the attenuation of noise by wall or windows, and personal susceptibility to noise.

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