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EFFECTS OF ROAD TRAFFIC NOISE ON INHABITANTS OF TOKYO

T. Yoshida and Y. Osada

National Institute of Public Health, 4-6-1, *Shirokanedai*, *Minato-Ku*, *Tokyo* 108 *Japan*

T. Kawaguchi, Y. Hoshiyama and K. Yoshida

School of Medicine, *Showa University*, 5–8, *Hatanodail* 1-*Chome*, *Shinagawa-Ku*, *Tokyo* 142, *Japan*

AND

K. Yamamoto

Department of Psychology, *Keio Gijyuku University*, 15–45, *Mita* 2-*Chome*, *Minato-Ku*, *Tokyo* 108, *Japan*

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A questionnaire-based study was performed in an area of about 16 ha near a main road in Tokyo to elucidate any relations between road traffic noise and the effects of this noise among women living on both sides of the road. Questions concerned annoyance, sleep disturbance, interference with daily activities, health-related symptoms and disease histories. 366 inhabitants were analyzed. Dose–response relationships were found in high reported responses to noisiness, annoyance, dissatisfaction with the nearby environment and interference with listening to TV, conversation and reading. It was also found that the number of high responses to questions increased clearly at noise levels above 70 dB(A), $L_{eq(24h)}$, with regard to interference with thinking and sleep disturbance (waking during the night), fatigue, headache, gastroenteric disorders, loss of appetite, depression and irritation. Furthermore, there was an increase in reports of disease histories with noise above 70 dB(A) for climacteric disturbance, and at noise above 65 dB(A) for deafness, heart disease and hypercholesterolemia. These all suggest that noise may be related to the health status of inhabitants living in areas with heavy road traffic. A noise level of 65 dB(A) or 70 dB(A) in $L_{eq(24h)}$ was the critical point above which respondents indicated increased effects on health and reports of disease increased.

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1. INTRODUCTION

Noise can cause annoyance and interfere with daily activities, and may thus be considered to lead to health disorders. Knowledge about the health effects of road traffic noise in relation to noise levels is scarce, however, although much evidence has been presented for the health effects of aircraft noise [1].

The aim of this study was to elucidate relations between noise levels and health-related symptoms and reported disease histories, as well as relations between noise and annoyance, sleep disturbance and interference with daily activities.

2. METHOD

Five hundred women aged 20 to 60 years residing near a main road in Tokyo were surveyed. Areas on both sides of the road were included, measuring about 16 ha along

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about 800 meters of road. Data recorded for 366 women were available for analysis and were collected in interviews of 393 women after questionnaires had been dispatched by post. Noise levels outside the houses were estimated in 5 dB steps by contours of $L_{eq(24h)}$, which ranged from 40 dB(A)–75 dB(A). Information was also gathered on age, duration of residence, types and ages of houses (years from time of construction) (see Table 1). Questions related to general nuisance, sleep disturbance, interference with daily activities, physical symptoms, psychological symptoms and reported disease histories.

3. RESULTS AND DISCUSSION

Table 2 and Table 3 show the percentages of high respondents among the different noise levels, where definitions of the high responses to each question are also designated. Table 2 demonstrates dose–response relationships for high responses to annoyance, noisiness, dissatisfaction with the nearby environment and interference with listening to TV, conversation and reading (designated by D-R). Table 2 and Table 3 indicate that high responses increased clearly at noise levels above 70 dB(A) for interference with thinking and sleep disturbance (waking during the night), fatigue, headache, gastroenteric disorders, loss of appetite, depression and irritation. Furthermore, reports of disease increased with noise above 70 dB(A) for climacteric disturbance, and with noise above 65 dB(A) for deafness, heart disease and hypercholesterolemia.

Odds ratios were estimated in order to evaluate relative risks of each noise effect [2]. In calculation of odds ratios, noise levels were divided into two categories at the critical points of noise levels above which high responses increased clearly. Odds ratios of the relative risks ranged from 2·0 to 16·8, which were not adjusted by other individual factors (see Table 2 and Table 3). In the cases showing dose–response relationships, the critical noise level was assumed to be 70 dB(A).

It is important to evaluate total health status through symptoms or disease histories. For a total evaluation of the status of physical symptoms or disease histories in this study,

TABLE 1

Characteristics in percentages of inhabitants (*women*) *among noise levels*

Items	Categories	Noise levels ($L_{eq(24h)}$, dB(A)) 45-	50-	55-	60-	65-	70-	Chi square tests
Age	20–39	14·3	39·0	27·4	29·2	29·8	34·9	
	40–49	38·1	28·8	36·3	30·6	27·7	30·2	ns
	50–60	47·6	32·2	36·3	40·3	42·6	34·9	
Duration of residence	<20 years	33·3	28·8	30·6	22·2	36·2	34·9	
	20–29	28·6	30·5	38·7	19·4	34·0	30·2	$p < 0{\cdot}05$
	29 <	38·1	40·7	30·6	58·3	29·8	34·9	
Types of houses	Wooden detached	81·0	84·7	83·1	70·8	48·9	44·2	
	Others	19·0	15·3	16·9	29·2	51·1	55·8	$p < 0{\cdot}01$
Ages of houses	<20 years	33·3	23·7	20·2	16·7	19·1	39·5	
	20–29	23·8	30·5	37·1	25·0	44·7	16·3	$p < 0{\cdot}05$
	29 <	42·9	45·8	42·7	58·3	36·2	44·2	
Sample numbers	(366)	(21)	(59)	(124)	(72)	(47)	(43)	

TABLE 2

Rates (%) of high response to disturbance

Disturbance items	Definitions of high responses	Noise levels, $L_{eq(24h)}$, dB(A)						2 × 2 contingency tables		
		45-	50-	55-	60-	65-	70-	Chi square tests	Odds ratios of relative risks	Critical points of noise, dB(A)
[General responses]										
Annoyance	1/3	0·0	13·6	20·2	36·1	57·4	74·4	39·7**	8·0	70 (D-R)
General nuisance	2/5	0·0	11·9	20·2	37·5	55·3	65·1	26·8**	5·2	70 (D-R)
Dissatisfaction with nearby environment	1/4	0·0	1·7	9·7	11·1	14·9	34·9	25·2**	5·6	70 (D-R)
[Disturbance in lives]										
Listening to TV	2/6	0·0	1·7	4·0	12·5	19·2	53·5	71·9**	14·3	70 (D-R)
Conversation	2/6	0·0	0·0	1·6	4·2	10·6	34·9	60·3**	16·8	70 (D-R)
Reading	2/6	0·0	0·0	4·8	4·2	8·6	21·2	39·5**	10·3	70 (D-R)
Thinking	2/6	0·0	3·4	2·4	5·6	4·2	20·1	22·6**	7·5	70
[Sleep disturbance]										
Waking during the night	2/5	28·5	10·2	21·8	20·8	19·1	32·5	3·9*	2·0	70
Difficult to fall sleep	2/5	4·8	13·6	14·5	16·6	17·1	20·9	ns	–	–
Light night sleep	2/5	15·3	8·5	18·6	26·4	19·1	27·9	ns	–	–
Difficult to wake up	2/5	19·1	10·2	12·9	20·9	19·2	20·9	ns	–	–

Chi square tests were performed and odds ratios of relative risks were calculated for each contingency table for each disturbance which was divided at critical points of noise above which high responses increased clearly. In cases of a dose–response relationship (designated as D-R), critical points of noise were assumed to be 70 dB(A). **, $p < 0{\cdot}01$; *, $p < 0{\cdot}05$; ns, no significance.

TABLE 3

Rates (%) of high response to health-related symptoms and disease histories

Symptoms and disease	Definitions of high responses	Noise levels, $L_{eq(24h)}$, dB(A)						2 × 2 contingency tables		
		45-	50-	55-	60-	65-	70-	Chi square tests	Odds ratios of relative risks	Critical points of noise, dB(A)
[Physical symptoms]										
Tired	2/5	23·8	6·8	14·5	9·7	10·6	30·4	13·5**	3·6	70
Headache	2/5	4·1	3·4	8·1	9·7	6·4	18·6	6·5*	3·0	70
Gastroenteric disorder	1/5	0·0	5·1	0·8	2·8	2·1	9·3	6·6*	4·6	70
No appetite	2/5	0·0	3·4	0·8	0·0	0·0	4·7	3·9*	5·2	70
Tinnitus	2/5	0·0	8·5	4·8	9·7	6·4	7·0	ns	–	–
Palpitation	2/5	0·0	1·7	4·0	1·4	2·1	4·7	ns	–	–
[Psychological symptoms]										
Depression	2/5	4·8	1·7	6·4	11·2	4·3	16·3	5·7*	2·9	70
Irritation	2/5	9·5	5·1	9·7	12·5	8·6	21·0	5·4*	2·6	70
Listlessness	2/5	4·8	5·1	4·0	7·0	4·3	7·0	ns	–	–
Vague thinking	2/5	4·8	1·7	6·4	9·7	2·1	4·7	ns	–	–
Sudden desire for loud voice without any reason	2/5	0·0	1·7	2·4	4·2	2·1	0·0	ns	–	–
[Disease histories]										
Climacteric disturbance	Yes	14·3	10·2	11·3	6·9	10·6	20·9	4·3*	2·3	70
Deafness	Yes	0·0	6·8	7·3	4·2	19·1	9·3	5·9*	2·7	65
Heart disease	Yes	0·0	3·4	4·8	5·6	14·9	9·3	6·1*	3·1	65
Hypercholesterolemia	Yes	4·8	1·7	4·8	5·6	8·5	4·7	8·5*	4·2	65
Anemia	Yes	52·4	35·6	27·4	18·1	25·5	37·2	ns	–	–
Dizziness	Yes	23·8	22·0	19·4	13·9	12·8	27·9	ns	–	–
Hypertension	Yes	14·3	18·6	10·5	11·1	19·1	9·3	ns	–	–
Autonomic disorder	Yes	4·8	5·1	7·3	7·7	8·5	14·0	ns	–	–

Chi square tests were performed and odds ratios of relative risks were calculated for each contingency table for each disturbance, which was divided at critical points of noise above which high responses increased clearly. **, $p < 0{\cdot}01$; *, $p < 0{\cdot}05$; ns, no significance.

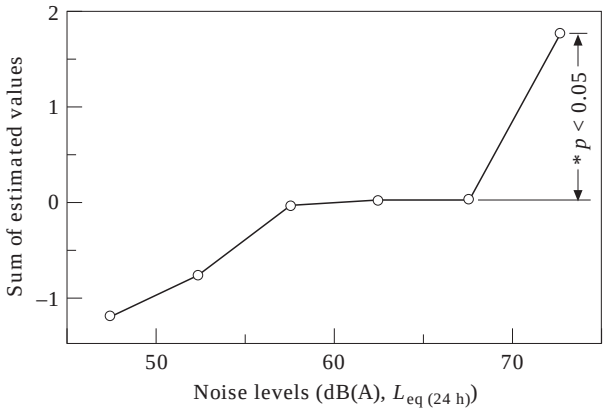

Figure 1. Sum of estimated values for physical symptoms at each level of noise, $L_{eq(24h}$.

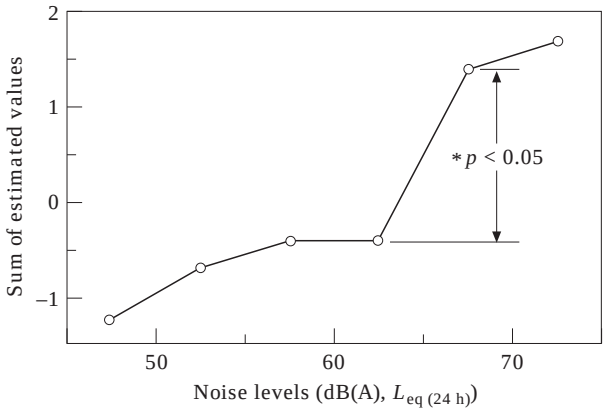

Figure 2. Sum of estimated values for disease histories at each level of noise, $L_{eq(24h)}$.

a multivariate analysis method (Nishisato's Dual Method [3]) was applied. Averages and standard deviations were calculated for the sum of new scores obtained. These results are shown in Figure 1 and Figure 2. It is seen in Figures 1 and 2 that the mean scores increased with noise above 70 dB(A) for physical symptoms and with noise above 65 dB(A) for disease histories.

Although some researchers have reported no evidence from questionnaires or epidemiological studies of heart disease and psychiatric disorders in relation to noise [4, 5], Yoshida *et al*. previously reported some evidence relating the status of ill health to relatively low levels (65–75 dB(A), $L_{eq(24h)}$), of railway noise and environmental noise [6, 7]. The results of this study are similar and suggest that road traffic noise may have some relation to the health status of those residing nearby.

4. CONCLUSION

The results showed clear dose–response relationships between annoyance and noise, and also demonstrated a clear increase in high responses to some symptoms and some diseases. This suggests that road traffic noise has a detrimental effect on the health status of exposed residents. A critical noise level would be 65 dB(A) or 70 dB(A) as concerns clear increases in high responses relating to ill health in terms of symptoms and disease histories.

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