

inter.noise 2000

*The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE*

I-INCE Classification: 6.6

HEALTH SIGNIFICANCE OF DATA ON ANNOYANCE BY AMBIENT NOISE

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Keywords:

ABSTRACT

A study on the relationship between the degree of annoyance by ambient noise and subjective data on the health state was conducted. The study used data from the monitoring of noise and its effects on health based on responses of 9,465 inhabitants from places with different noise levels. Out of the total number of inhabitants annoyed by ambient noise, 64.1% suffer or have suffered from one or more civilization diseases. Subsequent analysis showed a statistically significant relationship between the increasing percentage of inhabitants feeling to be annoyed by noise and the occurrence of the group of civilization diseases under follow-up, hypertension and frequent catarrhs of the upper respiratory tract especially. Consequently, data on feeling annoyance by ambient noise can be considered as significant from the point of view of health.

1 - GENERAL CONTEXT

The influence of noise on the population is mostly assessed on the basis of complaints or data on noise disturbance collected by a simple survey of reactions of the population to noise. However, from such data it is not possible to learn to what degree there occurs harm to health in the exposed population because the feeling of being annoyed may be modified by other factors, namely social, including political ones. In order to facilitate an estimate of the range of effects of noise on health on the basis of data on the disturbing effects of noise, there has been elaborated the present study dealing with the relation between the detected degree of being bothered by noise and the simultaneously revealed subjective data on ones' health. The study is based on data obtained through the monitoring of noise and its effects on health conducted as a part of health-environmental monitoring in the Czech Republic.

Through that monitoring (which is on-going) there have been carried out two surveys in 21 cities and towns. Results of the surveys were presented at the congress "Noise Effects '98" in Sydney. Therefore, there is presently being given just an abstract concerning the questionnaire survey and noise measurements. A more comprehensive presentation can be found in the congress proceedings [3].

Both surveys were carried out in such a way that in each town one noisy and one quiet locality have been chosen. The basis of the system is parallel monitoring of environmental noise alongside with the health of people exposed to the noise under monitoring. The above-mentioned part of the monitoring was conducted through the monitoring of noise and indicators of health in selected localities with population numbers -300 to 1000. At the same time the localities have been in view of meeting the option of 24-h noise measurement on one spot with validity for the whole area of the basic locality. At the same time, monitoring was running on the occurrence of selected indicators of health with regard to so-called "civilization" diseases and neurotic syndromes, by means of a questionnaire (based on CINDI) questioning for selected health indicators and demographic and sociological data. The selected "civilization" diseases include hypertension, myocardial infarction, gastric and duodenal ulcers, chole- and urolithiasis, diabetes mellitus, tumours, and frequent catarrhs of the upper respiratory tract.

Noise data from the selected localities were obtained from averages of 12 24-h L_{Aeq} in 42 individual localities and forms a continuous series of values. The range of noise levels was of L_{Aeq} from 75 to 48 dB in the day and from 69 to 37 dB at night. In the above-mentioned way, answers including data on

selected indicators of the health condition, were obtained from 30- to 90-year old people. 14679 replies in 1995 and 9,598 replies in 1997 were obtained in an epidemiological health survey.

The relationship between the noise at the site of residence and the prevalence of "civilization" diseases has been demonstrated in both periods of follow-up. Morbidity expressed by the percentage of diseases prevalent in the population of each locality was 76 to 96% in the last period under study. Significance of the relation between noisiness in L_{Aeq} at night and reported morbidity had a 90% probability ($p=0.1$). Significance of the relation between the noise level in L_{Aeq} at night and the percentage of the population annoyed in each locality, (options: annoyed vs. not annoyed) had a probability of over 99% ($p < 0.005$). The percentage of people annoyed is ranged from 24 to 96% on the resulting regression curve.

2 - METHODOLOGY

The data base of the last period of monitoring in which there had been obtained the above-mentioned results describing the effect of noise in the living environment on the population, has been used in the search of relationships between the degree of noise annoyance and morbidity. Evaluation was performed by logistic regression analysis with the ANOVA program.

The objective was to find

- what percentage of people who feel to be annoyed by noise, are ill with civilization-determined diseases under follow-up in relation to the noise level by which they are annoyed
- what relation is there between the overall morbidity expressed by the average number of illnesses per inhabitant and the percentage of people annoyed by noise in the localities in relation to the noise level therein;
- which of the illnesses under study are best characterized by the percentage of complaints;
- how the above findings depend on the age, gender and education status of the population.

3 - RESULTS

In the above-mentioned way it was found, that out of the whole population annoyed by noise from the outdoor environment, 64.1% suffer or have suffered one or more civilization-related diseases (that being highly significant statistically $p < 0.00001$). This phenomenon is statistically significant namely in populations affected by noise levels higher than $L_{Aeq} 55$ dB at night.

Furthermore, there has been found a dependence between the average number of "civilization" diseases correlated to an individual and the percentage of 30- to 90-year old inhabitants of localities disturbed by noise from the outdoor environment. This dependence is characterized by a linear trend found in this relationship having a 95% significance ($p=0.030$). It shows that with increasing percentage of those annoyed therein there increases the average number of "civilization" diseases from 0.8 to 1.1 per inhabitant. That means the finding of increased annoyance by noise from the outdoor environment can be considered a reliable signal of increased morbidity of civilization-derived etiology in the adult population in the age range mentioned above. On dividing the responses of the inhabitants from localities disturbed by noise, into a group of under 55 years and a group of over 55 years of age, there has been found a more significant ($p=0.018$) linear trend increasing from 1.2 to 1.5 illnesses per person in the case of older inhabitants than in the whole series of the annoyed. In the younger group the trend is not significant. That points, to an expected, greater unfavorable health effect of noise is in older noise-annoyed inhabitants. The influence of noise in earlier years manifests itself with great latency in later years. Furthermore, the said increase in morbidity in relation with the percentage of inhabitants who feel annoyance of noise has been found to be statistically more significant in localities with noise levels exceeding $L_{Aeq} 55$ dB at night. In that case the linear trend expressing the correlation of the average number of "civilization" diseases with the percentage of 30- to 90-year old inhabitants of the localities rises from 0.65 to 1.25 per person, and is substantially more significant statistically and characterized by $p=0.005$.

A significant correlation between the percentage of the annoyed and the incidence of a certain illness was found in hypertension. The linear trend characteristic of this correlation, rising from 19% to 31%, is statistically significant ($p=0.016$). The most significant correlation with a linear trend from 16% to 27% (level of significance $p=0.007$) was found in the case of frequent incidence of upper respiratory tract catarrhs. The correlation of the incidence of gastric and duodenal ulcers with the percentage of the noise-annoyed did not manifest itself as being statistically significant, just as the incidence of the remaining civilization-determined diseases under follow-up, including myocardial infarction.

As far as the influence of demographic factors on the incidence of a feeling of being annoyed by noise from the outdoor environment is detected, it was found in all the localities together that among inhabitants with a higher educational status there is significantly less people feeling the annoyance than among inhabitants with only primary education, and that significantly more people feel noise-annoyed who live in matrimony.

The significance of the above-mentioned trends in the correlation between the feeling of being annoyed and morbidity was not influenced by the demographic and social conditions of the populations under study. That has already been demonstrated in the original processing of the respondents' responses [3] wherein was studied the incidence of individual factors in correlation to the noise levels in each locality, and therefore presently only a brief review of the data is being presented.

The lower limit of the age interval of the inhabitants was 30 years because in younger persons there cannot be presumed a sufficiently long stay in one place (at least 5 – 10 years) and so it is not possible to presume any consequent influence of measured noise. The upper age limit was set so as, on the one hand, to obtain as many respondents as possible, and on the other hand, for the recording of alterations of health also in the oldest age group and thus to be able to register the life-long influence of noise on the population. In the selected age range of 30 – 90 years the age composition of the respondents in the localities does not correlate with the increasing noise levels therein. From the evaluation it follows that from this point of view there is no difference between individual localities. In the composition of the population concerning gender there have been found no statistically significant differences between the localities. Similar results were obtained concerning the education level and marital status. It has been found that there is only statistically less males as well as solitarily living people in the centers of large cities. There have been found no significant differences in the current economic activity of the respondents.

There have been found no significant differences between the localities as regards the respondents' physical activity. Likewise, the incidence of health risk factors such as smoking, coffee and alcohol consumption do not show any statistically significant differences between the localities under follow-up.

4 - DISCUSSION

From the results presented it is evident that it is possible to estimate the percentage of morbidity in the population from the data on the proportion of the population feeling annoyed by noise from the outdoor environment obtained through the questionnaire (not spontaneous complaints). In all, it is 65% and that confirms the adequateness of the argument which is based on data on the feeling of annoyance and it is possible to use it for the evaluation of relevance of concrete noise situation.

Through more detailed analysis it has been revealed that the rising proportion of noise-annoyed people there also increases significantly the occurrence of so-called civilization-related diseases. This correlation between the feeling of being annoyed by noise from the outdoor premises and morbidity is valid namely in localities with noise levels greater than $L_{Aeq}55$ dB at night. That strengthens the presumption that complaints from inhabitants of localities with noise levels exceeding $L_{Aeq}55$ dB in the night-time are substantiated from the point of view of health. The limit recommended by the WHO seems to be substantiated even by this study because the permissible limit cannot be set in the range of values characterized by increased morbidity.

The fact that increased morbidity befalls namely inhabitants exceeding 55 years of age can also be expected on the basis of previous epidemiological studies. However, that does not mean that the increased morbidity is caused by the age of the population because morbidity increases statistically significantly along with an increased proportion of those annoyed by noise in parallel with increasing noise levels although there is no significant difference in the age composition of the population between noisier localities and the more quiet ones [3]. That in play is the influence of noise levels and not age, is also supported by that the above-mentioned significant correlation between the percentage of the noise-annoyed and the incidence of civilization-determined diseases has been demonstrated not only in a series of respondents of 30 to 90 years of age, but also on a series of 30- to 70-year olds. In view of that, the effects of noise in the living environment can be expected only after a several-year delay, one cannot underrate even the significance of data on noise-annoyance in the younger population.

The same conclusions are valid for the incidence of hypertension, because that is considered to be one of the major consequences of stress, and the association between hypertension and noise levels has been already demonstrated previously [1], [2], [3] and [4].

Likewise, the already mentioned incidence of frequent upper respiratory tract affections can be expected as a result of stress due to disturbed sleep [3]. In this way there is manifested the unfavorable influence of stress and thereby even of noise on the immune system. Disturbances of sleep in themselves caused

by noise lower the immune capabilities of the human organism [5]. The effect of both influences has manifested itself in a statistically significant correlation ($p=0.007$) between an increasing percentage of those annoyed by noise and the incidence of frequent upper respiratory tract infections. It is supported by a previous finding [3] of a likewise statistically significant ($p < 0.005$) increase of frequent upper respiratory tract infections in localities with elevated night-time noise levels. To this contributes even the presumed influence of noise on the metabolism of magnesium [6] increasing the feeling of being annoyed by noise when there arises a vicious circle formed on the one hand by losses of magnesium causing a greater readiness to stress reactions, and on the other hand an all the more greater sensitivity to noise annoyance. In consequence of that disturbances of immunity enhance the susceptibility of the human organism to infection and thereby the deepening of the unfavorable effect of noise. The feeling itself of being annoyed by noise is thus an aggravating factor in the effect of noise. A change in attitude towards noise in the sense of diminishing the feeling of annoyance may thus cause a partial alleviation of the negative effect of noise, and that could be utilized as a component of measures against the effects of noise.

Data on the feeling of being annoyed by noise from the outdoor environment can be considered as significant as regards health, namely also in the sense of an unfavorable influence on immunity. In places with noise levels exceeding $L_{Aeq}55$ dB at night such data may serve a rough estimate of the incidence of civilization-related diseases, hypertension, and weakened immune resistance.

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