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# THE EFFECT OF AIRPLANE NOISE ON THE INHABITANTS OF AREAS NEAR THE OKECIE AIRPORT IN WARSAW

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Translation of "Wplyw halasu samolotowego na mieszkancow rejonow przylotniskowych lotniska Okecie w Warszawie," Rocznik Panstwowego Zakladu Hygieny, Vol. 27, No. 2, 1976, pp. 113-121



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16. Abstract: Evaluation was made of the state of health and noise annoyance among persons living in areas near Okecie airport exposed to various intensities of noise. Very high annoyance effects of airplane noise of intensities over 100 dB (A) were established. A connection between the airplane noise and certain ailments complained about by the inhabitants was demonstrated.

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# EFFECT OF AIRPLANE NOISE ON INHABITANTS OF AREAS NEAR THE OKECIE AIRPORT IN WARSAW

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## INTRODUCTION

The problem of the influence of aircraft noise on inhab- /113** tants of areas near airports has become an object of particular interest at numerous scientific centers.

The main direction of studies concentrates on establishing the extent and degree of danger to the health of the population, and on determining the annoyance effects of the aircraft noise [1, 3, 7, 7, 8]. Many authors concerned with the above problems find that persons living near airports have an increase in such symptoms as headaches, lack of appetite, difficulties in concentrating their attention, difficulties in falling asleep, very frequent disturbances in their sleep, general feelings of fatigue, as well as abnormalities in the function

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of heart-circulatory and respiratory systems, nervous disturbances and psychic ailments. Inhabitants of those regions complain of the disturbing effects of noise, preventing normal work and normal rest. These symptoms increase as the level of noise at near-airport areas increases and the tempo of development of air traffic grows.

Another no less important problem of the effect of aircraft noise is an attempt to find a possibly strict correlation between physical parameters of noise and its annoyance effects for inhabitants [5, 9, 11, 12]. The results of studies obtained so far indicate the possibility of utilization of scales of the noise annoyance for development of more accurate methods of evaluation of aircraft noises.

In our investigations of the effects of aircraft noise in the region of Okecie we tried to consider both the above mentioned directions of studies. The main emphasis was put on evaluation of the state of health of inhabitants and on establishing the degree of annoyance in various zones of noise level. We undertook also an attempt to evaluate the agreement of the used methods of measurement of aircraft noise with the subjective estimation of its annoyance.

## METHOD AND MATERIAL OF INVESTIGATION /114

To realize the above formulated aims we used in our investigations a detailed health questionnaire and a scale of the noise annoyance. Principles of treatment of the questionnaire and methods of collecting the data were described in our previous

communication [8]. However, in the present investigation we have made certain changes in the method of treatment of an annoyance scale, enabling us to gain greater cohesiveness of answers and their ordering according to importance of questions. When constructing the scale, we applied the method of scalogram analysis of Guttmann [10], consisting of allotting to each investigated person a degree of annoyance depending on the extent of disturbances caused by the action of aircraft noise. A 5 degree evaluation scale was adopted. The noise degree amounting to at least 3 points, or 60%, was taken as very disturbing to the environment. It is the threshold above which systematic distortions of audio perception occur. It was established that for persons placed on the scale above this threshold the aircraft noise constitutes the major source of the feeling of discomfort.

A similar method of investigation of the hardship of aircraft noise was used in England, France and Benelux countries [2].

Within the present work, 256 inhabitants of areas located in a zone with the intensity level above 100 dB (A) and 255 persons living in regions with the noise intensity level 80-90 dB (A) were investigated. Studies were carried out in the winter months of the year change 1974-1975. The investigated groups are represented in equal measure by men and by women of the age 20-70, with similar type of education, profession, and conditions of work, but with different conditions of housing and living. Tables 1 and 2 and Figure 1 give closer characteristics of the social-professional structure and living conditions of people in investigated regions.

Table 1. Age of investigated persons

| Sex | Average age in various age groups | | | | | | Average age | |
|---|---|---|---|---|---|---|---|---|
| | 20-36 | | 37-53 | | 54-74 | | | |
| | A | B | A | B | A | B | A | B |
| Women | 28 | 28 | 44 | 43 | 63 | 63 | 45 | 44 |
| Men | 28 | 27 | 45 | 44 | 62 | 64 | 45 | 44 |

A - region 100 < dB(A) < 110
B - region 80 < dB(A) < 90

Table 2. Living conditions

| Condition | Indicators | Number of persons or dwellings | | t | P |
|---|---|---|---|---|---|
| | | A | B | | |
| Density level | Average number of persons per room | 1.39 | 1.31 | 0.08 | n.s. |
| Property | Own house | 30.9% | 18.9% | 3.16 | 0.01 |
| | Rented | 69.1% | 81.1% | | |
| Facilities | Bathroom | 33.3% | 77.6% | 11.25 | 0.0001 |
| | Toilet | 59.3% | 85.8% | 7.03 | 0.001 |
| | Plumbing | 69.9% | 84.6% | 4.02 | 0.001 |
| | Central heating | 28.9% | 75.6% | 11.95 | 0.0001 |
| Evaluation of dwelling | Content | 30.5% | 50.8% | 4.77 | 0.001 |
| | Discontent | 69.5% | 49.2% | | |

A, B - as in Table 1

t - value of t-Student test

P - degree of significance

n.s. - not significant statistically

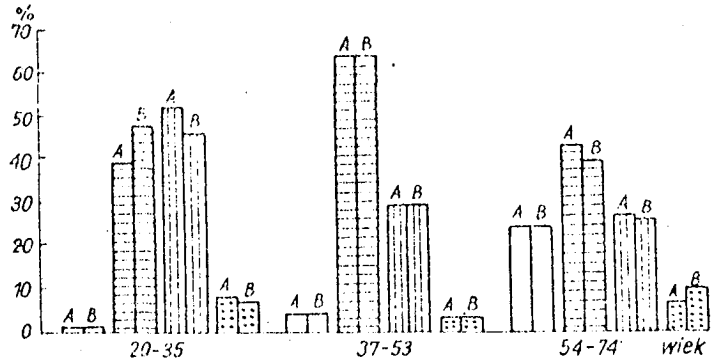


Figure 1. Education. White field - incomplete elementary; field crossed horizontally - basic (elementary) education; field crossed vertically - high school; dotted field - higher (college) education. A and B - as in Table 1

Differences in the housing-living conditions could affect to some degree the credibility of obtained results because of an increase of sensitivity to noise by persons under unfavorable conditions. However, this feature cannot be avoided because it arises from the general character of the investigated regions. Actually, the effect is not large and concerns mainly the inhabitanta of regions at lower levels of noise intensity [2, 8].

## RESULTS AND DISCUSSION

Evaluation of acoustical conditions in the Okecie area involved, among others, determination of the sources of noise and the degree of their annoyance. Table 3 presents detailed data grouped according to the average degree of annoyance for both of

TABLE III

EVALUATION OF ACOUSTICAL CLIMATE IN THE REGION OF OKECIE

| Source of noise | No. of persons studied(%)describing noise as: very annoying | | | | medium annoyance | | | | not annoying | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | t | P | A | B | t | P | A | B | t | P |
| Domestic appliances | 0,8 | 0,4 | 0,57 | n.i. | 0,8 | 5,1 | 2,88 | 0,01 | 98,4 | 94,5 | 2,33 | 0,05 |
| railway traffic | 0 | 1,6 | 2,63 | 0,05 | 0 | 9,8 | 3,25 | 0,01 | 100,0 | 88,6 | 5,71 | 0,001 |
| industrial plants | 1,6 | 5,5 | 2,37 | 0,05 | 1,2 | 12,2 | 5,07 | 0,001 | 97,2 | 82,3 | 5,69 | 0,001 |
| utilities | 16,3 | 2,1 | 6,22 | 0,001 | 8,1 | 10,2 | 0,81 | n.i. | 75,6 | 87,8 | 4,07 | 0,001 |
| neighboring homes | 8,1 | 8,3 | 0,08 | n.i. | 10,6 | 35,8 | 7,01 | 0,001 | 81,3 | 55,9 | 6,37 | 0,001 |
| street traffic | 13,0 | 7,9 | 1,86 | n.i. | 22,4 | 29,9 | 1,91 | n.i. | 64,6 | 62,2 | 0,55 | n.i. |
| air traffic | 54,5 | 24,4 | 7,22 | 0,001 | 36,6 | 39,0 | 0,55 | n.i. | 8,9 | 36,6 | 7,88 | 0,001 |

A - region 100 <dB (A) < 110

B - region 80 <dB (A) < 90

t - value of t-Student test

P - degree of significance

n.i. - not statistically significant

the discussed regions.

The analysis of the material shows that the major /115
role is played by aircraft noise, out of the various noises occurring in a given region. In the region above 100 dB (A) the number of persons complaining about this type of noise is 91.1% of the inhabitants, and even in the zone of an intensity of 80 - 90 dB (A), it was 63.4%. The number of persons considering the noise as very annoying is considerable - and is 54.5% and 24.4%, respectively.

Street traffic noise is the object of complaints for about 38% of all respondents. The noise coming from neighboring houses presents a certain problem only for the inhabitants of the zone with lower intensity of aircraft noise. It is also necessary to point out that the number of persons considering street traffic noise and the noise /117
coming from neighbors as very annoying is small (it does not exceed 13%). The remaining types of sources of noise do not create any problems for inhabitants of the region studied.

In spite of finding certain differences in annoyance created by particular types of noise occurring in both of the zones discussed, only the aircraft noise may provide

the basis for further analyses and comparisons. It concerns particularly the actual aims of this work, namely the determination of aircraft noise annoyance and its correlation with physical measurements, and the effect of noise on health of inhabitants.

The adopted scale of measurements enabled us to establish the average degree of the annoyance by aircraft noise, and it amounts to 4.1 points for the region of very high intensity, and 2.8 points for the second zone. Expressing the above numbers in relative values we can say that the annoyance of aircraft noise in the first of the discussed regions is 82%, whereas in the second region it is 54% (Figure 2).

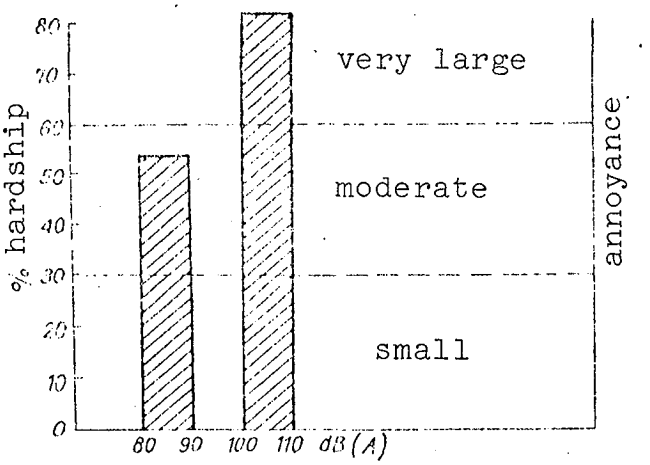


Figure 2. Annoyance of aircraft noise.Left ordinate: % Hardship; right - Annoyance.

This extent of annoyance refers principally to daylight time since night flights connected with the Okecie airport occur only sporadically.

In conformity with assumptions regarding the scale, and with comparable studies [2], it is necessary to accept the aircraft noise above 100 dB (A) as very annoying, whereas the noise in the zone 80-90 dB (A) is of moderate annoyance, approaching its upper limit. It is, however, highly probable that as the intensity of air traffic in a given region increases, so also will the percent value of its annoyance. This increase, as shown in investigations, is approximately proportional to the logarithm of the frequency of flights of aircraft [2, 12].

Our investigations have shown the existence of a strict correlation between the estimate of the annoyance caused by noise and the objective measurement of its intensity. This connection is very strong if we take into consideration the average noise annoyance of a given region (the coefficient of correlation is 0.86), but is not so high if we consider individual sensitivity of persons examined (the coefficient of correlation is 0.42). It follows then that the intensity level of the noise alone does not decide the degree of its annoyance. Specific personal factors, social and /118 living conditions, the type of work performed, and even the attitude towards aviation, additionally affect the formation of feeling of the noise annoyance [8, 13]. Alexandre [2] remarks that the above factors have only a limited degree of effect upon the change of annoyance. This effect is rather small if the noise disturbs the

normal activity of everyday life.

The agreement between the estimate of annoyance of the noise and the objective measurement of its intensity would indicate that the accepted principles of the determination of annoyance of aircraft noise are proper. A disturbing fact is, however, that in the areas considered with respect to the noise intensity to be zones suitable for dwellings and schools, as many as 65% of investigated persons expressed negative estimate of acoustic conditions.

The percentage indicator of annoyance is also high, and although it is still within the boundaries of the so-called moderate noise, it indicates a considerable worsening of the comfort of living in those regions.

Evaluation of the state of health and self-feeling of the population of investigated regions was made on the basis of frequency of occurrence and intensity of symptoms indicating bad health and bad self-feeling in the groups of persons living under different acoustical conditions.

The following phenomena were observed:

1. In the complex evaluation of the state of health, no significant differences between men of the two investigated regions were observed (chi square = 0.11). But there were significant differences among the investigated women (chi square = 4.114, $p = 0.04$).

2. In neurotic and extraversion studies, no statistically significant differences between men as well as between women were

noted. The distribution of results of these characteristics was in agreement with the general distribution observed in the Polish population.

3. When the frequency of occurrence of particular symptoms indicating bad state of health or bad self-feeling was analyzed, only among women living under worse acoustic conditions was there a frequent occurrence of general ailments of heart and gastro-intestinal nature, an increased feeling of fear and unrest, more frequent irritation, as well as more frequent cases of taking headache medicines and drugs for heart ailments.

4. Independent of differences which arose between the discussed regions, it is necessary to stress that among all the investigated persons there were frequent cases of complaints of chronic fatigue, disturbances of sight, stubborn headaches, irritation, deterioration of hearing, and more frequent taking of medicines for heart ailments and headaches. Detailed numerical data are compiled in Tables 4 and 5.

It is difficult, on the basis of presented results of the investigation, to draw final conclusions with regards to the effect of acoustical conditions upon the state of health of inhabitants of the near-airport areas. A high percentage of persons complaining on the feeling of fatigue, headaches, impairment of hearing, frequent irritation, ailments connected with heart and alimentary system, as well as differences in the frequency of occurrence of symptoms of ailments and poor self-feeling among women living

TABLE IV
FREQUENCY OF OCCURRENCE OF SYMPTOMS OF AILMENTS AND SICKNESS IN DIFFERENT ACOUSTICAL REGIONS

| Indicators of state of health | Men | | Women | |
|---|---|---|---|---|
| | A | B | A | B |
| | % | | % | |
| Sleep disturbances | 20 | 15 | 28 | 30 |
| Fatigue | 71 | 65 | 85 | 82 |
| Headaches | 23 | 23 | 48 | 43 |
| Fear or unrest | 17 | 11 | 28 | 18 |
| Nervousness | 34 | 29 | 20 | 8 |
| Headache medicines | 13 | 8 | 29 | 15 |
| Sleeping pills | 8 | 5 | 12 | 6 |
| heart ailments | 15 | 12 | 34 | 23 |
| Vision disturbances | 53 | 48 | 61 | 54 |
| Hearing impairment | 34 | 40 | 28 | 24 |
| Stomach pains | 22 | 19 | 28 | 18 |
| Heart ailments | 24 | 20 | 48 | 43 |

A--100<dB(A)<110; B--80<dB(A)<90

TABLE V
CORRELATION BETWEEN OBJECTIVE MEASUREMENTS OF AIRCRAFT NOISE AND SELECTED INDICATORS OF STATE OF HEALTH

| Indicators of state of health | Men | | Women | |
|---|---|---|---|---|
| | $\chi^2$ | P | $\chi^2$ | P |
| Sleep disturbances | 0,527 | n.i. | 0,157 | n.i. |
| Fatigue | 0,940 | n.i. | 0,343 | n.i. |
| Headaches | 0,084 | n.i. | 0,694 | n.i. |
| Fear or unrest | 2,016 | n.i. | 3,843 | 0,05 |
| Nervousness | 0,631 | n.i. | 5,121 | 0,03 |
| Headache medicines | 1,734 | n.i. | 6,871 | 0,01 |
| Sleeping pills | 1,026 | n.i. | 3,641 | n.i. |
| Heart ailments | 0,398 | n.i. | 3,830 | 0,05 |
| Vision disturbances | 0,110 | n.i. | 1,090 | n.i. |
| Hearing impairment | 1,012 | n.i. | 0,542 | n.i. |
| Stomach pains | 0,501 | n.i. | 3,843 | 0,05 |
| Heart ailments | 0,298 | n.i. | 4,416 | 0,04 |
| Neurotic behaviour | 0,824 | n.i. | 0,046 | n.i. |

$\chi^2$ - chi square criterion
P - degree of significance
n.i. - insignificant statistically

under worse acoustical conditions, seem to indicate a correlation between the aircraft noise and the state of health. On the other hand, the assumption should not be excluded that the above listed indicators arise due to other reasons dealing with unfavorable effects of the environment, particularly the work environment.

The observed differences in the effect of acoustic conditions at the dwelling location on the state of health of men and women seem to favor such an interpretation. /120

Among women there was the largest group of individuals who either did not work professionally (23% more than men), or worked under better acoustical conditions (this was 13% more than men). Different acoustical conditions at the site of dwelling could play then a more decisive role in determination of the state of health of women than of men, for whom acoustically unfavorable conditions of work (60%) were more decisive. Further studies are needed to provide detailed explanation of this problem.

## CONCLUSIONS

1. Aircraft noise at the level above 100 dB (A) constitutes a considerable annoyance for the inhabitants. The noise at this level should be considered as harmful, and the zone as unsuitable for building of dwellings.

2. Aircraft noise at the level 80-90 dB (A) at the present volume of air traffic presents a moderate hardship for inhabitants. One has to consider, however, the possibility of an increase of its annoyance as the air traffic increases. This is so much more probable that the percent annoyance in a given region is now already near its limiting value.

3. Correlation between certain symptoms of ailments and poor feeling and acoustical conditions at the site of dwelling points to a probability of the negative effect of aircraft noise on the state of health of the inhabitants.

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