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AVIATION NOISE OVERLOAD IN THE IMMEDIATE PROXIMITY
OF THE WARSAW-OKECIE AIRPORT

Zbigniew Koszarny and Stefan Maziarka

Translation of "Uczliwosc halasow lotniczych w
najblizszym otoczeniu otniska Warszawa-Okecie,"
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16. Abstract The authors present the results of investigations on noise overload around the Warszawa-Okecie airport on persons inhabiting the area where it exceeds 100 dB for a single aircraft flight. Of 256 subjects 91.1% complained about aircraft noise overload. In the population studied considerable differences were noted respecting the subjective sensitivity scale. Statistical analysis showed numerous correlations between the individual noise sensitivity threshold and the subject's state of health, age, sex, type of work, etc. At the same time the investigations demonstrated various forms and levels of disturbance in the organism for individual subjects and groups. The most frequent complaint was chronic fatigue (68.1%), followed by nervousness (36.6%), frequent headaches (36.2%), hearing disturbances (30.0%) and sleep disorders (23.9%).					
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AVIATION NOISE OVERLOAD IN THE IMMEDIATE PROXIMITY
OF THE WARSAW-OKECIE AIRPORT

Zbigniew Koszarny and Stefan Maziarka
Municipal Health Division of the State Health Department, Warsaw
Acting Director: Dr. S. Maziarka

Introduction

/1*

Aviation noise has an ever growing effect on health conditions of cities and residential areas close to airports.

Thus the practical introduction of new types of jet aircraft and the rapid tempo in the development of air transportation is precisely linked with increased noise levels in the vicinity of airports and the gradual extension of areas exposed to the effects of aircraft noise.

Prediction data for the rate of air transport development in Poland assign a constant annual increase in that rate [8]. Peak acceleration should fall between 1980 and 1985. The tendency for Polish passenger air service is shown in Figure 1.

An additional factor influencing the development of poor acoustic conditions in airport vicinities are the urban processes that result in intensified building near airports.

The above situation creates many problems in the health area in respect to protecting people from the negative action of air noise.

The phenomena described above likewise occur in the Okecie airport zone and adjacent areas. At this airport traffic grows by the year and so does the number of takeoffs and landings involving large passenger planes, intense sources of noise [3, 4].

* Numbers in the margin indicate pagination in the foreign text.

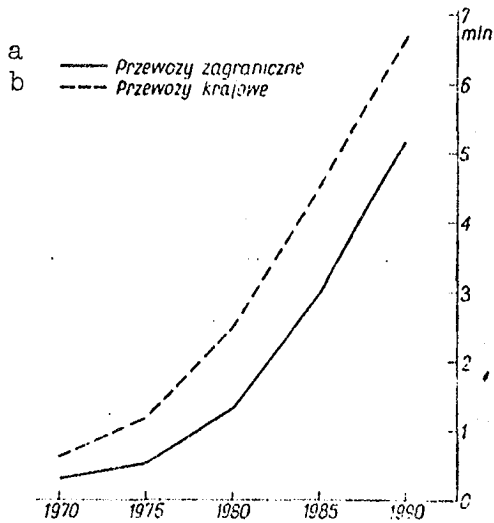


Fig. 1. Prognosis for development of passenger air transport in Poland.

Key: a. International flights
b. Domestic flights

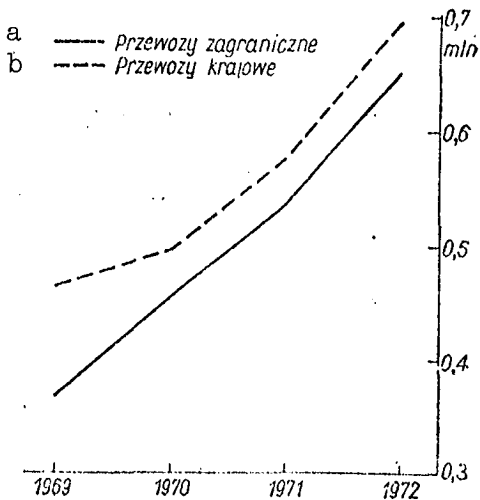


Fig. 2. Passenger traffic at the Warsaw-Okecie airport.

Key as above

many persons living near the airport complained of noise overload.

The research of Rajpert et al. [11] on the diffusion of air noise around an airport and along the takeoff strips established that such noise traces a path that takes in a goodly portion of the city and its suburbs.

Fig. 2 illustrates the growth of passenger traffic at Okecie.

Warsaw, the capital, is also expanding as well as the residential suburbs, including residential areas that fall within the noise zone of the Okecie airport. It should also be noted here that in part of the area exposed to noise on a large scale there has been a freeze on building. Thus there is more point to problems of determining the maximal permissible air noise levels in built up (residential) areas and the control, on the basis of future planning development, of air traffic patterns, which should be kept away from cities and residential areas. These ideas apply equally to many other airports.

Air noise testing around the Okecie airport was done in 1963 and thus at a time when only sporadic takeoffs of Caravelle type jets indicated that a good portion of the Warsaw area to the southwest was affected by intense air noise [9].

At the same time it was found that

Figures put out by the Warsaw Development Office [10] have indicated that more than 150,000 urbanites are presently living under conditions of air noise overload; of these 55,000 live in areas where the noise exceeds 80 dB (A). Private estimates declare that about 8,000 urbanites live in areas where the noise overload exceeds 100 dB (A).

In connection with the situation as outlined studies were undertaken in respect to the effect of air noise on people living in the Okecie area and in particular an assessment made of noise overload in that area near the airport which is the worst from the acoustic point of view.

Methodology

/3

On the basis of the earlier studies [9] and data from other test reports [11] a special questionnaire was prepared on urbanites' health that furnished a trial assessment of their state of health and their sensitivity to noise and made possible an understanding of the general characteristics of the test subjects. Residents' state of health and the assessment of noise sensitivity were encompassed by a seven stage scale indicating the direction and degree of intensity of the phenomena mentioned. This method permitted an overall summation of individual assessments for a whole series of problems, facilitating numerical classification and differentiation of test subjects on the scale continuum. In working out the questionnaire, as well as in the course of gathering questionnaire data, special attention was paid to preventing surmise on the part of test subjects and keeping them from realizing the basic purpose of the research, which was determination of the degree to which the noises being studied were overloading the citizenry. Now previous studies showed [2] that in such cases some residents, hoping for definite advantages or on the other hand afraid of negative material results, responded to the questionnaire in a premeditated fashion and tendentially.

The questionnaire was an expansion of the "Personality Inventory" developed by the Psychometric Laboratory of the Polish Academy of

Sciences [2].

Within the framework of the present study we tested 256 residents of areas located within the jet noise areas with a level over 100 dB (A). The subjects were chosen by lot using the method of systematic test sampling. At the outset 12% were not included in the study either because it was too hard to get in touch with them or because they refused to participate.

The research group included in equal proportions males and females aged 20 to 70, with different education, occupational background, working conditions and living conditions. Tables I and II and Figure 3 characterize rather accurately their occupation and social structure and the living conditions of the population in the test area.

TABLE I. AGE OF TEST SUBJECTS

Sex	Average age of subjects in various age groups in years			Average age of subjects
	1900-1920	1921-1937	1938-1953	
Female	63	44	28	45
Male	62	45	28	45

Results and Discussion

The range of noise effects on the human organism is quite broad and is both psychological and physiological in nature. Many authors, emphasizing the real importance of both these aspects, use the word overload for the first and damage for the second. However these two aspects of the noise effect are hard to separate. The research of Jansen [5], Jerison [6] and others [7] indicates that the overload element is harmful to health, inducing primarily disturbances in the nervous system.

TABLE II. RESIDENTIAL CONDITIONS

Type of assessment	Indices	Number or persons or residents
Degree of density	Average number of persons in apartment	1.39
Proprietorship	Own	30.9%
	Rent	69.1%
Furnishing	Kitchen	86.6%
	Bath	33.3%
	Running water and plumbing	69.9%
	Central heating	28.9%
	Toilet	59.3%
Assessment of dwelling	Satisfactory	30.5%
	Unsatisfactory	69.5%

TABLE III. DEGREE OF AIR NOISE OVERLOAD IN THE OKRECIE AREA

Specification	Number of subjects (%) defining noise as:		
	high overload	average overload	no overload
Total test subjects	54.5	36.6	8.9
of whom			
Female	53.1	37.6	9.2
Male	56.0	35.3	8.6

Table III shows the degree of overload experienced by residents of the area where the noise level reached 100 db (A) or more.

Although the test group were exposed to loud noises, a portion of the residents did not remark on the unpleasantness of the noise being tested for. However a decisive majority complained about air

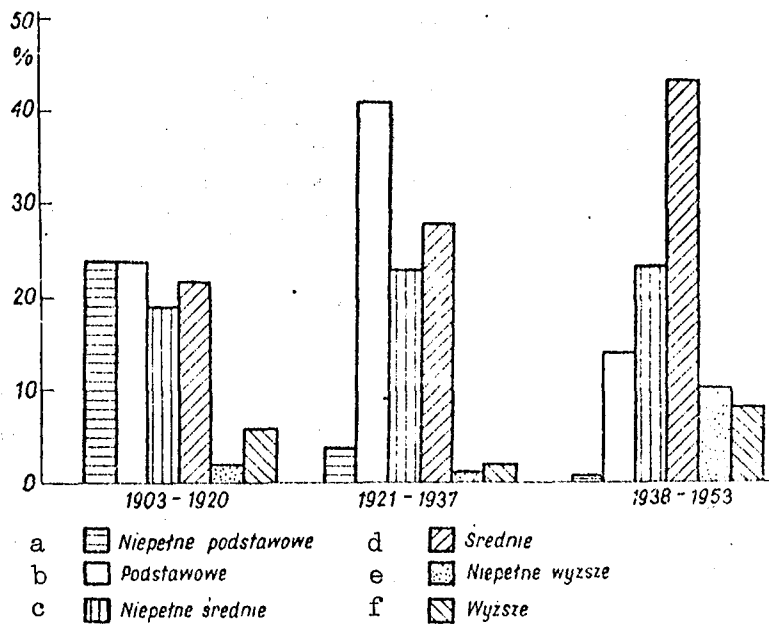


Fig. 3. Education
 Key: a. elementary incomplete
 b. elementary
 c. secondary incomplete
 d. secondary
 e. higher incomplete
 f. higher

noise and this confirms the correctness of the norms adopted for this area.

The test program showed that wide variations exist in the test population in respect to the scale of sensitivity to noise overload (Tables IV and V).

Our finding was that greater sensitivity to noise existed among young males, males with a high degree of education, residents dissatisfied with existing housing conditions, persons who do mental work and persons with impaired hearing. Greater sensitivity expressed by persons with impaired hearing was also found among female subjects. Lesser tolerance to noise among the hearing impaired is most probably associated with simultaneous damage to the muscles of the middle ear which protect the organ from excessive acoustic impulses [1, 10].

Concomitant tests revealed different forms and a different level of disturbance in the organism of individual persons and groups.

TABLE IV. VARYING SENSITIVITY TO NOISE BY AGE AND SEX

Sex	Grouping by age and sex		χ^2	P
Female	Group I	Group II	3.45	insignif.
	Group I	Group III	1.07	"
	Group II	Group III	0.32	"
Male	Group I	Group II	1.92	"
	Group I	Group III	4.32	0.05
	Group II	Group III	1.36	insignif.
Total subjects	male	female	1.25	"
*) Group I born 1953-1938				
Group II born 1937-1921				
Group III born 1920-1900				

TABLE V. SENSITIVITY TO AIRPLANE NOISE AS A FUNCTION OF DIFFERENT TRAITS IN TEST SUBJECTS

Specification	χ^2	
	females	males
Education	1.24	6.27 *)
Profession practiced	3.16	3.87 *)
Work amid noise	0.02	0.97
Housing dissatisfaction	3.62	5.12 *)
Impaired hearing	13.60 **)	3.87 *)
*) reliability interval 0.05		
**) " " 0.001		

Most frequently noted were chronic fatigue (68.1% of subjects), vision disorders (57.3%), frequent nervousness (36.6%), severe headache (36.2%), hearing disorders (30.0%) and sleep disorders (23.9%).

Data analyzed statistically showed numerous connections and relationships between the noise sensitivity scale and state of health, age, sex, type of occupation, etc. These relationships are illustrated in Fig. 4 and Tables VI and VII.

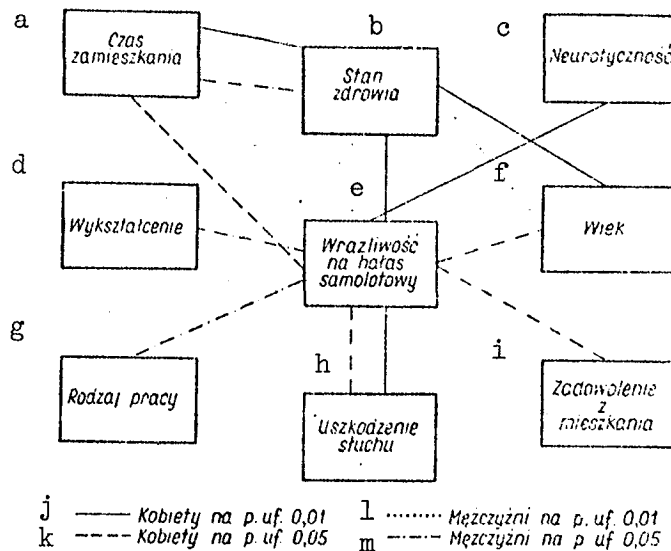


Fig. 4. Essential statistical relationships occurring in male and female groups.

- Key:
- a. residence time
 - b. state of health
 - c. nervousness
 - d. education
 - e. sensitivity to airplane noise
 - f. age
 - g. type of work
 - h. impaired hearing
 - i. housing satisfaction
 - j. females, reliability P = 0.01
 - k. females, reliability P = 0.05
 - l. males, reliability P = 0.01
 - m. males, reliability P = 0.05

Subjective sensitivity to plane noise is associated in a real way, for both men and women, with the state of health and hearing impairment. These two basic connections point to the special vulnerability of the ill to noise. /7

The studies also indicate the link between age and noise sensitivity. This connection is curvilinear and inversely proportional. Actually a real correlation was found only among males, but the female subjects likewise showed a marked tendency in this direction. Thus it is likely that young people are more sensitive to noise than middle aged or older people. The widespread view about the sensitivity of older people most probably arose because of their poor state of health.

TABLE VI. CORRELATION OF SELECT TRAITS IN MALE GROUP

Correlation item	Correlation coefficient *)	P
State of health and sensitivity to noise	$r = 0.296$	0.01
Residence time and sensitivity to noise	$r = 0.120$	insign.
Residence time and state of health	$r = 0.200$	0.05
Age and state of health	$r = 0.399$	0.01
Noise sensitivity and age	$\eta = 0.210$	0.05
Education and noise sensitivity	$\phi = 0.250$	0.02
Noise sensitivity and housing satisfaction	$\phi = 0.210$	0.05
Hearing impairment and noise sensitivity	$\phi = 0.190$	0.05
Nervousness and noise sensitivity	$r = 0.097$	insign.
Extroversion and noise sensitivity	$r = 0.070$	insign.
Type of work and noise sensitivity	$\phi = 0.220$	0.05

*) r -- Pearson correlation coefficient
 η -- correlation quotient
 ϕ -- Yule correlation coefficient

TABLE VII. CORRELATION OF SELECT TRAITS IN FEMALE GROUP

State of health and sensitivity to noise	$r = 0.380$	0.01
Residence time and sensitivity to noise	$r = 0.240$	0.05
Residence time and state of health	$r = 0.320$	0.01
Age and state of health	$r = 0.297$	0.01
Noise sensitivity and age	$r = -0.169$	insign.
Education and noise sensitivity	$\phi = 0.140$	"
Noise sensitivity and housing satisfaction	$\phi = 0.167$	"
Hearing impairment and noise sensitivity	$\phi = 0.320$	0.001
Nervousness and noise sensitivity	$r = 0.315$	0.01
Extroversion and noise sensitivity	$r = 0.085$	insign.

Studies of nervousness and extroversion did not reveal any marked connections between the degree of sensitivity to noise overload and the frequency with which neurotic states occurred.

Conclusions . . .

1. Aircraft noise of high intensity (100 dB (A) and more) are very burdensome for residence dwellers. More than 90% of these persons experience such an overload.

2. A link has been established between the test subjects' state of health and the degree of subjective sensitivity to noise. This suggests the hypothesis that such a great amount of noise can cause the residents' state of health to deteriorate.

3. Persons who in a questionnaire reported hearing disturbances showed greater sensitivity to noise.

4. The study results tally with the norms set up so far in the area of maximal admissible noise. In the given instance aircraft noise at 100 dB (A) or more must be considered inadmissible.

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