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# RESTING HEARING THRESHOLDS IN CHILDREN AGED 7 10 YEARS

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Resting hearing thresholds were measured in 107 children in 7 – 10 years of age category, from primary schools in Warsaw. The children were recruited regardless of the priority of these in which problems with hearing acuity were observed or these in which such problems might have been expected on the grounds of their children-illness history. The measurements were performed with the use of tonal audiometry with intermittent 250/250 ms signal, in the range of frequencies from 100 Hz to 16 kHz. In the children with deeper hearing loss, both air and bone conduction procedures were used. In the tested group normal hearing within ±10 dB was found in only 13% of the children. In the rest of the group hearing loss of various nature was found, i.e.: wideband hearing loss (8%), high frequency (24%), selective V-dip type (36%), low frequency (54%) and deep hearing loss of various configurations (16%). In the fraction with low frequency hearing loss often conductive hearing loss was found, whilst in the case of high frequency hearing loss, bone conduction audiometry indicated sensorineural type of hearing loss. High frequency hearing loss, selective and low frequency hearing loss in excess of 20 dB was found in 25% of the children tested. In the fraction with deep hearing loss in 25% of the children tested, hearing loss of approximately 40 dB was found.

## 1. Introduction

In audiometric data of music students and candidates applying the Faculty of Sound Engineering, obtained over the period 1991 – 1999, a very characteristic high frequency sloping hearing loss and selective V-dip hearing loss was found. In the group of 98 music students examined, selective V-dip hearing loss 10 – 30 dB deep was found in 64 cases (65.3%), JAROSZEWSKI [7]. Similarly, in the group of 214 music students tested later, selective hearing loss was found in 145 cases (68%), JAROSZEWSKI *et al.* [4]. In audiometric examination of the other group of music students and candidates, carried out in the extended up to 16 kHz frequency range, selective hearing loss exceeding 10 dB was found in 132 cases (70%), JAROSZEWSKI [8].

Similar data could be found in the remarkable work by FEARN [3] who found hearing loss exceeding 15 dB at 4 kHz or 20 dB at 6 kHz in 31% of orchestral musicians and in 50% of musicians performing with electronic amplification. In many cases hearing loss was found at 6 kHz (selective V-dip hearing loss) and also in one ear only. According

to FEARN [3], exposures to emission of percussion and brass wind instruments and to electronically amplified music are particularly dangerous for the hearing system. This is in agreement with the data obtained in Poland, e.g. JAROSZEWSKI, RAKOWSKI [6], JAROSZEWSKI *et al.* [5], JAROSZEWSKI [8], ROGOWSKI *et al.* [1999].

In the situation in which significant hearing loss is found in the large proportion of young music students, and particularly in view of poorer perception of loudness, pitch and time, accompanying this loss e.g. JAROSZEWSKI [8], the question appears when exactly this loss is usually acquired and what is its ethiology. The present work was aimed at collection of the data, which could be used to formulate an answer to the first of these questions. It may be noted here that Fearn, of Leeds Polytechnic in UK, investigated hearing of young people over the last 30 years, however in the age category from 11 to 25 years that is without specification of the data for younger and older, FEARN [2]. He arrived at positive correlation between discotheque attendance and hearing loss, which amounted to from 15 to 20 dB or more between successive examinations. The earlier work by FEARN and HANSON [1] reports similar data i.e. hearing loss of 20 dB or more at 6 kHz was found in 17% of the tested youngsters in the age category from 11 to 17, however, also without specification for younger and older.

In the present report the results of audiometric examination of the group of 107 children 7–10 years of age are presented. This work is a first part of examination of children and teenagers in the categories: 7–10, 10–14 and 14–17 years of age.

## 2. Procedure and equipment

Hearing thresholds were measured with the use of a clinical audiometer Interacoustics AC40 in tonal audiometry mode. An interrupted 250/250 ms tone was used at 11 standard audiometric frequencies, i.e. 0.125, 0.250, 0.5, 0.75, 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 8.0 kHz and at two frequencies above this range i.e. 12.0 and 16.0 kHz. Signal level was adjusted manually using an integral electronic attenuator with 1 dB step. In the range of low frequencies a headphone set Telephonics TDH 39P with MX41/AR cushions was used, and in the range of high frequencies (12.0 and 16.0 kHz) a headphone set KOSS HV PRO with circumaural cushions.

A Hewlett Packard PC running under control of the IABASE 95 program performed data acquisition, its preliminary processing and storage. Statistical analysis was performed with the use of MATLAB procedures.

A group of 107 children recruited from Warsaw primary schools over a period 1999–2000 undergone careful audiometric examination. The children were participating voluntarily with their parents who answered questions with reference to the childrens illness history, drugs administration with special attention to antibiotics and with reference to exposures to loud and very loud sounds (noise). To avoid stressing situations one of the parents was always present throughout the entire test. Only healthy children, according to opinion of their parents, participated in the examination. In all cases of doubts with reference to health status, children undergone careful medical examination and audiometric testing was repeated.

### 3. Results

The data from audiometric examination of the group of 107 children tested showed large qualitative and quantitative dispersion. Hence, the statistical analysis on the data was performed on the whole sample of 107, and separately for the six groups selected typologically from the group of 107, on the grounds of the type and the depth of hearing loss. The quartiles of hearing loss in the six groups selected are given in Figs. 1–8.

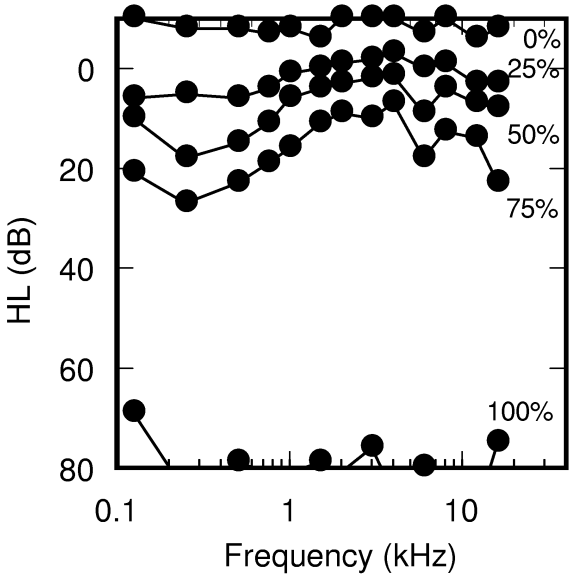


Fig. 1. Statistical data of the results for the whole group of 107 children.

The statistical data of the results for the whole group of 107 children is given in Fig. 1. From this group subjects with normal hearing (criterion ±10 dB) were selected and the results for this fraction (13.1% of the whole sample) are given in Fig. 2. Figures 3 to 7 present the data for the fractions with wide-band hearing loss (Fig. 3, 8.4%), with selective V-dip hearing loss (Fig. 4, 36.4%), with low frequency hearing loss (Fig. 5, 54.2%), with high frequency sloping hearing loss (Fig. 6, 24.2%) and with deep hearing loss of various configurations (Fig. 7, 15.9%). It should be observed that some cases were qualified to the two fractions (e.g. in the cases of two types of loss present in the audiogram, for instance both HF loss and V-dip loss). Hence the sum of percentages in the fractions exceeds 100%.

Statistical data of the results for the group of children in whom parents suspected that there might have been something wrong with their hearing is given in Fig. 8. Detailed examination of the correspondence of the hearing loss data and the data from the questionnaires, concerning illness history and drug administration, will be given in a separate report.

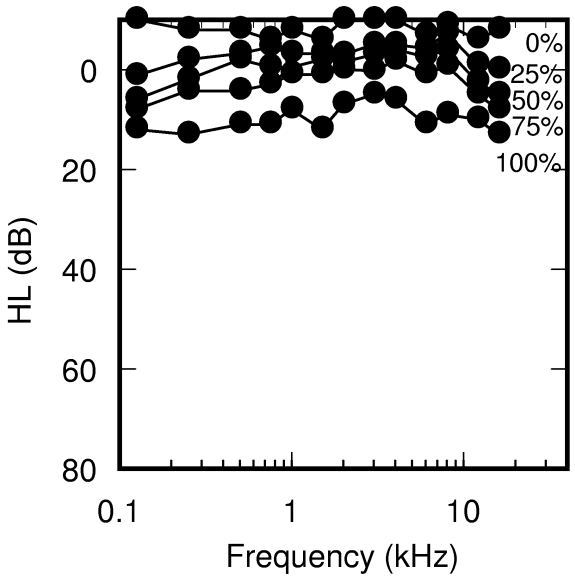


Fig. 2. Statistical data of the results for the group of subjects with normal hearing (criterion ±10 dB).

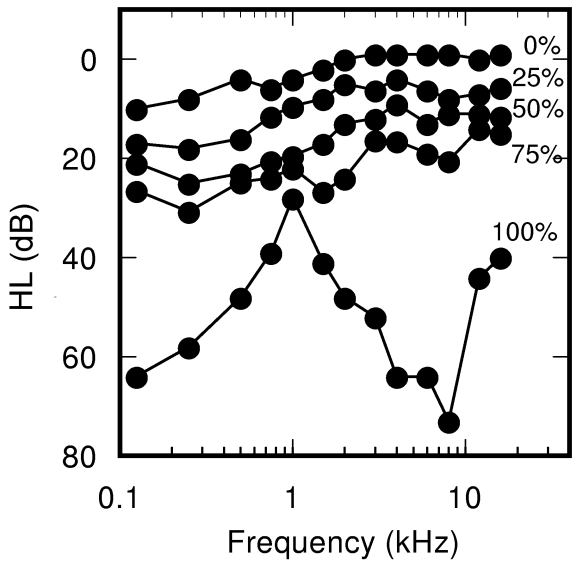


Fig. 3. Statistical data of the results for the group of subjects with wide-band hearing loss.

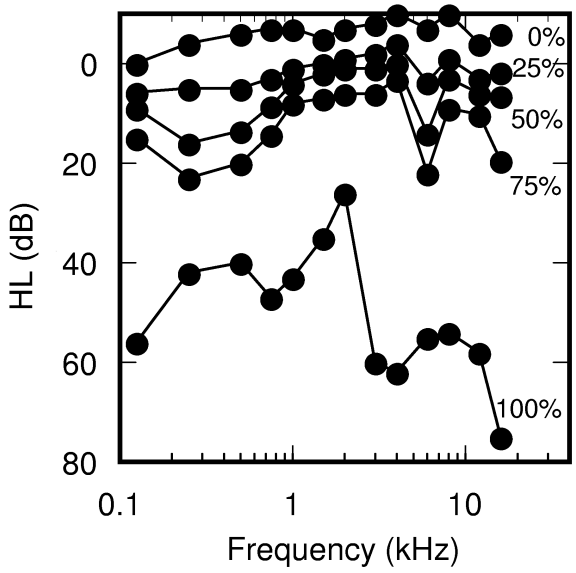


Fig. 4. Statistical data of the results for the group of subjects with selective V-dip hearing loss.

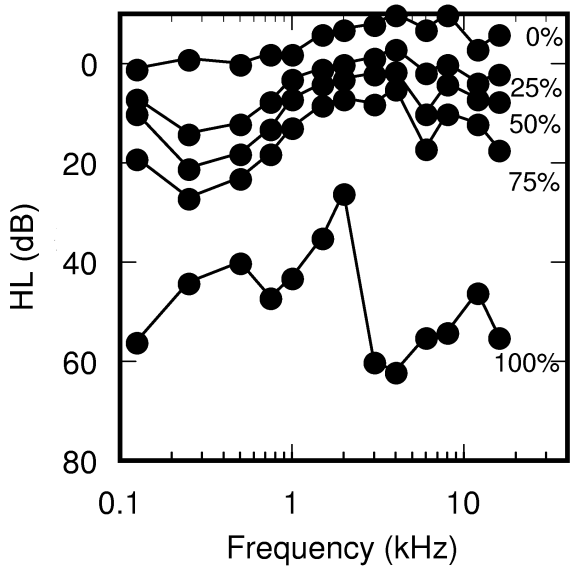


Fig. 5. Statistical data of the results for the group of subjects with low frequency hearing loss.

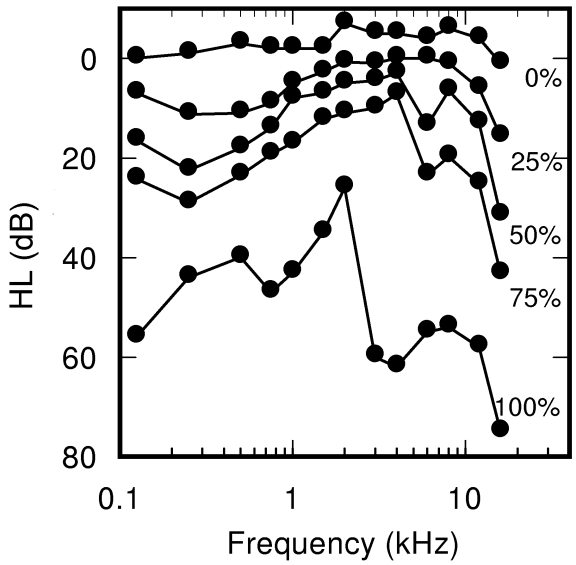


Fig. 6. Statistical data of the results for the group of subjects with high frequency sloping hearing loss.

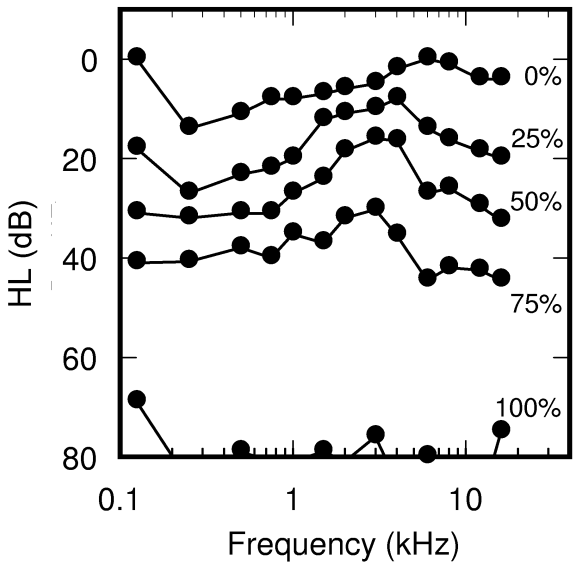


Fig. 7. Statistical data of the results for the group of subjects with deep hearing loss of various configurations.

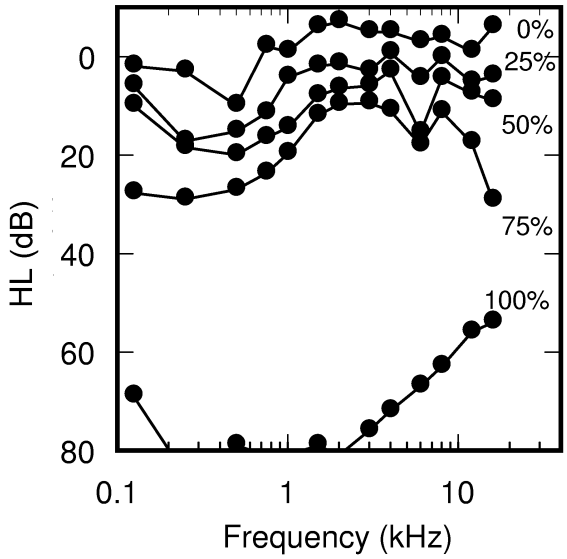


Fig. 8. Statistical data of the results for the group of the children in whom parents suspected that there might have been something wrong with their hearing.

## 4. Discussion

Voluntary participation in the audiometric examination within the present work could probably result in the increased representation of children in which problems with their hearing were earlier observed. Hence the data presented do not necessarily apply to the whole population. However, the "Questionnaire" data show, that the proportion of the children in whom parents suspected that there might have been something wrong with their hearing, does not exceed 12% of the sample. Also it should be observed that the children with normal hearing are also present in the tested sample, see (Fig. 8).

Characteristic is large proportion of low frequency hearing loss (54% of the sample) and selective V-dip hearing loss (36% of the sample). Preliminary typological analysis seems to indicate various kinds of middle ear, throat and nose infections, as leading to the low frequency of hearing loss, which in most cases is conductive in its nature. For the first time high frequency hearing loss (at 16 kHz, the so called peculiar hearing loss) was found in various degrees in 24% of children in the tested sample. High frequency hearing loss and selective V-dip hearing loss in most cases are rather caused by overexposures to sounds or noises with very high frequency components and high sound pressure levels. It is hypothesised that the peculiar hearing loss, reported in the present investigation, may be recognised as a forerunner, announcing the appearance of more serious hearing loss at lower frequencies.

Unfortunately parents and schoolmasters, and people who look after children, only rarely are aware of the negative effects of noise to which their pupils are often exposed. A good example in that respect is the data from the schoolboy aged 8, who was assigned

by his parents to percussion class. He practised percussion for two years, usually 1 h three to four times in a week. His audiometric data show 40 dB V-dip at 6 kHz and hearing loss exceeding 45 dB at 12 kHz, reaching 58 dB at 16 kHz. Also very loud music, the sounds from TV set or computer (often emitted from the headphones) and other noises are usually treated as normal phenomena, the exposure to which should not necessarily be avoided. The amount of the specific hearing loss, resulting from the exposure to percussion and to brass wind instruments, is discussed in another report, ROGOWSKI *et al.* [9].

## 5. Conclusion

The results obtained, i.e. hearing loss exceeding 10 dB found in 87% of the tested sample are alarming. It should be also observed that the present data seem to indicate that the hearing loss observed in music students and candidates for studies in the Academy can probably be acquired in the early childhood. However, further investigation of the hearing system in school children is necessary to obtain better statistical significance of the threshold in quiet data.

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