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DURATION OF EXPOSURE TO NOISE AMONG FARMERS AS AN IMPORTANT FACTOR OF OCCUPATIONAL RISK[1]

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Abstract: Occupational exposure to noise is determined by the value of acoustic energy and the duration of exposure - a parameter which is especially important while considering exposure to noise among private farmers. In order to describe the duration of exposure to noise, time-schedule measurements were carried out of occupations performed by a selected group of 30 self-employed farmers during the whole year. Three calculated time values were analysed: mean total monthly time of exposure (t_t); mean daily time of exposure (t_d) and mean monthly time of daily exposure (t_m). The results of the study showed that the highest time values of exposure to noise were observed during the months of intensive field and transport occupations associated with harvesting of cereals and root crops, i.e. in August, September and October; as well as during soil cultivation and chemical treatment activities in April. This was connected with a greater number of workdays in conditions of exposure to noise - 20–21 days on average - and a greater duration of such workdays, often up to 11 hours a day.

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INTRODUCTION

The degree of exposure to noise at workplaces is determined by two factors. Apart from parameters determining the values of acoustic energy, such as sound level, exposure to noise or noise dose [4, 6, 7], the duration of exposure is also of great importance. The duration of exposure is an underestimated or imprecisely defined parameter, although it is very important in the case of exposure to noise among private farmers. This is associated with its great variability, almost every day throughout the whole year, as well as with the presence in the rural environment of a large number of various sources of noise, e.g. agricultural tractors of various types, self-propelled agricultural machines, machinery for the production of fodder, workshop machinery or circular saws. The studies conducted previously [9] showed that the greatest risk for the organ of hearing is caused by medium and low-power tractors (84–101 dB) which are most frequently used on private farms, as well as by combine harvesters (88–92 dB). High-power tractors produce considerably lower levels of noise. Considering various work tasks performed with the use of tractors it was observed that the highest levels of noise accompany the occupations which cause great engine load, such as: transportation of loaded trailers, digging potatos, sugar beets and ploughing (93–101 dB). Among other machinery applied on private farms, the crusher for the production of

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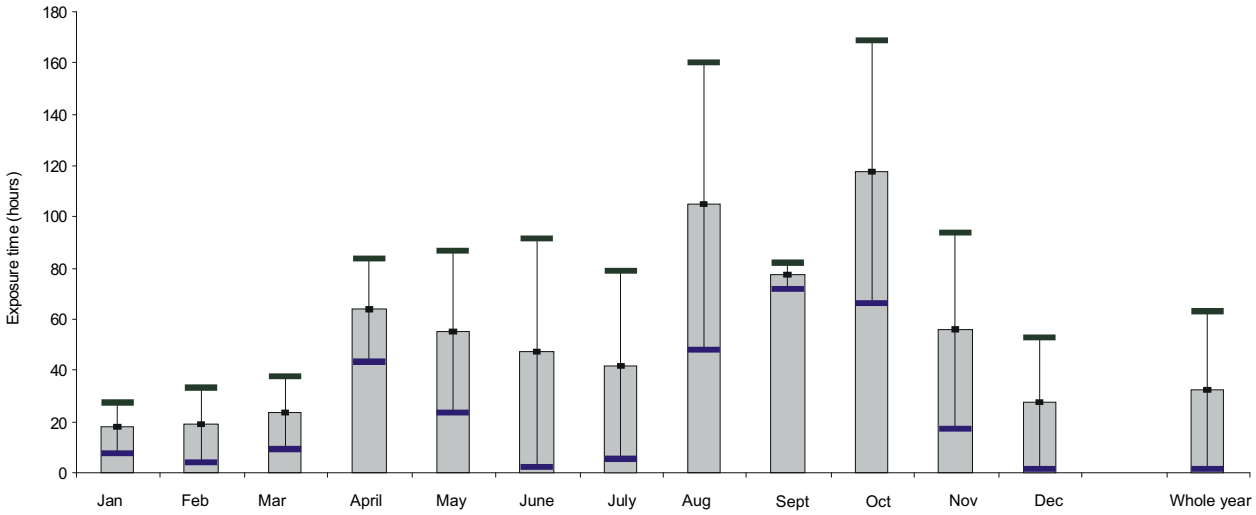

Figure 1. Mean total exposure time to noise (t_t), per month (mean ± S.D.).

fodder (99 dB), and the circular saw (108 dB) are the machines which deserve special attention. In Poland, the level of exposure to noise of 85 dB, calculated for an 8-hour workday has been adopted as permissible [4].

In order to determine the existing exposure to noise among private farmers it is necessary to conduct a careful observation (time-schedules) of work tasks performed over a long period of time, basically a whole year.

OBJECTIVE AND METHODS

In order to characterise the duration of exposure to noise among private farmers, time-schedule measurements were conducted of the occupations performed by a selected group of 30 farmers (owning private farms of an area of 5–40 ha) during the whole year. Plant and animal production farms, with at least one tractor and the basic agricultural machinery were selected for the study.

The data concerning the time-schedule of the working time in conditions of exposure to noise on the selected farms were registered by the farmers themselves in special work diaries. The farmers were provided with instructions about how to keep correct time-schedule records and were equipped in a model time-schedule chart. The correctness of records kept by selected farmers was controlled every two weeks. The numerical data obtained in this way enabled the determination of the time of farmers' exposure to noise with the consideration of the types of occupations performed each workday. Due to very high variability of exposure (working time changing almost daily, variability of the work tasks performed, variability of machines and equipment) the weekly (40-hour) exposure to noise was not applied, as it would be associated with great standard deviations. For this reason, a period of work of one month was adopted for the study as a basic time. A similar analysis of monthly exposure to

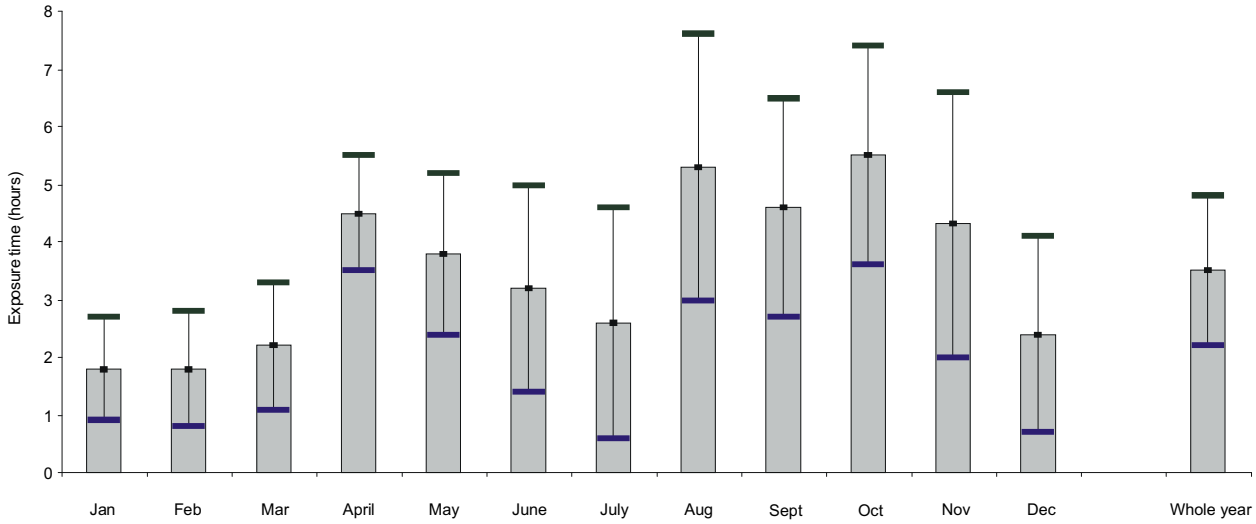

Figure 2. Mean daily exposure time to noise (t_d) (mean ± S.D.).

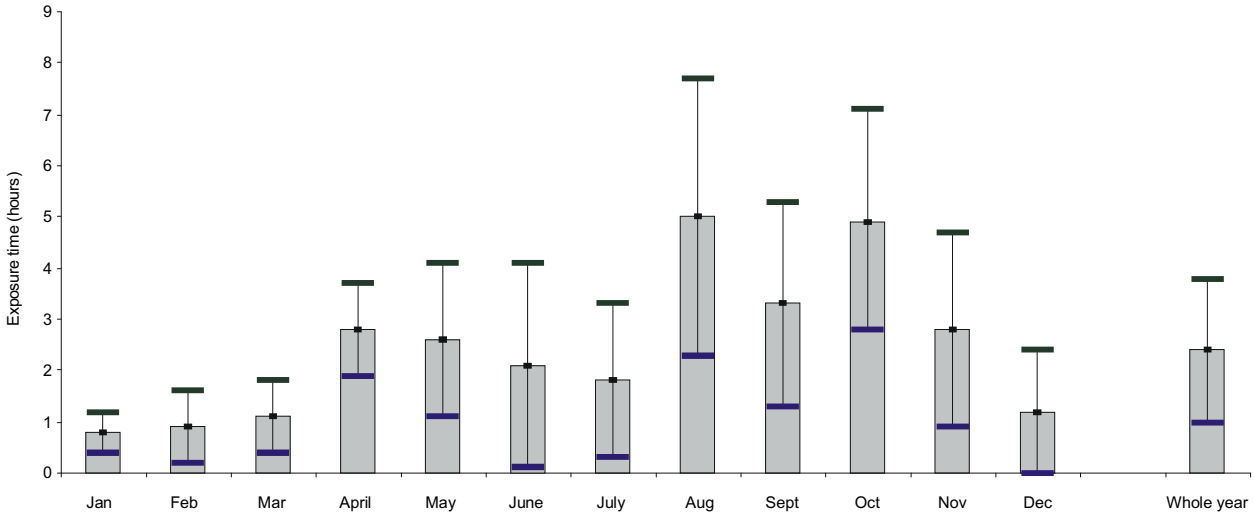

Figure 3. Mean monthly exposure time to noise (t_m), per legal workday (mean ± S.D.).

noise was applied by Mieńszow [2]. The legally accepted working time in Poland is 42 hours a week (5 days a week, 8 hours a day; 3 Saturdays a month free of work and 1 Saturday a workday), but it applies only to collective farms. Private farmers have no obligation to comply with these regulations.

The following time values were calculated in individual months of the year:

- mean total time of exposure during one month (t_t);
- mean time of daily exposure (t_d);
- mean monthly time of daily exposure (t_m) referring to legally established workdays during one month.

The introduction of an additional mean value (so-called mean monthly time of daily exposure - t_m) is justified by the fact that due to a different number of workdays in conditions of exposure to noise in individual months, the mean value of daily exposure (t_d) would not be equivalent to the average exposure to noise. The mean monthly value also includes workdays with no exposure to noise. The same mean value was applied by Mieńszow [2].

Mean values of time parameters for the whole year were also determined. The numerical data obtained were subjected to statistical analysis using the SPSS/PC [10] statistical programme.

RESULTS

The results obtained indicated that the individual time values analysed were highly variable and varied widely during the period of the whole year. The highest time values of exposure to noise were observed during the months when intensive field-transport occupations associated with harvesting of cereals and root crops were performed, i.e. in August, September and October, as well as during the cultivation of soil and chemical treatment in April. The lowest time values of exposure were noted in winter

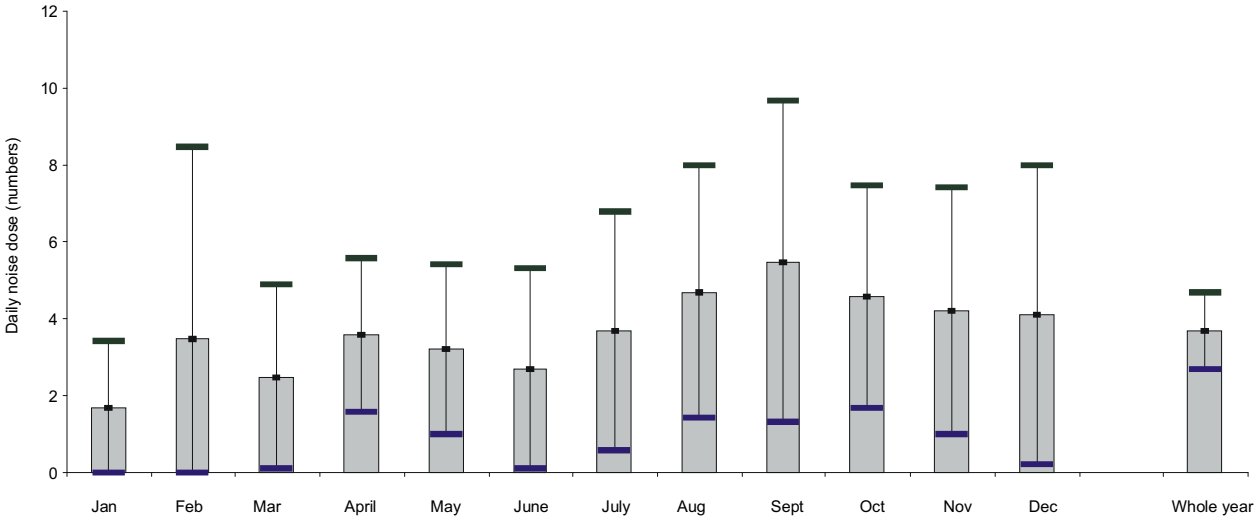

Figure 4. Mean daily noise doses during the whole year (D_d); standard: 1.00 (mean ± S.D.).

(December, January, February and March), when only repair occupations were performed with the use of workshop machinery, as well as wood-cutting (with the use of circular saw) and animal fodder production activities. Although a circular saw is the noisiest machine used by the majority of farmers, especially in winter (108 dB), it does not basically create a great risk due to the short time of exposure (our studies showed that the total time of exposure of a farmer is 3.5 hours monthly) [9]. However, because of the very high noise level emitted by this machine it should be operated within the shortest time possible and with the use of personal means of hearing protection.

Thus, in the case of mean total duration of exposure to noise (t_t) (Fig. 1), the highest values were observed in October (117.3 ± 51.3 hours), August (104.7 ± 56.4 hours), and September (77.0 ± 45.4 hours), whereas the lowest values were noted in January (17.9 ± 10.0), February (18.7 ± 14.6), March (23.7 ± 14.0) and December (27.3 ± 25.6). This is associated with the type of occupation and the need to perform individual occupations during the whole year. The mean total duration of exposure to noise calculated for the whole year was 32.4 ± 31.0 hours per month.

At the same time, the mean time duration of daily exposure to noise (t_d) (Fig. 2), reached the highest values in October, August, September, April and November - from 4.3 to 5.5 hours, while in January, February and March the lowest values were noted: 1.8 - 2.2 h. Such a distribution of time values was associated with the intensity of the occupations performed, especially with field-transport activities during summer-autumn and spring seasons. The mean duration of daily exposure for the whole year was 3.5 ± 1.3 hours.

The highest values of the mean monthly calculated duration of daily exposure to noise (t_m) (Fig. 3), were observed mainly in August (5.0 ± 2.7 h) and October (4.9 ± 2.1 h); whereas the lowest values were noted in winter months: December, January, February and March (0.8 - 1.2 h). The highest values of monthly duration of daily exposure are due to the occurrence in summer and autumn (August and October) of an increased number of workdays in conditions of exposure to noise (maximum up to 31 days; 20–21 days on average) and prolonged working time, often lasting 12–14 hours per day. For the period of the whole year, the mean monthly duration of daily exposure was 2.4 ± 1.4 h.

DISCUSSION

The results obtained from the study showed that the duration of a private farmer's exposure to noise is characterised by high variability and a considerable variation throughout the whole year. This is confirmed by high values of standard deviations. The variability of the duration of exposure is determined by the number of workdays with noise emission in individual months of the year (the mean range of workdays: from 11 days in January, February, March and December to 20-21 days in August and September; with the spread of individual values: 4-31 days), as well as by a variable duration of daily exposure (the mean range of work hours: from 1.8–2.4 hours in January, February, March and December to 5.3–5.5 hours in August and September; with the spread of individual values: 0.5–11 hours).

The highest values of the time parameters analysed were noted in August, September and October, which is associated with intensification of field-transport occupations, harvesting of cereals and root crops, and first ploughing, while the lowest values were observed in winter and were associated with workshop occupations, wood cutting with circular saws, and fodder production.

Analysis of time data showed that in summer and autumn there are cases of farmers working longer than 8 hours daily. This is associated with the need to perform individual work tasks, very often in difficult climatic conditions. Private farmers are not obliged to respect the legally accepted working time, because they are self-employed. It is practically impossible to decrease the excessive exposure, as it would require the implementation of a rotary system of work which is not possible in conditions on private farms.

The seasonal character and variability of agricultural occupations performed within the period of the whole year, non-typical rhythm of work, the subjection of the whole production process to natural conditions and the powers of nature, as well as a special technology of work and the degree of its mechanization contribute to the creation of an extremely changeable and complex exposure to noise. The occurrence on private farms of highly varied machinery, and exposure time changing almost daily make it difficult to evaluate the risk objectively. In order to obtain a reliable evaluation of the noise dose to which a private farmer is exposed, while analysing the time of exposure it is necessary to consider the whole production cycle which covers the period of one year. The need to carry out such studies has been pointed out by a number of occupational hygienists dealing with this problem: Mieńszow and Sota [2], Franzinelli *et al.* [1], Miettinen *et al*. [3] and the author of the present report [5, 9]. Figure 4, presenting the distribution of mean noise doses received by farmers during the whole year shows variability of exposure and the degree of noise risk [8].

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