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# Noise in the Work Environment in the South Moravian and Moravian-Silesian Regions

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## ABSTRACT

**Introduction:** Among risk factors in work environment, noise has a significant impact on hearing and health of the employees. In the Czech Republic, a large number of employees are in the noise risk categories and the numbers have been rising recently.

**Aim:** To compare the Moravian-Silesian and South Moravian regions in terms of employees' exposure to noise in their work environment in selected jobs and to assess the differences.

**Methodology:** The comparison is based on classification of economic activities, from which certain jobs were selected and the numbers of employees in these job and the respective noise level categories were considered.

**Findings:** Statistically significant differences in the represented categories between the regions were found. The Moravian-Silesian region leads in the number of employees exposed to noise in their professions (21%) compared to the South Moravian region (9%). The most employees listed in the noise-risk categories are in the Moravian-Silesian region, where heavy manufacturing industry still prevails. By contrast, the South Moravian region focuses more on light industry, agriculture and services.

**Conclusions:** The survey and the statistical data analysis performed by the Regional Public Health Authority the National Institute of Public Health indicate that the number of employees in noise-risk professions in gradually rising. This is the case even though the decreasing impact of the heavy industry and company strategies based on modern technology and procedures. For this reason, it is important to pay constant attention to the risk factors in every area and to try to eliminate effectively employees' exposure to noise.

## KEY WORDS

Risk factors, noise, work environment, job categories

## INTRODUCTION

Hearing is a very important basic sense necessary for valuable life. Quality of life decreases with hearing impairment or with loss of hearing. The World Health Organization states that by 2018 there were 466 million people with a hearing impairment, which is about 5% of total world population. Of that number about 432 million people are adults.

The aim of this study is to find out the number of people affected by noise in their working environment. The study focuses on two regions of the Czech Republic with different industry distribution. Among other risk factors, noise in the working environment has a significant impact on the health of workers. Over-limit exposure to this factor can result in health damage. It is necessary to reduce the influence of noise on workers as much as possible. Decreasing noise pollution is carried out on several levels: from the production strategy, soundproofing of manufacturing technology and the working environment, to personal protective equipment that has to be available for workers exposed to over-limit noise levels.

## METHODOLOGY

The aim of this study is to find out differences in the number of people exposed to noise in work environment in the South Moravian (SMR) and the Moravian-Silesian regions (MSR). On December 31st 2016,

772,488 people in the age from 15 to 64 were economically active in SMR and 802,696 people in MSR.

The data about workers in environments with over-limit noise levers were obtained from the catalogue of job positions (IS KaPr) with the consent of the director of the Occupational Health & Safety Department at the Regional Hygiene Station in Brno, and according to Act No. 101/2000 Coll data, as amended. The data shows a detailed record of workers in noise-risk environment in categories 2, 2R, 3, and 4 in South Moravian and Moravian Silesian regions in selected divisions of Classification of Economic Activities (CZ-NACE) as of December 22nd 2017.

In order to compare them, the data were converted to percentages in their categories, as the absolute numbers in certain sections were very different. Since the research focuses on workers in the second category, we could compare the statistical differences in classification of workers into individual categories: category 2 without risk, category 2R with lesser risk, and the risky categories 3 and 4 which were joined for the purposes of the comparison. We were enquiring whether there were statistically significant differences in each category of work among the regions by calculating the chi-square and the corresponding p-values in the Open Epi program.

## RESULTS

The two regions were almost equal in the number of economically active persons: 601,062 in SMR and 611,663 in MSR. There were apparent differences in the exposure to noise at workplaces, as 29,626 persons were registered in SMR and 74,233 in MSR. We researched the total number of employees working in the noise-risk environment as well as their distribution into categories 2R, 3, and 4 (See table no. 1). In the South Moravian Region, the category 2R was represented by 5.35%, category 3 by 92.52%, making it the largest category, and category 4 by 2.13%. In the Moravian-Silesian Region, category 2R was represented by 5.54%, category 3 was the largest with 89.38%, and category 4 was represented by 5.08% of all subjects.

The results for individual categories and divisions of CZ-NACE are converted to percentage and shown in table no. 2. The table also shows the p-value which indicates a statistically significant differences in given sections between the regions. We consider the difference to be statistically significant if the final number (i. e. the p-value) is smaller than 0.05.

In both regions category 3 was the largest. In this category, the workplace noise exposure equals to 85 dB or more. It was dominated by two sections: section A which includes crop and livestock production, forestry and logging, and section B which includes quarrying and mining extraction, and which was prevailing in MSR. Coal mining and refining, for instance, did not occur in SMR at all. In MSR, 10,067 workers were registered in this field (9,573 workers in the third category and 494 in the fourth one). In the field of oil and natural gas extraction there were 51 workers registered in third category in SMR while there were none in MSR. The mining and refining section had no registered workers in neither region. There were no workers registered in the second category either. Other parts of section B are listed in table no. 2.

Section C covers the highest number of persons and sub-sections. An overview of the number of people exposed to noise in their working environment is shown in table no .3, while the percentage distribution of workers in table no. 2. In both regions, there was a high number of workers in the field of manufacture of fabricated metal products, except machinery and equipment—11,826 in MSK and 11,269 in SMR. The highest number of workers exposed to noise-risk environment in section C was in manufacture of basic metals and metallurgical processing (12,165 workers in MSR and 1,400 in SMR), manufacture of fabricated metal products, except machinery and equipment (7,352 in MSR and 4,446 in SMR), and manufacture of motor vehicles (9,097 in MSR and 1,350 in SMR).

The lowest number of people within section C was in production of coke and refined petroleum products, where there were only three men working in the non-risk second category in SMR, and further in section H in the air transport section with 13 people in the second category in MSR and no registered workers in SMR. The lowest number of people working in noise-risk environment was in section J in film, video and television programs, making sound recordings and music publishing with 7 people in the risk category 3 in SMR.

At the end, workers from all sections were counted in their respective categories and we calculated their relative frequency, which is shown in graph no. 1. The results were subsequently statistically compared between the regions. We found a statistically significant difference between regions in categories with p-value 0.00004.

## DISCUSSION

The WHO states in a report that excessive noise is one of the most common occupational risks. Noise exposure above 85 dB has been considered dangerous for workers for a long time. Long-lasting exposure to noise can result in permanent damage of the auditory nerve and/or sensory cells. This kind of damage

is known as noise induced hearing loss (NIHL). It is, however, essential to note that noise in workplace is largely preventable and noise pollution can be mitigated by considering technical and technological factors, providing personal protective equipment, as well as by instructing the employees (3, 4, 5). This study compares the Moravian-Silesian Region and the South Moravian Region in terms of the number of workers exposed to noise in workplace.

The data collected by the Regional Hygiene Station in recent years (6, 7) support our findings that the highest number of workers belongs to the third category. An Australian study focusing on workers in various sectors found that up to 20% of all persons was exposed to noise levels exceeding the noise exposure limit (PEL) which is 85 dB. At the same time, almost a half of the workers was regularly exposed to noise levels equal to or higher than 90 dB (8). There was a significant difference between the regions in the number of workers in the mining and quarrying section, where workers in MSR accounted for 92%. As stated above, the vast majority of workers was classified as belonging to the third category. According to a US study focusing on workers in mines, most of them were exposed to PEL noise levels (85 dB) or higher. We can therefore estimate that working conditions in the mines were similar.

The manufacturing industry was the section with the highest number of workers in general, but there were at least twenty-seven thousand more people working in the sector in MSR than in SMR (2). In both regions, practically the same number of employees worked in the non-risk category 2 (49,000) and in the risk categories 2R, 3 and 4 (54,009), i. e. 52% of workers were exposed to noise-risk environment at workplace. There were 49% of workers at workplaces where the noise level exceeded the permissible limit. Australia classifies workers using the Australian and New Zealand Standard Industrial Classification (ANZSIC), which is identical with the Czech CZ-NACE. This classification ranks the manufacturing industry on the third place according to the number of workers. The percentage of workers at risk of noise in categories equivalent to category 3 and 4 was 38%. The manufacturing industry included areas such as food production, baking industry, and production of leather, wood, primary metals and metal goods (8). Rubak and co. studied Danish workers with hearing loss in the manufacturing industry. They found out that up to a half of the workers were exposed to levels above PEL 85 dB (10). In MSR, the most numerous group of workers in category 3 was in metalworking industry. Singha's study focuses on noise at workplace in foundry and metalworking industry and measures the levels of noise with the use of personal sound level meter. The level of noise was measured to be higher than 90 dB in most work activities. In the regions which are the focus of this study, 60% of workers employed in the metalworking industry were exposed to levels exceeding the permissible noise level. Nietzel assessed the noise pollution in Swedish paper mills and after several years of research estimated that 50% of employees on 8-hour shifts schedule were exposed to noise levels equal to or higher than the limit 85 dB (11).

In both regions, 45% of workers in production and distribution of electricity were classified as belonging to category 2 and 52% to category 3. In water purification and sewage treatment, 70% of workers belong to second category and 28% to the third one. It is therefore evident that most workers were exposed to noise levels below PEL 85 dB. Williams's study indicates that 32% of employees in this industry were exposed to noise levels higher than PEL.

The construction sector was one of the few areas in the researched regions with lower exposure to noise at workplace. Of the total amount of workers in this sector, 63% were classified in the non-risk category 2 and only 30% were classified as belonging to the third category. Studies conducted by foreign institutions show a variety of results in this area. The Australian study measured the average level of noise at workplace at 83.9 dB, while the Danish study at 85.7 dB and as such it corresponds with the risk category 3 (10, 8). In wholesale and motor vehicles repair, 80% of workers belong to the second category. Only 19% of employees in this section were classified as belonging to the third category. Williams determined the average noise level for employers in the wholesale industry to be 80.4 dB. According to the results of his study, retailers were exposed to an even lower average levels, 75 dB (8).

Our study shows that in transport 81% of workers fall into the second category. Only 16% belong to the third category. The majority of workers were thus exposed to noise levels lower than PEL. These figures are lower in comparison to results from other studies. Karimi states that the range of noise levels measured for bus and truck drivers extents from 77 dB to 92 dB (12). In rail transport the noise level depends on the types and the age of machines in the driver's cab. In newer types, noise levels are reduced below the risk level of 85 dB.

In accommodation and food service activities, very few workers were registered as working in noise-risk environment. 92% of all employees were categorized as in the non-risk category 2. This categorization corresponds with the noise levels measured by Toa in restaurants. He measured the noise levels in several

restaurants during a rush hour. He found out that the average noise level in Chinese restaurants was 73.88 dB, in fast food 74.08.dB, and in "western restaurants" 73.91 dB (14). Conversely, in a study conducted by Lao, the noise levels were significantly higher. He used personal noise dosimeters in restaurants to measure the participant's daily average noise exposure. The average level of noise for chefs was 92.2 dB and 90.5 dB for dishwashers.

In architectural and engineering activities, three quarters of workers were assigned to category 2. Almost one quarter of workers were then placed in category 3. Williams states in his study that only 2.2% of the total number of workers in this section are exposed to the noise-risk levels, i. e. 85 dB or more.

The public administration and defense section consists for the greater part of workers placed in the second category (65%). However, the third category was represented more than in the previous sections (29%). It is likely that workers in the risk categories are members of armed forces. This can be inferred from the outcomes of a study focusing on the members of the Belgian army which measured the hearing loss in relation to noise exposure and the length of service. The findings showed that the prevalence of hearing loss among participants was 55.8% (16).

In healthcare, 75% of workers were classified as belonging to the non-risk category 2 and 15% to category 3. We can estimate a similar classification of workers into risk and non-risk categories from the results of foreign studies. They show that only 2.2% of workers in health and social care were as exposed to risk noise levels (8). Kol assessed the noise environment in the intensive care unit before and after the implementation of strategies of noise reduction and his findings show that the average level of noise was reduced by almost 12 dB (17).

On the basis of comparing workers in various categories and the outcomes of different studies that focus on noise levels in working environment, we can assume that the noise exposure of Czech workers is very similar to the noise exposure of workers elsewhere in the world. This can be estimated also from the fact that modern techniques and technologies are available at most workplaces and they are widely used and available worldwide. Employers thus tend to replace old machines and equipment with new ones in order to improve the working conditions of their employees.

## CONCLUSION

We compared the occupational noise exposure in selected occupations in the Moravian-Silesian Region and the South Moravian Region. We found from the data we obtained from IS KaPr KHS Brno that more workers in risk of noise are in MSR.

**Table 1** Total number of workers exposed to risk of noise in workplace in both regions

| | South Moravian Region | Moravian-Silesian Region |
|---|---|---|
| Category 2R | 1 586 | 4 110 |
| Category 3 | 27 411 | 66 352 |
| Category 4 | 629 | 3 771 |

The findings of this study and the statistically processed data show that the number of workers in risk of noise is slightly increasing. This is a current trend despite the declining impact of heavy industry and the strategies of business managements to use modern techniques and technologies. It is therefore necessary to constantly address the issues of occupational risks in all fields and to eliminate as much as possible the exposure to noise, since it is evident that better working environment will result in a lower number of workers' injuries and occupational diseases.

The findings of our study, together with the outcomes of other studies, show that the measured values of noise at various workplaces in different states more or less correspond to the number of workers in individual categories (mainly risk categories) in SMR and MSR.

**Table 2** The percentage of workers in individual sections

| | | Category 2 | Category 2R | Category 3 + 4 | Statistical significance p < 0,05 |
|---|---|---|---|---|---|
| Section A | *Crop and animal production* | | | | |
| | MSR | | 13% | 87% | 0,0543 |
| | SMR | | 6% | 94% | |
| | *Forestry and logging* | | | | |
| | MSR | | | 100% | 0,0021 |
| | SMR | | 7% | 93% | |

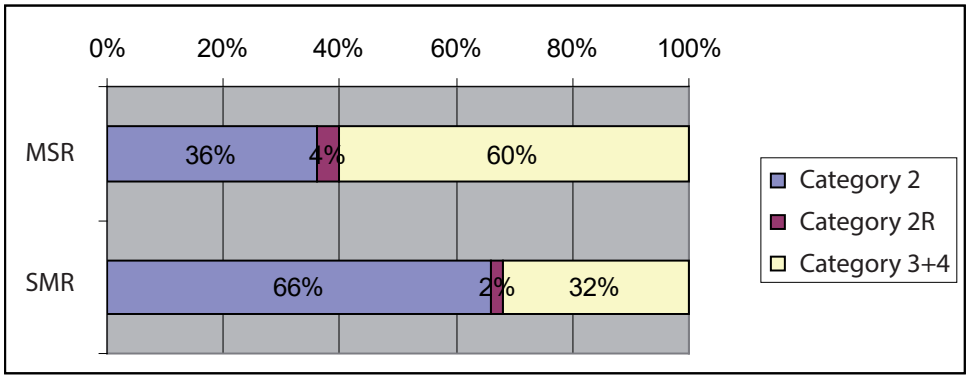
| | | | | | |
|---|---|---|---|---|---|
| **Section B** | ***Other mining and quarrying*** | | | | |
| | MSR | | 35% | 65% | 0,00006 |
| | SMR | | 12% | 88% | |
| | ***Mining support service activities*** | | | | |
| | MSR | 18% | | 82% | 0,0000001 |
| | SMR | 65% | | 35% | |
| **Section C** | ***Manufacture of food products*** | | | | |
| | MSR | 59% | 3% | 38% | 0,0941 |
| | SMR | 70% | 4% | 26% | |
| | ***Manufacture of beverages*** | | | | |
| | MSR | 26% | 9% | 65% | 0,0005 |
| | SMR | 55% | 7% | 38% | |
| | ***Wood processing*** | | | | |
| | MSR | 27% | 2% | 71% | 0,0361 |
| | SMR | 41% | 3% | 56% | |
| | ***Manufacture of coke and refined petroleum products*** | | | | |
| | MSR | 30,5% | 0,5% | 69% | - |
| | ***Manufacture of other non-metallic mineral products*** | | | | |
| | MSR | 59% | 1% | 40% | 0,7163 |
| | SMR | 62% | 1% | 37% | |
| | ***Manufacture of basic metals*** | | | | |
| | MSR | 19% | 4% | 77% | 0,0064 |
| | SMR | 39% | | 61% | |
| | ***Manufacture of fabricated metal products*** | | | | |
| | MSR | 38% | 4% | 58% | 0,0016 |
| | SMR | 61% | 2% | 37% | |
| | ***Manufacture of electrical equipment*** | | | | |
| | MSR | 54% | 8% | 38% | 0,00002 |
| | SMR | 84,9% | 0,1% | 15% | |
| | ***Manufacture of other electrical equipment*** | | | | |
| | MSR | 54% | 5% | 41% | 0,0443 |
| | SMR | 70% | 1% | 29% | |
| | ***Manufacture of motor vehicles*** | | | | |
| | MSR | 28% | 7% | 65% | 0,0001 |
| | SMR | 67,9% | 0,1% | 32% | |
| | ***Repair and installation of machinery and equipment*** | | | | |
| | MSR | 44% | 1% | 55% | 0,0002 |
| | SMR | 71% | 1% | 29% | |
| **Section D** | ***Electricity, gas, steam and air conditioning supply*** | | | | |
| | MSR | 41% | 3% | 56% | 0,0010 |
| | SMR | 66% | | 34% | |
| **Section E** | ***Water collection, treatment and supply*** | | | | |
| | MSR | 73% | 1% | 26% | 0,0098 |
| | SMR | 55,8% | 0,2% | 43% | |
| | ***Waste collection, treatment and disposal*** | | | | |
| | MSR | 72% | 1% | 27% | 1,0000 |
| | SMR | 72,9% | 0,1% | 27% | |
| **Section F** | ***Specialized construction activities*** | | | | |
| | MSR | 54% | 4% | 42% | 0,0006 |
| | SMR | 76% | 5% | 19% | |
| **Section G** | ***Wholesale and retail trade and repair of motor vehicles*** | | | | |
| | MSR | 72% | 1% | 26% | 0,0058 |
| | SMR | 88,6% | 0,4% | 11% | |

| | | | | | |
|---|---|---|---|---|---|
| **Section H** | ***Land transport and transport via pipelines*** | | | | |
| | MSR | 76% | 3% | 21% | 0,0087 |
| | SMR | 90% | 1% | 9% | |
| **Section I** | ***Accommodation and food service activities*** | | | | |
| | MSR | 87% | 4% | 9% | 0,0052 |
| | SMR | 99% | 0,5% | 0,5% | |
| **Section M** | ***Architectural and engineering activities, technical testing and analysis*** | | | | |
| | MSR | 67% | 9% | 24% | 0,0124 |
| | SMR | 86% | | 14% | |
| **Section O** | ***Public administration and defense, compulsory social security*** | | | | |
| | MSR | 61% | 10% | 29% | 0,5857 |
| | SMR | 70% | | 30% | |
| **Section Q** | ***Health care*** | | | | |
| | MSR | 78% | 7% | 14% | 0,1099 |
| | SMR | 64% | 21% | 15% | |

**Table 3** The number of workers at risk of noise in section C in both regions

| | SMR | MSR |
|---|---|---|
| Manufacture of food products | 1334 | 1157 |
| Manufacture of beverages | 222 | 267 |
| Wood processing | 1828 | 1227 |
| Manufacture of coke and refined petroleum products | 0 | 312 |
| Manufacture of other non-metallic mineral products | 1362 | 557 |
| Manufacture of basic metals | 1400 | 12165 |
| Manufacture of fabricated metal products | 4446 | 7352 |
| Manufacture of electrical equipment | 621 | 779 |
| Manufacture of other electrical equipment | 2795 | 2759 |
| Manufacture of motor vehicles | 1350 | 9097 |
| Repair and installation of machinery and equipment | 697 | 2282 |

**Graph 1** Relative frequency of workers across all sections



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