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Noise annoyance from mining in the Czech Republic

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ABSTRACT

Mining is one of the main industrial sources of noise and it is a significant long-term source of negative effects on the immediate surroundings. The subject of the study is the Turow mine in Poland, located near the border with the Czech Republic. The monitored area in the Czech Republic was in two border villages Uhelna and Oldrichov, and in the control area Vaclavice, where a noise measurement and a questionnaire survey were conducted in 2022. The aim of this project is to produce a methodology for assessing the adverse impact of noise from mining activities on subjective health (annoyance, sleep disturbance). The principle of the methodology is based on the relationship between the objectively determined noise values and subjective perceptions obtained by a questionnaire survey. The questionnaire used is a modification of the validated questionnaire Acoustics – Assessment of noise annoyance by means of social and socio-acoustic surveys. The preliminary results of the questionnaire survey showed that the residents of the monitored area perceive the noise from the Turow mine as a significant problem. The methodology will include quantification of the exposure-response function and reflects the need of evaluation the noise frequency characteristics in buildings, such as the effect of low-frequency noise. The proposed methodology is supposed to be possible to apply for the assessment of other industrial noise sources.

Keywords: industrial noise, mining, noise annoyance, questionnaire

INTRODUCTION

Industrial sources of noise including mining belong among the environmental noise that is attributed to second place among the causes of ill health in Europe [1]. Even though noise

from industrial activities is less frequent than road traffic noise or aircraft noise, negative effects on the environment and human health cannot be ignored. Although noise annoyance and negative health impacts from road, rail or air traffic noise are proven by countless studies, industrial sources of noise including mining are still more or less an open question in relation to population nuisance [2]. Mining activity has a long tradition not only in the Czech Republic or Poland, it is an important part of the national economy.

The place of interest is the Turow mine located in the southwestern part of Poland. It is a lignite mine with total area of 28 km^2, maximum depth of 225 meters and the length of the conveyor belt is almost 90 km. The Turow Power Station is a part of the Turow mine. Mining activity began in 1904 and it has been extended towards the Czech border until 2044. The Turow mine extension is facing an opposition from the Czech Government as well as nearby Czech and German communities, who said that the environmental impact from the mine is severely affecting their quality of life and threatening survival of several villages close to the border [3]. The Court of Justice of the European Union (CJEU) ordered to mine operator the immediate closure of the mine. However, Poland defied an injunction by the CJEU claiming it would have an adverse impact on the country's energy system and would lead to the loss of thousands of jobs. Poland had not ceased lignite extraction activities, CJEU ordered Poland to pay the European Commission a daily penalty payment of half a million Euros, however the Polish Government refuse to comply. That was the reason for an agreement made between the Polish and Czech Government [4, 5]. The agreement includes numerous points that must be fulfilled by Poland [6].

The aim of the project is to produce a methodology for evaluating the impact of noise from mining activities on exposed residents with regard to subjective negative effects. Noise values obtained by long-term noise monitoring and subjective effects obtained by application of the internationally validated questionnaire will be a baseline for this methodology.

MATERIALS AND METHODS

The monitored area in the Czech Republic was in two border villages Uhelna (42 inhabitants) and Oldrichov (178 inhabitants), and in the control area Vaclavice (360 inhabitants) where a noise measurement and a questionnaire survey were conducted. The noise measurement was provided by the Public Health Institute, Ostrava, Czech Republic. The long-term measurement (outside the buildings) took place in five weekly cycles (April, June, July, September, October/November) during the time intervals from 10 p.m. to 6 a.m. in the year 2022. The short-term measurement took place in three nights (2 days in June, 1 day in July 2022) inside the buildings. The questionnaire survey was conducted by the University of Ostrava, Faculty of Medicine. It started with a pilot study in May, then the main survey followed in three days during June, August and September in 2022. The questionnaire is a modification of the validated questionnaire Acoustics – Assessment of noise annoyance by means of social and socio-acoustic surveys. The questionnaire could be completed in printed or electronic form (the printed questionnaire was provided with a QR code and the SW Click4survey was used for the data entry). Respondents received a financial reward for the fulfilment of the questionnaire. The statistical analysis of the first results, descriptive statistics, and the differences between the monitored and the control area were evaluated using statistical tests (Chi-squared test, Fisher's exact test, Two-Sample t-Test, Mann-Whitney test), the

significance level was set to 5%. The results were expressed as odds ratio (OR) and 95 % confidence intervals (CI) were calculated using SW Stata v. 17.

RESULTS

The sample comprised of 80 residents, 48.0% males and 52.0% females, mean age 53.5 years (min 17, max 97). The response rate was extremely low (13.8 %). The respondents did not differ significantly by age, gender, education, marital status, lifestyle between the areas but they differed by economic activity (p=0.045). In the monitored and the control area the respondents currently perceive, without area differences (p=0.701), rising energy prices to be the biggest problem (Figure 1). In the control area, people significantly more perceive the lack of drinking water (p<0.001) and the pollution of waterways (p=0.023) as significant problems, as well as the consumption of alcohol (p=0.012) or smoking of tobacco products (p=0.034) and the quality of public transport in the place of residence (p=0.017) comparing with the monitored area.

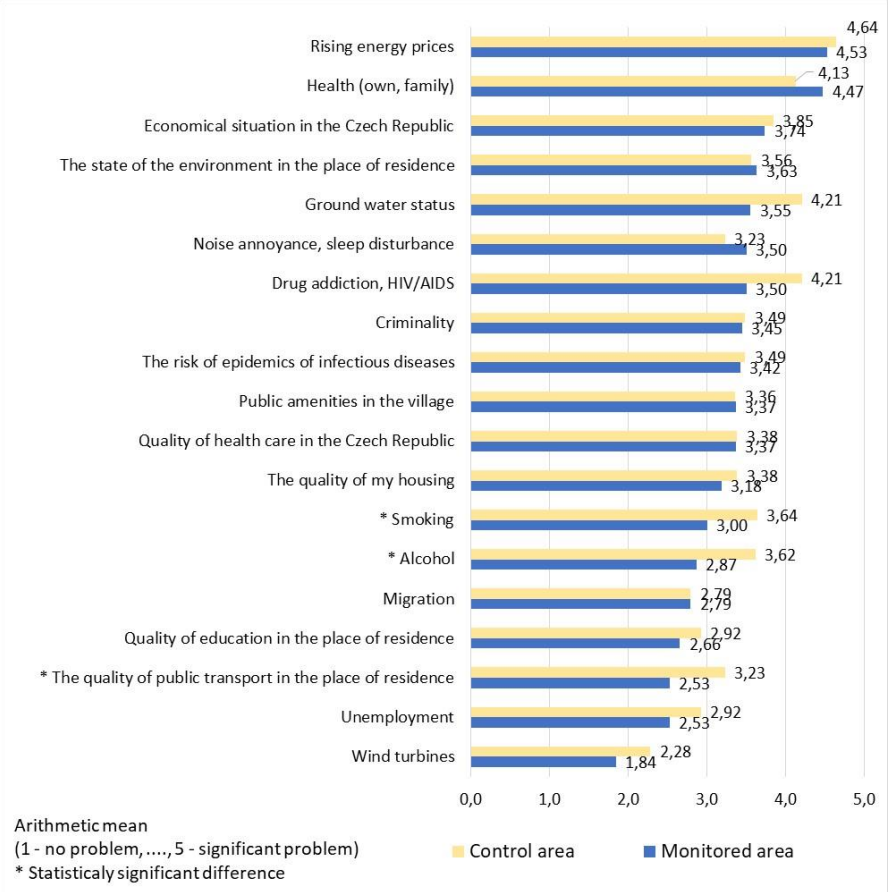

Figure 1: Perception of the severity of various risks in the monitored and control area

Conversely, in the monitored area residents perceive industrial noise as a significantly more important problem (p=0.004). The results of the sex adjusted model showed a significantly more severe perception of industrial noise in the monitored area (OR=3.2; 95% CI=1.25-8.42). Residents in the monitored and control area consider without area differences a street noise (p=0.086) and neighborhood noise (p=0.347) to be the least annoying. In the monitored area

57.9% of residents perceived the noise situation in the place of residence as “worse”, in contrary, only 35.7% of the residents in the control area perceived worse noise situation and 59,5% the persisted situation during the last 5 years and the differences were not significant (p=0.114). After merging the variables “better” and “same” into one category the worse situation was statistically more pronounced in the monitored area (p=0.035). Furthermore, in the monitored area 89.5 % of residents, 92.3 % of residents in the control area (p=0.711), answered that they regularly follow current information about the development of the situation in the Turow mine in 2022. Residents in the monitored area can more determine the source of noise that bothers them with a statistically significant difference (84.2 %, p=0.008). Residents in the monitored area perceive annoying noise especially more as “rumbling” (p=0.026), “humming” (p=0.004), “variable over time” (p=0.002) or “roar” (p<0.001).

DISCUSSION

Mining activity has a long tradition in many European countries. It is an important part of the national economy, but it is also significant source of negative impacts on environment like noise, pollution, lack of drinking water or vibration.

In addition to fulfilled questionnaires also qualitative data were obtained during the personal contacts with many residents in monitored and control area. Respondents often said that they had already communicated with various organizations that’s why they did not want to comment the situation about Turow mine anymore. As resulted from the preliminary results of the 1st questionnaire survey in 2022 in monitored and control area currently the respondents perceive rising energy prices, own health status, groundwater status or economic situation in the Czech Republic to be the most serious problems. The lack of drinking water is a big problem especially in the control area due to the absence of community water supply. Industrial noise (noise from the Turow mine) is assessed by residents of the monitored area as very disturbing. Noise limits were exceeded in several cases. The total long-term exposure to industrial noise does not exceed the limit value for all-night long-term exposure, recommended by the World Health Organization and accepted by the European Commission. However, the mine will expand towards the Czech border for that reason more frequent exceeding of noise limits can be expected. Construction noise, street noise or neighborhood noise is assessed by residents as a minor problem. Respondents in the monitored and control area answered in the interviews that a light pollution is another huge problem. The light pollution comes from the greenhouses for growing vegetables that are located near the Turow Power Station, and that use the wastewater for heating. The light pollution comes also from mine illumination, machine lighting and safety lighting. Furthermore, respondents in monitored and control area mentioned emerging cracks in the plaster of houses as a very serious problem.

Currently there is a very intensive communication between Czech and Polish Governments. Polish Government is gradually performing points included in the agreement between Czech and Polish Governments from 2021. Underground wall was built to prevent groundwater depletion. The underground wall is in the test operation now. The construction of an above-ground embankment is planned to reduce noise, air pollution and light pollution from the mine. It must be at least 1 km long. Poland had to choose a measuring point for noise measurement and must provide the measured data to the Czech Republic [6, 7].

The limitation of the questionnaire survey is the extremely low response rate. Respondents often said that they were afraid to give their personal information. This project is the first study investigating the effect of industrial noise (mine noise) on exposed residents. The produced methodology will include quantification of the exposure-response function and will reflect the need of evaluation the frequency characteristics of noise in buildings, such as the effect of low-frequency noise. The proposed methodology is supposed to be possible to apply for the assessment of other industrial sources.

CONCLUSION

Since 1904 more than 800 million tons of lignite were mined and approximately 300 million tons of lignite remain. The residents in the monitored area are significantly more annoyed by industrial noise (in that case from the Turow mine) comparing with the control area. However people perceive more serious problems such as lack of groundwater, economic situation in the Czech Republic or groundwater status. People have lost confidence in improvement the environment in the place of residence. The noise measurement and the questionnaire survey will continue in 2023.

Acknowledgements

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