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Ljubiša Balanović
Dejan Tanikić

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to welcome all esteemed participants of the 54th International October Conference on Mining and Metallurgy (IOC 2023), scheduled to take place at the picturesque Bor Lake, Serbia, from October18th to 21st 2023.

The collaborative efforts of the University of Belgrade, the Technical Faculty in Bor, and the Mining and Metallurgy Institute Bor have meticulously organized this year's IOC. Our focus remains unwavering on showcasing the latest research findings and advancements in geology, mining, metallurgy, materials science, technology, environmental protection, and other engineering disciplines. Our primary objective is to foster a dynamic environment where academics, researchers, and industry professionals can come together to share their knowledge, experiences, and innovative ideas while exploring opportunities for collaborative research endeavors.

Our conference agenda is rich and diverse, encompassing plenary sessions, engaging invited lectures, technical presentations, enlightening oral and poster sessions, informative technical tours, a diverse exhibition, and memorable social gatherings. At the heart of this event lies our strong commitment to sustainable development within the mining and metallurgy sector. We are dedicated to exploring ecologically conscious methodologies, responsible resource extraction practices, and cutting-edge technologies that reduce the industry's environmental impact and enhance the well-being of local communities.

The conference proceedings comprise 129 papers authored by individuals from universities, research institutes, and industries in 22 countries. We are proud to welcome participants from Bosnia and Herzegovina, Bulgaria, Canada, China, Croatia, Germany, Greece, India, Iran, Kazakhstan, Libya, North Macedonia, Montenegro, Morocco, Romania, Russia, Slovakia, South Africa, Spain, Turkey, United States, and, of course, Serbia.

We are excited to host the 8th International Student Conference on Technical Sciences (ISC 2023) as part of IOC 2023. This event offers students from Serbia and the wider region a unique chance to showcase their research and discuss the future of their fields with experts.

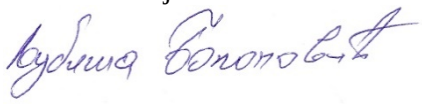
We sincerely thank the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia for their generous financial support. In addition, we express our profound gratitude to all our sponsors, exhibitors, and friends of the Conference for their contributions and unwavering support for playing a pivotal role in ensuring the success of IOC 2023.

We would like to express our heartfelt thanks to all authors, committees, reviewers, speakers, and chairpersons for their invaluable contributions in shaping IOC 2023.

We look forward to welcoming you to the 55th International October Conference on Mining and Metallurgy (IOC 2024), which will be held in October 2024.

On behalf of the 54th IOC Organizing Committee,

Prof. dr Ljubiša Balanović



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OCCUPATIONAL INJURIES IN UNDERGROUND COAL MINING: STATISTICAL ANALYSIS OF DATA

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Abstract

For employers, occupational accidents are the biggest problem in occupational safety and health. In underground coal mines, where a large number of injuries occur, this problem is even more significant. In order to find a suitable model for the analysis and prediction of occupational accidents, data collection research was conducted in underground coal mines in Serbia. This research took the form of statistical data collection and data collection using a questionnaire. A total of 1051 correctly completed questions were collected from the population of production workers. The descriptive statistics used to process the collected data revealed a central problem related to the safety and health of workers.

***Keywords**: injury, coal mine, statistics*

1. INTRODUCTION

One of the biggest problems related to occupational safety and health in the mining industry is workplace accidents. This industry, along with construction, is known as the one with the highest number of injuries. There are several models that describe the problem of injuries and the actions that need to be taken to reduce the number of injuries. However, the factors that influence occupational injuries are not clearly defined.

Considering the multidisciplinary nature of the research conducted, the empirical research method was selected as the most appropriate method for data collection using a questionnaire. The proposed method of analysis is based on the collection of data on workers and injuries that occurred in underground coal mines. The data in the observed sample are collected using a questionnaire. The questionnaire contains all the questions that the author considers relevant to the injury of workers in the mines of Serbia, as well as the questions available in the literature [1, 2, 3, 4]. The procedure consists in interviewing the workers in a given mine. Then, the data obtained from the interviews are statistically processed and sorted by categories.

In order to better understand the collected data and its structure, and to discover regularities in the tendencies of the observed variables, descriptive statistics was applied. The basic statistical indicators of descriptive statistics were calculated: Measures of central tendency (mean, mode and median) and measures of dispersion (standard deviation, variance), as well as the display of frequencies and percentages of the collected data.

After collecting, processing and classifying the data obtained by interviewing the workers, descriptive statistics methods were applied. Based on descriptive statistics, basic statistical indicators were calculated, which were used to determine the dependencies between subjects (frequencies and percentages, arithmetic mean, standard deviation, etc.) in order to create a preliminary picture of the data collected.

The Statistical Package for the Social Sciences (SPSS) software package, version 17.00, was used for data processing. SPSS is a very powerful package that many researchers use to process a large amount of data.

2. EXPERIMENTAL

Data collected at the Resavica Underground Coal Mining Public Company (JP PEU Resavica) were used for this study. In addition to the downloaded data on workplace injuries, a survey was conducted among workers to determine the factors influencing the occurrence of workplace injuries. A total of 1051 correctly completed questionnaires were analysed.

Table 2 shows (in percentage and numerical terms) the demographic characteristics of the entire sample in the following categories: Sex, age, total calendar work experience, total work experience at current job, and worker qualification or occupational skill.

Table 1 – Demographic characteristics of the tested sample

Demographic parameter	Category	Frequency	Percentage %
Paul	Male Female	981 70	93,3 6,70
Age	18–25 26 –35 36 –45 46–55 56–65	82 278 307 265 119	7,80 26,5 29,2 25,2 11,30
Total calendar work experience	≤ 10 11–15 16–20 21–25 26–35	450 160 105 124 212	42,8 15,2 10,0 11,8 20,2
Total work experience in the current workplace	≤ 10 11–15 16–20 21–25 26–35	720 111 66 55 99	68,5 10,6 6,30 5,20 9,40
Qualification/professional qualifications	Unqualified Qualified High school diploma University degree Master's degree and doctorate	308 473 225 39 6	29,3 45,0 21,4 3,70 0,60

If we look at the data on the gender of the respondents, shown in Table 1, we can see that 93.3% of the respondents are male, while only 6.7% are female. This is certainly to be expected in mining companies, where even at the global level, the percentage of women employed does not exceed 10%.

The following demographic parameter of the respondents - age - shows that the largest number of respondents is found in the 36-45 years category (29.2%), while the lowest percentage is in the youngest category 18-25 years (7.8%). The oldest employees are also represented by a very low percentage of 11.3%.

The data on total years of service show that the highest percentage of workers belongs to the group of workers with the least work experience (≤ 10 years) - 42.8%, followed by the group of workers with the most years of service (26-35) - 20.2%. A similar distribution is found in the category of total seniority in the current workplace, where 68.5% of workers have been working in the current workplace for less than 10 years. The population of the younger generation that should have the least work experience is represented by a small percentage. The data that 40% of workers have

less than 10 years of work experience indicate that mines employ older groups of workers with little or no experience, suggesting that miners are hired in their later years rather than immediately after graduation from high school.

The data on the categories of qualifications or professional degrees show that most respondents belonged to the second category, i.e. qualified is 45.00%, followed by those with the lowest education - unqualified (29.3%), followed by secondary education (21.4%), a university degree (3.7%) and a master's or doctorate (0.60%). Since most mining technology in Serbia is not mechanised, skilled and unskilled workers are the labour force that drives production itself. The selected representative sample describes very well the actual qualification structure in JP PEU Resavica, in 2019. PEU Resavica, has the following qualification structure of employees: KV - qualified (48.21%), NK - unqualified (29.37%), SSS - secondary school degree (17.22%), VSS - university degree and Ms/Phd - master degree and doctorate have in total (5.17%).

3. RESULTS AND DISCUSSION

For variables within each group of questions, Table 2 shows the basic indicators of descriptive statistics: measures of central tendency (mean, mode and median) and dispersion measures (standard deviation, variance).

Table 2 - Descriptive response statistics of respondents

Encrypted Question Name	Median	Modus	Mean	Standard deviation	Variance
PPE_1	5	5	4,75	0,743	0,552
PPE_2	4	4	4,01	1,169	1,367
PPE_3	4	4	3,83	1,499	2,247
PPE_4	5	5	4,32	1,087	1,181
PPE_5	5	5	4,66	0,761	0,580
WEM_1	5	4	4,23	1,217	1,482
WEM_2	5	4	4,28	1,121	1,258
WEM_3	5	5	4,21	1,176	1,383
WEM_4	4	4	3,43	1,428	2,040
WE_1	5	4	4,32	1,087	1,181
WE_2	5	5	4,50	0,886	0,785
WE_3	5	5	4,32	1,087	1,181
WE_4	5	5	4,29	1,106	1,223
WE_5	4	3	3,66	1,494	2,231
M_1	5	4	4,27	1,148	1,318
M_2	5	4	4,21	1,234	1,522
M_3	5	4	4,20	1,195	1,429
M_4	5	4	4,43	0,986	0,973
M_5	5	4	4,24	1,212	1,470
OR_1	5	4	4,29	1,055	1,114
OR_2	5	5	4,38	1,039	1,079
OR_4	4	4	4,04	1,165	1,358
T_1	5	5	4,61	0,895	0,800
T_2	5	4	4,34	1,034	1,069
T_3	5	5	4,58	0,924	0,853

The data presented in Table 2 show that the workers studied gave the highest score to the question PPE_1 - I believe that personal protective equipment is necessary for work at my workplace (4.75). Workers recognized the importance of PPE and have a positive attitude towards it. Personal protective equipment plays an important role in the event of an injury - this refers to both preventing injury and providing protection when the injury occurs - with personal protective equipment influencing the severity of the injury. In addition to its role in preventing injury, personal protective equipment also has an impact on reducing occupational illness, chronic disease, and work comfort. The lowest rated question was WEM _4 - The conditions of the work environment (temperature, humidity, dust...) are satisfactory (I feel comfortable at work) (3.43). It is obvious that the conditions of the working environment in mines are not satisfactory, while the negative conditions of the working environment in underground mines are even more pronounced. Confined spaces, working underground, artificial ventilation, etc. contribute to a poor rating of this issue.

4. CONCLUSION

The conducted analysis of the collected data in the population of productive workers in underground coal mining in Serbia has highlighted certain indicators of safety and health at work as those to which workers attach the greatest importance. Among the workers with the highest rating, i.e. as positively most important, was the issue of the use of personal protective equipment, indicating a high level of awareness among workers regarding the use of personal protective equipment at work. The issue of working conditions was also rated among the lowest, indicating that workers are aware of poor working conditions and the resulting hazards. Working conditions are in fact a factor created not by workers but by mine management, which should be considered another weakness of the OHS system in mines.

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