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Evaluation of the Workplace Accident Severity in an Underground Coal Mine By Logistic Regression Analysis

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Keywords: Accident Severity, Injury, Underground Coal Mining, Work Accident

Abstract

Background: *Accidents in underground coal mining can cause deaths, serious injuries, and material losses.* **Methods:** *This study examined 10,334 work accidents that occurred between 2011 and 2021, resulting in injuries, and evaluated the causes, severity, and types of injuries. The accidents were investigated under the following subheadings: location of accidents, causes of accidents, work shifts when the accidents occurred, accident time, accident days, distribution of accidents by months and years, age of workers, occupational groups, educational status of workers, working day losses, and body parts that were injured. The severity of accidents was categorized into three levels: mild, moderate, and severe, based on the workday losses incurred by the workers after the accident. The severity of accidents and factors affecting their severity were analyzed using multinomial logistic regression.* **Results:** *There is a significant statistical relationship between the severity of accidents and factors such as experience, workplace, accident cause, age, education status, occupational category, and the affected body part, work shift, according to the analysis. The findings indicate that accident severity is influenced not only by the immediate circumstances of the incident but also by broader individual and occupational factors, such as the employee's level of experience, the work environment, the occupational group, and the specific body part affected. The analysis revealed that the occupational group variable had statistically significant interaction effects with multiple other variables.* **Conclusions:** *The study presents all aspects of the hazards faced by the workers and suggests measures to reduce the number and severity of accidents that occur in underground coal mining.*

1. Introduction

Mining is one of the sectors that includes the most occupational health and safety risks. In particular, underground coal mining is a complex process. It requires numerous professional disciplines (mining, geological, geophysical, mechanical, and electrical and electronics engineering) to work in harmony under changing environmental conditions, where carelessness and small mistakes can result in significant injury [1]. A lack of qualified personnel in underground and surface mining operations, failures in periodic maintenance of heavy machinery, and faulty operating methods can lead to an increase in work-related accidents.

In the Occupational Health and Safety Law (OHSL), a work accident is defined as "an event that occurs in the workplace or due to the execution of work, causing death or causing mental or physical disability to the unity of the body" [2]. The International Labour Organization (ILO) defines a work accident as "an unexpected and unplanned event

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that occurs outside or in connection with work, including acts of violence, that causes injury, illness, or death of one or more workers". Work accidents are categorized into fatal and non-fatal, depending on the severity of their occurrence. Work accidents with injuries are grouped according to loss of working days and permanent disability [3]. In Turkey, the Social Security Institution (SSI) determines the severity of work accidents with injuries: Working on the same day, 1 day of work loss, 2 days of work loss, 3 days of work loss, 4 days of work loss, five or more days of work loss [4].

Work accidents can happen in underground mines due to cave-ins, gas and dust explosions, transportation of equipment, flooding, machinery use, electrical hazards, mine fires, falling material or slips, lack of breathable air, and exposure to toxic and suffocating gases, among other causes. These accidents often lead to fatalities, serious injuries, and material damage [5]. One effective way to prevent work accidents is to analyze past incidents and develop appropriate mitigation measures. There are numerous studies on work accidents available in the literature [6-11].

This study systematically examined work accidents that occurred between 2011 and 2021 in an underground coal mine in Turkey over a 10-year period. Unlike similar studies, it analyzed not only the types of accidents but also various personal and occupational variables—such as injured body parts, workers' educational levels, occupational groups, work duration, and age—to evaluate their combined impact on accident severity. As one of the few studies conducted in Turkey's underground coal mining sector using such a comprehensive dataset and multinomial logistic regression analysis methods, this research is considered to make a significant contribution to the literature.

2. Methods

Classifying accidents solely as injuries and fatal incidents is insufficient for a detailed analysis (Figure 1).

It is essential to classify injuries based on whether they lead to lost workdays or not (when a worker returns to work on the same day). The probability of an accident offers insights into the frequency of work-related incidents across various sectors; however, data on lost workdays also indicate the severity of accidents within these sectors. This study analyzed accident severity according to the number of lost workdays. Work accidents with no injury or with a loss of 2 or fewer workdays were categorized as "mild injury," a loss of 3-9 days as "moderate injury," and a loss of 10 or more days as "severe injury." According to the Regulation on Social Insurance Procedures, the workplace physician authorized by the company can prescribe rest for up to 2 days, while an institutional healthcare physician can prescribe up to 10 days of rest [12]. Therefore, the classification was based on the authority of both the workplace physician and the institutional healthcare physician. Factors affecting accident severity were

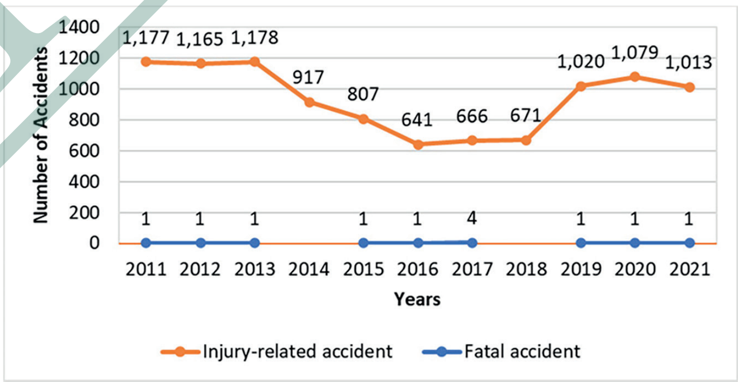

Figure 1. Injuries and fatal work accidents in an underground coal mine from 2011–2021.

Table 1. Dependent and independent variables.

Variables	Categories
Dependent variable	
Accident severity	1. Mild (working day loss < 3); 2. Moderate (working day loss 3-9)and 3. High severity (working day loss ≥ 10)
Independent variables	
The body part injured	1. Head, face, eyes; 2. Hand, finger; 3. Foot, toe; 4. Arm, shoulder; 5. Leg, calf; 6. Torso and other parts (reference category)
Workplace	1. Mine face; 2. Preparation; 3. Transportation(reference)
Occupational group	1. Preparation worker; 2. Production worker; 3. Transportation worker (reference)
Age (y)	1. 18–23; 2. 24–29; 3. 30–35; 4. 36–41; 5. 42 and over (reference category)
Duration of work (y)	1. 0–4; 2. 5–9; 3. 10–14; 4. 15–19; 5. 20 years or more (reference category)
Education status	1. Primary school; 2. Middle school; 3. Secondary school and above (reference)
Cause of the accident	1. Electricity and machinery; 2. Cave-in; 3. Transportation; 4. Firedamp and gases; 5. Material handling and use; 6. Miscellaneous/other (reference category)
Shift	1. 07:59–15:59; 2. 16:00–23:59; 3. 00:00–07:59 (reference category)

analyzed using multinomial logistic regression analysis. A multinomial logistic regression model was created to identify variables (such as workplace, occupational group, age, injured body part, experience, shift, etc.) that influence accident severity. Data were processed using IBM SPSS 22.0. In this study, accident severity (mild, moderate, and severe) was the dependent variable, while occupational group, workplace, cause, injured body parts, and age group served as independent variables. Table 1 lists the variables considered.

3. Results

Between 2011 and 2021, this enterprise experienced 10,334 injuries and 12 fatal accidents (Figure 1). The number of accidents decreased after 2013, then rose again after 2016. No fatal accidents occurred in 2014 and 2018.

Table 2 displays the distribution of accidents based on the demographic information of the study groups. The most common causes of accidents (43.1%) were related to material handling and use (Table 2). The least common causes involved firedamp and gases. Accidents mainly occurred in July (9.2%) and March (9%) (Supplementary Material, Figure S1). The majority of accidents happened on Monday (19.7%), Tuesday (19.4%), and Wednesday (19.5%) (Supplementary Material, Figure S2). After the first three workdays of the week, the accident rate gradually declined.

When accidents occurring during three different shifts are analyzed in 2-hour intervals, the most frequent accidents happen in the 2nd hour, followed by the 3rd and 1st hours, with the fewest accidents in the 4th hour of each shift (Supplementary Material, Figure S3). For the total number of accidents across different shifts (Table 2), the highest count occurs during the 1st shift, likely due to increased preparation, repair, and scanning activities during this time. Additionally, workers' difficulty in fully concentrating during the initial hours of their shifts and their struggle to adapt may also contribute to the occurrence of accidents (Table 2).

One factor contributing to accidents is employees' educational background. Notably, 49.7% of employees who experienced accidents in underground coal mining had only completed primary school (Table 2). When examining the experience of workers involved in accidents, it was found that the accident rate was 40.6% for those with 0–4 years of work experience and 32.7% for those with 5–9 years of experience. The rate declined as experience increased, although the highest number of accidents occurred

Table 2. Distribution of accidents based on demographic information of the study groups.

Demographic information		**N.**	**%**
Accident severity	Mild (working day loss < 3)	1,330	12.9
	Moderate (working day loss 3-9)	4,552	44.0
	High (working day loss ≥ 10)	4,452	43.1
Injured body parts	Head, face, eyes	1,017	9.8
	Hand, finger	3,124	30.2
	Foot, toe	2,010	19.5
	Arm, shoulder	1,254	12.2
	Leg, calf	1,054	10.2
	Torso and other parts	1,875	18.1
Workplace	Mine face	8,494	82.2
	Preparation	1,033	10
	Transportation	807	7.8
Occupational group	Preparation worker	1,269	12.3
	Production worker	7,987	77.3
	Transportation worker	1,078	10.4
Age (years)	18–23	407	3.9
	24–29	2,488	24.1
	30–35	4,362	42.2
	36–41	2,579	25.0
	42 and over	498	4.8
Experience (years)	0–4	4,196	40.6
	5–9	3,376	32.7
	10–14	2,184	21.1
	15–19	448	4.3
	20 years or more	130	1.3
Educational status	Primary school	5,132	49.7
	Middle school	1,669	16.2
	Secondary school and above	3,533	34.2
Accident cause	Electricity and machinery	103	1.0
	Cave-in	2,471	26.5
	Transportation	573	5.5
	Firedamp and gases	56	0.5
	Material handling and use	4,455	43.1
	Other	2,406	23.3
Shift	08:00–15:59	5,456	52.8
	16:00–23:59	2,734	26.5
	00:00–07:59	2,144	20.7

among workers in the production group. The body parts most frequently affected by accidents were hands and fingers (30.2%), feet and toes (19.5%), and the torso and other areas (18.1%) (Table 2).

Approximately 12.9% of injured employees returned to work within 0–2 days, 44% within 3–9 days, and 43.1% after 10 or more days. The number of accidents with moderate and high severity exceeded those with mild severity (Table 2).

The severity of accidents and the factors influencing their severity were analyzed using multinomial logistic regression. These results show that the impact of the occupational group on accident severity becomes clearer when considered alongside other variables.

The fact that the interactions between the occupational group and variables such as accident cause, workplace, educational status, and shift were found to be statistically significant suggests that the severity of work accidents should be assessed not only based on individual factors but also within the context of the occupational group (Supplementary Material, Table S1).

As shown in Table S1, the occupational group variable displays significant interaction effects with several other predictors. Therefore, the analyses were stratified by occupational group to allow for a more precise and context-sensitive interpretation of the results. The multinomial logistic regression analysis indicates that being a preparation worker is linked to a significantly lower likelihood of experiencing minor injuries (fewer than three lost workdays) compared to severe injuries (ten or more lost workdays) ($B = -0.609$; $p < 0.001$). This suggests that preparation workers may face a higher risk of more severe occupational injuries. Similarly, being a production worker is significantly associated with decreased odds of minor injuries versus severe injuries ($B = -1.486$; $p < 0.001$), implying that this group also encounters an increased risk of serious workplace accidents. For transportation workers, the model likewise shows a significantly reduced likelihood of minor injuries compared to severe injuries ($B = -0.467$; $p < 0.001$), indicating a greater vulnerability to severe injury outcomes within this occupational category (Supplementary Material, Table S2).

Based on the model fit information, including the Pearson and Deviance statistics, the established model is determined to be statistically significant (Supplementary Material, Table S3-S4).

The variables of age, injured part, and experience are significantly linked to accident severity, as removing them from the model causes a notable decline in model fit ($p < 0.05$). Furthermore, interaction terms between occupational group and other variables—such as accident cause, education level, workplace, and shift—significantly improve the model's ability to explain the variation in accident severity (Supplementary Material, Table S5).

The factors influencing accident severity were examined using a multinomial logistic regression model. The dependent variable was accident severity, classified into three categories based on lost workdays: 0–2 days, 3–9 days, and ≥10 days (reference category). Independent variables included experience, workplace, occupational group, cause of the accident, age, injured body part, education level, and work shift. Additionally, interaction terms between occupational branch and each of these variables were assessed to understand their combined effects on accident severity (Table 3).

Statistically significant interactions were identified between the occupational group variable and several other variables. The interaction between occupational group = 1.00 and accident cause = 5.00, as well as the interaction between occupational group = 1.00 and education = 1.00, are statistically significant in the mild severity (0–2 days) category; the interaction between occupational group = 1.00 and accident cause = 3.00 is statistically significant in the moderate severity (3–9 days) category.

4. Discussion

This study analyzed in detail the injuries caused by accidents in an underground coal mine from 2011 to 2021, focusing on various individual and occupational risk factors. It revealed that multiple factors influence the severity of accidents. Among the workers involved in an accident, 42.2% (n = 4,362) were aged 30–35, 25% (n = 2,579) were 36–41, 24.1% (n = 2,488) were 24–29, 3.9% (n = 407) were 18–23, and 4.8% (n = 498) were 42 and older. Most

Table 3. Parameter estimates

Accident Severity[a]		B	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
					Lower Bound	Upper Bound
1. Mild (Working Day Loss < 3)	Intercept	1.457	0.000			
	[Accident Cause =1.00]	-1.627	0.000	0.197	0.084	0.460
	[Accident Cause =3.00]	-1.040	0.000	0.353	0.215	0.581
	[Accident Cause =5.00]	-0.691	0.001	0.501	0.337	0.746
	[Educational Status=1.00]	-0.995	0.000	0.370	0.250	0.546
	[Workplace=1.00]	-0.939	0.000	0.391	0.258	0.592
	[Workplace=2.00]	0.733	0.004	2.081	1.266	3.421
	[Injured Body Part=1.00]	0.748	0.000	2.114	1.656	2.698
	[Injured Body Part=2.00]	-0.691	0.000	0.501	0.411	0.611
	[Injured Body Part=3.00]	-0.324	0.003	0.723	0.584	0.895
	[Injured Body Part=5.00]	0.619	0.000	1.857	1.454	2.373
	[Experience=1.00]	-0.858	0.007	0.424	0.227	0.790
	[Experience=2.00]	-0.933	0.003	0.393	0.214	0.722
	[Experience=3.00]	-0.617	0.035	0.540	0.304	0.958
	[Occupational Group =1.00] * [Accident Cause=5.00]	-0.575	0.047	0.563	0.319	0.992
	[Occupational Group =1.00] * [Educational Status=1.00]	0.649	0.017	1.915	1.122	3.267
	[Occupational Group =2.00] * [Educational Status=1.00]	0.949	0.000	2.584	1.689	3.955
	[Occupational Group =1.00] * [Workplace=2.00]	-1.232	0.000	0.292	0.149	0.572
2. Moderate (Working Day Loss 3-9)	Intercept	0.018	0.956			
	[Accident Cause=1.00]	-0.705	0.047	0.494	0.246	0.991
	[Age=1.00]	0.582	0.003	1.790	1.225	2.616
	[Injured Body Part=1.00]	0.579	0.000	1.784	1.493	2.133
	[Injured Body Part=2.00]	-0.582	0.000	0.559	0.494	0.633
	[Injured Body Part=3.00]	-0.212	0.002	0.809	0.706	0.927
	[Injured Body Part=5.00]	0.495	0.000	1.640	1.381	1.948
	[Experience=1.00]	-0.577	0.033	0.562	0.330	0.955
	[Experience=4.00]	-0.586	0.024	0.557	0.335	0.926
	[Shift=1.00]	0.430	0.031	1.538	1.041	2.273
	[Occupational Group =1.00] * [Accident Cause=3.00]	-1.257	0.048	0.285	0.082	0.990

a. *The reference category is High (Working Day Loss ≥ 10).*

accidents occurred at the mine face. Production in underground coal mines is carried out within the time specified in the deadline plan. Underground mining conditions are highly variable; therefore, the monthly production rate must be planned well. Otherwise, occupational accidents are inevitable. The increased rate of accidents in July and March may have been due to efforts to complete production within the specified deadline.

In all three work shifts, accident rates were especially high during the 2nd hour of work and gradually decreased in the subsequent working hours. This may be due to workers' inability to adapt and lack of attention, as a result of starting work in the evening hours in Shift 2 and at night in Shift 3. Working in shifts can cause sleep problems and various physical and mental health issues, which can affect the likelihood of work accidents [13]. When the distribution of accidents in Shift 1 was examined at 2-hour intervals, the highest number of accidents occurred between 10:00 and 11:59. This could be because employees are less able to focus on work before the meal break.

When the causes of accidents were examined, material handling and use were found to be the most common causes of accidents. In addition, the most commonly affected body parts were the hands, fingers, feet, and toes. There are sometimes disruptions in the production rate in underground coal mines, as workplace conditions are constantly changing. With excessive acceleration in the production process, incidents may occur, such as falling rocks, which cause numerous head injuries. Hand, arm, foot, and finger injuries may occur due to material handling and use during accelerated installations. The production group had the highest number of accidents, and 49.7% of the workers had only completed primary school. Karadeniz [14] identified low education status as the primary cause of work-related accidents and illnesses, which can be understood through two aspects. First, uneducated employees often take hazardous jobs to support their livelihoods. The second aspect is that a lack of education hinders employees from recognizing the occupational risks they face.

Accordingly, the reasons for the high number of accidents among production workers may be the dangerous nature of the work and the low level of education. The number of moderate-severity accidents (44%) was higher than that of high-severity (43.1%) and mild (12.9%) accidents. These assessments help determine what kind of accidents can be prevented and how. Furthermore, the accidents that cause the most frequent and highest number of working day losses should be urgently included in the accident prevention program. Based on this justification, accident severity was categorized according to working day losses.

There are many studies about work accidents. Laflamme and Blank [6] examined injuries in underground mines in Sweden from 1980 to 1993 and reported that the most common injuries were to the hands, fingers, and wrists (28%). One study reported that injuries during maintenance and repair at mining sites in the United States result in an average of 20 finger cuts, 180 hand and finger fractures, and 455 hand and finger cuts annually [7]. Similar to previous research findings, hand and finger injuries were the most common in this study. Stojadinovic et al. [8] analyzed accidents using data recorded in Serbian coal mines over 10 years, from 2000 to 2009, examining severity, injured body parts, accident location, shifts, occupational groups, and workers' ages. They found that most accidents were mild, that workers aged 31–40 experienced the highest number of accidents, that injuries mostly involved the upper limbs and occurred during Shift 1, and that injured workers had lower education levels. Tatar and Özfirat [9] investigated work accidents that occurred between 1992 and 2000 at the Eynez underground lignite mine of Aegean Lignite Enterprise in Turkey, which is operated by the Turkish Coal Enterprise (TCE). They assessed workers' ages, shifts, injured body parts, and the day, type, and location of accidents. They observed that accidents increased due to worker demoralization, high work intensity, the transition to mechanized production alongside traditional methods, adaptation issues, and working conditions such as narrow and hazardous environments. Önder and Önder [10] analyzed injuries in TCE-related enterprises in Turkey from 2001 to 2008 and found that cave-ins and material handling were the leading causes. They identified that surface diggers were the riskiest occupational group, that construction machinery was the primary cause of accidents, and that mechanics in the repair, maintenance, and manufacturing departments were at high risk. The most frequently injured body part across all enterprises was the hand. Önder [11] examined non-fatal work accidents with lost workdays occurring from 1996 to 2009 in ELE's open mines under TCE, using binary logistic regression analysis.

This study analyzed the severity of occupational accidents in an underground coal mine in Turkey over a 10-year period using a multinomial logistic regression model. The results showed that experience, age, and the injured part had statistically significant effects on accident severity ($p < 0.05$) (Supplementary Material, Table S5). The occupational group exhibited significant interactions with several predictors; therefore, analyses were stratified by this variable for more precise and context-specific interpretation. The stratified analysis results highlight notable differences in accident severity among preparation, production, and transportation workers, with each group facing a higher risk of severe injuries compared to minor ones.

Additionally, interaction effects between the occupational group and other variables—such as accident cause, education status, workplace, and work shift—also played a significant role in explaining the variation in accident severity. This indicates that accident severity should not be interpreted solely through individual variables but rather through their contextual interactions within specific occupational settings. For example, while material handling was the most common cause of accidents (43.1%, Table 2), its impact on accident severity varied depending on the context. This study examines factors influencing occupational accident severity in underground coal mining, highlighting the roles of occupational group, experience, injury site, cause, education, age, workplace, and shift. Injuries to hands and feet are most common, with severity influenced by occupational roles and shift patterns. Less experienced workers (0–4 years) are more vulnerable, accounting for 40.6% of accidents, emphasizing the importance of targeted training (Table 2).

Multinomial logistic regression revealed that variables such as accident cause, education, experience, age, injured body part, workplace, and shift significantly influence severity, with the majority of outcomes being more severe (≥10 days off). Lower education and experience increased risk, suggesting these may serve as protective factors through increased awareness and safety practices. Specific causes (categories 1, 3, and 5) are more likely to result in serious injuries, underscoring the need for targeted prevention.

The injured body part is crucial; head, chest, or multiple injuries tend to cause longer recovery and work absence, aligning with prior research on injury location and severity. Significant interaction effects indicate that the influence of education and cause varies by occupational group, with some categories at higher risk due to low education or specific accident types.

In summary, the findings reveal the multifaceted nature of accident severity, emphasizing the need for targeted safety training among less experienced and lower-educated workers, as well as enhanced safety measures in high-risk areas and industries.

4.1. Limitations

This study presents valuable insights by comprehensively analyzing occupational accident data from an underground coal mine. However, several limitations should be acknowledged. The most critical limitation is the unavailability of denominator data—specifically, the total number of workers stratified by relevant variables such as age, gender, or occupational group. As a result, it was not possible to calculate precise accident rates or to assess the proportion of accidents in relation to the population at risk. Consequently, definitive conclusions regarding relative risk levels across subgroups (e.g., occupational branches or age categories) could not be drawn. Future studies should aim to access more detailed workforce data, including the number of employees in each subgroup and their exposure times, to enable more precise calculation of accident incidence rates. Comparative studies across multiple mining sites may also enhance the external validity and generalizability of the findings.

5. Conclusion and Recommendations

Underground coal mining is a hazardous activity, with accidents often caused by factors such as excessive speed, fatigue, carelessness, lack of experience, inadequate safety measures, difficult working environments, non-compliance with safety rules, ineffective oversight, and insufficient control mechanisms. Retrospective accident analysis can help identify accident types and locations that cause significant workday loss or damage. Training programs and safety measures should be developed based on these findings, considering accident severity by analyzing the number of rest days lost.

This study examined the severity of occupational accidents in a Turkish underground coal mine from 2011 to 2021, using multinomial logistic regression. Accident severity was classified as less than 3 days, 3–9 days, or 10+ days of work lost, with factors like experience, age, workplace, occupational group, education, shift, cause, and injured body part analyzed for their impact. Significant relationships were found between severity and experience, workplace, cause, education, and injury site. Workers with lower education, less experience, and certain causes are more likely to suffer severe injuries. The injured body part also significantly influenced severity. Interactions between occupational groups and variables like education, shift, and cause suggest the need for tailored safety policies, as uniform approaches may be insufficient.

Findings indicate that accident severity depends on individual attributes and workplace conditions, especially experience, workplace, and occupational group. Interactions between occupational groups and variables such as age, cause, injury site, education, and shift type necessitate customized safety measures for each group. Recommendations include targeted training for less educated and inexperienced workers, specific precautions for high-risk sectors, and protective measures focused on common causes. These measures should help reduce accident frequency and severity.

The study emphasizes moving beyond generic risk assessments towards comprehensive, group-specific safety policies. Proposed actions include providing more training and supervision for new workers, conducting regular analyses of accident causes and injury patterns by sector, restructuring work schedules, and implementing fatigue management, particularly during shift start times. Future research could involve larger datasets or comparative studies across mining enterprises.

Injuries to hands, fingers, and wrists are most common, caused by careless practices, lack of precautions, and neglect of PPE. Safety training must emphasize the use of PPE, including gloves, footwear, and helmets, and ensure compliance. Limb injuries require stronger PPE enforcement and worker evaluation. Frequent warnings and post-accident health assessments are crucial, as accidents affect not only individual workers but also companies and the economy. Regular data analysis can inform prevention strategies.

Accident evaluation data should guide safety training, with the shared goal of zero incidents. Proper use of PPE, responsibility, vigilance, training, and discipline are essential. Regular statistical analysis can prevent similar accidents and mitigate risks, ultimately reducing costs for all parties involved.

Supplementary Material: The following are available online: Figure S1. Monthly distribution of the accidents”; Figure S2. Distribution of the accidents according to days; Figure S3. Distribution of the accidents according to working hours and shifts; Table S1. Step summary; Table S2. Intercept estimates of stratified multinomial logistic regression by occupational group; Table S3. Model fitting information; Table S4. Goodness-of-Fit; Table S5. Likelihood ratio tests.

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References

1. Bayraktar B, Uyguçgil H, Konak A. Kaplan-Meier survival analysis in Karadon Hardcoal Enterprise. International Symposium on Occupational Health and Safety in Mining' 2019, Adana/Turkey, 2019;247-256.
2. OHSL, Occupational Health and Safety Law. Official newspaper, no:28339, 2012, Ankara. https://www.resmigazete.gov.tr/eskiler/2012/06/20120630-1.htm, accessed: 10.05.2024.
3. ILO, International Labour Organization, Occupational safety and health statistics, 2024. https://ilostat.ilo.org/resources/concepts-and-definitions/description-occupational-safety-and-health-statistics,accessed:10.05.2024.

4. SSI, Social Security Institution. Statistical yearbooks, 2024. https://www.sgk.gov.tr/Istatistik/Index/6863b1e8-c384-4f46-90c6-511dac2376d2, accessed: 10.05.2024.
5. Güyagüler T. The effect of human characteristics on accidents. Proceedings of the Occupational Health and Safety Symposium in Mining Operation, Adana, 2007;51-55.
6. Laflamme L, Blank VLC. Age-related accident risks: longitudinal study of Swedish iron ore miners. Retrieved from. *Am J Ind Med.* 1996;30 (4):479-487. Doi: 10.1002/(SICI)1097-0274(199610)30:43.0.CO;2-1.
7. Pollard J, Heberger J, Dempsey PG. Maintenance and repair injuries in US mining. *J Qual Mainten Eng.* 2014; 20(1):20-31. Doi: 10.1108/JQME-02-2013-0008
8. Stojadinovic S, Svrkuta I, Petrović D, Denic M, Pantovic R, Milić V. Mining injuries in Serbian underground coal mines – A 10-year study. *Injury.* 2012;43 (12):2001-2005. Doi: 10.1016/j.injury.2011.08.018
9. Tatar C, Ozfirat K. An investigation on the accidents at TKI-ELI Eynez underground lignite mines between 1992 and 2000. In: Proc. 13th Coal Congress of Turkey, 2002;61–73.
10. Önder S, Önder M. Analysis of injured occupational accidents at Turkish Coal Enterprises. *J Min Sci*. 2010;49 (3):3-12.
11. Önder S. Evaluation of occupational injuries with lost days among opencast coal mine workers through logistic regression models. *Saf Sci.* 2013;59:86–92. Doi:10.1016/j.ssci.2013.05.002
12. SSI, Social Security Institution. Social Insurance Transactions Regulation, Ankara: Official Newspaper, No:27579, 2010.
13. Camkurt MZ. The effect of personal characteristics of employees on occurrence of work accidents. TUHIS Business Law and Economy Journal 2013;24 (6): 80-106.
14. Karadeniz O. Work Accidents and Occupational Diseases in Turkey and the World and the Lack of Social Security. *Work and Society*. 2012;34:17-75. https://dergipark.org.tr/tr/download/article-file/2576442.

Appendix

Supplementary Material

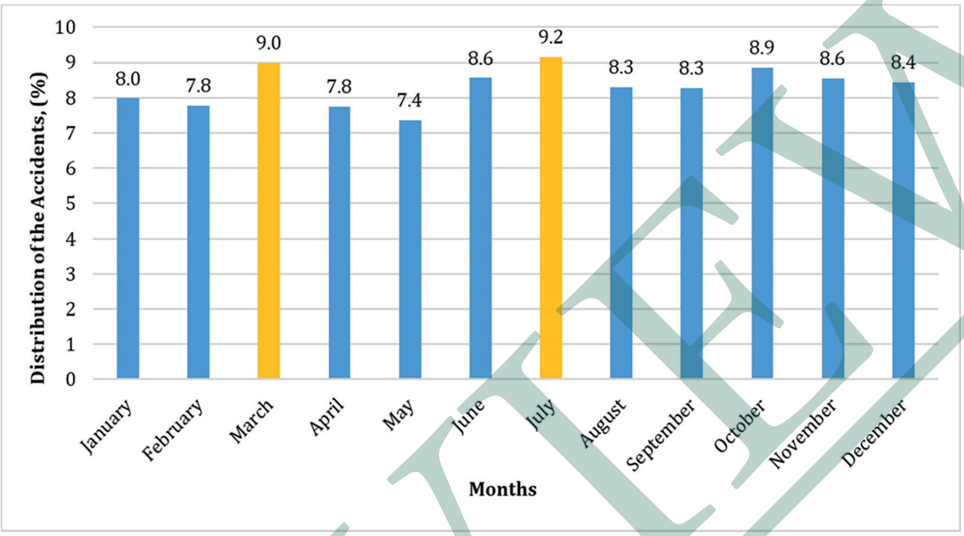

Figure S1. Monthly distribution of the accidents.

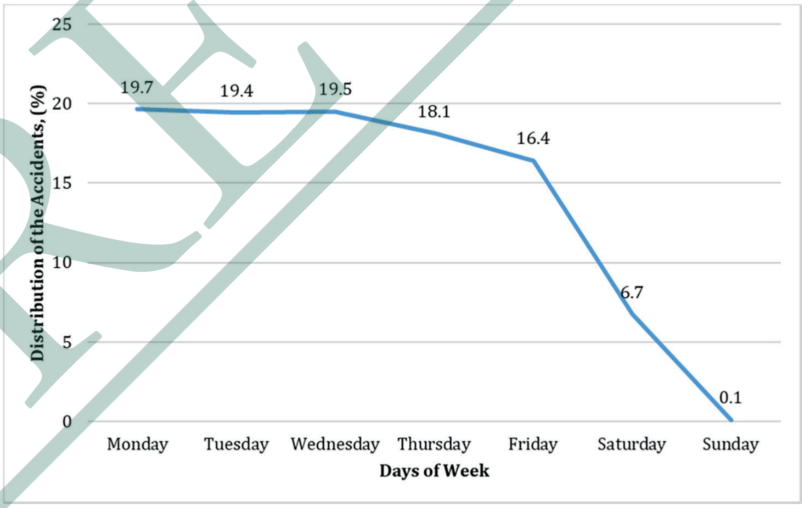

Figure S2. Distribution of the accidents according to days.

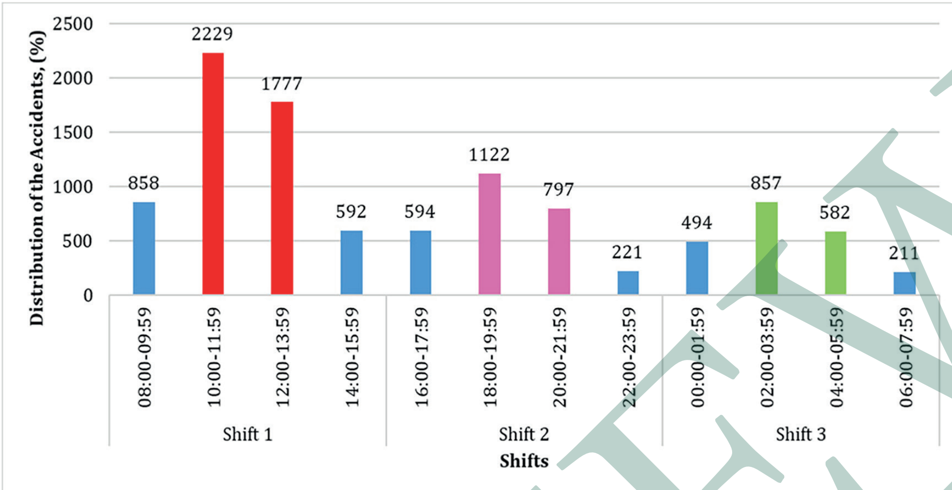

Figure S3. Distribution of the accidents according to working hours and shifts.

Table S1. Step summary.

			Model Fitting Criteria	Effect Selection Tests		
Model	**Action**	**Effect(s)**	**-2 Log Likelihood**	**Chi-Square[a]**	**df**	**Sig.**
0	Entered	Intercept, Accident Cause, Experience, Age, Workplace, Occupational Groups, Injured Body Part, Education, Shift	9756.091			
1	Entered	Occupational Group * Workplace	9719.057	37.035	8	0.000
2	Entered	Occupational Group * Shift	9691.042	28.015	8	0.000
3	Entered	Occupational Group * Education	9663.680	27.362	8	0.001
4	Entered	Occupational Group * Accident Cause	9626.170	37.510	20	0.010

Stepwise Method: Forward Entry
a. The chi-square for entry is based on the likelihood ratio test.

Table S2. Intercept estimates of stratified multinomial logistic regression by occupational group.

Occupational Group	Accident Severity Level	B (Intercept)	SE	Wald	Sig.
Preparation Worker (1)	Mild (Working Day Loss < 3)	-0.,609	0.077	62.442	0.000
	Moderate (Working Day Loss 3-9)	0.105	0.063	2.781	0.095
Production Worker (2)	Mild (Working Day Loss < 3)	-1.486	0.039	1445.512	0.000
	Moderate (Working Day Loss 3-9)	0.025	0.024	1.078	0.299
Transport Workers (3)	Mild (Working Day Loss < 3)	-0.467	0.078	35.824	0.000
	Moderate (Working Day Loss 3-9)	-0.101	0.070	2.071	0.150

Table S3. Model fitting information.

Model	Model Fitting Criteria	Likelihood Ratio Tests		
Intercept	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	10723.515			
Final	9626.170	1097.345	96	0.000

Table S4. Goodness-of-Fit.

	Chi-Square	df	Sig.
Pearson	6465.199	6200	0.009
Deviance	6662.190	6200	0.000

Table S5. Likelihood ratio tests.

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	9626.170[a]	0.000	0	.
Accident cause	9626.170[a]	0.000	0	.
Education	9626.170[a]	0.000	0	
Age	9656.013	29.843	8	0.000
Occupational Group	9626.170[a]	0.000	0	
Workplace	9626.170[a]	0.000	0	
Injured Part	10040.212	414.042	10	0.000
Experience	9655.513	29.343	8	0.000
Shift	9626.170[a]	0.000	0	.
Occupational Group * Accident Cause	9663.680	37.510	20	0.010
Occupational Group* Education	9651.742	25.572	8	0.001
Occupational Group* Workplace	9662.445	36.275	8	0.000
Occupational Group * Shift	9649.996	23.826	8	0.002

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.