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Determination of Impact of Mining Operations on Accidents and Diseases at Work in Turkey

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Abstract: Today, due to the rapidly developing technology, new production techniques are used to utilize natural resources more efficiently. The rapid change and competition conditions brought about by technology cause occupational accidents as a result of some deficiencies and negative situations in working life. In this study, the situation of mining activities in 5 different classes within occupational accidents was evaluated by using the statistics of Social Security Institution of Turkey (SSI) between the years 2010-2019. In addition, the current situation of mining activities in terms of occupational accidents and occupational diseases in other sectors was analyzed by examining the data of 5 other sectors together. The results of present study reveal that occupational accidents, related deaths and workday losses are high in the mining sector among other sectors.

Keywords: Occupational health & safety, mining sector, working life.

Introduction

Worldwide, 2.78 million workers lose their lives each year from occupational accidents and work-related diseases (2.4 million disease-related), and 374 million workers are affected by non-fatal occupational accidents (ILO, 2019).

In addition to the economic cost, employee problems caused by poor occupational health and safety (OHS) conditions have an intangible cost that cannot be fully measured in numbers. Psychosocial risks, work-related stress, and noncommunicable diseases are a growing concern for many workers around the world (ILO, 2019).

Statistics on occupational accidents and diseases in Turkey are collected and published by the Social Security Institution (SSI) of Turkey. In accordance with the OHS Law No. 6331 of Turkey, the employer is obliged to report the occupational accident and occupational diseases to SSI within three working days (Official Gazette of Turkey, 2012).

The deficiencies in the diagnosis and reporting of occupational diseases are the biggest obstacle in reflecting the real picture in Turkey. According to the literature, although the number of occupational diseases is between 4-12 per thousand of employment, it is seen that this number is much lower in the records (General Directorate of Labor and Social Security of Turkey-GDLSST, 2013)

In order for a disease to be accepted as an occupational disease, there must be a causal link between the disease and the occupation. The types and classification of occupational diseases are important in terms of helping to establish the causality link and to understand whether the disease is caused by the operating conditions of the work.

Classification of occupational diseases, according to the organs affected by occupational diseases (respiratory system, digestive system, hematopoietic system, musculoskeletal system, excretory system, hearing organ and system, multi-organ influence) or the factor that causes occupational disease (chemical causes, physical causes, biological reasons, dusts). in addition, in the examination and classification of occupational diseases, classification can be made by considering factors such as the entry route of the agent into the body (skin, respiratory and digestive), the appearance and course of the disease (acute and chronic), and the region affected by the disease (local and systemic) (GDLSST, 2013).

Occupational Accidents and Occupational Diseases in Mining Sector

As in all fields of working life, occupational accidents and occupational diseases cannot be ignored at any stage of the production process in the mining sector.

Underground coal mining is an area where a significant number of occupational accidents occur due to unfavorable natural conditions. If mining work places are not constantly controlled and disciplined, they are the address of accidents that can cause disasters for both employees and the whole society (Sari et al., 2004; Chunli et al., 2014).

Underground coal mining has an important place in terms of fatal and injured occupational accidents due to spontaneous combustion of coal, methane and coal dust explosion, roof collapse (Fu et al., 2017; Zhu et al., 2019). Methane explosions are seen as the cause of the biggest accidents causing mass deaths in underground coal mines (Güyagüler et al., 2005; Wang et al., 2014; Wang and Meng, 2018).

Mining accidents from the public agenda with casualties that occurred in Turkey and similarities regarding the cause of accidents as a result of investigations carried out at these mines are listed below (State Supervisory Board of Turkey-SSB, 2011).

- No risk evaluation realized,
- Contracting/subcontracting practice,
- Production enforcement
- Lack of lessons learned from past accidents,
- Insufficient measures against the risk of methane explosion,
- Control and methane drainage drilling are not realized sufficiently,
- Irregularities in drilling-blasting process,
- Employees do not have a CO mask,
- Inadequacy of gas monitoring and warning systems,
- Lack of ventilation,
- Problems with methane safe electrical devices and equipment,
- Inadequacies regarding the escape route,
- Deficiencies in the supporting system,
- Problems with rescue services,
- Insufficient surveillance (internal audit) services in mining companies,
- Technical supervision etc. problems with internal audit practices,
- Ineffectiveness of public units' audits,
- Lack of vocational training and occupational safety culture.

Since 1983, the largest occupational accidents occurred in Turkish mines are given in Table 1 (Yasar et al. 2015; Turkish Chamber of Mining Engineers-TCME, 2021).

Table 1. Some mining accidents and their causes occurred in Turkey.

Place of Accident	Date of Accident	Reason of Accident	Number of Fatality	Place of Accident	Date of Accident	Reason of Accident	Number of Fatality
Armutçuk	1983	Methane	103	Dursunbey	2010	Methane	17
Kozlu	1983	Methane	10	Karadon	2010	Methane	30
Yeni Çeltek	1983	Methane	5	Keşan	2010	Roof collapse	3
Kozlu	1987	Roof collapse	8	Elbistan	2011	Slope shift	11
Amasra	1990	Methane	5	Kozlu	2013	Methane	8
Yeni Çeltek	1990	Methane	68	Soma	2014	Mine fire	301
Kozlu	1992	Methane	263	Ermenek	2014	Flooding	18
Sorgun	1995	Methane	37	Yeşilova	2015	Poisoning	2
Aşkale	2003	Methane	8	Şirvan	2016	Landslide	16
Ermenek	2003	Methane	10	Kemer	2017	Methane	2
Küre	2004	Mine fire	19	Şırnak	2017	Landslide	7
Bayat	2004	Methane	3	Kilimli	2017	Roof collapse	2
Gediz	2005	Methane	18	Milas	2019	Block sliding	3
Dursunbey	2006	Methane	17	Ağlı	2019	Stone fall	2

Some major mining accidents in the world are also listed below;

On March 10, 1906, a coal dust explosion occurred in the Courriéres underground coal mine located within the borders of Northern France, 1060 people died in the explosion. This accident is known as the biggest mining disaster in European history (Anon (a), 2015).

Monongah Mine Disaster on December 6, 1907, an explosion occurred in the underground coal mine in the city of Monongah in West Virginia. The death toll is estimated to be around 500. The methane and coal dust explosion caused this accident, which is the largest mining accident in the history of the United States of America (Anon (b), (c), 2015).

On October 14, 1913, a chain explosion of coal dust occurred in the Senghenydd underground coal mine in the Caerphilly district of Wales, as a result of a methane explosion and 440 people died. The Senghenydd disaster is the largest mining disaster in the history of the United Kingdom (Anon (d), 2015).

A coal dust explosion occurred on 26 April 1942 at the Benxihu coal mine in Liaoning region of the People's Republic of China. The entry of the mine shaft collapsed with the explosion. 1549 people died as a result of the explosion. This disaster has been among the biggest disasters in world history and has the feature of the biggest mining disaster in history (Anon (e), 2015).

On the other hand, the most common diseases encountered among the occupants of mining sector such as pneumoconiosis and other respiratory system diseases, musculoskeletal diseases, cardiovascular diseases, high blood pressure, cholesterol and lipid elevation, visual and hearing disorders, gastrointestinal diseases, endocrine system, goiter, diabetes, skin diseases, neurological and psychiatric diseases can take place on the list. Hearing loss in noisy environments can also lead to headache, psychological tension and high blood pressure. Visual impairments, which were common in the past, even called miner's nystagmus, have decreased considerably today due to appropriate lighting in the mines (Bilir, 2019).

Evaluation of Statistical Data

Accident Frequency (AFR), Accident Weight (AWR) and Accident Probability (APR) rates are generally used in the evaluation of occupational accident data (Şensöğüt and Uysal, 2019; Bayraktar et al, 2018; Erginel & Toptancı, 2017; Arıtan & Ataman, 2017; Balcı et al, 2013). Equations used in calculating these ratios are given below (ILO, 1998).

$$Accident\ Frequency\ Rate = \frac{Total\ accident\ number\ x\ 10^6}{Total\ worked\ hour} \quad (1)$$

$$Accident\ Weight\ Rate = \frac{Lost\ workday\ x\ 10^3}{Total\ worked\ hour} \quad (2)$$

$$Accident\ Probability\ Rate = \frac{Total\ accident\ number\ x\ 10^5}{Number\ of\ occupants} \quad (3)$$

In the annual statistics of SSI of Turkey, 99 "Economic Activity Classifications" were defined and 5 of these activities were evaluated as direct mining activities. In addition, 5 different sectors were selected and evaluated together in order to compare the annual work accident rates with respect to some other sectors.

The SSI statistics, including the number of insured persons who had an occupational accident and occupational disease and the number of insured who lost their lives in mining activities and some other sectors, are given in Tables 2 and 3 (SSI, 2021).

Table 2. Number of insured occupants who had an occupational accident and disease and who died due to accidents at work in Turkish Mining Activities in 2019.

Economic Activity Classification	Insured Occupant Who Had Occupational Accident	Number of Fatality	Insured Occupant Who Had Occupational Disease	Number of Fatality
05-Coal & lignite production	8 983	13	50	0
06-Crude Oil & Natural Gas extraction	67	0	0	0
07-Metal ore mining	1 756	7	7	0
08-Other mining & quarrying	2 435	28	14	0
09-Mining support service activities	926	0	1	0

Table 3. Number of insured occupants who had an occupational accident and disease and who died due to accidents at work in some other sectors in Turkey in 2019.

Economic Activity Classification	Insured Occupant Who Had Occupational Accident	Number of Fatality	Insured Occupant Who Had Occupational Disease	Number of Fatality
10-Manufacture of food products	22 734	27	23	0
13-Manufacture of textiles	20 274	20	16	0
41-Building construction	25 551	207	19	0
42-Construction of outdoor structures	15 927	105	5	0
56-Food and beverage service activity	25 969	22	16	0
GRAND TOTAL	422 463	1 147	1 088	0

The SSI of Turkey statistics, which include temporary incapacity periods (standing + inpatient), number of workplaces and compulsory insured employees in mining activities and in some other sectors and in general total are listed in Tables 4 and 5 for the year 2019 (SSI, 2021).

In 2019, there was no death record due to occupational diseases. Among 1088 people suffering from occupational diseases, coal and lignite production took the first place with 50 people. Among the remaining ones, 14 people died in mining sector and from 23 people in the production of food products, 19 people in building construction, 16 people in the production of textile products, 16 people in food and beverage service. In addition, the low number of occupational diseases indicates that there are deficiencies in registration.

Table 4. Temporary incapacity periods (standing + inpatient) in mining activities, some other sectors and general total, number of workplaces and number of compulsory insured employees for the year 2019.

Economic Activity Classification	Temporary Disability Period	Number of Workplaces	Number of Occupants	Economic Activity Classification	Temporary Disability Period	Number of Workplaces	Number of Occupants
05	128 790	443	36 436	10	185 722	45 097	466 144
06	476	38	2 300	13	192 526	17 069	430 571
07	16 594	783	28 188	41	295 335	90 389	727 961
08	38 811	4 966	58 320	42	138 641	11 549	293 312
09	9 284	605	9 083	56	124 599	128 617	713 057
GRAND TOTAL					3627934	1891512	14314313

In Table 5, AFR, AWR and APR values of the selected sectors in 2019 are given together.

Table 5. AFR, AWR and APR values of the selected sectors in 2019.

Economic Activity Classification	AFR	AWR	APR	Economic Activity Classification	AFR	AWR	APR
05	110,88	2,79	24 654,19	10	21,70	0,37	4 877,03
06	12,96	0,09	2 913,04	13	20,96	0,35	4 708,63
07	27,74	1,09	6 229,60	41	15,62	1,13	3 509,94
08	18,60	1,90	4 175,24	42	24,17	1,41	5 430,05
09	45,47	0,46	10 194,87	56	16,20	0,18	3 641,92
GRAND TOTAL					13,12	0,38	2 951,33

When the data for 2019 given in Table 5 are examined, the highest AFR is in the field of coal and lignite extraction (5), followed by metal ore mining (7) and construction of outdoor structures (42). AWR, on the other hand, is the highest in the area of coal and lignite extraction (5), followed by other mining and quarrying (8) and construction of outdoor structures (42). Although the highest death toll in 2019 was in the area of building construction (41). It is seen that these rates were low due to the very high number of employees.

The AFR, AWR and APR values of the last 10 years were calculated (Figs. 1-3).

When the AFR change graph in Figure 1 is examined, it is seen that the highest values have been reached in the field of coal and lignite extraction in all years. Meanwhile, a significant increase has been observed in other areas. While the increase in coal and lignite extraction, which has the highest AFR value, was 1.5 times within ten years, it was 9.5 times in the field of building construction and non-building construction, 7 times in the production of food products, 13 times mining support service activities and food and beverage service activities. There is a 4.5-fold increase in the general average.

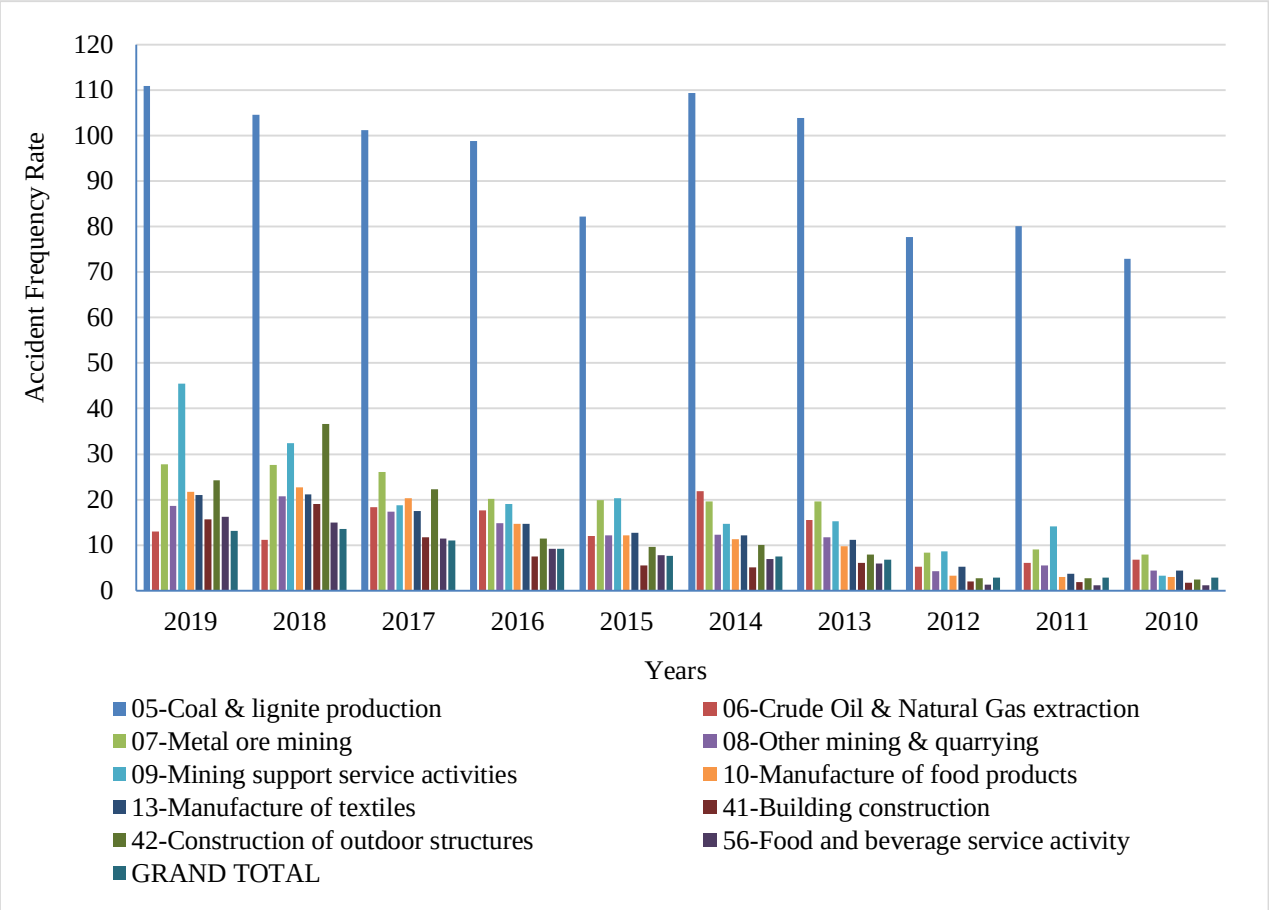

Fig. 1 AFR variation between 2010-2019

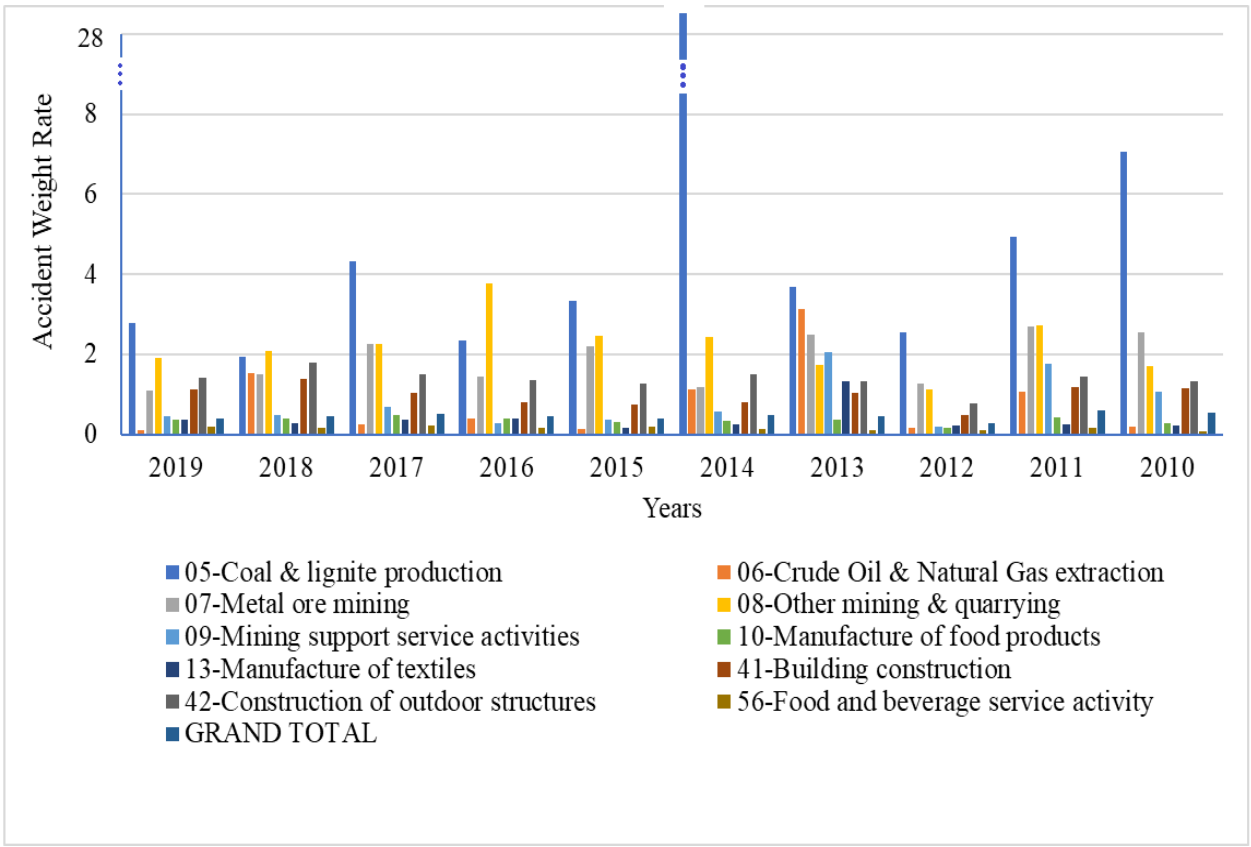

Fig. 2 AWR variation between 2010-2019.

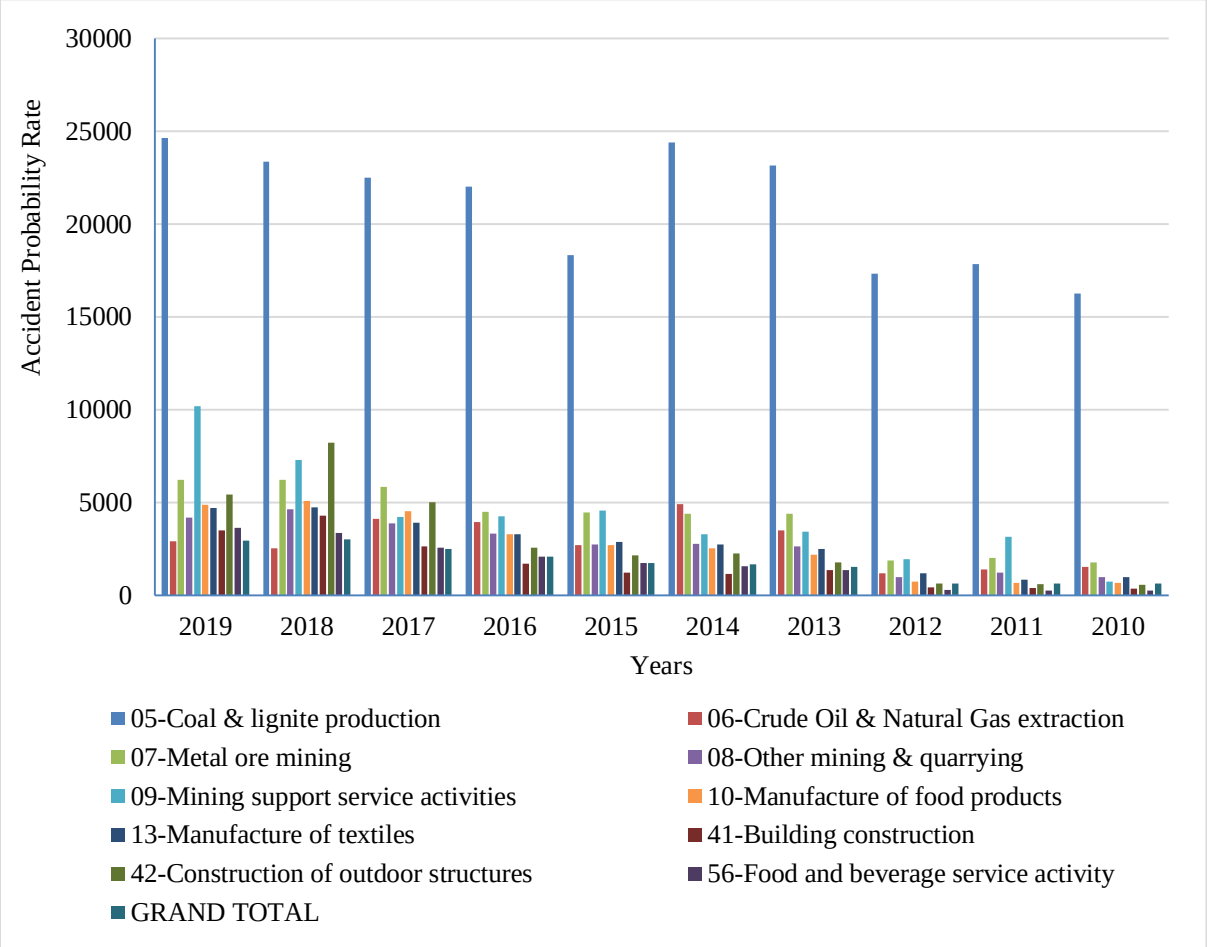

Fig. 3. APR variation between 2010-2019.

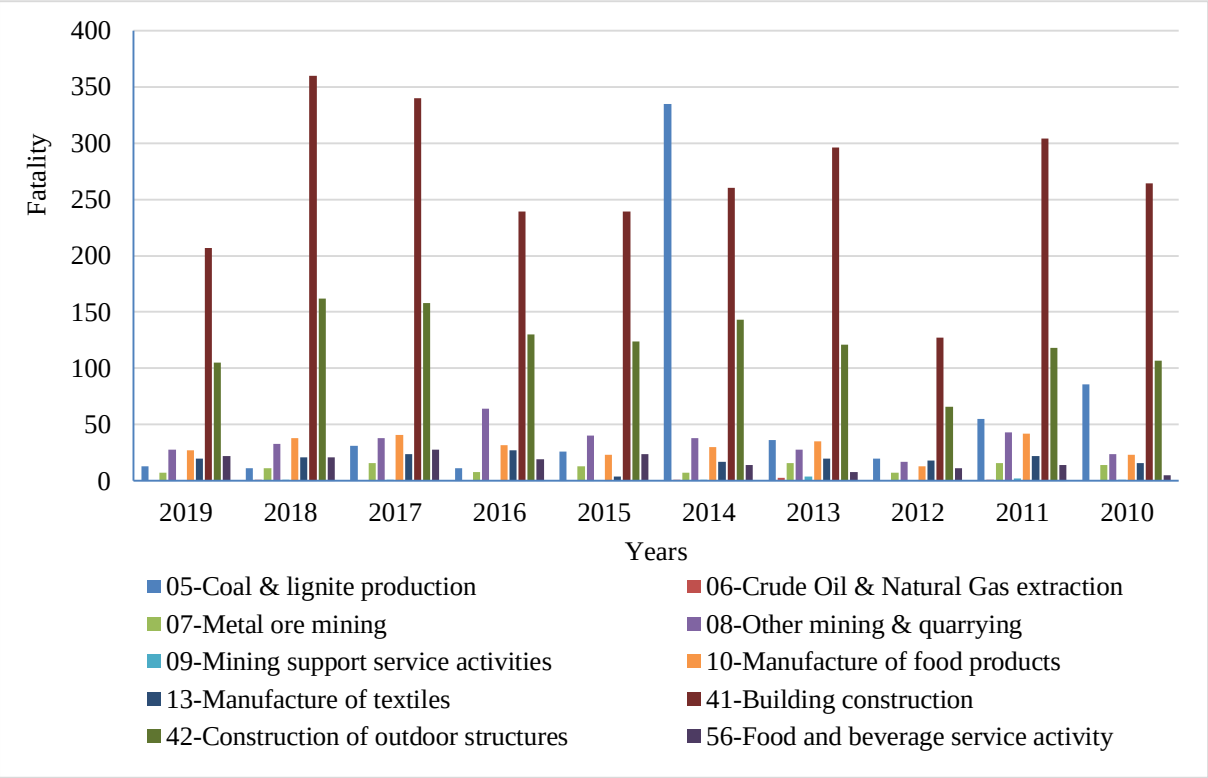

Fig. 4. Number of deaths between 2010-2019 by field of activity.

When the AWR change graph given in Figure 2 is analyzed, this value has reached a very high value due to the Soma and Ermenek accidents that occurred in 2014, and 335 deaths in the field of coal and lignite extraction. In 2010, 86 fatalities including Dursunbey, Karadon and Keşan accidents occurred, resulting in the closest accident weight ratio to this value.

When the APR change graph in Figure 3 is examined, a similarity can be seen in the AFR graph. While the highest values were observed in the field of coal and lignite extraction in all years, a significant increase was also observed in other areas. Fatality rates in the fields of activity examined for the last 10 years are given in the graphic in Figure 4.

Although there were 260 deaths in 2014 and 264 deaths in 2010 in the field of building construction, 143 deaths in 2014 and 107 deaths in 2010 in the field of construction of non-building structures, the number of insured workers is very high compared to other fields, resulting in low AWR values.

Results and Discussion

According to the present study, it is seen that occupational accidents and related deaths and workday losses are among the sectors with high levels occurred in the mining sector. In the fatal occupational accidents of 2019; 4.8% of deaths occur in all mining activities, while 18.05% are in building construction and 9.15% are in the construction of non-building structures. In the ten-year period, the highest death toll was in 2018, as 360 fatalities in the building construction area. In total, 1700 occupants lost their lives in 2011. The very low number of occupational diseases indicates that they have some problems in reporting occupational diseases. Studies on occupational diseases should be developed, databases should be created and notifications of occupational diseases should be secured.

It is of great importance that occupational safety experts working in areas with high levels of occupational accidents and diseases are primarily graduates of this field. In addition, OHS audits in very dangerous activity areas should be carried out in parallel with technological developments. When evaluated in terms of OHS, no work accident and occupational disease cannot be prevented. In this respect, it should be considered that enterprises that make themselves safe parallel with safety regulations at work should be rewarded with some incentives.

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