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Occupational health and safety in flour Mills: A research and risk assessment

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Abstract

Flour mills are one of the workplaces with occupational health hazards due to irregular workplaces and environments where insufficient attention is paid to workers' safety. In this context, considering the extent of difficulties faced by workers in flour mills, hazards and risks that could affect the health and occupational safety of workers were investigated in a sample of flour mills in Iğdır province. The data obtained as a result of the research was ranked using the matrix method. The study identified 68 specific risks, of which 38% were identified as unacceptable risks requiring immediate action and 33% as risks requiring medium-term action. The results show that among the factors negatively affecting the health of workers, the respiratory hazard level of wheat dust with RS:15 (l:3, s:5) and the explosion hazard with RS:20 (l:4, s:5) occupy significant positions. Despite the emphasis on the importance of hygiene standards, serious deficiencies were identified, such as RS:20, which is considered high risk. In addition, the presence of many machines, such as conveyors, silos, compressors and rollers, was found to increase the risks on the system in the range of RS:20-25, which could lead to serious injury or death. Bacteria and microorganisms, such as RS:16-18, proliferate due to the low availability of personal hygiene facilities in the factory. For each identified risk, the necessary control measures are proposed and it is emphasized that protective measures should also be taken even after the implementation of these measures. Among the factors that negatively affect the health of workers in flour mills are the lack of use of personal protective equipment, working in dirty conditions, the presence of elements that can cause respiratory problems, as well as injuries related to carrying heavy loads on slippery floors and using unprotected machinery.

Keywords: Flour mill, Occupational health and safety, Hazard, Flour dust, Hazards

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INTRODUCTION

The history of milling probably dates back to prehistoric times. Modern flour milling systems, as we know them today, have a history of about 250-300 years. Flour, defined as the ground particles of grains and legumes, is considered a hazardous substance by the Health Safety Executive (HSE). The American Conference of Governmental Industrial Hygienists (ACGIH) defines flour as a complex organic dust and recommends that it be kept below a threshold limit value (TLV) of 0.5 mg/m3 in the workplace (Kakooei and Marioryad, 2005).

Flour dust, like many other organic substance dusts, is a harmful and potentially hazardous material (El Karim et al., 1986). It is known to cause occupational asthma and can sensitize the respiratory tract, leading to reactions such as allergic rhinitis (Smith and Lumley, 1996). It can trigger asthma attacks in people with asthma and can lead to chronic bronchitis. It also has irritating properties and can cause short-term respiratory, nasal, and ocular symptoms (Ajeel and Al-Yasin, 2007). In order to mitigate these harmful effects, occupational exposure limits have been accepted in work environments ranging from 0.5-10 mg/m3 for an 8-hour shift (Kakooei and Marioryad, 2005). The maximum exposure limits are set at 10 mg/m3 in the United Kingdom and the United States, while Italy sets it at 0.5 mg/m3 (REF). In our country, according to the dust control regulations published in the appendices, the threshold limit value (TWA) for grain dust is set at 10 mg/m3 (Babel & Rajvanshi, 2013).

In the last five years, 17 people have lost their lives in our country due to work accidents in the production of ground cereals and vegetable products. The average number of work accidents in this sector between 2018 and 2022 was 734, while in 2021, three people were diagnosed with occupational diseases (SGK, 2023). Occupational disease is a temporary or permanent illness, physical or mental disability that occurs in the course of the employee's work or due to a recurring cause arising out of the nature of the work or working conditions (Horozoğlu, 2017).

The flour manufacturing process, classified as "Hazardous" in the "Regulation on Workplace Hazard Classes Related to Occupational Health and Safety", generally consists of stages such as raw material supply, storage, cleaning, washing, tempering, grinding, sieving, and storage. Throughout this process, areas where grinding occurs, called rollers, transfer screws for product transfer between processes, cleaning with sieves, distribution, and washing sections, are areas where vibration and noise exposure are particularly intense (Ali & Mohamed, 2023). However, the presence of many machines operating mechanically and electrically, along with personnel movement in the workplace, brings along a series of risks. During this process, especially physical hazards arising from machine movements and electrical-related risks are significant. Additionally, there is a risk of workers being exposed to health issues such as dust particles, skin irritation, and respiratory tract infections (Tiikkainen et al., 1996). Companies should identify potential hazards, take appropriate precautions, and train and inform workers. Furthermore, regular maintenance and inspections are crucial.

In the crushing, grinding, sieving, and washing sections where flour mill production takes place, workers may experience problems such as hearing loss due to excessive noise. Measurements taken at these points have shown that the noise level is well above the legal limits (Yağmur, 2016). Similarly, vibration exposure in these areas exceeds action levels and will adversely affect workers. Those working in enclosed spaces are exposed to these effects throughout their working hours. However, workers outside the production area are distant from this effect.

The manufacturing sector, due to its high workload, requires more attention to occupational health and safety (Tekin & Rizvan, 2016). Research shows that there are more workplace accidents in the manufacturing sector than in the service sector (Çalış & Büyükakıncı, 2021). These bitter experiences better illustrate the importance of sensitivity in the manufacturing sector. The accidents that can occur on a production line can cause larger and more serious problems than in other work environments, such as offices; however, the criteria for risk assessment may also change, taking into account the frequency and likelihood of accidents.

The occurrence of work accidents and occupational diseases in workplaces has significant destructive effects both morally and economically. Due to factors such as the unsuitable nature of the ambient air and the variety of machinery and equipment used, flour mills are considered hazardous workplaces where workers face a high probability of occupational accidents. With this aim, to evaluate the risks arising during the work conducted in the sampled factory, whether the measures taken to ensure the health and safety of mill workers are adequate and meet legal requirements is examined. Are workers exposed to particles, gases, fumes, and vapors in the air? How do workers perceive occupational health and safety measures? Are there any risks associated with the tools, machinery, or equipment used, and what measures are taken against these risks? To what extent are workers exposed to thermal comfort conditions? Are workers exposed to excessive noise or vibration in the workplace? Are there any chemicals in the workplace that could cause illness or health problems for workers? These questions have been investigated.

The prioritization and treatment of risks was linked to the implementation of identified control measures and the impact of these measures was discussed. Implementing control measures includes improving work practices, enhancing communication, supporting education and training, and ensuring supervision and maintenance. Improving work methods assists in making workplace activities safer, while communication aims to promote clear and effective communication among employees. Education and training activities ensure that employees acquire the necessary knowledge and skills to recognize risks and apply control measures correctly (Şerifoğlu & Sungur, 2007). Supervision involves monitoring the effectiveness of control measures in the workplace and taking corrective actions when necessary. Maintenance contributes significantly to occupational safety and worker health by ensuring regular maintenance of equipment and tools used.

MATERIALS AND METHODS

Quantitative or qualitative methods traditionally used in risk assessment methodologies are tending to be replaced by hybrid methods in modern times. Among the many methods, which can be expressed in hundreds of ways, risk assessment decision matrices are the most popular because of their broad and easy-to-understand application areas (Gul & Ak, 2018). The method, which aims to rank risks, risk sources, or risk treatments according to risk level, was initially used in military systems and later became widespread, being preferred primarily in many sectors (Bakx & Nyce, 2017).

The Severity-Likelihood matrix is a method that combines qualitative or semi-quantitative results with probability rankings to determine risk levels or risk assessments. These matrices allow us to analyze the relationship between two or more variables through visual diagrams. In addition, they help identify factors that influence the problematic events and understand the relationship between those factors and the events, as well as aid in problem solving. The format and definitions of the matrix vary depending on the context of use, and selecting an appropriate design is critical (Korshunov et al., 2020). The risk posed by workplace accidents is defined as the combination of the probability of occurrence in the risk matrix and the severity of the consequences. The severity-likelihood matrix is used to rank risks or assess risk sources and treatments according to risk levels. When various risks are identified, it serves as a common screening tool to determine which risks require more detailed analysis, which risks should be prioritized, or which risks should be reported to senior management (Oliveira et al., 2018). Toward these objectives, two different risk assessment decision matrix methods are used: X-type and L-type. In this study, the L-type matrix was preferred because it contributes to understanding complex issues and supports multidimensional thinking. This method also aids in identifying factors contributing to or affecting the problem or event and determining their relationship. Its prominent advantage is graphically representing the degree of relationship between each variable. For the effective application of this method in risk analysis processes in complex work environments, the competence of a single person is not sufficient. Conducting studies requires disciplined teamwork under the leadership of an experienced team leader. The research has adopted a comprehensive approach to ensure the effective implementation of the risk management process, which begins with the identification of potential hazards. The process of identifying hazards and analyzing them is a crucial step in determining potential risks (Lyon & Hollcroft, 2012). The potential impact of each hazard and the size of the risk have been meticulously evaluated (Figure 1). Subsequently, measures and strategies necessary to minimize or eliminate these risks have been identified.

After potential hazards are identified in the hazard list recorded in the work log, the detailed identification of the risks they pose begins (Wijeratne et al., 2014). Each risk should be subjected to evaluation using the following methods:

Likelihood of the risk occurring: The likelihood of the risk occurring is assessed and assigned to one of five different probability categories.

Level of damage caused by the event: The level of the risk is assessed and assigned to one of five different impact categories.

Risk Level: The level of risk is calculated by multiplying the probability of the risk occurring by the impact of the risk.

As a result of this calculation, it is determined whether the risk is low, medium, or high. The risk level is equal to the product of the probability of the event occurring and the severity of the event (RS = I x S, RS: Risk, I: Likelihood, S: Severity).

While the matrix technique can be used for risk assessment, other techniques can also be used. The matrix technique visualizes potential hazard levels, making them easier to comprehend. However, it's important that the method used for risk assessment aligns with the characteristics and needs of the workplace. Expert opinions and necessary teamwork contribute significantly to assessing the hazards identified, converting them into risks, and determining the probability and magnitude of the resulting harm. The obtained values are transferred to the risk assessment matrix. Based on the scoring in the matrix, a risk map is obtained, ranging from highest to lowest priority. Risks that are high and require immediate attention for treatment are marked in red, risks that are planned to be addressed in the near investment periods, considering the medium-term or financial situations of the business, are considered notable risks and marked in yellow, while risks that do not require urgent action are marked in green (Lindholm et al., 2022).

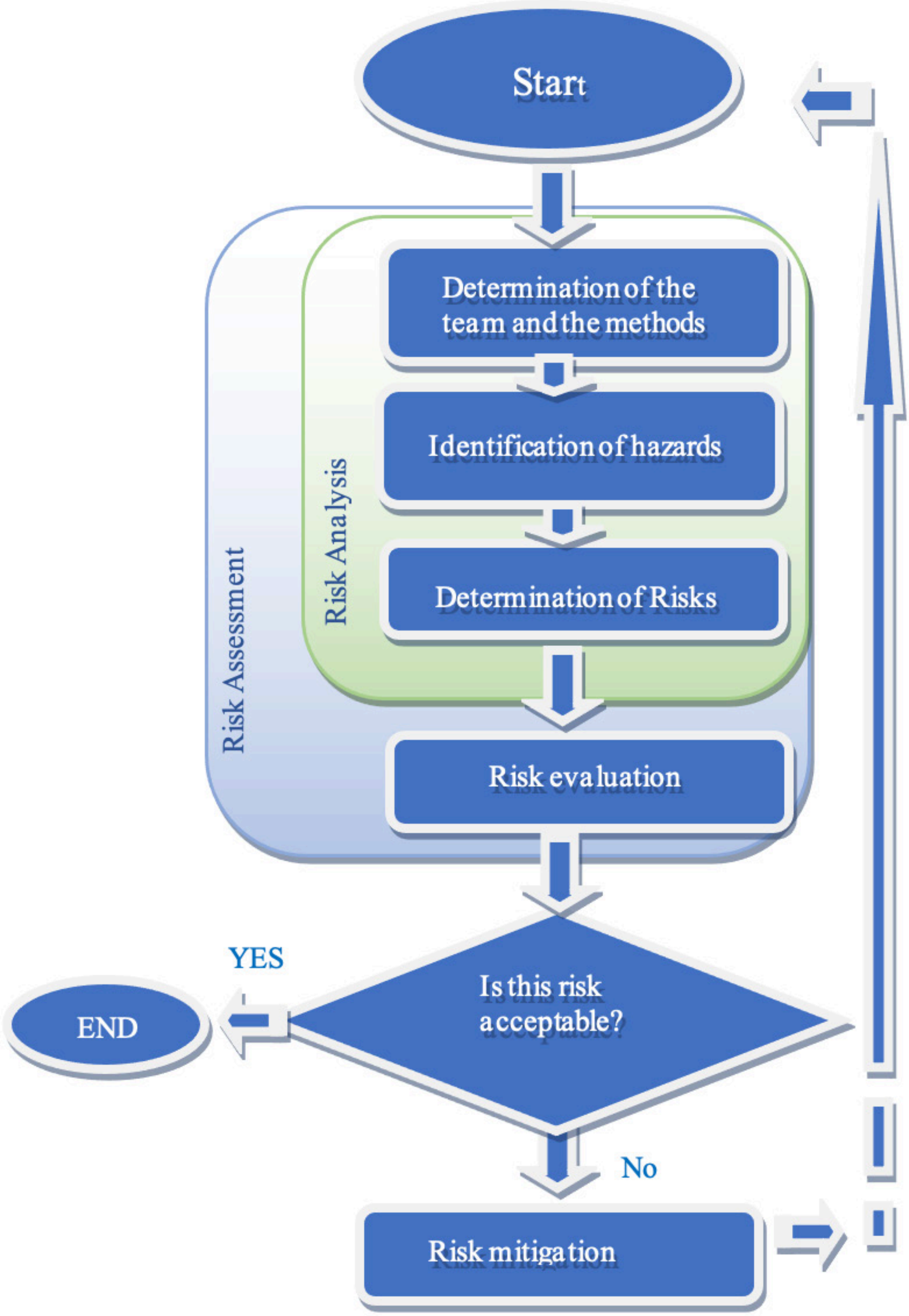

Figure 1. Risk assessment stages

Table 1. Severity and likelihood matrix

Severity		Rating	Likelihood		Rating		Severity 1	2	3	4	5
1	Considerable	No Loss of Work Hours, No First Aid Required	1	Very low	Once a year	Likelihood 1	1 Very Low Risk	2 Low Risk	3 Low Risk	4 Low Risk	5 Low Risk
2	Important	No Loss of Working Days, No First Aid Required	2	Low	Once 3 months	2	2 Low Risk	4 Low Risk	6 Low Risk	8 Signi. Risk	10 Signi. Risk
3	Serious	Minor Injury Requires Treatment	3	Moderate	Once a month	3	3 Low Risk	6 Low Risk	9 Signi. Risk	12 Signi. Risk	15 High Risk
4	Very Serious	Death Serious Injury, Occupational Disease	4	High	Once a week	4	4 Low Risk	8 Signi. Risk	12 Signi. Risk	16 High Risk	20 High Risk
5	Catastrophe	Multiple Deaths, Permanent Disability	5	Very High	Everyday	5	5 Low Risk	10 Signi. Risk	15 High Risk	20 High Risk	25 Very High Risk

RESULTS AND DISCUSSION

The process in the flour mill where the study is conducted involves various stages from the procurement of wheat to the packaging and shipment of flour. This process involves several critical steps. First, starting with the procurement of wheat, the moisture content, temperature, and storage conditions of the product are meticulously controlled. This is essential to ensure the quality of the wheat, which is stored in low humidity, dry, and well-lit environments (+4 ºC). This stage also includes the cleaning and separation of foreign materials in the wheat, such as pieces of metal, dust, soil, and plant debris. This is followed by a stage called "blending", in which the same type of wheat is subjected to a homogeneous milling process, improving the quality and consistency of the final product. The wheat, free of foreign matter and impurities, is washed to obtain a more homogeneous product. Then, through the "clean wheat tempering" process, the husk is removed to obtain the highest quality flour. This stage is critical to improving the quality of the flour and achieving the desired product specifications. Finally, the wheat is ground. This complex process is carried out through a system integrated with rollers, sieves, and other machines. Sieves are used to separate and classify the materials ground in the rollers. The final product is packaged in a warehouse with suitable storage conditions and prepared for shipment.

Workers in flour milling are exposed to many hazards, with major risks including electricity, careless behavior, rotating machinery, and exposure to flour dust, which can lead to workplace accidents or occupational diseases. During the preliminary hazard analysis, risks were addressed in three separate sections: general factory operations, production, and other departments. The presence of three separate electrical panels in the factory and multiple splitters connected to sockets, especially, poses a high risk with a probability of occurrence (P) of 1:5 and severity (S) of 5, resulting in a high-risk score (RS) of 20 (Table 2). This poses a serious risk of death or disability for users. Therefore, in electrical work, open and un-insulated elements should be checked and corrected, proper grounding should be done in compliance with regulations, electrical panels should be regularly maintained by qualified personnel, warning signs should be placed, and insulating mats should be placed in front of them (Tosun, 2022). Lightning protection systems should be installed according to the project of the installation to eliminate the risk of RS:20 from lightning strikes and checked annually. The resistance of the lightning protection grounding system should not exceed 10 ohms (ETTY, 2001).

In emergencies such as fire, it is necessary for fire extinguishers to be of sufficient quantity and easily accessible, eliminating any barriers to intervention. The identified deficiency regarding the insufficient number of fire extinguishers has been classified as a risk class that requires immediate intervention with an RS:20 score (Table 2). Fire extinguishers and, when necessary, fire detectors and alarm systems will be present in closed and open areas of the workplace with effective and adequate fire extinguishing equipment based on the size of the workplace, the nature of the work performed, the physical and chemical properties of the substances used, and the number of employees (Şimşek & Aydoğdu, 2020). Fire extinguishing equipment will be easily usable, placed in visible and easily accessible locations, and free from obstacles in front of them. Fire extinguishing devices will be marked in accordance with the Safety and Health Signs Regulation, placed in appropriate locations, and permanent (SGİY, 2012).

The inadequacy of signs indicating prohibition, warning, command, escape route, or firefighting equipment in emergencies results in a high-risk value (P: 3, S: 4, RS: 12) (Table 2). For this issue, signs should be made of sufficient quantity, suitable for the environment in which they are used, and made of impact and weather-resistant materials. The dimensions, colorimetric, and photometric properties of the signs will ensure that they are easily visible and understandable (SGİY, 2012).

The inadequate ventilation and hygiene conditions of shower cabins will lead to the proliferation of microbiological organisms, thus posing a risk of occupational diseases (P: 3, S: 3, RS: 9) (Table 2). These conditions will be prevented by suitable ventilation with aspiration and ventilation systems to prevent odor and dirt. Shower cabins will be adequately heated according to the season, with the temperature not falling below 25°C, and provided with hot and cold running water, clean towels, and bathrobes provided by the employer, stored in special cabinets. Used towels and robes shall not be used by others until they have been washed, dried and thoroughly cleaned. Workers' lockers will be locked, and their cleaning will be carried out according to guidelines prepared by the employer. In areas where toxic, hazardous, dusty, and dirty work is performed, employees should be provided with two separate lockers for storing work clothes and external clothing. Maintenance of dressing rooms, wardrobes, and lockers will be carried out by the employer, and employees should not be allowed to work with wet clothes (Eser, 2015).

Among the identified deficiencies in the workplace is the lack of regularity in employees' night shifts and inadequate rest periods, resulting in a risk of accidents and illnesses (L: 3, S: 5, RS: 15). The maximum duration of work in night shifts should be 7.5 hours, and employees should be scheduled to work during the day in the second work week after working at night for a maximum of one work week. During shift changes, workers should not be required to work continuously without being rested for at least eleven hours (İş Kanunu, 2003).

The absence of a sufficient number and quality of emergency exit doors that enable all employees to immediately and safely evacuate the workplace in any hazardous situation poses a risk of injury and death in emergencies (L: 4, S: 5, RS: 20) (Table 2). Emergency exits and doors should open directly and unobstructed to the outside or to a safe area, and the number, size, and location of doors should be appropriate to the nature of the work, the size of the workplace, and the number of employees. Additionally, emergency exit doors should not be locked or obstructed (BYKHY, 2007).

The neglected condition of fuel tanks poses a risk of fire or explosion (L: 3, S: 5, RS: 15). These tanks should be securely placed on solid bases and surrounded by suitable safety walls. In the event of a fire, there should be remotely controlled fire extinguishing systems and pressure valves that open and close automatically in response to pressure changes.

The failure of employees to receive occupational health and safety training is a significant risk with an RS value of 12. This training should be provided particularly before starting work, when there is a change in workplace or job, when there is a change in work equipment, or when new technology is implemented. Trainings should be updated in accordance with new and emerging risks and should be repeated at regular intervals as necessary. To reduce the risks associated with confined spaces with an RS value of 6, adequate fresh air supply should be ensured based on the nature of the work. When using forced ventilation systems, the system should always be operational. The airflow should not disturb the workers. Thermal comfort conditions should be appropriate for the nature of the work, intended use, and the energy expended by the workers; otherwise, it may lead to significant consequences, including workday losses due to the risk of work accidents with an RS value of 6.

Due to the construction style of the workplace, adequate utilization of daylight is not achieved, which may lead to work accidents and, at the same time, result in vision impairments for continuous workers. Lighting systems in work areas and passageways should be of a type that does not pose a risk of accidents for workers and should be appropriately positioned. In areas where any malfunction in the lighting system could pose a risk to workers, there should be backup lighting systems to provide emergency and adequate illumination. In workplaces, floors and surfacing are sound, dry, and as flat and non-slippery as possible, with no dangerous slopes, pits, or obstructions (YİİSGY, 2013). Floor coverings and coatings in workplaces will be made of materials suitable for cleaning to ensure proper hygiene conditions.

Arrangements will be made to ensure the safe movement of pedestrians and vehicles in both open and closed work areas. There will be adequate distance between roads open to vehicle traffic and pedestrian walkways, as well as between gates and pedestrian crossings. Considering the nature of the work being carried out in work areas, and taking into account machinery and materials, pathways for vehicle passage will be clearly marked to protect workers. Access to hazardous areas where there is a risk of falling materials or workers due to the nature of the work will be prevented using appropriate tools and equipment. Measures will be taken to protect individuals authorized to enter hazardous areas, and these areas will be clearly identified. Personnel who do not obtain a health report from the occupational health physician cannot be employed. Those entering the workplace must undergo periodic health checks every three months, and the results must be recorded in health reports. Individuals found to be carriers during health checks must receive immediate treatment. Those who have completed treatment but have not received a clean bill of health cannot be employed. Individuals with febrile illness, skin disease, or diarrhea must be immediately sent for examination at a healthcare facility.

Table 2. Risks present throughout the factory

Hazard	Risk	Consequences	I	S	RS
Electrical Panel and Installation	Electrical leaks, electrocution	Injury, death, property damage	4	5	20
Lack of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
Fire extinguishing systems not easily accessible	Failure to intervene in fire	Injury, death, property damage	4	5	20
Lack of maintenance of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
Lack of lightning system (lightning rod)	Lightning	Injury, death, property damage	4	5	20
Failure to perform periodic checks of the lightning system (Lightning Rod)	Lightning strike, fire, explosion	Injury, death, property damage	4	5	20
Lack of warning and warning signs and signs	Increase in work accidents	Injury, death, property damage	3	4	12
Showers—Sinks-Toilets	Increase in occupational diseases, disease transmission from various bacteria and harmful microorganisms	Infectious diseases	3	3	9
Changing areas and wardrobes	Increase in occupational diseases, disease transmission from various bacteria and harmful microorganisms	Infectious diseases	3	3	9
Shift Work	Work accident due to insomnia, fatigue, careless work	Injury, death, property damage	3	5	15
Inappropriate Emergency exit routes and doors	Workers' inability to leave the danger zone	Injury, death	4	5	20
Fuel tank	Fire, explosion	Injury, death, property damage	3	5	15
Lack of Occupational Health and Safety training for employees	Increase in work accidents	Injury, death, property damage	3	4	12
Inadequate ventilation	Work accidents that may occur as a result of work stress, carelessness, and depression	Injury and various health problems	2	3	6
Inappropriate Ambient Temperature	Work accidents that may occur as a result of work stress, carelessness, and depression	Injury, loss of working days, material damage	2	3	6
Insufficient Lighting	Insufficient visibility, increase in work accidents	Injury, death, property damage	4	4	16
Slippery ground	Slip - fall	Injuries, fractures	2	3	6
Movement of Pedestrian and Vehicles	Impact, crush	Injury, death	3	4	12
Lack of health checks on employees	Increase in occupational diseases	Infectious diseases, respiratory diseases	3	3	9

The continuous operation of the existing electrical panel in the production area with connections left open poses significant risks (I:4, s:5, RS:20) (Table 3). Attention must be paid to ensuring that the panel's periodic maintenance, operating instructions, and necessary precautions and labeling comply with regulations. Electric motors operating with alternating voltage potentials of 230 volts or higher must be located in special motor rooms or at least 3 meters above the ground or within an enclosure system. Motors that do not meet these conditions and specifications will be appropriately protected. Distribution panels, control equipment, and similar installations located inside workshops or accessible to workers will be placed in locked cabinets or enclosures, or their bases will be covered with non-conductive material (Mutlu & Çabuk, 2021). When isolating live equipment for maintenance and repair, the use of screens or protectors to cover these sections eliminates many risks.

According to regulations, effective and sufficient fire extinguishing equipment, as well as fire detectors and alarm systems when necessary, must be present in the workplace based on its size, the nature of the work performed, the physical and chemical properties of materials used, and the number of employees. However, the lack of sufficient fire extinguishing equipment in visible and easily accessible locations without obstacles in the existing facility poses a high risk (l:4, s:5), reaching an RS:20 level, in emergency situations (Table 3). Another crucial aspect is ensuring that fire extinguishing devices are appropriately labeled in accordance with the Safety and Health Signs Regulation, placed in suitable locations, and remain permanent.

It is possible to say that there are significant deficiencies in hygiene in the workplace. These deficiencies stem from both the educational levels of the employees and their social environments. Especially, attention is not paid to body, hand, and face hygiene throughout the day. The current situation poses a high risk of causing diseases (l:3, s:3), reaching an RS:9 level, and requires urgent action (Table 3). The importance of washing with water and soap should be emphasized in training, followed by the application of suitable antiseptics to the hands. The recommended amount of hand antiseptic (3-5 ml) should be applied to both hands and rubbed until dry. Hand sanitizing, like washing with water and soap, aims not only to reduce dirt and bacteria by mechanical action, but also to kill bacteria or prevent their reproduction by chemical action. In other words, they have bactericidal and bacteriostatic effects. For this purpose, hand-operated, elbow-operated, or sensor-operated disinfectant dispensers should be used (IHOTAHY, 2023).

The machines used in the operation are constantly at risk due to some of their feeds being exposed and not isolated (l:3, s:4, RS:12) (Table 3). Firstly, the wiring in the installation must be insulated within the channel. The body grounding of the machines must be done without fail.

The existing guards on the machines are either broken or missing, which indicates a risk that requires action (l:3, s:4, RS:12). According to our regulations, machine guards used in the workplace must be structurally sound, not create additional hazards, not be easily removable or rendered ineffective, be at a sufficient distance from the hazard zone, not obstruct the view of the equipment's operating points, only restrict access to the area where the operation is performed, and allow for the installation, removal, and maintenance of parts without their removal (MEY, 2009).

The ceiling-mounted motors in the facility create a risk of oscillatory movement (l:3, s:4, RS:12) while also generating significant noise due to being unsecured (Berberoğlu et al., 2002).

All moving parts of the drive machines along with the transmission mechanisms and all hazardous parts of the machinery and equipment shall be adequately guarded. These guards shall only be removed during inspection, adjustment, maintenance, and repair, and shall be immediately replaced upon completion of the work. In the event of a fault or deficiency in the machinery or its guard, the machine or equipment shall be immediately stopped, and the relevant personnel shall be notified. Measures preventing anyone from working on the machine or equipment with a fault or defective guard shall be taken, and the situation shall be indicated by affixing a sign on them (Ünsar, 2004).

The level of noise exposure experienced by employees, being a significant source of complaints and causing discomfort to individuals, constitutes risks that need to be taken into account (l:3, s:4, RS:12) (Table 3). Employees working in noisy environments should undergo periodic general health examinations. The noise level of the machines in the mills has SPL (sound pressure level) more than 85 dBA (permissible limit by NIOSH) in locations where they were used most of the time (Rawat & Gaikwad, 2020). Employees working in noisy environments should be selected from those who are suitable for working in such environments in terms of health. When noise exposure exceeds the lowest exposure action values, the employer should provide ear protectors readily available for the employees to use (ÇGİRKDY, 2012). When noise exposure reaches or exceeds the highest exposure action values, ear protectors should be used. The employer shall make every effort to ensure the use of ear protectors and shall be responsible for monitoring the effectiveness of the measures taken.

It is noteworthy that the compressors used in the operation are poorly maintained and old, and if precautions are not taken, there is a risk of explosion and fire (l:4, s:5, RS:20) (Table 3). In compressors, when the pressure reaches the set pressure, automatic stopping of the compressor motor should be ensured, and in case of delayed stopping of the motor, a safety device should be available to release the compressed air. The speed governor of air compressors shall be periodically inspected and maintained in good working order, and a mechanism shall be provided to monitor the flow of cooling water therein.

The ducts or pipes used in the aspiration system shall be made of non-flammable material in appropriate sections, and flexible hoses such as spiral or bendable hoses shall be used at portable suction points. Daily maintenance and cleaning of the aspiration system shall be carried out, and a general inspection and cleaning shall be performed every three months, ensuring that the installation characteristics of the system are not altered after repairs. The electric motors of aspirators shall be suitable for the working environment, and in cases where combustible and flammable substances are present in the air being drawn, the motor shall be appropriately mounted or made of a type resistant to such substances.

There should be guardrails to prevent approaching the sieves from more than a certain distance on the sieve floor. No one other than the responsible person should be allowed to enter this area while the machines are running.

Table 3. Risks identified in the production area

Hazard	Risk	Consequences	I	S	RS
System Room	Electrical leaks, electrocution	Injury, death, property damage	4	5	20
Electrical Panel and Installation	Electrical leaks, electrocution	Injury, death, property damage	4	5	20
Control panels	Electrical leaks, electrocution	Injury, death, property damage	4	5	20
Lack of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
Fire extinguishing systems not easily accessible	Failure to intervene in fire	Injury, death, property damage	4	5	20
Lack of maintenance of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
Lack of warning and warning signs and signs	Increase in work accidents	Injury, death, property damage	3	4	12
Inappropriate hygiene conditions	Bacteria and microorganisms occurring between hands and nails	Infective diseases	3	3	9
Electricity leaks in machines	Electrocution, shock	Injury, death, property damage	3	4	12
Insufficient Machine guards	Piece flying, hand-arm entrapment	Loss of limb, injury	3	4	12
Mill motors fixed to the ceiling	Engine falling to the ground	Injury, death, property damage	3	4	12
Roller mill machine	Hand-arm capture	Loss of limb	4	4	16
Roller mill machine	Exposure to Excessive Noise	Hearing loss	3	4	12
Compressor	Explosion	Injury, death, property damage	4	5	20
Grain Tempering machine	Hand-arm capture	Loss of limb	2	3	6
Pneumatic Fan	Fire -explosion	Injury, death, property damage	3	4	12
Sieve	Falling, Tripping	Injuries, fractures in various parts of the body	2	3	6

The lack of maintenance, cleaning, and operational procedures in the existing boiler room poses significant risks (I:4, s:5, RS:20) in the workplace (Table 4). All boilers used in the workplace must be located in a separate compartment or building resistant to fire and explosion, and no workers should be employed on the floor above the boiler room. Our regulations require boiler rooms in workplaces where explosive, flammable, or highly flammable materials are handled to have windows and doors opening to other workplaces. It is important to ensure that qualified individuals perform the inspection and testing of boilers. Before an employee enters the boiler for cleaning, maintenance, or repair, the blow-off, feedwater, steam, and hot water outlet stop valves, as well as all other valves, must be closed and warning signs placed on them.

A guide should be provided for aligning the truck properly with the wheat unloading section in the raw wheat unloading area, and the truck driver should wait in a safe area outside the vehicle during unloading. Lifting machines and vehicles should be checked before each operation, and operators should control the machine from a safe distance. No personnel should be present in this section during unloading, and the lift should be remotely controlled from outside the unloading area. The regulation states that there should be an aspiration system capable of removing wheat dust at such points, and personnel should not enter this area until the dust is completely removed from the environment. Compressors should be remotely stopped in case of danger, and safety valves should be installed in the air tanks. Special compressor oil should be used in compressors, and the tanks should be located in a compartment resistant to explosions, or mobile compressors should be located at least 10 meters away or inside a durable compartment. When the pressure is adjusted, the compressor motor will automatically stop, and there will be a safety device to release the compressed air. The speed regulators of compressors should be periodically checked, and clean air intake should be ensured. Periodic checks should be conducted after assembly and repair to ensure the safe operation of compressors, and a pressure test should be conducted at 1.5 times the maximum pressure (BEY, 2018).

Precautions should be taken against the risk of trapping hands and arms (l:3, s:4, RS:12) in elevators used in silos, and employees should be ensured to move at a safe distance (Table 4). Work should not commence if protective parts are removed, and in case of blockage, the movement of the elevator shaft should be completely stopped to rectify the malfunction. There should be a safety mechanism that automatically stops the elevator in case of overheating, and a grounding system should be in place to prevent static electricity buildup. The cleaning of cylinders or drums at the head of belt conveyors should be done using appropriate blades or rotating brushes, and a grounding system should be installed to prevent static electricity buildup. Adequate precautions should be taken for welding and cutting operations, and conveyor mechanisms should be explosion-proof (Karadağ, 2001). Grain silos and warehouses should be equipped with dust and waterproof covers and ventilation systems. Ventilation should be provided inside the silos, and lightning rods and grounding systems should be installed to prevent static electricity or lightning risks. Before maintenance and repair, the power source of the mixing device should be cut off, and personal protective equipment attached to safety belts should be used on silo stairs. Guards should be designed to cover hazardous parts by interrupting all types of contact and should be made of castings, sheet metal, tubing or other suitable materials. Pulleys should not be used if cracked or damaged, transmission belts should be made sound, seamless, and belt joints should be securely fastened. (MEY, 2009).

Work with hazardous chemicals should be carried out in accordance with technological advancements, and appropriate processing, usage, transportation, and storage conditions should be provided based on the size of the workplace, the nature of the work performed, and the characteristics of the substances used (Table 4). Due to the potential risk of accidents, fire, and death associated with working with chemical substances (l:4, s:4, RS:16), adequate firefighting equipment and, when necessary, fire detectors and alarm systems should be provided (Table 4). In addition, appropriate conditions for personal hygiene should be provided, and the conditions for the use and storage of chemicals obtained from manufacturers should be arranged according to the information provided in the relevant forms. (BYKHY, 2007).

It is important for the personnel working in the packaging department to be trained and provided with personal protective equipment to address significant risks (l:3, s:3, RS:9). Transparent and hinged covers should be used to cover the front of the filling pipes on the sack filling machines (Table 4). Suitable work organization and mechanical systems should be used for the transportation of loads without the need for manual handling in the workplace (Özlem & Akalp, 2017). Programs should be tailored to the job and adjustable according to the operator's knowledge and experience, but they should not be changed except by the operator's intervention. Systems should be feedback-controlled to increase the efficiency of workers and provide convenience, delivering information to the operator at suitable speeds and formats. Additionally, importance should be given to the ease of perception and use of data in accordance with ergonomic principles. All these measures will eliminate the possibility of work accidents and provide a safer working environment (Figure2).

The working conditions and unsafe behaviors of employees significantly increase the risk level (l:3, s:5, RS:15) in the loading section (Table 4). Primarily, it is important to ensure that the rotating parts in the working area are enclosed to prevent entry of hands and arms, the cylinders or drums at the beginning of conveyor belts are not cleaned manually but with appropriate guards, openings on roller conveyors are covered with suitable caps, and conveyors are protected when they are in a pit or at ground level. It is necessary to install guards against belt breakage on conveyor belts and replace damaged cables (Horozoğlu, 2017). Proper placement of controls devices, keeping them away from water sources, ensuring system grounding of electrical installations, and providing appropriate personal protective equipment (such as insulating gloves) are important for occupational safety.

In office work conducted without taking occupational safety and employee health measures, especially musculoskeletal disorders can be encountered. Additionally, there are many risks (l:2, s:3, RS:6) that may lead to other occupational diseases and work accidents due to the conditions of the work process (Table 4). The work environment in executive offices presents ergonomic hazards, and symptoms of burnout have been observed among employees. For ergonomic arrangement of the workspace, the keyboard should be separate and movable, wrist support should be provided on the front, the keyboard should have a matte finish, and characters should be arranged to facilitate use.

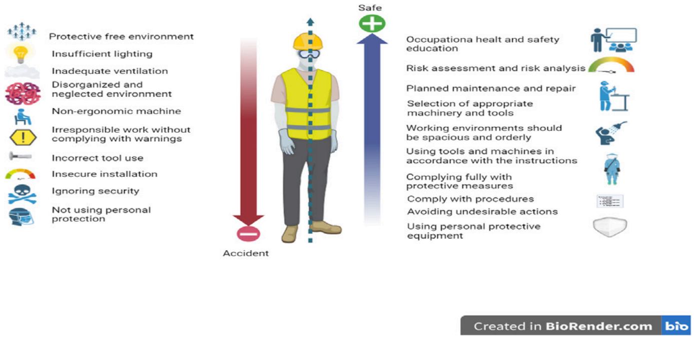

Figure 2. Causes of accidents and prevention of hazards

Table 4. Risks recorded according to fields of activity

	Hazard	Risk	Consequences	I	S	RS
Boiler Room	Inappropriate location of the Boiler Room	Fire, explosion	Injury, death, property damage	4	5	20
	Maintenance-Free Boiler	Fire, explosion	Injury, property damage	4	5	20
	Improper Working Methods	Fire, explosion	Injury, death, property damage	4	5	20
Raw Material (Wheat) Unloading	Truck	Crashing, tipping over, crushing, crushing while the truck approaches the lift	Injury, death, property damage	3	4	12
	Wheat powder	Excessive dust exposure during unloading of raw material	Lung respiratory diseases	3	4	12
	Compressor	Explosion	Injury, death, property damage	3	5	15
Raw Material Storage	Elevator	Hand and arm capture	Limb loss	3	4	12
	Transporter	Hand and arm capture	Limb loss	3	3	9
	Silos	Dust explosion	Injury, death, property damage	2	5	10
	Working at Height	Falling from high	Injury, death	3	5	15
	Blending Machine	Hand and arm capture	Limb loss	3	4	12
laboratory	Chemicals	Fire, explosion	Injury, death, property damage	4	4	16
	Lack of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
Packaging	Packaging machine	Hand and arm capture	Injury, limb loss	2	4	8
	Sack Filling Benches	Exposure to excessive flour dust	Lung respiratory diseases	2	4	8
	Manual handling	Physical strains	Musculoskeletal system diseases	3	3	9
	Computer programs in Display Vehicles	Difficulty in perception and use	Various eye diseases	2	3	6
Loading	Belt Carriers	Hand and arm capture	Injury, limb loss	3	4	12
	Belt Carriers	Electric shock	Injury, death, property damage	3	5	15
Administration Building	Electrical Panel and Installation	Electrical leaks, electrocution	Injury, death, property damage	4	5	20
	Lack of fire extinguishing systems	Failure to intervene in fire	Injury, death, property damage	4	5	20
	Fire extinguishing systems not easily accessible	Failure to intervene in fire	Injury, death, property damage	4	5	20
	Vehicles with Display	Detection problems caused by the monitor	Various eye and nerve diseases	2	3	6
	Vehicles with Display	Disorders caused by keyboard use	Carpal tunnel syndrome	2	3	6
	Vehicles with Display	Unsuitable Physical strain caused by the work table and its surface	Musculoskeletal system diseases	2	3	6
	Lack of lightning system (lightning rod)	Lightning	Injury, death, property damage	4	5	20
	Lack of first aid cabinet	Failure to intervene in the injured person in the event of an accident	Injury, death, property damage	3	5	15
	Inappropriate Emergency exit routes and doors	Workers' inability to leave the danger zone	Injury, death	4	5	20

The work table or surface should be adjustable to allow the employee to work comfortably and efficiently without reflecting light. For ensuring safe exits in emergencies, emergency exit routes should directly lead outside, be unobstructed, and appropriately marked (İBEASGÖİY, 2013). Emergency exit doors should not be locked and should be prevented from being obstructed by any barriers. Backup lighting systems should be available in emergency exit routes that need to be illuminated in case of power outage.

CONCLUSION

Increasing awareness of workplace risks and taking appropriate measures to protect the safety and health of employees is crucial within the scope of occupational health and safety efforts. In this study, various hazards faced by flour mill workers and the necessary measures to reduce these hazards have been comprehensively addressed. In addition to potential risks such as electricity, careless behavior, rotating machinery, and exposure to flour dust, issues such as fire, lightning, deficiencies in signage, inadequate hygiene conditions in shower cabins, organization of night shifts, and lack of emergency exit doors have also been discussed. Measures taken to mitigate these hazards and steps that need to be taken have been outlined, emphasizing key points to be considered regarding occupational health and safety. In order to eliminate the negative effects of flour dust on workers' health, proper operation of the necessary ventilation system must be ensured. In areas where dust exposure is high, it would be advisable to use appropriate personal protective equipment such as masks. Periodic maintenance should be carried out on the electrical system and guards should always be used on machinery with rotating parts.

In this analysis, significant risks related to the maintenance and safety of electrical panels in the production area (l:4, s:5, RS:20), inadequate firefighting equipment (l:4, s:5, RS:20), compliance with hygiene standards (l:3, s:3, RS:9), lack of machine guards (l:3, s:4, RS:12), and noise levels (l:3, s:4, RS:12) have been identified, requiring urgent measures. Therefore, it is critical for employers and employees to be aware of these risks, provide the necessary training, and diligently implement the necessary measures. The lack of procedures in the boiler room exposes serious risks such as fire and explosion. Proper installation, inspected by qualified personnel, and maintained as required are essential. In the raw material unloading area, appropriate guidelines should be provided for the safe unloading of trucks and necessary precautions should be taken to ensure the safety of personnel during operations.

Identifying potential workplace hazards and taking the necessary precautions against those hazards is critical to ensuring the safety and health of employees. Employers and employees who are aware of occupational health and safety issues and take the necessary precautions will ensure that everyone has a safe working environment. Therefore, it is important to continually review workplace risks and take preventive measures.

Compliance with Ethical Standards

Peer-review

Externally peer-reviewed.

Conflict of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

Author contribution

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REFERENCES

Ajeel, N. A. H and Al-Yassen, A. K (2007). Work related allergic disorders among flour mill workers. The Medical Journal of Basrah University (MJBU). 25(1):29-32.

Ali, D. M., & Mohamed, R. H. (2023) Effect of Educational Program on Occupational Health and Safety Competencies Among Flour Mill Workers. Journal of Nursing and Health Science, 3(2), 38-44. DOI: 10.9790/1959-1203023844

Babel, S., & Rajvanshi, R. (2013). Occupational health hazards faced by the flour mill workers. Indian Journal of Extension Education, *21*, 165-169.

Bakx, G. C., & Nyce, J. M. (2017). Risk and safety in large-scale socio-technological (military) systems: a literature review. Journal of Risk Research, *20*(4), 463-481. https://doi.org/10.1080/13669877.2015.1071867

Berberoğlu, U., Eskiocak, M., Ekuklu, G., & Saltık, A. (2002). Tam Gün İşyeri Hekimi Çalışan Bir İşletmede İşçi Sağlığı ve İş Güvenliği Hizmetleri Yönetim Sürecinin Değerlendirilmesi. Ttb Mesleki Sağlık ve Güvenlik Dergisi, (in Turkish),*3*(9), 31-35.

BEY, (2018). Basınçlı Ekipmanlar Yönetmeliği, (in Turkish) Retrieved in January, 24, 2023 from https://www.mevzuat.gov.tr

BYKHY, (2007). Binaların yangından korunması hakkında yönetmelik. (in Turkish), Retrieved in January, 20, 2023 from https://www.mevzuat.gov.tr

Çalış, S., & Büyükakıncı, B. Y. (2021). Türkiye'nin iş kazaları açısından durumu: ILOSTAT ve SGK verileri karşılaştırması. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*, (in Turkish), *23*(2), 574-585. https://doi.org/10.32709/akusosbil.623803

ÇGİRKDY, (2012). Çalışanların Gürültü İle İlgili Risklerden Korunmalarına Dair Yönetmelik, (in Turkish), Retrieved in January, 22, 2023 from https://www.mevzuat.gov.tr

ÇPOTKHY, (2013). Çalışanların Patlayıcı Ortamların Tehlikelerinden Korunması Hakkında Yönetmelik, (in Turkish), Retrieved in January, 25, 2023 from https://www.resmigazete.gov.tr

El Karim, M. A. A., El Rab, M. O. G., Omer, A. A. A., & El Haimi, Y. A. (1986). Respiratory and allergic disorders in workers exposed to grain and flour dusts. Archives of Environmental Health: An International Journal, *41*(5), 297-301.

Eser, A. (2015). Maden işlerinde solunum koruyucu donanımlar. Maden İşletmelerinde İşçi Sağlığı ve İş Güvenliği Sempozyumu, (in Turkish), 21-22.

ETTY, (2001) Elektrik Tesislerinde Topraklamalar Yönetmeliği, (in Turkish), Retrieved in January, 22, 2023 from https://www.mevzuat.gov.tr

Gul, M., & Ak, M. F. (2018). A comparative outline for quantifying risk ratings in occupational health and safety risk assessment. Journal of cleaner production, *196*, 653-664. https://doi.org/10.1016/j.jclepro.2018.06.106

Horozoğlu, K. (2017). İş kazalarının iş sağlığı ve güvenliği açısından analizi. Karabük Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, (in Turkish), *8*(2), 265-281.

İBEASGÖİY, (2013). İş yeri Bina ve Eklentilerinde Alınacak Sağlık ve Güvenlik Önlemlerine İlişkin Yönetmelik, (in Turkish), Retrieved in January, 12, 2023 from https://www.mevzuat.gov.tr

İHÖTAHY, (2023). İş Hijyeni Ölçüm, Test ve Analizleri Hakkında Yönetmelik, (in Turkish), Retrieved in January, 27, 2023 from https://www.resmigazete.gov.tr

İş Kanunu (2023) İş Kanunu, (in Turkish), Retrieved in January, 21, 2023 from https://www.mevzuat.gov.tr

Kakooei, H. and Marioryad, H. (2005). Exposure to Inhalable Flour Dust and Respiratory Symptoms of Workers in a Flour Mill in Iran. Iranian Journal of Environmental Health Science & Engineering. 2 (1):50-55.

Karadağ, Ö. K. (2001). Kaynak İşlerinde İş Sağlığı ve Güvenliği. TTB Mesleki Sağlık ve Güvenlik Dergisi, (in Turkish), *2*(8), 27-32.

Korshunov, G. I., Kabanov, E. I., & Cehlar, M. (2020). Occupational Risk Management In a Mining Enterprise With the Aid of an Improved Matrix Method for Risk Assessment. Acta Montanistica Slovaca, *25*(3). https://doi.org/10.46544/AMS.v25i3.3

Lindholm, M., Rantala, M., & Tappura, S. (2022). Development needs for risk assessment–A case study of five Finnish companies. Safety Management and Human Factors, Vol. 64, 2022, 177–183 https://doi.org/10.54941/ahfe1002643

Lyon, B. K., & Hollcroft, B. (2012). Risk Assessments. Professional Safety, *57*(12), 28-34.

MEY, (2009). Makina Emniyeti Yönetmeliği, (in Turkish), Retrieved in January, 22, 2023 from https://www.mevzuat.gov.tr

Mutlu, M., & Çabuk, A. (2021). Türkiye'de Elektrik Kazalarında Kök Neden Analizi. İSG Akademik, (in Turkish), *3*(1), 15-24.

Oliveira, M. D., Lopes, D. F., & Bana e Costa, C. A. (2018). Improving occupational health and safety risk evaluation through decision analysis. *International Transactions in Operational Research*, *25*(1), 375-403. https://doi.org/10.1111/itor.12339

Özlem, K. & Akalp, G. (2017). İş Sağlığı ve Güvenliği Açısından Elle Taşıma İşlerinin Değerlendirilmesi: Tekstil ve Otomotiv Sektörü Örneği. ISGUC The Journal of Industrial Relations and Human Resources, (in Turkish),71-82. https://doi.org/10.4026/isguc.371037

Rawat, I., & Gaikwad, N. (2020). Work environment in the wheat mills of Punjab, India. Current Science, *118*(4), 526-531.

SGİY, (2012). Sağlık ve Güvenlik İşaretleri Yönetmeliği, (in Turkish), Retrieved in January, 26, 2023 from https://www.resmigazete.gov.tr

SGK, (2023). Sosyal Güvenlik Kurumu, (in Turkish), Retrieved in January, 12, 2023 from https://www.sgk.gov.tr/

Smith, T. A and Lumley K. P. S (1996). Work-related asthma in a population exposed to grain, flour, and other ingredient dusts. Occupational Medicines. 46: 37-40. https://doi.org/10.1093/occmed/46.1.37

Şerifoğlu, U. K., & Sungur, E. (2007). İşletmelerde Sağlık ve Güvenlik Kültürünün Oluşturulması; Tepe Yönetimin Rolü ve Kurum İçi İletişim Olanaklarının Kullanımı. *Yönetim Dergisi*, (in Turkish), *58*.

Şimşek, H., & Aydoğdu, M. (2020). Endüstriyel İşlerde Yangın Sistemlerinin İş Sağlığı ve Güvenliğinde Etkileri. İSG Akademik, (in Turkish), *2*(1), 35-45.

Tekın, P. & Rızvan, E. (2016). Risk analizi: Bir otomotiv fabrikasında gerçekleştirilen X tipi karar matrisi uygulaması. Kahramanmaraş Sütçü İmam Üniversitesi Mühendislik Bilimleri Dergisi, (in Turkish), *19*(3), 91-98.

Tiikkainen, U., Louhelainen, K., & Nordman, H. (1996). The Nordic expert group for criteria documentation of health risks from chemicals 120. Flour Dust.

Tosun, S. (2022). Elektrikle Çalışmalarda İş Sağlığı ve Güvenliği Üzerine Bir Değerlendirme. Sürdürülebilir Mühendislik Uygulamaları ve Teknolojik Gelişmeler Dergisi, (in Turkish), *5*(2), 232-246. https://doi.org/10.51764/smutgd.1082589

Ünsar, A. S. (2004). İş kazalari ve örgütsel verimlilik. Verimlilik Dergisi, (in Turkish), (3).

Wijeratne, W. M. P. U., Perera, B. A. K. S., & De Silva, L. (2014). Identification and assessment risks in maintenance operations. Built Environment Project and Asset Management, *4*(4), 384-405. https://doi.org/10.1108/BEPAM-09-2013-0041

Yağmur, R. (2016). Un İmalatında Çalışanların Gürültü ve Titreşim Maruziyetlerinin Değerlendirilmesi. Ç. V. S. G. Bakanlığı, Uzmanlık Tezi, (in Turkish).

YİİSGY, (2013). Yapı İşlerinde İş Sağlığı ve Güvenliği Yönetmeliği, (in Turkish), Retrieved in January, 22, 2023 from https://www.mevzuat.gov.tr