

## EVALUATING OCCUPATIONAL HEALTH AND SAFETY RISKS IN THE TEXTILE SECTOR: A TEXTILE WORKSHOP CASE STUDY IN İĞDIR

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### Abstract

The textile industry, known for its labor-intensive nature, often encounters occupational health and safety challenges, impacting both worker welfare and production efficiency. This study conducts a comprehensive risk assessment in a textile workshop in İğdır, employing the 5x5 matrix method to analyze health and safety risks. The assessment identified potential hazards within workplace operations that could endanger employee health and safety. Notably, small-scale subcontractors in the sector tend to overlook occupational health and safety regulations, leading to inadequate safety protocols. The results indicate high-risk levels (R:20-25) for electrical, emergency response, workplace hygiene, and ergonomic factors, posing significant health risks. However, immediate implementation of appropriate countermeasures can mitigate these risks to acceptable levels (R:2-8). Additionally, risks associated with the thermal comfort conditions in the work environment were assessed at R:15-20, which can also be reduced to tolerable levels through periodic maintenance and targeted investments. Given the sector's labor intensity, it is crucial for both workers and employers to cultivate a strong awareness and understanding of occupational health and safety. Enhancing sector-wide adherence to health and safety standards is essential for safeguarding employee well-being and maintaining workplace efficiency.

**Keywords** occupational risk assessment, 5x5 matrix method, textile industry, workplace hazards

**JEL Codes** J81, L67, I18, J28

**Research and Publication Ethics Statement** The study has been prepared in accordance with the rules required by research and publication ethics. It does not involve any situation that requires ethical committee approval.

**Financial Support and Conflict of Interest Statement** No support has been received from any institution or organization for this study.

## INTRODUCTION

The textile industry plays an important role in the economy of our country. According to data from the Social Security Institution (SSI), as of November 2022, Turkey's garment sector employs 1,229,423 people and ranks 6th in the world in terms of garment exports. Moreover, its share in Turkey's total manufacturing sector is 27.4%. In terms of exports of ready-made garments to EU countries, Turkey ranks 3rd after China and Bangladesh (according to Ministry of Trade data). In addition to these achievements, various programs are being developed to support exports to the textile industry and investments are being made in new textile production facilities (Ağraş & Çetinkaya, 2023, p. 27).

The textile sector has become an important part of Turkey's growth and transformation strategies, especially with the growth of international brands. With the impact of globalization, automation and mechanization, as well as energy and labor efficiency, have become important variables in the sector (Koçak *et al.*, 2023, p. 51).

With technological and economic advances, occupational accidents and diseases are on the rise, negatively impacting the health of workers. Today, workers in the workplace are aware of the need for improvement in working conditions and are demanding that employers conduct risk assessment studies. The Occupational Health and Safety Law No. 6331, which came into effect in 2012, is based on the European Union's Directive 89/391 and makes risk assessment mandatory in all workplaces and places important responsibilities on employers in this regard (Eraslan, 2023, p. 134).

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The textile industry includes various sub-sectors such as spinning, weaving, dyeing, wet processing, and knitting, and with the advancement of technology, safety and health risks have also increased (Shah *et al.*, 2015, p. 868). As in other sectors, the textile industry has serious hazards and accident risks to worker health. These risks can endanger worker health, cause accidents, and reduce economic productivity (Mohamadinejad *et al.*, 2019, p. 65).

Between 2008 and 2021, a total of 172,445 occupational accidents occurred in Turkey's textile manufacturing sector. Due to the high number of female workers in this sector, 25% of the workers affected by these accidents are women, a rate not seen in other sectors. Between these years, 5% of all occupational accidents in all sectors occurred in the textile products manufacturing sector (Sekmen & Zengin, 2023, p. 66). In addition, a total of 222 occupational diseases were recorded during the same period.

The textile industry poses several hazards, including health risks such as hearing loss, musculoskeletal disorders due to workplace conditions, and high industrial noise levels. These hazards include ergonomic risks such as postural disorders, repetitive movements, static work, carrying and pulling heavy loads, inadequate work areas, and working above shoulder height (Akyol, 2022, p.73).

In the category of chemical risks, factors such as solvents, paint thinners, fibers, dust, and vapors harm health. Regarding physical factors, factors such as high noise levels, vibrations, and lack of appropriate thermal comfort conditions are among the possible causes of accidents and occupational diseases (Rençber, 2022, p.752).

In addition, psychosocial problems are also significant. Stress-related problems can significantly negatively affect workers' health and performance (Demiral *et al.*, 2023, p.57). Therefore, identifying, assessing, and effectively managing risks is extremely important to improve workplace safety and productivity in the textile industry.

## **MATERIAL AND METHOD**

The risk assessment methodology begins with identifying hazards present in the workplace or that may occur during activities. Once the hazards are identified, the risks posed by these hazards are assessed. Control measures to be taken to prevent risks are identified and implemented. The final stage is a monitoring and review phase in which the arrangements' accuracy and the practices' effectiveness are checked (Çavuş, 2015, p.7). Risk assessment is a continuous cycle and should be regularly checked and updated (Figure 1).

A risk assessment was conducted with the data obtained by evaluating the working environment, the machines used, and human and environmental conditions in a sample ready-to-wear textile workshop in Iğdır. In the workplace where the study was conducted, the workplace was examined in detail to determine the existing hazards in the workshop for risk assessment. The noise generated by the machines in the workplace during operation exceeds 85 dB. To reduce the damage caused to the employee by this noise level, the employer-provided each employee with hearing protection as personal protective equipment.

The L-type matrix method is commonly known as a 5x5 matrix and is also referred to as a "cause-and-effect matrix." This method is used to assess the likelihood of events occurring and the severity of damage if they do occur (Öztürk & Şimşek, 2020, p. 64). In Turkey, it is one of the most widely preferred methodologies for risk assessment. The L-type matrix method has a simple and understandable structure and stands out as a technique that an analyst can easily apply. It is an ideal method, especially for small workplaces (Aker & Özçelik, 2020, p. 68).



**Figure 1.** Risk Assessment Steps

However, more than the L-type matrix method is required in the case of complex structures with different workflows in larger companies. When using this method, the entire workplace workflow is risk assessed, and the organization is reviewed in detail (Selçuk & Selim, 2018, p.27). This process meticulously identifies all sources of hazards that could pose a risk and creates a hazard list, regardless of the significance or magnitude of those hazards.

To identify hazards, machine manufacturers' instructions, material safety data sheets, and all work accidents and near misses that have been recorded or not recorded in the past are examined. This way, overlooked hazards are also identified and added to the hazard list (Kabakulak, 2019, p.103).

A risk score is then calculated for each identified hazard. This score is obtained by multiplying the likelihood and severity values. The likelihood of the hazard occurring (Table 1.) takes into account the effectiveness of existing control measures, the number of workers exposed to the hazard, the duration and frequency of exposure to the hazard, the level of protection provided by personal protective equipment and the frequency of its use, and the unsafe behavior of workers (Güneysu, 2016).

**Table 1.** Likelihood Rating

Likelihood	Rating	
VERY SMALL	1	Once a Year
SMALL	2	Every Three Months
MIDDLE	3	Once a Month
HIGH	4	Once a Week
VERY HIGH	5	Every Day

An assessment is made according to Table 2 to determine a value for the severity of the consequences if the hazard occurs. The product of probability and severity calculated on the basis of these criteria yields the risk score. The severity of the risk is determined according to Table 3. The highest risk scores are evaluated according to Table 4 to determine which actions to take first, what actions to take, and when to take them.

**Table 2. Severity Rating**

Severity	Rating	
VERY LIGHT	1	No Lost Working Hours
LIGHT	2	No Lost Working Days
MIDDLE	3	Minor Injury
SERIOUS	4	Death, Limb Loss
VERY SERIOUS	5	Multiple Deaths

**Table 3. Matrix Decision Grid**

Severity	1	2	3	4	5
Likelihood					
1	Very Low Risk 1	Low Risk 2	Low Risk 3	Low Risk 4	Low Risk 5
2	Low Risk 2	Low Risk 4	Low Risk 6	Significant Risk 8	Significant Risk 10
3	Low Risk 3	Low Risk 6	Significant Risk 9	Significant Risk 12	High Risk 15
4	Low Risk 4	Significant Risk 8	Significant Risk 12	High Risk 16	High Risk 20
5	Low Risk 5	Significant Risk 10	High Risk 15	High Risk 20	Very High Risk 25

**Table 4. Risk Score Evaluation Table**

Risk Score	Decision
16, 20, 25	UNACCEPTABLE RISK Work must be done immediately on these risks
8, 9, 10, 12, 15	SIGNIFICANT RISK These risks should be addressed as quickly as possible
1, 2, 3, 4, 5, 6	ACCEPTABLE RISK May not require immediate action

## RESULTS AND DISCUSSIONS

Risk assessment is a fundamental process for protecting the safety and health of workers in the workplace. The objective of this process is to identify the Company's exposure to risk and reduce it to an acceptable level by applying appropriate control methods. This study, conducted in the textile workshop, addressed all factors that could affect the safety and health of employees and determined the probability of possible risks and the severity of the risk if it occurred. In this framework, appropriate control methods have been determined to mitigate risks and these control methods can be used to reduce the likelihood of risks or minimize their impact (Ceylan & Başhelvacı, 2011, p. 28). Full implementation of these control methods required a new risk assessment and reevaluation of risk levels.

Control methods can be used to reduce the likelihood that risks will occur, as well as to help reduce the severity of any damage that may occur as a result. Therefore, implementing risk assessment and control methods in the workplace is critical to protecting the safety and health of employees (Karadaş & Çögenli, 2020, pp. 115-120).

It is essential to be prepared for a fire that may occur in the workplace for any reason, because a fire that may occur in the workplace for any reason will grow in dimensions that cannot be intervened in a very short time. In the current situation, the fact that the fire extinguishers in the workshop are in disrepair and not located at appropriate points indicates that the probability of fire occurrence is high (L: 4), and if it occurs, the severity will be high (S: 5) and the risk score

is unacceptable and requires immediate intervention (R:20). As control methods, it was suggested that a fire extinguisher of appropriate size and type should be kept in the workshop and that it should be checked every six months by the authorized company and the location of the fire extinguisher should be indicated with warning signs and fire training should be given to the employees (Kahraman, 2009). As a result of the application of control methods, it is stated that the severity will be one, the probability will be five, and the risk will be reduced to an acceptable level (S:5).

The presence of defective and inappropriate installation of electrical panels, especially broken switches and fuses in the open (L:5, S:3, R:15). It will increase the risk of fire in case of leakage current (Tosun, 2022). If the residual current relay is installed and controlled by persons in accordance with the legislation, the electrical lines are maintained annually and the panel is closed and opened only by the authorities, both the severity and the probability will decrease (L:1, S:2, R:2).

The occasional inappropriate behavior of employees, especially smoking while operating machinery, requires reorganizing the workplace order and working conditions. The risk of fire and pollution of the ambient air necessitates immediate intervention (L:5, S:3, R:15). Workers should be trained not to approach the sewing machine with fire or cigarettes, not to pay attention to electricity and static electricity, and warning signs should be placed. As a result of these measures, the possibility of the risk will be eliminated (L:1, S:3, R:3).

Emergency directions should be made, and emergency gathering areas should be determined so that it is easy to find the exit in the workplace in case of emergency. Emergency exit doors should open outwards. Doors on the escape route and in the assembly area should not be locked, and these routes should be illuminated so as not to be affected by power failures (Colak *et al.*, 2018). Emergency training and drills should be conducted regularly. Warning signs and signs should be used, emergency exit doors should be designed in accordance with legislation, and they should be fire resistant.

As can be seen in Table 5, emergency training for employees will significantly reduce the risk. Failure to use personal protective equipment (L:4, S:4, R:16) can lead to significant, life-threatening risks. Visors and protective goggles must be used when working with sewing machines. Employees should be informed about this issue and should be constantly supervised. Failure to establish work procedures will cause disruptions in the workplace. The procedures required before and after using the devices must be specific (Polat, 2019). In particular, electronic hand tools should not be left in the socket after use (L:4, S:5, R:20) and should be placed and stored afterward. Employees should be trained on this issue, and continuous (L:1, S:5, R:5) warnings should be provided.

According to the Regulation on Electrical Internal Facilities, the plugs and sockets to be used in workplaces must comply with Turkish Standards, and the sockets should not be used as distribution boxes (Figure 2). Connecting more than one plug to the sockets and stacking materials in front of them (L:4, S:5, R:20) will increase the fire risk. All sockets should be protected and covered, and employees should be trained and constantly monitored (L:1, S:5, R:5). Open-ended, damaged, and worn electrical cables should not be used and should be replaced immediately. Unused cables should not be in the working environment (L:1, S:5, R:5); the current should be cut, connected with insulators, and removed from the environment.

Unprotected water and natural gas connections made by unqualified persons may result in loss of life and property due to the risks they may cause in the workplace (L:4, S:4, R:16). Qualified persons can remedy this situation through maintenance and repairs (Figure 2). Materials or shelves should not be placed in front of water, natural gas, and electricity lines; they should be

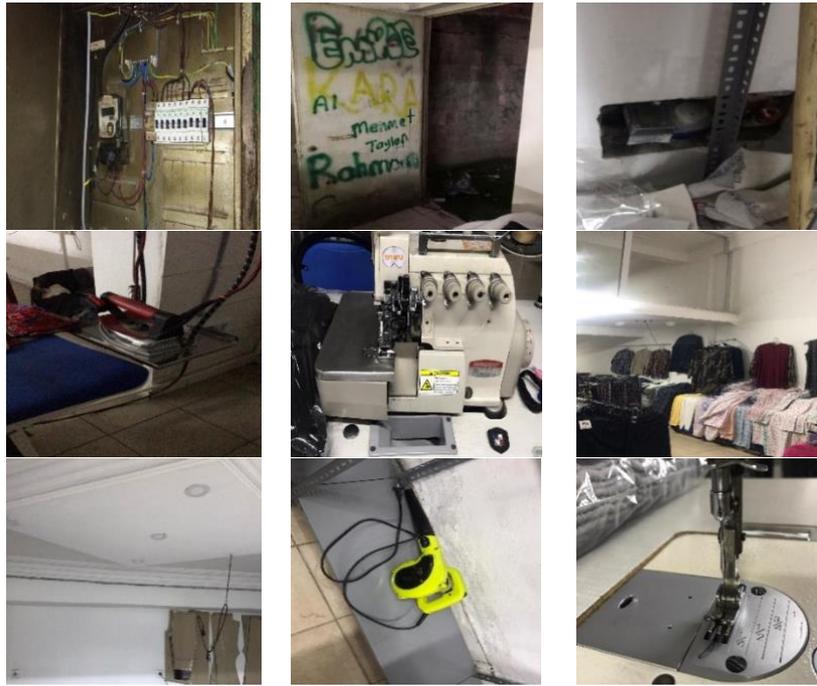
easily accessible (Kaya, 2022). These sections should have covers and be opened and closed by authorized persons (L:4, S:1, R:4). Regular periodic checks of these lines should be carried out.

**Table 5.** Unacceptable Risks Assessment Table

Hazard Source	Hazard	Risk	Outcome	BEFORE			AFTER		
				Severity	Likelihood	Risk Score	Severity	Likelihood	Risk Score
Emergency Plans	Having fire extinguishers that are outdated and not periodically inspected	Failure to Respond to Fire	Stampede, Crush	4	5	20	1	5	5
Emergencies - Electricity	Deformed Switch	Electric Shock Due to Leakage Current - Fire	Death, Fire	3	5	15	2	1	2
Working Environment	Non-ergonomic Chairs and Tables, Manual Handling	Ergonomic Risks	Musculoskeletal Diseases	4	4	16	2	1	2
Sewing Machine Oil Tank	Approach with Fire, Electricity, Spark	Loss of Life and Property due to Fire	Death, Fire	3	5	15	3	1	3
Emergency Plan and Emergency Signage	Lack of Emergency Gathering Area, Lack of Signage	Loss of Time, Confusion in Emergency Situations as a Result of Undetermined Gathering Area in Emergency Situations, Exit Doors Not Opening to the Outside / Lack of Emergency Guidance, Lack of Emergency Exit Signs	Stampede, Death	4	5	20	4	1	4
Emergency Exit Door	Locked Escape Doors at the End of Emergency Exit	Inability to Exit the Environment Due to Locked Exit Route, Confusion, Injury, Death	Multiple Deaths	4	4	16	4	1	4
Emergency Exit Routes Blocked with Material	Objects on the Escape Route Blocking the Escape Route	Inability to Exit the Environment in Emergency Situations Tripping, Falling, Injury, Death	Death	4	4	25	2	1	2
Sewing Machine	Sewing Machine Needle Breakage	Injury as a result of a sewing machine needle breaking and flying into the eye or face	Injury, Loss of Limb	4	4	16	4	1	4

In terms of workplace organization, materials should not be stacked on ironing boards. When the work with the iron is finished, the electricity should be cut off and turned off. Attention should be paid to the steam pressure of irons and explosion should be prevented (L:1, S:5, R:5). Employees should be informed and continuously supervised in this regard.

Cabinets used in the working environment must be fixed to the walls (L:1, S:4, R:4). Unfixed cabinets should not be stacked and should be removed from the working environment. Doorways should not be stacked in a way to prevent entry and exit, should not cause confusion, their paths should be clear and exit doors should be indicated with warning signs (L:1, S:4, R:4). In emergencies, simple irregularities that seem like they will not be a problem beforehand can lead to serious problems.



**Figure 2.** Pictures Showing Risky Situations at the Work Environment

There is a noticeable lack of personal protective equipment in the workplace. Protective gloves should be used when working with the machines used, instructions for use should be placed in visible places and should be understandable (L:1, S:3, R:3). They should only be used by trained people and warning signs should be placed to prevent unauthorized access (Çelebi, 2017).

The window should be closed and warning signs should be hung. Handrails should be installed in accordance with the legislation. Employees should be frequently informed about the danger (L:1, S:2, R:2). The workplace should be cleaned daily or weekly with appropriate disinfectants and sprayed against pests.

Failure to include hygiene requirements in the procedures in accordance with the work can lead to many problems in the workplace (Figure 3). Toilets and sinks should be cleaned daily within the scope of biological risk, appropriate disinfectants should be used, cleaning cards should be created, hygiene instructions should be posted at appropriate points (L:1, S:3, R:3).

Kitchen and equipment must be cleaned with necessary cleaning materials. They should be cleaned periodically every day, a cleaning list should be made and the person who cleans them should sign the list (L:1, S:4, R:4).

Garbage should not be accumulated and should be separated according to waste type. Garbage should not be kept in the working environment (L:1, S:4, R:4). Garbage should be sealed and disposed of permanently.

In particular, pieces of cut or processed fabrics may cause health problems by inhalation due to their fibrous structure (Figure 3). For this purpose, a regular ventilation system should be installed in the workplace and cleaned at regular intervals to ensure proper hygiene conditions (L:1, S:3, R:3).

In artificial ventilation systems, the air flow should be such that it does not disturb the employees, and it should have technical features that can immediately expel residues and impurities that can harm the health of the employees by polluting the ambient air (Demirel & Neriman, 2018, p. 577).

As part of workplace organization, materials should not be stacked on the machine, should be checked before the operation, employees should be warned about this issue and should be constantly inspected. The materials to be stored should be separated according to their types and stacked regularly, and the shelves should have covered (Figure 3).

Materials that may break should not be placed on the top shelves. Hygiene materials should be stacked separately (L:1, S:2, R:2).

**Table 6.** High Risks Assessment Table

Hazard Source	Hazard	Risk	Outcome	BEFORE			AFTER		
				Severity	Likelihood	Risk Score	Severity	Likelihood	Risk Score
Hand Tools and Extension Cords	Extension Cables Not Fixed	Electric Shock, Tripping, Falling, Injury	Injury, Death	5	4	20	5	1	5
Sockets	Stacking in Front of Unprotected Socket, Broken Socket and Connecting Multiple Plugs	Fire, Electric Shock,	Injury, Death	5	4	20	5	1	5
Electricity	Using Open-Ended, Damaged, Frayed, Electrical Cable	Electric Shock	Injury - Death	5	4	20	5	1	5
Water Line	Water Line Difficult to Intervene in an Emergency	Increased Loss of Life and Property as a Result of Failure to Intervene in Water, Natural Gas, Electricity Lines in Emergency Situations	Injury, Loss of Limb	4	4	16	4	1	5
Iron	Material Stacking on the Ironing Board	Fire Due to Material Stacking on the Ironing Board	Injury, Death	5	4	20	5	1	5
Cabinets	Unfixed Cabinets	As a Result of Falling on the Employee	Injury - Death	4	4	16	4	1	4
Scattered Items	Blocking of Roads by Objects	Tripping, Falling	Injury	4	4	16	4	1	4
Overlock Machine	Overlock Machine Needle Puncturing the Hand	Needle breakage	Injury, Loss of Limb	5	4	20	5	1	5
Open Unshielded Window	Falling from a Height	As a result of a fall from height	Injury - Death	5	4	20	2	1	2
First Aid Training	Failure to take	Failure to Intervene in Emergency Situations, Wrong Intervention	Serious Damage, Death	4	5	20	4	1	4
Medicine Cabinet	Absence, Incompleteness	Failure to Intervene in Emergency Situations, Wrong Intervention	Serious Damage, Death	4	5	20	4	1	4
Personal Protective Equipment	Absence	Working without PPE	Poisoning, Death	4	4	16	3	1	3
All Employees	Failure to Take Covid 19 Precautions	Epidemic Disease	Illness, Contagion, Death	4	5	20	4	2	8

For both the quality of the work and the eye health of the workers, where there is insufficient lighting in the working environment, the lights should be repaired, new bulbs should be installed and until all these are done, adequate ambient lighting should be provided with portable lighting (L:1, S:3, R:3). Regular renewal of the ambient air should be ensured with ventilation systems such as opening windows, air conditioners, etc.

**Table 7.** Significant Risks Assessment Table

Hazard Source	Hazard	Risk	Outcome	BEFORE			AFTER		
				Severity	Likelihood	Risk Score	Severity	Likelihood	Risk Score
Sanitation	Unhygienic Environment	Infectious Diseases and Infection	Disease, Treatment	3	3	9	3	1	3
Toilet Use	Unhygienic Sinks and Toilets	Biological Risk	Infectious Disease	4	3	12	4	1	4
Ventilation	Lack of Ventilation	Loss of workforce due to inadequate ventilation and the risk of infections	Lost Working Days	4	3	12	4	1	4
Storage	Stacking on the Machine	Machine Failure and Material Loss as a Result of Stacking on the Machine	Workday and Material Loss	2	4	8	2	1	2
Kitchen	Inadequate Kitchen Cleaning	Unhygienic Kitchen and Equipment	Infection and Food Poisoning	4	3	12	4	1	5
Storage	Irregular Storage	Material Loss due to Storage Disorganization	Rollover, Fall, Injury	3	4	12	2	1	2
Lighting	Inadequate Lighting	Stuck due to insufficient lighting,	Fall, Injury	3	3	9	3	1	3
Air conditioning	Delayed or Non-performance of Air Conditioner Maintenance	Legionella Bacteria Formation	Lung Diseases	4	3	12	3	1	3
Dirty and unclean floor	Bacteria and Dirt on the Floor	Infection	Poisoning, Skin Diseases	4	2	8	4	1	4
Workflow	Disorganized Work Environment	Psychosocial Problems	Lost Working Days	3	3	9	3	1	3
Garbage	Hazard of Infection	Infections that may occur due to open-mouthed garbage and the distribution of garbage in the working environment	Illness, Lost Working Days	4	3	12	4	1	4
Ambient Air	Dust Exposure	Lung Disorders	Illness, Lost Working Days	4	3	12	4	1	4

## CONCLUSION

The textile industry, which plays an important role in Turkey's economic development, requires more attention and effort in occupational health and safety issues. Protecting the physical health of employees and minimizing work-related injuries is critical to the sustainability of the industry. To this end, it is essential that industry stakeholders focus more on occupational health and safety issues and take appropriate action.

Many of the activities in this high-employment sector are labor-intensive. This situation brings along many risks. Especially during manual work, there are problems related to musculoskeletal disorders. In addition, contract manufacturing is carried out with an understanding that does not take occupational health and safety into account.



**Figure 3.** Illustrations Showing Moderate Risks at the Work Environment

In the study, a risk assessment was carried out in a textile workshop operating in Iğdır province, considering the activities performed and the working environment. 5x5 matrix method was used in risk assessment studies. Risks that may put the health and safety of employees at hazards have been identified. Recommendations were made to eliminate each risk, and the tables show how the risk situation changed after the action was taken.

The risk score, which expresses the deficiencies in the organization of the workplace, was expressed between 15 and 25, and it was stated that this situation would eliminate the possibility of accidents and diseases that may occur if this situation is actually implemented by binding it to a procedure. It is stated that the ventilation of the environment and the things that need to be done about electricity can draw the risk score to values such as 3-6 and that these are among the problems that need to be solved in the short term. In emergencies, the risk will be very high, and in the short term, it is possible to reduce the risk score from the highest levels such as 25 to levels such as 2-4 through training and necessary infrastructure investments.

In the 5x5 matrix method used in the study, the experience and attention of the safety professional performing the analysis is very important for the correct determination of the risk score. A small error in determining the probability or severity value can cause a less important hazard to be more prominent than a more important hazard and cause the necessary precautions not to be taken in a timely manner.

Identifying ergonomic risks in the work environment is the first step in preventing occupational diseases, absenteeism due to occupational diseases, and loss of manpower and productivity.

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