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Occupational Health and Safety Risk Assessment of a Tobacco Manufacturing Industry

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ABSTRACT

Occupational safety and health remain a critical challenge in the tobacco industry, where workers are exposed to a range of risks, including chemical, biological, and physical safety hazards. This study uses the Occupational Safety and Health Administration (OSHA) framework to represent the first-ever risk assessment of Pakistan's tobacco industry. Data was collected through a designed questionnaire survey filled out by the employees across various departments and the administration of a comprehensive safety checklist. The risk matrix was developed using the AS4360 standard of risk management. The checklist focused on identifying workplace hazards, compliance with safety regulations, and the effectiveness of existing risk mitigation measures. Findings revealed that the industry was ISO 14001 and OSHAS 18001 certified with no significant risks associated with prolonged exposure to tobacco dust and inadequate ventilation systems. Employees were well aware of and equipped with personal protective equipment (PPE) usage and training on hazard awareness. Cuts during material supervision in primary and secondary departments have high significance measured at 8 on a scale of 1-10, followed by fire hazard at the warehouse with high severity at 6 measured on a scale of 1-6 and high significance at 7. However, control measures were in place in the industry. This study underscores the importance of implementing effective occupational health policies, enhancing worker training, and regular monitoring to mitigate risks and ensure a safer work environment. These findings offer actionable insights for improving occupational safety in the tobacco industry and contribute to the broader discourse on workplace risk management.

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1. Introduction

The World Health Organization (WHO) characterizes a healthy workplace as one where employees and management work collaboratively through a continuous improvement process to safeguard and enhance the health, safety, and well-being of workers while ensuring workplace sustainability (WHO, 2010). This definition, considered foundational to occupational health and safety (OHS), encompasses multiple dimensions, including the physical work environment (e.g., addressing physical hazards), physiological health (e.g., disease prevention), health-related behaviors (e.g., promoting healthy lifestyles), psychological well-being (e.g., mental health support), and social aspects (e.g., fostering social relationships and support). Moreover, the concept of a healthy workplace extends beyond risk and hazard

prevention to actively promoting health, safety, and overall well-being (De Cieri & Lazarova, 2021). Risk assessment involves evaluating the effectiveness of different strategies or interventions for managing risks through a clear, reproducible, and well-defined methodology. Occupational health risk assessment (OHRA) is a vital focus area within environmental and sustainability studies, as well as cleaner production and industrial processes.

Broadly, the environment can be classified into two categories: the internal workplace environment and the external environment outside the workplace (Maragkidou et al., 2017; Zhang et al., 2021). Health risk assessment plays a crucial role in environmental and sustainability evaluations. Despite advances in technology, numerous studies have long established a connection between poor environmental conditions and health issues (Li et al., 2022; Savitsky, Radomislensky, & Hendel, 2021). OHRA provides a comprehensive analysis of occupational environments to identify factors, processes, or situations that may pose risks to human health, thereby supporting sustainable societal development (Maragkidou et al., 2017). The International Labour Organization (ILO) reports approximately 340 million occupational accidents and 160 million cases of work-related illnesses globally each year (International Labour Organization, 2022). In China, occupational diseases and work-related accidents result in an estimated annual direct economic loss of 100 billion CNY, with indirect losses reaching approximately 200 billion CNY (Li et al., 2022). Occupational health is increasingly recognized as a critical global public health challenge. OHRA has significantly advanced our understanding of occupational environments and their contribution to sustainability assessments, emphasizing its undeniable importance (Badri, Boudreau-Trudel, & Souissi, 2018; Berman, El-Sabawi, & Shields, 2019). Though risk assessment is a well-established tool for informing regulatory decisions, its application to tobacco regulation is in its nascent phase. China is the largest manufacturer of cigarettes followed by United States of America. 1.5 million of people are employed in the manufacturing of tobacco. Even though it's a profitable business but very little of the money earned by the industries is spent on its raw material i.e. tobacco, while the majority of it is spent on the paper, filter and the packaging of cigarettes. Two stages i.e. manufacturing and packaging of cigarettes are highly resource intensive. The former takes up 92% of tobacco industry revenue globally (Mackay et al., 2006). This huge production of cigarettes involves the use of large portion of natural and human resources. For every 200 cigarette manufactured, one tree is cut down (Ballard et al., 1995; Hussain et al., 2014).

Researchers have stated that smoking cigarettes and more specifically producing them has contributed in increasing the earth's temperature and therefore affecting the different ecosystems. The process of farming and cultivating tobacco, processing it and manufacturing it into cigarettes requires vast amount of energy for which forests are cleared. Cultivation of tobacco is done on annual basis and there are various ways through which it can be harvested. Unlike the old days, in modern era like today not only tobacco fields are harvested mechanically but processed further and converted into tobacco cigarettes as well (Arcury & Quandt, 2006) (Mackay et al., 2006). The effect off tobacco production on the human health includes nicotine poisoning also known as green tobacco sickness (GTS), exposure to pesticides, respiratory problems, muscular or skeletal problem and other such injuries. Tobacco and its smoke is strongly linked with different skin conditions with contact dermatitis being the most significant which is more common in tobacco harvesters and cigar makers but rarely found in smokers or workers involved in packaging the cigarettes. The most negative impact of tobacco production on the environment is deforestation. Around 6% of deforestation is done yearly in developing countries. This does not only damage the land alone but results in flooding and overall affecting the earth's climatic condition with an increase in global warming (Arcury & Quandt, 2006). Throughout the life cycle of cigarette production, each and every step generates significant greenhouse gases (Bialous & Yach, 2001). Globally, the tobacco industry employs hundreds of thousands of workers in roles ranging from raw leaf handling to product packaging, often exposing them to a variety of occupational hazards. Studies have documented a high prevalence of respiratory issues, noise-induced hearing loss, and musculoskeletal injuries among tobacco workers, particularly in low- and middle-income countries where regulatory enforcement may be weaker. According to international labor reports, exposure to tobacco dust, repetitive tasks, and inadequate safety protocols contribute to elevated rates of work-related illness and injury in this sector. These conditions not only endanger workers' health but also lead to productivity losses and increased healthcare burdens. By assessing these risks in

detail, this study seeks to inform targeted interventions and strengthen workplace safety standards across tobacco manufacturing operations.

1.1. Aim of the Study

This study aims to systematically assess occupational risks in the tobacco industry, utilizing a multidisciplinary approach that combines qualitative and quantitative methods. The research seeks to identify and characterize occupational hazards faced by workers in various roles, highlighting critical risk factors. The study develops a comprehensive risk matrix to categorize and prioritize risks based on their likelihood and potential impact. Workers' perceptions and experiences are incorporated through structured interviews to better understand workplace hazards and the effectiveness of existing safety measures. The developed risk matrix is validated by cross-referencing it with insights from the interviews to ensure its relevance and practical application. Based on the findings, evidence-based recommendations are proposed to mitigate identified risks, enhance workplace safety, and promote a culture of proactive risk management. This study underscores the importance of tailoring risk management practices to the specific needs and experiences of the workforce, paving the way for more inclusive and effective occupational health strategies.

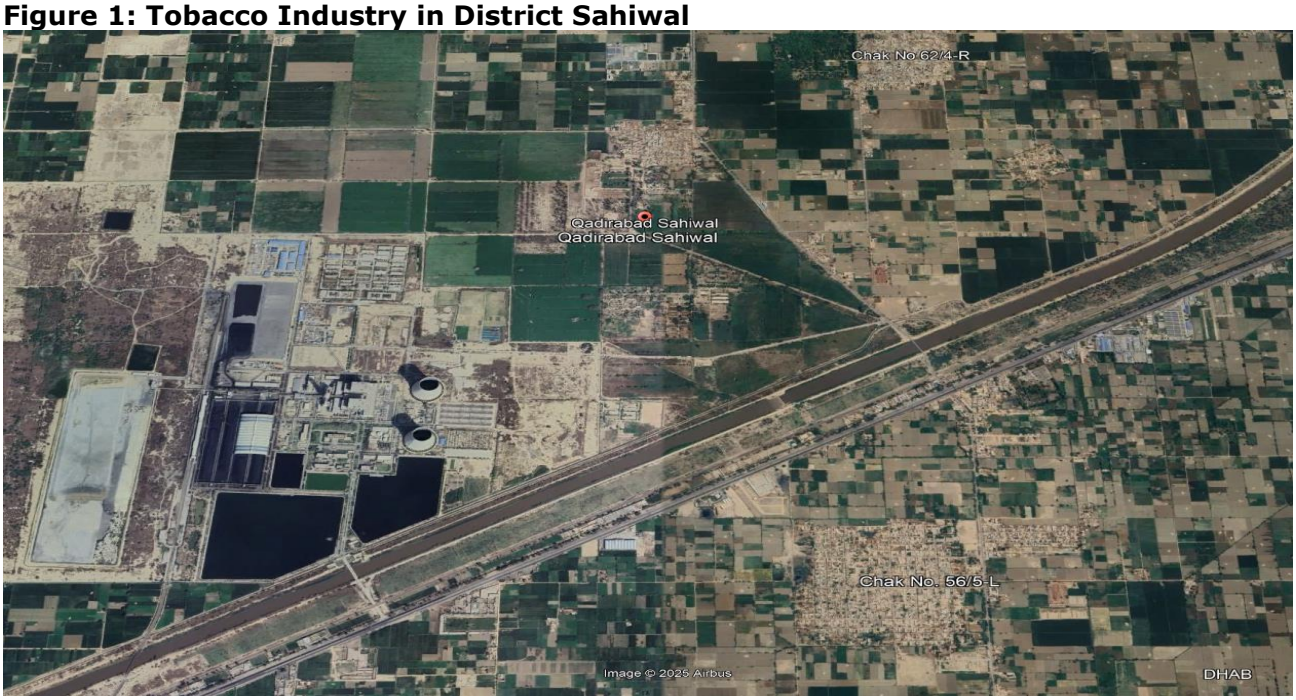
2. Methodology

2.1. Study Area

A tobacco industry located in the district Sahiwal (30.5854° N, 72.9933° E) Pakistan, was selected for the study. The industry is engaged in the manufacturing of well-known local cigarette brands in the region. The production capacity of the industry is approximately 83 Million Cigarettes per day, utilizing 60 tons of tobacco and other non-tobacco material. The typical cigarette manufacturing process generally involves three main processes that are further divided into several sub-constituents. Following are the three main sections of cigarette manufacturing process:

- Processing of the Tobacco Leaf
- Manufacturing of cigarette sticks
- Cigarette Packing

Figure 1: Tobacco Industry in District Sahiwal



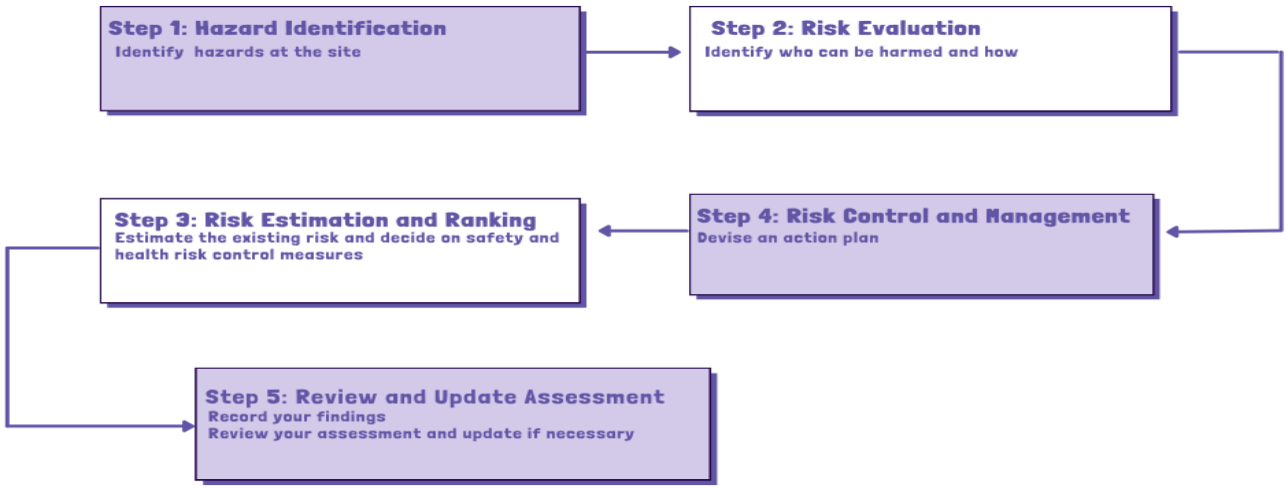
2.2. Secondary Data

In order to collect secondary data, relevant information regarding tobacco industry and its adverse environmental impacts were studied from various sources such as books, articles and journals.

2.3. Primary Data

For primary data, information was carried out by conducting visit to site area, collecting required information and filling in the checklist to assess the environmental risks. Workers from each department were selected to ensure that all stages of the tobacco industry were adequately represented in the study.

Figure 2: Steps of risk assessment



2.4. Risk Assessment

Risk assessment is a method used to identify and analyze potential events that could adversely affect individuals and/or the environment. The steps involved in conducting a risk assessment include: identifying hazards, determining who could be at risk and how, evaluating the risks along with preventive measures, recording the findings, implementing them, and evaluating existing control measures. This method serves as a vital tool in ensuring that risks are properly managed and mitigated to protect the workers.

2.5. Hazard Identification

The first step of risk assessment i.e. identifying the risks/hazards was carried out in a field visit to the site area (tobacco industry). Possible hazards were identified with the help of a checklist. Observations of the study area were made in a systematic manner. Later environmental variables were monitored to assess the severity and extent of the hazards. The risk matrix was developed using Australian standard on Risk Management (AS4360) (Sari, Pujotomo, & Wardani, 2017; Zhang et al., 2020).

2.6. Risk Management

Using the risk ratings, and after the categorization of risks, final step of risk assessment i.e. Risk management was carried out. During this stage, certain control measures were suggested to the facility to minimize or in some cases entirely control the hazard from occurring in future.

2.7. Risk Evaluation

Risk evaluation was done using the Industrial Accident Prevention Association (IAPA) 2006 standards as shown in Table 1. The significance of risk was evaluated using the following formula:

Significance = Severity + Frequency + Probability

Table 1: Risk evaluation standards (Source: IAPA)

Severity (0-6)	
0	No injury or illness
2	Minor injury or illness
4	Injury or illness without permanent disability
6	Permanent disability or loss of life or body part

Table 2

Frequency (1-3)			
Number of people likely to be exposed to hazard	**Number of times people may be exposed to or have contact with hazard**		
	Less than daily	**Few times per day**	**Many times per day**
1	1	1	2
2	1	2	3
3	2	3	3

Table 3

Probability (-1 to +1)	
-1	Less than average chance of happening
0	Average chance of happening
+1	Greater than average chance of happening

Table 4

Significance (1-10)	
0-2	Low
3-5	Medium
6-10	High

2.8. Occupational Health and Safety Questionnaire

For this purpose, a questionnaire was devised. A sample size of 30 was taken under consideration, 10 employees from 3 different units of industry. Various questions regarding their demographic profile, personal health status, knowledge on OHS policy and training were covered.

3. Results and Discussion

3.1. Demographics

Provision to a safe environment for work is a basic right of every employee. Hence, the current study area was evaluated for its occupational health and safety standard though the tobacco industry officials informed that the facility is certified with IS0 14001 and OSHAS 18001. The employees were interviewed to obtain first-hand information of how well they are aware of OHS measures in their workplace. The majority of employees (87%) did matriculation while few did intermediate i.e. 13%. 15% of employees have been working for almost 5 years in the industry while 65% have been working for 5-10 years, and only 20% have been working for 10-15 years (Figure 3 and 4).

Figure 3: Education level of tobacco industry workers

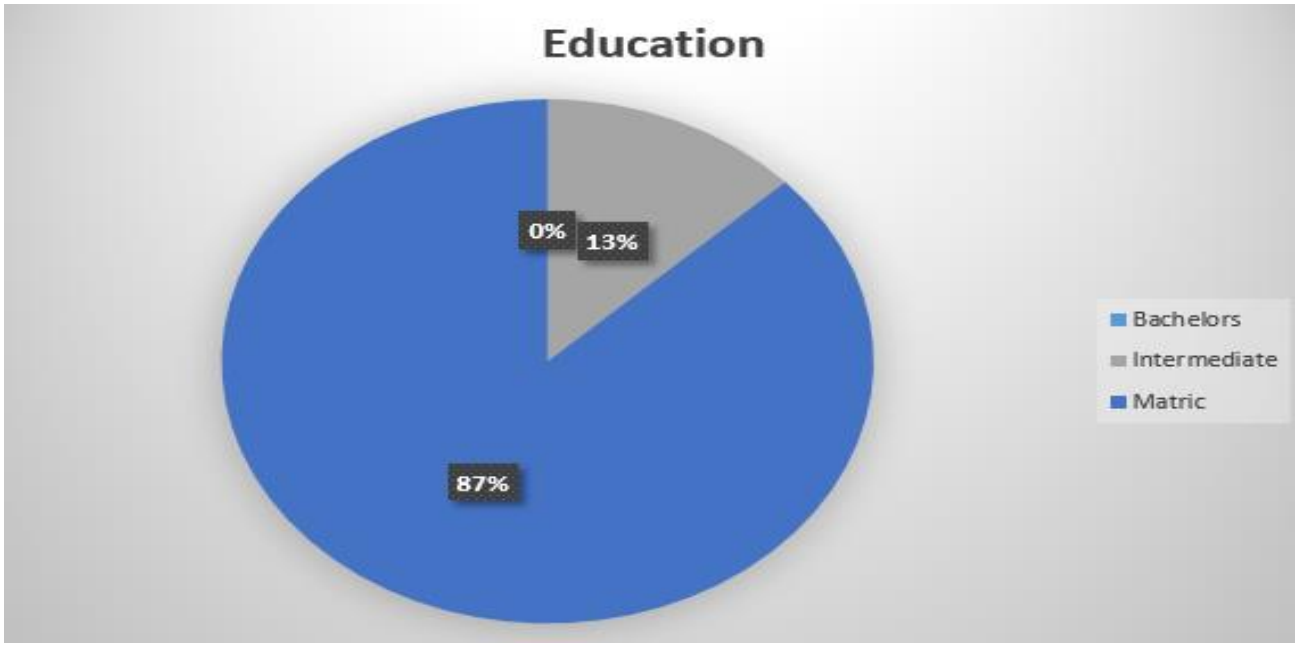
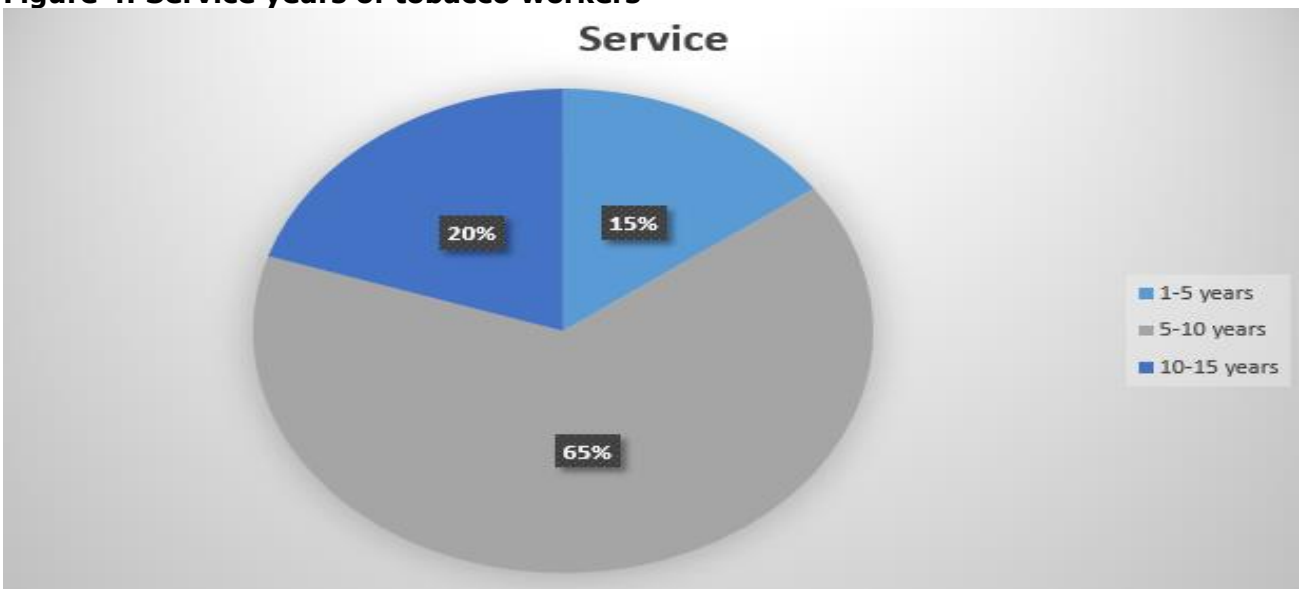


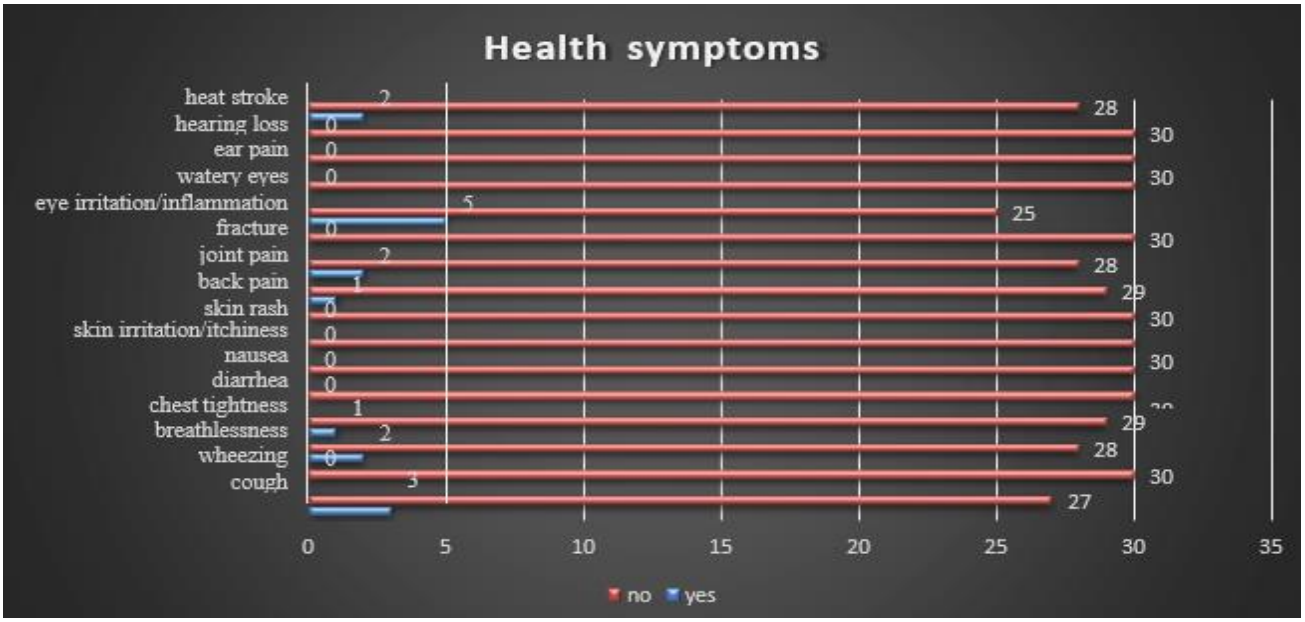
Figure 4: Service years of tobacco workers



3.2. Health assessment

The findings of this study highlight the importance OSHA guidelines in conducting comprehensive health assessments in the workplace (Mishra et al., 2023). Effective health assessments help identify potential hazards, monitor employee well-being, and ensure compliance with safety regulations (International Labour Organization, 2015). As per figure 5, employees were asked whether they experienced different health symptoms or not. Out of 30, 2 respondents one working in warehouse and one in primary department informed they experienced heat stroke, joint pain and breathlessness. The heat stroke they believed was due to hot temperature/atmosphere outside factory and not inside the factory buildings. Upon asking one of the respondents with joint pain it was revealed that he was suffering from arthritis while the employee who reported to suffer for breathlessness told he was recently diagnosed with mild asthma and was working in primary department where tobacco was sorted and treated with additives/chemicals. Moreover, 5 respondents told that they suffered from eye inflammation but when asked to further explain to what they think might have caused it, they told it was due to smog last year. While 3 of the respondents replied in yes when asked if they cough 4 to 6 times a day. All three respondents performed their duties as factory workers in secondary department where cigarette rods and packaging was done. 2 of these respondents had the habit of smoking as well. One of these employees also told how he once felt tightness in chest almost 3 months ago.

Figure 5: Health status of tobacco industry workers



In figure 6, when 30 of the respondents were asked if they already suffer from any health issues 18 of them told they suffer from headaches occasionally while 11 said they never experienced this while only one told he has frequent headaches. Only one respondent told he occasionally has respiratory problem while rest 29 said they never experienced any serious respiratory problem. All the employees informed that they never suffered from hearing problem. While 3 employees reported to face heat stress occasionally while 27 never experienced this. 1 of the respondents fainted due to humidity few months ago while 28 never experienced any serious problem due to humidity. The very same respondent felt dizzy too. When asked about if they faced any workplace hazard out of 30, one respondent told he tripped over the stairs in a hurry while one of the respondent fell when he was struck by one of the raw material pile which was being placed in the warehouse.

Figure 6: Health problems at workplace

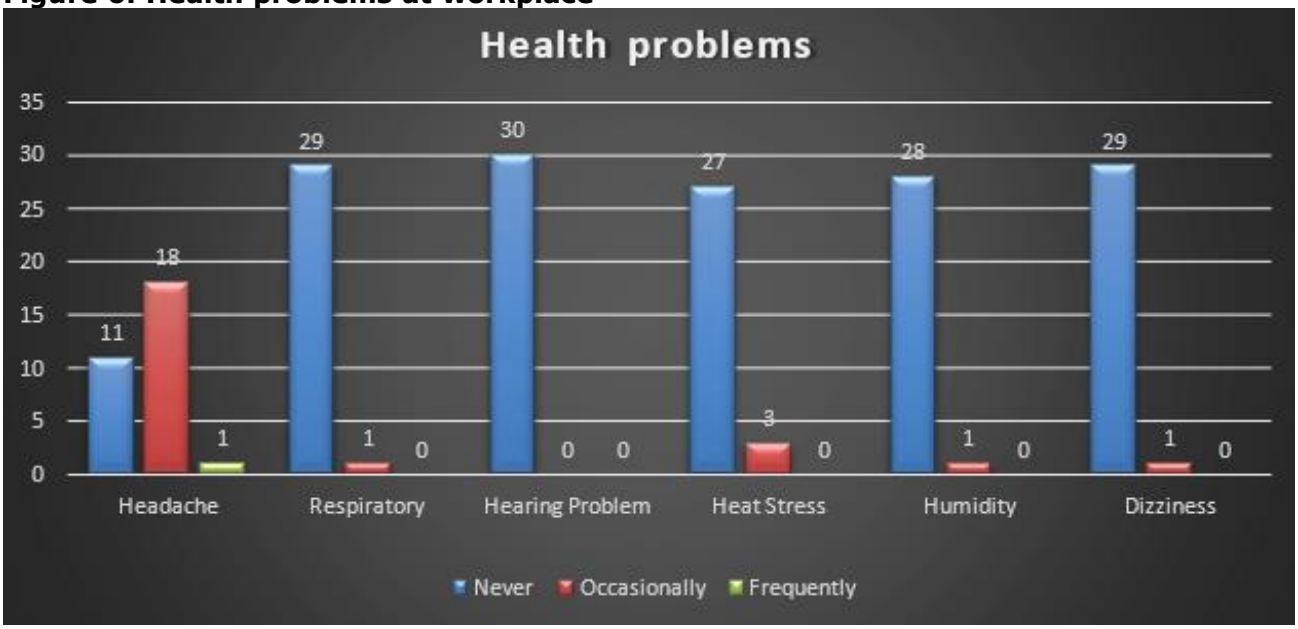


Figure 7 shows results of workplace accidents in tobacco industry. The respondents were asked about accidents at workplace, it was concluded that appropriate measure were taken and there were minimal accidents which included one case of tripping over and one case of being struck by an object.

3.3. Control measures

Effective implementation of engineering controls, administrative policies, and personal protective equipment (PPE) can significantly reduce occupational health risks (Patel & Davis, 2025). Our findings align with previous research indicating that proactive hazard assessments and mitigation strategies lead to improved worker safety and reduced incident rates (Niciejewska & Kiriliuk, 2020).

Figure 7: Workplace hazards that took place in tobacco industry

Questions were asked from employees regarding the knowledge they had about occupational health and safety and what control measures were taken by the industry. Figure 8 and figure 9 indicate that all replied in positive implying that all required steps were taken to ensure safe environment for employees such as provision of PPEs, training, first aid facility, warning signs and separate area for smoking. However, challenges such as inconsistent enforcement and resource limitations may hinder optimal outcomes.

Figure 8: OHS measures and awareness among employees in tobacco industry

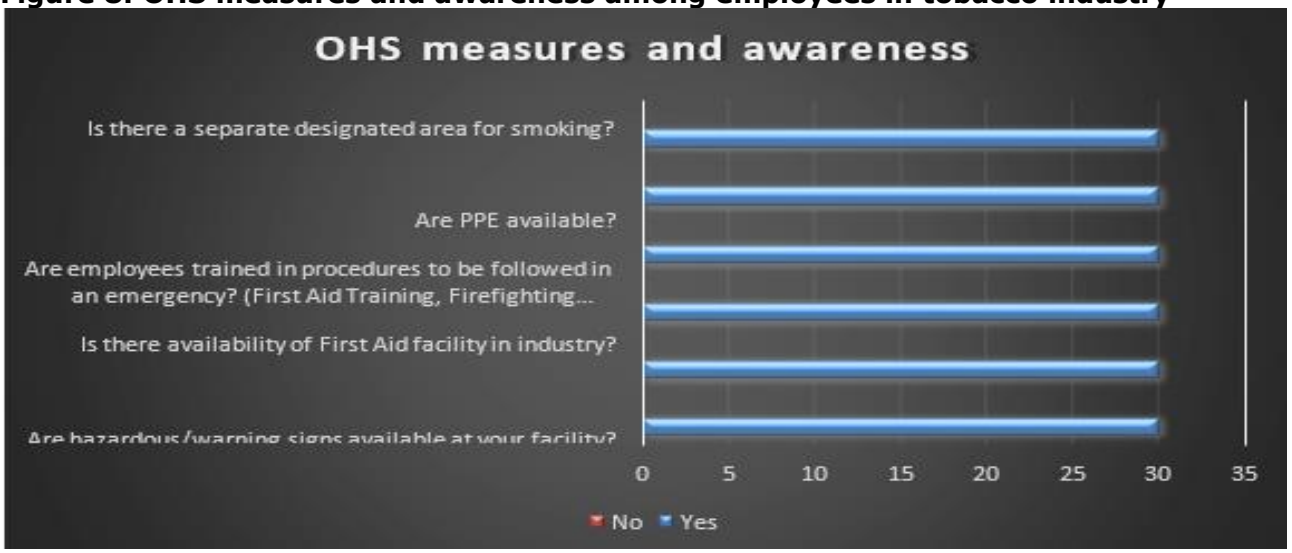
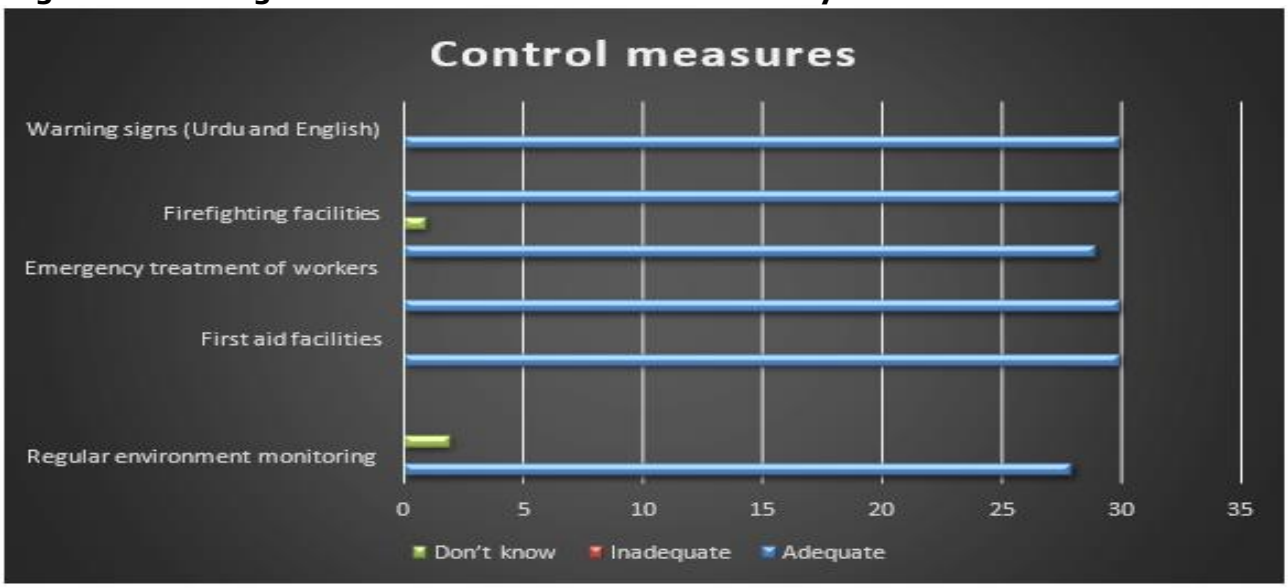


Figure 9: Existing control measures in tobacco industry



3.4. Risk assessment

Lastly, in order to perform risk assessment of the tobacco industry a walk through survey was done along with filling of a risk assessment checklist. The checklist allowed to analyze whether required safety and control parameters are in place and whether materials are stored and used as per the standard procedure. The hazards were identified in every department initially. Later on, their chances of happening or taking place along with the extent to which they can cause harm and the number of times employee might be facing it was calculated and thus its significance was found out which helped in categorizing the hazards in tobacco industry. This further allows to check if any training is required for the employees and if the control measure for it are in place. According to table 12 (see complete table in the appendix, table 1), in the primary and secondary department four of the identified hazards i.e. noise-hearing loss, cuts from material supervision, electrical shock and gas inhalation were rated as high while the rest of the hazards such as body injury, exposure to steam, chemical contact and body ache were rated as medium.

Workers handling raw tobacco (baled leaves, packaging materials, metal filters, etc.) face a frequent risk of cuts from sharp objects, edges, and moving parts. For example, material supervisors loading and unloading tobacco bales or machine operators clearing jams may encounter protruding nails, torn metal strapping, or unguarded blades. Such accidents can cause deep lacerations to hands and arms, severed tendons, or crushed fingers. OSHA reports that cuts and lacerations can lead to severe injuries and account for a significant fraction of factory injuries. Preventive measures such as PPEs are critical during routine tasks like cutting boxes or handling scrap. Maintenance technicians and machine operators who work on or near energized equipment face the danger of electrical shock. The energy hazard has high significance score of 8 (table 12). Even brief contact with wiring or energized machinery can cause muscle spasms, cardiac arrhythmias, or severe burns. For example, a maintenance electrician servicing a tobacco dryer's control panel might. Workers may also fall from ladders, causing injury. OSHA emphasizes that electricity is a "serious workplace hazard" causing electrocution and burns (Bero, 2003). Another major hazard, with significance score of 7 is fire hazard. Warehouses in tobacco facilities often store flammable chemicals alongside combustible goods such as dried tobacco, paper packaging. A fire in such settings can cause catastrophic burns and toxic smoke inhalation.

In a tobacco warehouse, a spark or static discharge could ignite solvent vapors. Fires also lead to secondary injuries such as falls, crush injuries during evacuation and can halt production (Abdalla et al., 2018; Ballard et al., 1995). As for the powerhouse and wastewater treatment plant, electrical shock hazard was rated as high while slips/trips in former and chemical contact in the latter were flagged as medium. While in the warehouse fire hazard was found out to be of high significance hazard and body injury as a medium-rated hazard. Long-term inhalation of tobacco dust, chemical fumes, or diesel exhaust can trigger chronic respiratory disease among tobacco workers. In practice, material handlers and machine operators who handle leaf tobacco or byproducts daily may develop persistent coughing, chest tightness, and sneezing. Respiratory diseases in this study have high significance score that is 6 (table 12). Warehouse workers can breathe in fine dust from broken bales or experience irritation from diesel fumes emitted by forklifts, leading to asthma-like symptoms. Inhalation hazards in tobacco operations can lead to occupational asthma, chronic bronchitis, and allergic airway disease among frontline and maintenance workers exposed to dust and fumes (Ballard et al., 1995).

Though various risks were evaluated in every unit of the industry but all the control measures were in place and as per the industry reports necessary training and drill is conducted for new and old employees both every year. Moreover, the industry uses the SDS (safety data sheet) process, a software that allows to document all the products, chemicals and materials in stock, their relevant information, hazard and safety measures are laid out which further makes the entire manufacturing process even more safe for industry employees. Tobacco industry safety programs must also be designed to address its unique hazards, such as dust inhalation, handling sharp raw materials, and working around flammable products. Specialized training often includes electrical safety certifications for maintenance teams, fire prevention drills focusing on chemical storage areas, and respiratory protection education for workers exposed to dust and fumes. Noise conservation programs, including regular hearing checks and earplug use training, are also critical. These targeted trainings ensure that workers are prepared for industrial hazards and potential risks in tobacco production environments.

Table 5: Risk Evaluation

Work activity	Hazard category (health & safety)	Identification of hazard	Risk Assessment				Training requirement Yes / No	Controls in place Yes / No
			Severity 0-6	Frequency 1-3	Probability -1 to +1	Significance 0-10		
Primary Department	Physical	Noise- hearing loss	4	3	-1	6 *(High)*	☐	☐
		Cuts- material supervision	6	3	-1	8 *(High)*	☐	☐
		Energy hazard – Electrical shock	6	1	0	7 *(High)*	☐	☐
	Chemical	Gas inhalation- respiratory disease	6	1	-1	6 *(High)*	☐	☐
Secondary Department	Physical	Noise- hearing loss	4	3	-1	6 *(High)*	☐	☐
		Cuts- material supervision	6	3	-1	8 *(High)*	☐	☐
	Chemical	Gas inhalation-	6	1	-1	6	☐	☐

Warehouse	Chemical	respiratory disease Fire hazard	6	1	0	*(High)* 7 *(High)*	☐	☐

4. Conclusion

The tobacco industry under study was found to be not only a safe environment for the workers to do their job but also the environmental parameters were in check and the industry has done an efficient job in making sure that it's activities and operation pose least possible threat and impact on the environment. Other industries in Pakistan unable to regulate environmental and safety standards can adopt and apply similar strategies especially in terms of installing renewable source of electricity generation as well as reusing the water since it's a developing country we have to make sure that safety of environment and people both are ensured in such workplaces. However, strengthening emergency preparedness through tailored response plans and regular drills is also vital. To ensure sustained improvements, the organization should foster a safety culture by engaging employees in safety committees and encouraging hazard reporting. Finally, adhering to OSHA standards through regular audits and adopting cleaner production techniques will contribute to a safer and more sustainable work environment. These measures collectively aim to address identified risks and promote the well-being of workers in the tobacco industry.

4.1. Future research

Future research should focus on longitudinally tracking the implementation and effectiveness of recommended safety measures within the tobacco industry. Establishing baseline health and injury data followed by periodic monitoring can help in future research. Regular audits and worker surveys could further refine safety programs by identifying ongoing challenges. Such long-term studies would provide strong evidence for continuous improvement in occupational health and safety in the tobacco sector.

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Appendix

Table 1: Risk evaluation of tobacco industry

Work activity	Hazard category (health & safety)	Identification of hazard	Risk Assessment				Training requirement Yes / No	Controls in place Yes / No
			Severity 0-6	Frequency 1-3	Probability -1 to +1	Significance 0-10		
Primary Department	Physical	Body injury – struck by object/slips and trips	4	2	-1	5 *(Medium)*	☐	☐
		Noise- hearing loss	4	3	-1	6 *(High)*	☐	☐
		Cuts- material supervision	6	3	-1	8 *(High)*	☐	☐
		Energy hazard Electrical shock	6	1	0	7 *(High)*	☐	☐
		Exposure to hot steam	4	2	-1	5 *(Medium)*	☐	☐
	Chemical	Gas inhalation-respiratory disease	6	1	-1	6 *(High)*	☐	☐
		Chemical contact-skin disease	4	1	-1	4 *(Medium)*	☐	☐
	Ergonomic	Body ache- working hours	2	3	-1	4 *(Medium)*	NA	NA
Secondary Department	Physical	Body injury – struck by object/slips and trips	4	2	-1	5 *(Medium)*	☐	☐
		Noise- hearing loss	4	3	-1	6 *(High)*	☐	☐
		Cuts- material superision	6	3	-1	8 *(High)*	☐	☐
	Chemical	Gas inhalation-respiratory disease	6	1	-1	6 *(High)*	☐	☐
		Chemical contact-skin disease	4	1	-1	4 *(Medium)*	☐	☐
	Ergonomic	Body ache- working hours	2	3	-1	4 *(Medium)*	NA	NA
Warehouse	Physical	Body injury- struck by object	4	2	-1	5 *(Medium)*	☐	☐
	Chemical	Fire hazard	6	1	0	7 *(High)*	☐	☐