THE IMPACT OF LIGHT AND HEAT LEVELS IN THE WORKING ENVIRONMENT ON WORKERS' SAFETY

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Abstract. The quality of the working environment plays a crucial role in workers' health and safety. This study examines the impact of physical workplace conditions, specifically lighting and temperature, on occupational safety in selected factories in Sri Lanka's Western Province. Using a descriptive research design, secondary data were analyzed from environmental monitoring reports and accident registers. The study found a significant negative correlation between light levels and occupational accidents ($r = -0.506$, $p < 0.01$), indicating that improved lighting reduces accident risk. A positive correlation was observed between high temperatures and accidents ($r = 0.367$, $p < 0.01$), suggesting that heat stress contributes to increased incident rates. Among the factories surveyed, 72.7% reported at least one workplace accident. Of the recorded incidents, 75.5% were minor injuries, 20.4% major injuries, and 4.1% fatal. The findings emphasize the necessity of maintaining adequate lighting and thermal conditions to enhance workplace safety. The study recommends stricter enforcement of occupational safety standards and further investigation into other environmental and organizational factors affecting worker health and safety.

Keywords. Occupational Health, Workplace Environment, Safety, Accident Prevention, Environmental Conditions

1. Introduction

The quality of the working environment plays an important role in ensuring workers' health and safety in the workplace. A better physical environment can motivate workers to improve their performance, while cluttered and poorly maintained workplaces are major contributors to accidents and occupational illnesses. Noble (2009) states that greater attention should be given to identifying and addressing working environment conditions, as employees who perceive their environment negatively may suffer from chronic stress. According to Opperman (2002), the working environment includes processes, systems, structures, tools, or conditions in the workplace that can influence individual performance either positively or negatively.

Numerous studies have shown that the physical work environment, including factors such as lighting, temperature, ventilation, and noise can significantly affect workers' job satisfaction, performance, and safety (Sundstrom et al., 1994; Vischer, 2007). In particular, poor lighting has been associated with increased visual fatigue, errors, and workplace accidents (Boyce, 2003), while excessive heat exposure has been shown to reduce concentration and physical performance, thereby increasing accident risks (Parsons, 2014; Ramsey & Bernard, 2000). As a result, employers are increasingly prioritizing the creation of positive and safe working environments, not only to comply with regulatory requirements but also to enhance productivity and employee retention (Zohar, 2000).

1.1. BACKGROUND OF THE STUDY

The working environment is argued to impact immensely on employees' performance either towards negative or the positive outcomes (Chandrasekar 2001). A quality workplace environment leads to reduce the workplace accidents and increase the productivity. A proper workplace environment helps in reducing the number of absenteeism and thus can improve the workers' performance which leads to increased productivity at the workplace (Boles et al.2004).

Governments around the world have recognized the importance of regulating workplace conditions to ensure employee safety, health, and well-being. These regulations aim not only to prevent occupational accidents and illnesses but also to promote fair labor practices and improve employee satisfaction. Research has consistently shown that the physical conditions of the

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workplace, including factors such as lighting, temperature, ventilation, and noise can have a substantial impact on workers' job satisfaction, mental health, and performance (Vischer, 2007; Seppanen, Fisk, & Faulkner, 2003). As a result, employers are increasingly focusing on creating conducive work environments to enhance employee motivation and safety outcomes.

The ILO's Decent Work and the 2030 Agenda for sustainable development emphasis that safety and health at work should be ensured by protecting labour rights and promoting safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment. According to the International Labour Organization (ILO), occupational accidents and work-related diseases cause approximately 2.3 million deaths each year, with 6,400 people dying every day due to these causes. Additionally, an estimated 860,000 people are injured on the job daily. The economic cost of these occupational incidents is significant, with an estimated annual loss of US$2.8 trillion- equivalent to 4 percent of global gross domestic product-resulting from lost working time, production interruptions, treatment costs, and compensation (ILO, 2023). These figures underscore the urgent need for global efforts to promote a culture of prevention that upholds the right to a safe and healthy working environment and ensures that both employers and workers are aware of their responsibilities and rights.

1.2. RESEARCH PROBLEM

Although workplace safety is a critical component of occupational health, many factories in Sri Lanka continue to face challenges related to inadequate physical environmental conditions, particularly poor lighting and excessive heat. These factors are often overlooked in occupational safety assessments, despite growing evidence that they significantly influence workers' well-being, performance, and risk of injury. While general studies exist on working conditions, there is a lack of focused research examining how specific environmental elements such as light and heat levels affect safety outcomes in industrial settings. This gap limits the ability of employers, policymakers, and safety officers to implement evidence-based interventions. Therefore, this study seeks to investigate the extent to which light and heat levels in factory environments impact the safety of workers, aiming to provide data-driven recommendations for improving occupational conditions and reducing workplace accidents.

1.3. RESEARCH OBJECTIVES

This research was guided by the following study objectives. The main objective of this study was to explore the impact of light and heat levels in the working environments on the safety of workers in selected factories in the Western province. The specific Objectives of this study were,

- To identify appropriate methods for measuring light and heat levels in the working environment.
- To evaluate the relationship between lighting and heat levels in the workplace and work-related accidents.
- To assess the current light and heat conditions in selected factories.
- To provide recommendations for improving workplace lighting and thermal conditions to enhance workers' safety.

1.4. RESEARCH QUESTIONS

1. What are the appropriate methods for measuring light and heat levels in the working environment?

2. What are the existing light and heat conditions in the selected factories?

3. Is there a relationship between workplace lighting and heat levels, and work-related accidents?

4. How can improvements in lighting and heat conditions contribute to enhanced worker safety?

This study was designed to examine the impact of light and heat levels in the working environments on safety of the workers in selected industries in Western province.

2. Literature Review

Numerous studies have established that physical environmental factors significantly affect workplace safety and employee performance. Among these, lighting and temperature play critical roles in influencing both the physical and cognitive functioning of workers.

Lighting is a key component of a safe and productive work environment. Adequate illumination helps reduce visual fatigue, improve precision in manual tasks, and prevent accidents caused by poor visibility (Boyce, 2003). Insufficient lighting has been linked to an increased likelihood of slips, trips, and falls, especially in industrial settings where workers must navigate machinery or hazardous materials (Hedge, 2000). Studies also show that poor lighting conditions can impair concentration and increase error rates, which in turn can elevate accident risks (Veitch & Newsham, 2000). The International Labour Organization (ILO, 2010) emphasizes lighting as a fundamental aspect of workplace safety regulations.

In parallel, temperature, particularly heat stress, has been identified as a major occupational hazard. Exposure to high temperatures can cause thermal discomfort, fatigue, dehydration, and reduced mental alertness (Parsons, 2014). These physiological responses may impair motor coordination and decision-making, increasing the likelihood of workplace injuries (Ramsey & Bernard, 2000). Furthermore, prolonged exposure to hot environments is associated with heat-related illnesses, which can affect long-term worker health and increase absenteeism (Kjellstrom et al., 2009). The risk is particularly high in factory environments where machinery and enclosed spaces contribute to elevated temperatures.

Consequently, the physical environment is a tool that can be leveraged both to improve business results (Mohr, 1996) and employee well-being (Huang, Robertson and Chang, 2004). Ensuring adequate facilities are provided to employees is critical to generating greater employee commitment and productivity. The provision of inadequate equipment and adverse working conditions has been shown to affect employee commitment and intention to stay with the organization.

Furthermore, McCoy and Evans (2005) stated that the elements of working environment need to be proper so that the employees would not be stressed while getting their job done. In their article, they also stated that the physical element plays an important role in developing the network and relationship at workplace. Result of the employees' performance can be increased from five to ten per cent depending on the improvement of the physical workplace design at their workplace (Brill, 1992).

An effective work environment management entails making work environment attractive, creative, comfortable, satisfactory and motivating to employees so as to give employees a sense of pride and purpose in what they do. The following are some of the tools used to manage work environment to improve productivity. Noise control, contaminants and hazard control, enhancing friendly and encouraging human environment, job fit, rewards, feedback, work environment modelling, creating qualitative work life concepts and making physical working conditions favourable (Cecunc, 2004; Opperman, 2002; Elywood, 1999).

Although much of the global literature highlights the importance of the environmental factors, few studies have examined the specific correlation between lighting, heat levels, and accident rates in factory settings within the Sri Lankan context. This research seeks to address this gap by offering empirical evidence on how variations in light and heat relate to workplace accidents, thereby contributing region-specific data to the broader field of occupational health and safety.

3. Research Methodology and Design

This section describes the methods that were used to gather the data relevant to the study. It contains the research design, study area, population, sample size and sample technique, sampling procedure and explains the method and procedures for data collection.

3.1. RESEARCH METHODOLOGY

Research design refers to a plan which shows the strategy of an inquiry thought appropriate to the research (Kothari, 2004). For the purpose of this study, descriptive research design was used. Since the data for this study were collected from various sources and the research focused on identifying and evaluating the impacts of the physical environment, specifically light and heat levels in factories, the study was primarily evaluative in nature. The collected data were analysed using descriptive analysis techniques.

3.2. STUDY AREA

The study area for this research was the selected factories those are situated in the western province of Sri Lanka. The target population of this study included the factories and their workers in the selected province.

3.3. SAMPLE SIZE, SAMPLING TECHNIQUE AND DATA COLLECTION METHODS

Twenty-two factories from the Western Province were selected as samples for this study. The convenience sampling method was used as the sampling technique. In this study, secondary data were used for data collection. Secondary data refer to information that has been collected by someone else and already exists. These data were obtained by reviewing various documents, such as inspection reports and environmental monitoring reports of factories, which were sourced from the Occupational Hygiene Division of the Labour Department. And also general registers of factories were analysed to collect data about accidents and dangerous occurrences in factories. These data included the number of reported occupational accidents, types of injuries, and recorded measurements of workplace lighting (in lux) and heat stress (WBGT in degrees Celsius) over a period. Websites of Department of Labour, Industrial Safety Divisions and Annual Labour statistics reports of Department of Labour, which are relevant to the theme of the study, were used for the purpose of gathering information. All secondary data were sourced from documented, officially maintained records to ensure accuracy and reliability.

4. Results and Discussion

The collected data were analysed using descriptive statistics to summarize key variables such as mean light levels, average heat stress, and accident frequencies across the sample. The software used for analyzing the findings included Microsoft Excel 2010 and the Statistical Package for the Social Sciences (SPSS) version 17.0. Pearson correlation analysis was then used to explore the strength and direction of relationships between light levels and accident rates, and separately between heat levels and accident rates. The correlation coefficients provided a basis for interpreting whether higher or lower environmental values were associated with increased or decreased accident frequencies. Where appropriate, graphical representations such as tables and charts were used to visualize the data relationships and enhance understanding. The sample

of 22 factories was taken and their environmental monitoring reports and general registers were analysed for the purpose of collecting data. Below is the analysis of collected data.

4.1. TYPE OF FACTORIES

The sample included a variety of factory types from the selected province. The distribution of these factories by type is shown in Figure 4.1. Among the selected factories, the majority were steel-based factories, accounting for 33%.

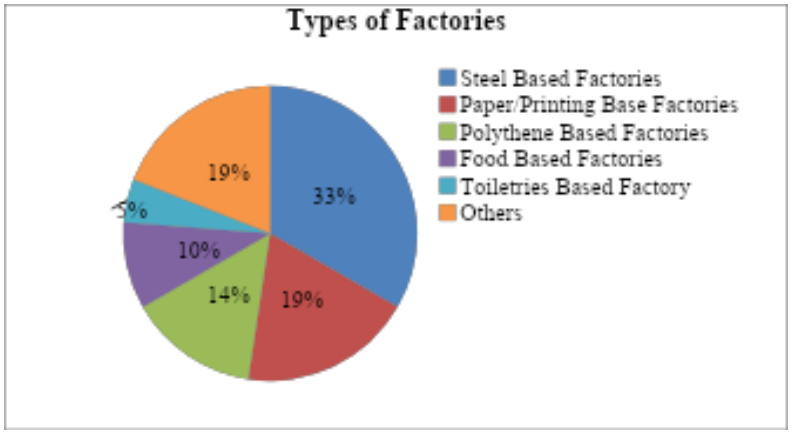

Figure 1: Types of factories

4.2. PHYSICAL WORKING ENVIRONMENT

In this study, the physical working environment was considered a key factor in determining the overall quality of the working environment. It is one of the major contributors to the health and safety of workers. The distribution of factories based on physical working environment characteristics is presented in Table 1.

Table 1: Distribution of factories according to the physical working environment.

Quality of working environment		Number of factories	Percent	Valid Percent	Cumulative Percent
	Bad	4	18.2	18.2	18.2
	Good	8	36.4	36.4	54.5
	Moderate	8	36.4	36.4	90.9
	Very Bad	2	9.1	9.1	100.0
	Total	22	100.0	100.0	

According to Table 4.1, the majority of the factories have a good or moderate working environment (36.4%). In some factories, the quality of the working environment is very poor (9.1%). None of the factories in the selected sample were classified as having a very good working environment.

4.3. NUMBER OF ACCIDENTS

Table 4.2 explains the number of accidents occurred in the selected factories in particular time period.

Table 2: Number of accidents

Number of accidents		Number of factories	Percent	Valid Percent	Cumulative Percent
	0	6	27.3	27.3	27.3
	2	8	36.4	36.4	63.6
	3	2	9.1	9.1	72.7
	4	4	18.2	18.2	90.9
	5	1	4.5	4.5	95.5
	6	1	4.5	4.5	100.0
	Total	22	100.0	100.0	

From the table it was noted that, in 27.3% of selected factories didn't record any accident in particular period and 4.5% of factories recorded more than five accidents.

4.4. NATURE OF ACCIDENTS

According to the severity of accidents, distribution of accidents is shown in Table 3.

Table 3: Distribution of accidents according to the severity

Severity		Number of accidents	Percent	Valid Percent	Cumulative Percent
	Fatal	2	4.1	4.1	4.1
	Major Injuries	10	20.4	20.4	24.5
	Minor Injuries	37	75.5	75.5	100.0
	Total	49	100.0	100.0	

According to the Table 3, two accidents are fatal accidents and 75.5% of accidents are recorded as minor injuries.

4.5. RELATIONSHIP BETWEEN LIGHT AND HEAT LEVELS OF WORKING ENVIRONMENT AND ACCIDENTS

Table 4: Relationship between light levels and number of accidents

		No. Of accidents	Light Level
No. Of accidents	Pearson Correlation	1	-.506**
	Sig. (2-tailed)		.000
	N	55	55
Light	Pearson Correlation	-.506**	1
	Sig. (2-tailed)	.000	
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

The data presented in Table 4 indicate a negative correlation between light levels and the number of occupational accidents. This suggests that lower light levels are associated with a higher frequency of accidents, whereas higher light levels tend to correspond with fewer incidents. This relationship is consistent with existing literature, which highlights that inadequate lighting can impair visibility, reduce hazard recognition, and increase the likelihood of slips, trips, and contact with machinery or objects (Boyce, 2003). Poor illumination may also contribute to visual fatigue, which can compromise workers' alertness and reaction time.

However, while this negative correlation supports the hypothesis that light levels influence workplace safety, it is essential to emphasize that correlation does not imply causation. The observed trend may be influenced by a combination of factors beyond lighting alone. These may include the nature of tasks performed, the design of the work environment, and adherence to safety protocols, shift timing, worker training, psychological stress, and fatigue. For instance, poorly lit environments may also coincide with less supervision or out-dated equipment, further increasing risk.

Therefore, while enhancing lighting conditions appears to be a practical intervention to reduce accidents, a comprehensive approach that addresses multiple environmental and human factors is necessary for meaningful improvements in workplace safety.

Table 5: Relationship between heat levels and number of accidents

		No. Of accidents	Heat Level
No. Of accidents	Pearson Correlation	1	.367**
	Sig. (2-tailed)		.006
	N	55	55
Heat	Pearson Correlation	.367**	1
	Sig. (2-tailed)	.006	
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

The data presented in Table 5 reveal a positive but weak correlation between the heat level of the working environment and the number of occupational accidents. This indicates that as ambient temperature increases, the number of workplace accidents tends to rise slightly, and conversely, as temperature decreases, accident rates tend to decline marginally. Although the correlation is not strong, the direction of the relationship aligns with existing research suggesting that excessive workplace heat can negatively affect workers' safety and performance.

Heat exposure has been shown to impair concentration, increase fatigue, and reduce physical and cognitive performance, all of which may elevate the risk of accidents, particularly in physically demanding or precision-based tasks (Parsons, 2014; Ramsey & Bernard, 2000). Additionally, thermal discomfort can lead to reduced alertness and slower reaction times, making workers more prone to errors or unsafe behaviours. However, the modest strength of the observed correlation implies that while heat is a contributing factor, it is likely not the sole or primary cause of accidents.

Other factors, such as the nature of the job, duration of exposure, availability of rest breaks, hydration status, ventilation systems, safety training, and behavioural responses may have a stronger influence on accident rates. It is also possible that workers develop adaptive behaviours or coping mechanisms that mitigate some of the risks associated with moderate heat exposure. Therefore, while heat control remains an important occupational safety consideration, it should be addressed alongside a range of physical, organizational, and psychosocial factors to effectively reduce workplace accidents.

5. Conclusion and Recommendations

The findings of this study confirm that physical aspects of the working environment, specifically light and heat levels have a measurable impact on workers' health and safety. The analysis revealed that inadequate lighting and elevated temperatures are associated with increased occupational accidents in factory settings. Therefore, it is evident that improving these environmental conditions is essential for enhancing workplace safety and reducing the incidence of injuries.

Based on the results, it is recommended that factory employers take proactive steps to ensure a safe and high-quality working environment. This includes maintaining optimal lighting conditions and controlling indoor temperatures to minimize risks associated with poor visibility and heat stress. Such improvements will not only support worker health but also contribute to overall productivity and operational efficiency.

This study was limited to selected factories in the Western Province of Sri Lanka, focusing solely on the effects of light and heat levels. While these limitations may narrow the generalizability of the findings, they also present opportunities for future research. Further studies are encouraged to explore additional environmental factors, such as noise, air quality, and ergonomic design and their combined effects on occupational health and safety across diverse industrial sectors and geographic regions.

Although previous research has examined the broader effects of workplace environments on employee well-being and productivity, few studies have investigated the direct correlation between measurable environmental parameters (light and heat levels) and occupational accident rates, particularly in developing country contexts. This study contributes new knowledge by offering quantitative, correlation-based evidence from Sri Lankan factory settings, where such data have been limited. By integrating secondary accident records with on-site environmental measurements, the research provides actionable insights that can inform safety audits and workplace design strategies. Furthermore, it underscores the need for stronger regulatory enforcement and environmental monitoring in occupational health and safety systems, especially in regions where implementation gaps remain.

This context-specific contribution helps fill a gap in the existing literature and highlights the critical role of environmental controls in safeguarding worker health and safety.

6. References

Babisch, W., Ising, H., Gallacher, J. E., Sweetnam, P. M., & Elwood, P. C. (1999). Traffic noise and cardiovascular risk: The Caerphilly and Speedwell studies, third phase–10-year follow-up. *Archives of Environmental Health: An International Journal, 54*(3), 210–216.

Boles, M., Pelletier, B., & Lynch, W. (2004). The relationship between health risks and work productivity. *Journal of Occupational and Environmental Medicine, 46*(7), 737–745.

Boyce, P. R. (2003). *Human factors in lighting*. Crc press.

Cecunc, E. (2004). *Improving employee productivity in regulating industries*. Academic Pres, New York.

Chandrasekar, K. (2011). Workplace Environment & Its impact on organizational performance in public sector organizations. *International journal of Enterprise computing and Bussiness systems*.

Department of Labour (2024). *Department of Labour*. Retrieved June 5, 2024, from Annual Reports: https://labourdept.gov.lk/annual-reports/

Huang, Y. R. (2004). *The role of environmental control on environmental satisfaction, communication, and psychological stress: effect of officenergonomics training:* Environment and Behaviour.

International Labour Organization. (2019). *Decent work and the 2030 Agenda for sustainable development*. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40europe/%40ro-geneva/%40ilo-lisbon/documents/event/wcms_667247.pdf

Kjellstrom, T., Holmer, I., & Lemke, B. (2009). Workplace heat stress, health and productivity–an increasing challenge for low and middle-income countries during climate change. *Global health action, 2*(1), 2047.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

McCoy, J. M., & Evans, G. W. (2005). Physical work environment. *In Handbook of work stress* (pp. 219-246). SAGE Publications, Inc..

Noble, C. (2009). *Business performance and employee wellbeing: A resource-based approach*. University of Nottingham.

Opperman, C. S. (2002). *Tropical business issues*. Partner Price Water House Coopers. International Business Review.

Parsons, K. (2014). Human thermal environments: *The effects of hot, moderate, and cold environments on human health, comfort and performance* (3rd ed.). CRC Press.

Ramsey, J. D., & Bernard, T. E. (2000). Heat stress—the effects of heat on working populations. Journal of Occupational and Environmental Medicine, 42(1), 94–100.

Seppanen, O., Fisk, W. J., & Faulkner, D. (2003). *Cost benefit analysis of the night-time ventilative cooling in office building*.

Sundstrom, E., Town, J. P., Rice, R. W., Osborn, D. P., & Brill, M. (1994). Office noise, satisfaction, and performance. *Environment and behavior, 26*(2), 195-222.

Veitch, J. A., & Newsham, G. R. (2000). Preferred luminous conditions in open-plan offices: Research and practice recommendations. Lighting Research & Technology, 32(4), 199–212.

Vischer, J. C. (2007). *The concept of environmental comfort in the performance of the work environment, 7*(1), 21-34.

Zohar, D. (2000). A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of applied psychology, 85*(4), 587.