Unified Health Critical Research

Journal homepage: https://journal.uin-alauddin.ac.id/index.php/ucr

Research

Work Climate and Occupational Fatigue among Furniture Workers

Ranti Ekasari*[1], Magfirah Insan Sakinah[2], Suci Rahmi[3], Nur Sasmita[4], Muh. Abdul Wahab[5], Lilis Widiastuty[6]

[1, 2,3,4,5,6] Department of Public Health, Faculty of Medical and Health Sciences, Universitas Islam Negeri Alauddin Makassar, Makassar, Indonesia

* Corresponding Author: ranti.ekasari@uin-alauddin.ac.id

ARTICLE INFO

Keywords:
Fatigue; Work Climate; Worker

History:
Submitted : 1 February 2026
Reviewed : 8 February 2026
Accepted : 11 February 2026

Competing Interests:
The authors declare no conflicts of interest related to this work.

ABSTRACT

Work climate refers to the interaction of environmental factors in the workplace. Fatigue is a common occupational health issue and can be affected by multiple factors such as work climate, age, gender, length of employment, and daily working duration. This study aimed to examine the relationship between work climate and work fatigue among furniture workers in Hertasning, Indonesia. A quantitative analytical study with a cross-sectional design was conducted in several furniture workshops in December 2023. The study involved 30 furniture workers selected through purposive sampling. Data were collected using the questionnaire to assess subjective feelings of work fatigue and a Heat Stress Monitor to measure workplace climate conditions. The results showed a statistically significant relationship between work climate and work fatigue ($p = 0.028$; $p < 0.05$), indicating that workers exposed to unfavorable work climate conditions were more likely to experience fatigue. These findings suggest that work climate plays an important role in influencing workers' fatigue levels. Therefore, it is recommended that furniture business owners improve workplace comfort by providing adequate rest areas with appropriate temperature control and installing cooling facilities, such as fans, to reduce heat exposure and prevent work-related fatigue.

1. Introduction

Workplace environmental conditions are a major driver of occupational health and safety, especially in industries with a high level of physical labour and temperature exposure. Workers in industrial settings such as manufacturing, construction, and artisanal workshops are frequently subjected to high temperatures, excessive humidity, and limited airflow, resulting in a work environment that may negatively impact physiological comfort and performance (Kim & Lee,

e-ISSN: 3109-0478 p-ISSN: 3109-0486

2020).This exposure can cause heat stress, which happens when the body's thermoregulatory systems are unable to keep core temperature within a safe range (Levi et al., 2018). Such situations accumulate physiological stress over time, increasing the chance of weariness, impaired cognitive function, and diminished physical labour capacity (Flouris et al., 2018).

Fatigue, defined as a decrease in muscle force generation, cognitive awareness, or motivation as a result of continuous activity, is widely acknowledged as a significant risk factor for decreased productivity and increased workplace incidents (Venugopal et al., 2020).Tasks in furniture factories frequently require repeated movements, extended physical handling, and sustained standing, making workers particularly prone to heat-induced fatigue when ambient circumstances are unfavourable. As a result, knowing the effects of work climate on occupational weariness is critical, not only for protecting workers' health but also for increasing total job efficiency and lowering the risk of workplace accidents.

Global and national health organizations have documented the increasing prevalence and impact of heat stress in workplaces, highlighting the urgency of addressing this issue from a public health perspective. Rising global temperatures and climate change are expected to exacerbate heat exposure in many occupational environments, significantly affecting workers' health outcomes and productivity (Abokhashabah et al., 2021). These institutional data underscore that heat stress and associated fatigue are not isolated phenomena; rather, they represent widespread occupational health challenges with implications for economic productivity and worker well-being on both local and global scales.

A number of empirical studies have investigated the relationship between work climate, heat exposure, and occupational fatigue, producing evidence that extreme thermal environments are linked with impaired worker performance and increased fatigue. For example, Kusmawan et al. (2025) found a statistically significant association between heat exposure and increased reports of fatigue among industrial workers in Indonesia, highlighting the role of environmental heat as a key contributor to worker discomfort. Similarly, previous study reported that workers exposed to higher ambient temperatures experienced significantly greater physical exhaustion compared to those in thermally moderate conditions (Ioannou et al., 2022).

While many studies corroborate the influence of heat stress on physiological strain and fatigue, there remain gaps in the literature regarding specific occupational groups such as furniture workers who are frequently exposed to prolonged heat without formal heat mitigation measures. Moreover, much of the existing research primarily focuses on outdoor or heavy industry settings, leaving a gap in understanding how indoor work climates in artisanal workshop environments affect fatigue levels. Rosita et al. (2025) emphasized that artisanal workspaces often lack adequate cooling and ventilation, yet detailed research quantifying the relationship between thermal conditions and worker fatigue in these contexts remains limited. This research gap suggests a need for more targeted studies that examine internal workshop conditions and their impact on workers' thermal stress and fatigue.

This study hypothesises that an unfavourable work environment, defined by higher ambient temperature, humidity, and less air flow, is strongly correlated with increased work-related weariness among furniture workers. The primary goal of the current study is to assess the relationship between measured work climate variables and self-reported work fatigue among furniture workers in Hertasning Street, Indonesia, using quantitative methods and validated measurement tools. This study intends to provide empirical information on how environmental heat conditions influence occupational weariness in an area that has received little attention in prior research. The findings are likely to help workplace health and safety practitioners, lawmakers, and furniture industry owners develop effective interventions to enhance a healthier working environment.

2. Method

This study employed a quantitative analysis with an analytical approach and a cross-sectional design. Cross-sectional study is an observational research design that analyzes data collected from a population, or a representative subset, at a single specific point in time. It is used to describe the frequency, prevalence, and characteristics of a phenomenon within that population (Wang & Cheng, 2020). The independent variable is the variable that causes or changes the dependent variable. The independent variable in this study is work climate. The dependent variable is the variable influenced or affected by the independent variable. The dependent variable in this study is work fatigue.

This research was conducted in Hertasning Street, across several locations, in December 2023. The population consisted of 30 furniture workers. Purposive sampling was used to select a sample of 30 furniture workers. The instruments used in this study were the KAUPK2 questionnaire (Questionnaire for Measuring Feelings of Work Fatigue) and the Heat Stress Monitor. The data used in this study comprised primary and secondary data. Primary data was obtained from the field, specifically the Hertasning furniture workers. This primary data was collected directly from the furniture workers in Hertasning. Primary data was obtained from Hertasning Furniture Workers regarding the data needed in this study, namely data on respondent characteristics, respondent descriptions based on work climate, employee characteristics, and fatigue. Data analysis techniques used univariate analysis and bivariate analysis, namely to describe the characteristics of independent and dependent variables where all data in the questionnaire were processed and then presented in the form of a frequency distribution table (n) using SPSS to determine the relationship between independent and dependent variables using chi-square test evaluation.

3. Results & Discussion

Result

A. Univariate Analysis

Table 1. *Frequency Distribution of Respondents' Characteristics and Environmental Condition*

Variables	Frequency (n = 30)	Percentage (%)
Age		
Elderly (46-65 Year)	1	3.3
Teenager (12-25 Year)	14	46.7
Mature (26-45 Year)	15	50
Work Length		
>5 years	27	90
≤5 years	3	10
Work Duration		
>8 o'clock	27	90

Variables	Frequency (n = 30)	Percentage (%)
≤8 o'clock	3	10
Sex		
Male	30	100
Female	0	0
Fatigue Category		
Tired	9	30
Not Tired	21	70
Work Climate		
Exceeding the Standard	30	0
Not Exceeding the Standard	0	100

Respondent Characteristics

The subjects in this study were 30 furniture workers in Hertasning. The characteristics identified were age, length of service, duration of work, and gender. Workers' age characteristics were grouped into three categories: elderly (46-65 years), adolescents (12-25 years), and adults (26-45 years). One worker was classified as elderly, 14 were adolescents, and 15 were adults.

Furniture workers' length of service was calculated from the time they first joined the workplace. Length of service was divided into two categories: >5 years and <5 years. Ninety percent of furniture workers had a length of service of >5 years, and 10% of furniture workers had a length of service of <5 years. Length of service was the length of time workers were exposed to the climate in their workplace. Work duration was also grouped into two categories: >8 hours and <8 hours. Twenty-seven respondents worked >8 hours, representing 90% of the respondents, and three respondents worked <8 hours, representing 10%. Respondent characteristics based on gender: all furniture workers were male.

Respondents' Occupational Fatigue

Occupational fatigue is a reflection of the body's response to the activities performed and exposures received during work. Occupational fatigue among furniture workers in Hertasning was categorized into two categories: not fatigued (score 0-8) and fatigued (score 9-17). Twenty-one workers, representing 70% of the respondents, did not experience fatigue, while nine workers, representing 30%, experienced fatigue.

Several factors can influence fatigue among furniture workers in Hertasning, such as age and gender. The furniture workers in Hertasning are all male, and the majority are in the adolescent and adult age ranges, meaning their organs and stamina are still strong, preventing them from easily becoming fatigued.

Respondents' Work Environment

Based on Decree of the Minister of Health of the Republic of Indonesia Number 1405/Menkes/SK/XI/200, the Threshold Limit Value (NAB) for the workplace is 18°C to 28°C. Work climate measurements were categorized into two categories: ≤ TLV (if ISBB ≤ 28°C) and >TLV (if ISBB > 28°C). This work climate measurement was conducted at five locations. In the work climate measurements conducted at the respondents' workplaces, 30 respondents, with 100% of them, experienced excess TLV in their workplace.

B. Bivariate Analysis

Table 2. *Relationship between Respondents' Characteristics and Environmental Condition toward Fatigue Category*

Variables	Fatigue Category				p-value
	Tired		Not Tired		
	n	%	n	%	
Age					
Elderly (46-65 Year)	0	0	1	4.8	0.770
Teenager (12-25 Year)	4	44.4	10	47.6	
Mature (26-45 Year)	5	55.6	10	47.6	
Work Length					
>5 years	2	22.2	7	33.3	0.543
≤5 years	7	77.8	14	66.7	
Work Duration					
>8 o'clock	8	88.9	19	90.5	0.894
≤8 o'clock	1	11.1	2	9.5	
Work Climate					0.028 (OR Crude 95%CI 4.8 (0.039-0.047)
Exceeding the Standard	9	100	21	100	
Not Exceeding the Standard	0	0	0	0	

Relationship between Respondent Characteristics and Worker Fatigue

Based on the statistical test in this study using a chi-square correlation test, a p-value of 0.770 was obtained between age and work fatigue. Therefore, it can be concluded that there is no significant relationship between age and work fatigue. The results indicate that workers experiencing high levels of work fatigue were in the adult category, with 5 respondents (55.6%) experiencing work fatigue.

Based on the statistical test in this study using a chi-square correlation test, a p-value of 0.543 was obtained with a significance level between length of service and work fatigue. Therefore, it can be concluded that there is no significant relationship between length of service and work fatigue. The results of the study indicate that 7 respondents (77.8%) experienced high levels of work fatigue, with a work duration of <5 years and a work fatigue.

Based on statistical testing of the results of this study using a chi-square correlation test, a p-value of 0.894 was obtained between the variables of work duration and work fatigue. Therefore, it can be concluded that there is no significant relationship between work duration and work fatigue. The results indicate that 7 respondents (77.8%) experienced high levels of work duration, with a work duration of >8 hours, and work fatigue.

Relationship between Work Climate and Worker Fatigue

The results of the statistical test of the distribution based on work climate and work fatigue obtained a p-value of 0.028 (<0.05), thus Ha is accepted and Ho is rejected. This indicates a relationship between work climate and feelings of fatigue among furniture industry workers in Hertasning. The result of Odds Ratio (OR) = 4.800 (95% CI: 0.039 -0.047) which means the risk of feeling tired in workers who work at temperatures not according to the NAB is 4.800 times greater than workers who work at temperatures according to the NAB. In the category exceeding the NAB there are 21 (70%) respondents who do not experience fatigue and 9 (30%) respondents who do experience fatigue.

Discussion

The results of this study indicate a significant relationship between work climate and occupational fatigue among furniture industry workers. A p-value of 0.028 ($p < 0.05$) indicates that exposure to a work climate exceeding the threshold value (TLV) is significantly associated with the occurrence of work fatigue. An odds ratio (OR) of 4.8 indicates that workers exposed to a hot work climate have a nearly five-fold greater risk of experiencing fatigue compared to workers working in a standard work climate. This finding confirms that work climate is an environmental factor that plays a significant role in the occurrence of work fatigue, particularly in the furniture industry, which generally has limited control over the work environment.

Theoretically, the relationship between a hot work climate and work fatigue can be explained through the concept of heat stress. Exposure to high environmental temperatures, especially when accompanied by high humidity and inadequate air circulation, increases the body's heat load. This condition triggers a physiological response in the form of increased peripheral blood flow and sweat production to maintain core body temperature. This process places greater strain on the cardiovascular system and increases fluid and electrolyte loss, ultimately accelerating the onset of physical and mental fatigue (De Sario et al., 2023). The risk of occupational weariness rises if heat exposure continues for prolonged periods of time without sufficient rest and fluids.

The results of this study align with recent research findings and scientific reports stating that workplace heat is closely linked to fatigue, reduced work capacity, and occupational health problems. A scoping review conducted by De Sario et al. (2023) showed that occupational heat exposure is consistently associated with increased fatigue, reduced productivity, and the risk of workplace accidents. Additionally, one of the fastest-growing occupational health hazards in the world is workplace heat, especially in tropical nations and in jobs requiring physical effort (Venugopal et al., 2016). Fatigue and decreased short-term and long-term job capability are more likely to occur in workers exposed to heat levels beyond the advised threshold (Lucas et al., 2014).

In this study, all work climate measurement points showed ISBB values exceeding the TLV, indicating that all respondents worked in environmental conditions potentially causing heat stress. However, only 30% of respondents were classified as fatigued, while the remaining 70% did not report fatigue. This condition can be explained by several possibilities. One is the process of heat acclimatization in workers. Workers who have been exposed to hot work environments for a long time can experience physiological adaptations, such as increased efficiency of the body's cooling mechanisms, so that symptoms of fatigue are not always felt even though heat exposure remains high (Garrett et al., 2014). In this study, the majority of respondents had worked for more than five years, allowing for this acclimatization process.

Furthermore, the age and physical condition of workers also play a role in determining their response to heat exposure. Most respondents were in the late adolescence to adulthood age group, who physiologically have relatively better endurance and work capacity. This can influence subjective perceptions of fatigue. Nath et al. (2026) in their umbrella review stated that individual responses to heat exposure are strongly influenced by age, physical fitness, and health conditions, so not all workers exposed to heat will exhibit the same level of fatigue.

The results of the bivariate analysis in this study also showed that the variables of age, tenure, and length of service were not significantly related to work fatigue. The lack of a significant relationship between these factors and fatigue is likely due to the relatively small sample size and homogeneous distribution of respondents. All respondents were male, and the majority worked more than eight hours per day, thus limiting data variation. Several previous studies have reported that long work hours and long tenure can increase the risk of fatigue, but this relationship is generally more pronounced in studies with large sample sizes or longitudinal designs (Ouyang & Luo, 2025).

The findings of this study are also consistent with research in the informal industrial sector in tropical regions. Ridwan et al. (2023)reported that industrial workers in Indonesia exposed to occupational heat with WBGT values above the TLV had a higher risk of fatigue and other occupational health disorders. This condition was exacerbated by the limited implementation of work environment controls and occupational safety and health management systems. Therefore, the furniture industry, which is largely informal, is a vulnerable group to the impacts of occupational heat.

Occupational fatigue due to heat exposure has broad implications for occupational health and safety. Fatigue can reduce concentration, slow reaction times, and increase the risk of errors and workplace accidents. Research by Ouyang & Luo (2025) showed that physical fatigue combined with exposure to high temperatures is associated with decreased cognitive function related to occupational safety. Thus, the findings of this study emphasize the importance of controlling the work climate as part of efforts to prevent fatigue and improve occupational safety.

Although this study demonstrates a significant relationship between work climate and fatigue, there are several limitations that should be considered. The cross-sectional design does not allow for direct causal conclusions. Furthermore, fatigue measurements were conducted subjectively based on score categories, thus the potential for perception bias is unavoidable. Other factors potentially influencing fatigue, such as physical workload, hydration status, and psychosocial factors at work, have not been analyzed in depth.

Overall, this study provides empirical evidence that a hot work environment exceeding a threshold value is significantly associated with work fatigue in furniture industry workers. This finding aligns with heat stress theory and recent research in occupational health. Therefore, efforts to control the work environment, such as improving ventilation, regulating work and rest periods, and educating workers about the risks of occupational heat, are needed to reduce the incidence of fatigue and improve occupational health and safety.

4. Conclusion

Workplace fatigue can be linked to several factors, such as the worker's age and gender, length of service, and duration. A comfortable work environment can make workers comfortable, less prone to illness, easier to concentrate, and faster completion of work according to targets. Meanwhile, an unhealthy and uncomfortable environment can reduce productivity, easily stress, and reduce enthusiasm for work. Extreme work climates, including heat and cold, are beyond human adaptation.

All furniture workers in Hertasning are male, and the majority are in the teenage and adult age categories. Ninety percent of workers have worked for more than five years, and 10% have worked for less than five years. Twenty-seven respondents worked for more than eight hours (90%), and three respondents worked for less than eight hours (10%). Twenty-one workers (70%) did not experience fatigue, and nine workers (30%) did. In workplace climate measurements conducted at the respondents' workplaces, 30 respondents (100%) experienced excess NAB in their workplace. The research results showed a p-value of 0.028, indicating a relationship between work climate and fatigue among furniture workers in Hertasning. This information is expected to inform furniture business owners to pay more attention to employee comfort in the workplace, by providing a dedicated rest area with a favorable room temperature and air conditioning, such as a fan, in the rest area.

5. References

Abokhashabah, T., Jamoussi, B., Summan, A. S., Abdelfattah, E., & Ijaz, A. (2021). Effects of heat stress exposure and climate change on health and safety of outdoor workers. *Current World Environment*, *16*(3), 836.

De Sario, M., de'Donato, F. K., Bonafede, M., Marinaccio, A., Levi, M., Ariani, F., Morabito, M., & Michelozzi, P. (2023). Occupational heat stress, heat-related effects and the related social and economic loss: a scoping literature review. *Frontiers in Public Health*, *11*, 1173553.

Flouris, A. D., Dinas, P. C., Ioannou, L. G., Nybo, L., Havenith, G., Kenny, G. P., & Kjellstrom, T. (2018). Workers' health and productivity under occupational heat strain: a systematic review and meta-analysis. *The Lancet Planetary Health*, *2*(12), e521–e531. https://doi.org/https://doi.org/10.1016/S2542-5196(18)30237-7

Garrett, A. T., Goosens, N. G., Rehrer, N. J., Patterson, M. J., Harrison, J., Sammut, I., & Cotter, J. D. (2014). Short-term heat acclimation is effective and may be enhanced rather than impaired by dehydration. *American Journal of Human Biology*, *26*(3), 311–320.

Ioannou, L. G., Foster, J., Morris, N. B., Piil, J. F., Havenith, G., Mekjavic, I. B., Kenny, G. P., Nybo, L., & Flouris, A. D. (2022). Occupational heat strain in outdoor workers: a comprehensive review and meta-analysis. *Temperature*, *9*(1), 67–102.

Kim, D., & Lee, J. (2020). Spatial Changes in Work Capacity for Occupations Vulnerable to Heat Stress: Potential Regional Impacts From Global Climate Change. *Safety and Health at Work*, *11*(1), 1–9. https://doi.org/https://doi.org/10.1016/j.shaw.2019.10.004

Kusmawan, D., Perdana, S. M., Putri Irwanti, S., Gustina, I., Bow-Olaksono, A., & Firmansyah, A. (2025). Association Between Heat Stress Exposure, Physical Activity, and Nutritional Status with Occupational Fatigue: Pilot Study. *Unnes Journal of Public Health*, *14*(2), 154–160. https://doi.org/10.15294/ujph.v14i2.16192

Levi, M., Kjellstrom, T., & Baldasseroni, A. (2018). Impact of climate change on occupational health and productivity: A systematic literature review focusing on workplace heat. *Medicina Del Lavoro*, *109*(3), 163–179. https://doi.org/10.23749/mdl.v109i3.6851

Lucas, R. A. I., Epstein, Y., & Kjellstrom, T. (2014). Excessive occupational heat exposure: a significant ergonomic challenge and health risk for current and future workers. *Extreme Physiology & Medicine*, *3*(1), 14.

Nath, A., Sahu, S., & Lee, J. K. W. (2026). An Umbrella Review of Systematic Reviews and Meta-Analyses on Occupational Heat Exposure, Health Risks, and Productivity Losses Globally. *Current Environmental Health Reports*, *13*(1), 2.

Ouyang, Y., & Luo, X. (2025). Effects of physical fatigue superimposed on high temperatures on construction workers' cognitive performance. *Safety Science*, *181*, 106705.

Ridwan, F. H., Anua, S. M., Aji, B. S., Nurdin, R., Rizky, M. H., & Tejamaya, M. (2023). Assessment of occupational heat stress in a selected Indonesian steel mill. *International Journal of Occupational Safety and Health (IJOSH)*, *12*(2), 292–303.

Rosita, V., Ratriwardhani, R. A., Romadhoni, M. N., Anggraini, W. M., Junaini, N. R. L., & Alfiana, F. (2025). Gambaran Keluhan Heat Stress pada Pekerja Bengkel Reparasi Truck CV. Karya Cipta Baru. *Jurnal Penelitian Inovatif*, *5*(4), 2731–2742. https://doi.org/10.54082/jupin.1745

Venugopal, V., Chinnadurai, J. S., Lucas, R. A. I., & Kjellstrom, T. (2016). Occupational heat stress profiles in selected workplaces in India. *International Journal of Environmental Research and Public Health*, *13*(1), 89.

Venugopal, V., Latha, P. K., Shanmugam, R., Krishnamoorthy, M., & Johnson, P. (2020). Occupational heat stress induced health impacts: A cross-sectional study from South Indian working population. *Advances in Climate Change Research*, *11*(1), 31–39. https://doi.org/https://doi.org/10.1016/j.accre.2020.05.009

Wang, X., & Cheng, Z. (2020). Cross-sectional studies: strengths, weaknesses, and recommendations. *Chest*, *158*(1), S65–S71.