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The correlation between work climate with work-related fatigue among parking ticket

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ABSTRACT

Hot work climate is a physical environmental factor that can affect both physical and mental health of workers. Continuous exposure to excessive heat without adequate control may trigger physiological responses. This study aimed to determine the correlation between hot work climate and work-related fatigue among parking ticket attendants in the Megamas Manado area. This study employed quantitative approach using an analytical survey design with cross-sectional method. The study population consisted of all 63 parking ticket attendants. Data were collected through direct measurement of heat exposure using heat stress monitor and assessment of work-related fatigue using standardized fatigue questionnaire. Statistical analysis was conducted using the Pearson correlation test. The statistical analysis revealed significant correlation between hot work climate and work-related fatigue among parking ticket attendants (p-value = 0.001). The correlation coefficient (r = 0.401) indicated moderate positive correlation, suggesting that higher heat exposure was associated with increased levels of work-related fatigue. There is significant positive correlation between hot work climate and work-related fatigue among parking ticket attendants. These findings highlight the importance of implementing effective heat control measures to reduce fatigue and improve occupational health and work performance.

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1. Introduction

Work-related fatigue is a major occupational health and safety issue that can increase the risk of workplace accidents. Fatigue may occur in all types of occupations, both formal and informal, and is defined as a decline in physical and mental capacity resulting from excessive workload and unfavorable working conditions. Excessive fatigue reduces concentration and work performance, thereby increasing the likelihood of occupational accidents.

The International Labour Organization (ILO) reported that approximately 32% of the global workforce experiences work-related fatigue, with severe fatigue complaints ranging from 18.3% to 27%, and prevalence in industrial settings reaching up to 45% (International Labor Organization, 2016). In 2023, the ILO estimated nearly three million worker deaths worldwide due to work-related accidents and diseases, representing a 5% increase compared to 2015 (International Labour Organization, 2023). In

Indonesia, 462,241 occupational accident cases were recorded in 2024, some of which were associated with work fatigue (Ministry of Manpower, 2024).

Poor working environments contribute significantly to worker stress, reduced concentration, illness, and decreased productivity. A safe and comfortable work environment is essential to prevent occupational accidents (Alviantika & Rifai, 2020). One major environmental risk is heat stress, which arises from exposure to high temperatures combined with humidity, air movement, and radiant heat (Ministry of Manpower of the Republic of Indonesia, 2018).

While organizational factors such as shift patterns, workload, duration of static sitting, and task monotony have been widely recognized as contributors to work-related fatigue, environmental heat exposure represents a more direct physiological stressor that simultaneously affects multiple body systems. Heat stress triggers thermoregulatory responses that increase cardiovascular load, fluid loss, and central nervous system strain, leading to faster onset of fatigue compared to purely organizational factors. Moreover, unlike workload or shift systems that may vary across individuals, thermal exposure constitutes a shared and measurable environmental risk affecting all workers within the same setting, making it a critical determinant for occupational fatigue assessment, particularly in outdoor and semi-enclosed workplaces. In tropical countries such as Indonesia, fluctuating temperature and humidity levels increase the risk of heat exposure, particularly for outdoor workers. Elevated ambient temperatures increase sweating as a thermoregulatory response. Without adequate fluid replacement, this condition may lead to dehydration, reduced productivity, and acute heat-related illnesses such as heat exhaustion and heat stroke, affecting the central nervous, cardiovascular, and musculoskeletal systems (Aulia et al., 2023). Previous studies have demonstrated a strong association between hot working environments and work fatigue, including among construction workers and smelting industry workers, where fatigue prevalence reached up to 70% (Aprilina, 2021).

However, most existing studies on heat-related fatigue have primarily focused on industrial or heavy labor sectors, with limited attention to informal or semi-formal service occupations characterized by low physical workload but prolonged static posture and constrained workspace. Furthermore, previous research often examines heat stress in isolation without considering its interaction with micro-environmental conditions such as confined booth design, limited ventilation, and continuous exposure duration in small operational units.

Megamas Manado is one of the most densely developed areas in Manado City and serves as a vital infrastructure hub. Parking ticket attendants working at exit booths are exposed to monotonous tasks, confined workspaces, limited mobility, and poor air circulation, resulting in uncomfortable and often hot working conditions. Observations indicate that attendants frequently experience fatigue-related complaints such as drowsiness, reduced concentration, dizziness, and musculoskeletal discomfort, particularly during daytime shifts.

This study offers a specific novelty by examining heat stress as a primary determinant of fatigue within a unique occupational setting—parking booth attendants—where physical workload is relatively low but environmental heat exposure is intensified by micro-space confinement and inadequate ventilation. By integrating environmental measurements of thermal conditions with subjective fatigue outcomes in a semi-enclosed urban informal work context, this research aims to bridge the gap between traditional heat stress studies in heavy industries and emerging occupational risks in urban service sectors. This study aims to examine the correlation between hot work climate and work-related fatigue among parking ticket attendants in the Megamas Manado area.

2. Methods

This study used an analytical quantitative approach with a cross-sectional design. In this study, data collection and analysis were conducted in numerical form to examine the correlation between the independent variable (hot work climate) and the dependent variable (work-related fatigue), with both variables measured simultaneously at one point in time. Although the article history (submission–review process) is recorded in the 2018–2019 period, the data used in this manuscript were obtained from a more recent field study conducted as part of an updated research project and manuscript revision. The inclusion of 2025 data reflects a data enrichment and validation process to improve the relevance and

accuracy of findings in the current occupational setting. Therefore, the timeline difference represents an updated dataset rather than the original data used in the earlier manuscript version. The study was conducted among 63 parking ticket attendants working in the Megamas Manado area from July to October 2025. The parking ticket attendants working hours into three shifts, with a total of 30 payment booths. The sample comprised the total population, in which all workers were included. The dependent variable in this study was work-related fatigue, while the independent variable was hot work climate. The Work Fatigue Feeling Measurement Questionnaire he Work Fatigue Feeling Measurement Questionnaire (Kuesioner Alat Ukur Perasaan Kelelahan Kerja/ KAUPK2) is a parameter designed to assess work-related fatigue based on subjective symptoms reported by workers. This questionnaire was adopted and developed from previous research conducted by Sitorus (2022). The questionnaire consists of 17 items, with response scores ranging from 1 as the lowest score to 5 as the highest score (Sitorus, 2022). Univariate analysis in this study was used to describe the specific characteristics of each variable examined. Bivariate analysis was conducted using the Pearson correlation test to analyze the correlation between hot work climate and work-related fatigue.

3. Results and Discussion

Results

a. Respondent characteristics, most respondents were female (58.7%) and predominantly aged 21 years. Nearly all respondents had a senior high school education (98.4%). Workers were evenly distributed between Shift 1 and Shift 2 (47.6% each), with minimal representation in Shift 3 (4.8%).

Table 1.
Distribution of Respondents Based on Characteristics

Respondent Characteristics	Category	N	(%)
Gender	Male	26	41.3
	Female	37	58.7
Age (years)	18	2	3.2
	19	3	4.8
	20	6	9.5
	21	14	22.2
	22	13	20.6
	23	12	19.0
	24	7	11.1
	25	1	1.6
	26	3	4.8
	27	2	3.2
Education Level	Senior High School / Equivalent	62	98.4
	Diploma (D3)	1	1.6
Work Shift	Shift 1	30	47.6
	Shift 2	30	47.6
	Shift 3	3	4.8
Total		63	100

Table 1 shows that most respondents were female (58.7%) and predominantly aged 21–23 years. Nearly all respondents had a senior high school education (98.4%). Respondents were almost evenly distributed between Shift 1 and Shift 2 (47.6% each), while only a small proportion worked in Shift 3 (4.8%). A total of 63 respondents participated in this study.

b. Hot work climate, the highest average WBGT was recorded during Shift 1 (29.8°C), followed by Shift 2 (26.6°C) and Shift 3 (24.4°C). The temperature during Shift 1 approached the threshold limit value for light workloads (31.0°C). Confined booths and direct solar exposure contributed to elevated indoor temperatures. Prolonged heat exposure may increase physiological strain and reduce work performance.

Table 2.
Frequency Distribution of Hot Work Climate Across Three Work Shifts Among Parking Ticket Attendants in the Megamas Manado Area

Hot Work Climate (Average Value)	N	(%)
29.8 ℃	30	47.6
26.6 ℃	30	47.6
24.4 ℃	3	4.8
Total	63	100

Based on Table 2, three respondents (4.8%) were exposed to an average WBGT value of 24.4℃, while 30 respondents (47.6%) experienced a hot work climate of 26.6℃ and another 30 respondents (47.6%) were exposed to an average WBGT value of 29.8℃. In total, 63 respondents were included in the analysis.

c. Work-Related fatigue, the description of work-related fatigue among parking ticket attendants in the Megamas Manado area was obtained using a work fatigue measurement instrument consisting of a questionnaire with 17 items. Moderate fatigue was most prevalent (57.1%), followed by high (31.7%) and mild fatigue (11.1%). Fatigue manifested as reduced concentration, cognitive decline, and physical exhaustion, potentially influenced by environmental and organizational factors.

Table 3.
Frequency Distribution of Work-Related Fatigue Among Parking Ticket Attendants in the Megamas Manado Area

Work-Related Fatigue	N	(%)
Mild Fatigue	7	11.1
Moderate Fatigue	36	57.1
High Fatigue	20	31.7
Total	63	100

Based on Table 3, the majority of respondents experienced moderate work-related fatigue, affecting 36 respondents (57.1%). High levels of fatigue were reported by 20 respondents (31.7%), while mild fatigue was experienced by 7 respondents (11.1%). A total of 63 respondents were included in the analysis.

d. Correlation Between Hot Work Climate and Work-Related Fatigue, a significant positive correlation was observed between hot work climate and work-related fatigue ($r = 0.401$; $p = 0.001$). Higher temperature exposure, particularly during Shift 1, was associated with increased fatigue levels. These findings align with previous studies, confirming heat exposure as a key contributor to occupational fatigue.

Table 4.
Cross-Tabulation Analysis of Work Shifts and Hot Work Climate

Work Shift	24.4 ℃	26.6 ℃	29.8 ℃	Total
Shift 1	0	0	30	30
Shift 2	0	30	0	30
Shift 3	3	0	0	3
Total	3	30	30	63

Based on Table 4, the analysis shows a clear distribution of hot work climate according to work shifts. All respondents working in Shift 1 (30 respondents) were exposed to a hot work climate with an average temperature of 29.8℃. Respondents in Shift 2 (30 respondents) experienced a hot work climate of 26.6℃, while respondents in Shift 3 (3 respondents) were exposed to a lower average temperature of 24.4℃.

e. Correlation Between Work Shifts and Work-Related Fatigue Among Parking Ticket Attendants in the Megamas Manado Area

Table 5.
Cross-Tabulation Analysis of Work Shifts and Work-Related Fatigue

Work Shift	Mild Fatigue	Moderate Fatigue	High Fatigue	Total
Shift 1	1	14	15	30
Shift 2	4	21	5	30
Shift 3	2	1	0	3
Total	7	36	20	63

Based on Table 5, the analysis shows variations in work-related fatigue across work shifts. Among respondents working in Shift 1, most experienced high fatigue (15 respondents), followed by moderate fatigue (14 respondents), and mild fatigue (1 respondent). In Shift 2, the majority of respondents experienced moderate fatigue (21 respondents), while 5 respondents reported high fatigue and 4 respondents reported mild fatigue. In Shift 3, most respondents experienced mild fatigue (2 respondents), followed by moderate fatigue (1 respondent), with no respondents reporting high fatigue.

f. Results of Pearson Correlation Analysis Between Hot Work Climate and Work-Related Fatigue Among Parking Ticket Attendants in the Megamas Manado Area

Table 6.
Pearson Correlation Test Between Hot Work Climate and Work-Related Fatigue

Variables	r	p-value	N
Hot Work Climate and Work-Related Fatigue	0.401	0.001	63

Based on Table 6, the results indicate a positive and statistically significant correlation between hot work climate and work-related fatigue among parking ticket attendants in the Megamas Manado area. This is evidenced by a correlation coefficient (r) of 0.401 and a significance value (p-value) of 0.001. Therefore, the alternative hypothesis (H_1) is accepted. The positive correlation suggests that higher levels of hot work climate exposure are associated with increased levels of work-related fatigue.

Discussion

This study was conducted on parking ticket attendants in the Megamas Manado area. Regarding the characteristics of the respondents, the majority were female, totaling 37 attendants (58.7%), while male respondents accounted for 26 attendants (41.3%). It can be concluded that the number of female respondents slightly exceeds that of males, although the numerical difference is not prominent. The most frequent age was 21 years (22.2%), while the least frequent was 25 years (1.6%). As age increases, individuals tend to experience a rise in health-related disorders (Dengo, 2023). In terms of educational background, the majority held a High School diploma or equivalent (98.4%), with the remainder having a Diploma (D3) degree (1.6%). Work shifts were distributed such that Shift 1 and Shift 2 had an equal number of workers (30 workers each, or 47.6%), while Shift 3 had the fewest (4.8%).

In occupational environmental health, the study focuses on how environmental factors such as noise, temperature, and air quality can influence workers' health (Nelwan & Sumampouw, 2025). When an individual works in an environment with high temperatures or humidity, the body automatically strives to maintain internal thermal balance by increasing blood circulation to the skin's surface to facilitate heat dissipation through the evaporation of sweat. This mechanism causes the heart to work more intensively, leading to an increase in heart rate. Conversely, in cooler or more comfortable environments, the body requires less energy to regulate its internal temperature, allowing the heart rate to remain relatively stable (Pasolang et al., 2025).

Regarding the hot work climate among the attendants, the highest temperature was recorded during Shift 1 (morning), which involved 30 respondents (47.6%) with an average temperature of 29.8°C. In Shift 2, the average temperature was 26.6°C, while Shift 3 recorded the lowest average temperature of 24.4°C, with only three workers. Continuous or prolonged exposure to heat in the workplace can trigger both physical and mental fatigue, decrease concentration, and increase the risk of occupational

accidents. Workers operating in high-temperature environments whether indoors with limited air circulation or outdoors under direct sunlight are at risk of experiencing health problems caused by heat stress (Danduru et al., 2025). Under hot conditions, workers are also prone to dehydration, heat stroke, and heat stress, which ultimately reduce productivity as workers require longer recovery times (Firmansyah et al., 2025).

According to Ministry of Manpower of the Republic of Indonesia (Ministry of Manpower of the Republic of Indonesia, 2018), the Threshold Limit Value (TLV) for a hot work climate allowed for light workloads is 31.0°C. This regulation applies to working hours requiring exposure between 75% to 100% per hour. Although the measured WBGT during Shift 1 (29.8°C) did not exceed the TLV of 31.0°C, it is important to emphasize that TLV represents a threshold for maximum allowable exposure under ideal conditions, not a guarantee of absence of physiological strain. In real working conditions, several modifying factors such as prolonged exposure duration, limited air circulation within confined booths, restricted worker mobility, and cumulative heat load throughout the shift can lead to significant fatigue even below the TLV. Therefore, the occurrence of high fatigue in Shift 1 can be explained by the combined effect of sub-threshold heat exposure and unfavorable micro-environmental conditions, which amplify thermal strain beyond what is predicted by WBGT values alone. Consistent with the study conducted by Mandalika (2025)on security personnel at PT Pelindo TPK Bitung, significant temperature variations were observed (26°C–35.5°C, mean: 29°C), indicating a high risk of heat stress that could potentially affect workers' health (such as dehydration and cardiovascular strain) and reduce operational productivity.

The assessment of work fatigue levels among the attendants showed that moderate fatigue was the most prevalent category, found in 36 attendants (57.1%). In this group, the majority reported frequent feelings of unease while working, reluctance to make eye contact, and forgetfulness, despite202 rarely feeling reluctant to work. Meanwhile, high-level fatigue was recorded at 37.1%, where attendants frequently experienced full-body exhaustion, decreased self-confidence and cognitive function, frequent anxiety, and fatigue when speaking. Mild fatigue was experienced by 11.1% of the attendants, with complaints such as slow movements and a lack of confidence. The level of fatigue experienced is further influenced by the working environment conditions.

Work fatigue is a complex phenomenon involving both physiological and psychological aspects. Its primary focus lies in a drastic decline in physical capacity, which correlates directly with the emergence of exhaustion, plummeting motivation, and reduced work effectiveness (Santosa, 2024). After an eight-hour workday, physical fatigue begins to set in. Common initial symptoms include frequent yawning, thirst, rapid onset of drowsiness, and difficulty concentrating (Yusuf et al., 2025).

Based on the Pearson correlation test, the study indicated a significance value of 0.001 ($p \leq 0.05$) with a correlation coefficient of 0.401. These findings indicate a moderate positive correlation between a hot work climate and work fatigue, meaning that an increase in workplace temperature is directly proportional to the increase in worker fatigue.

From a strict epidemiological and occupational health perspective, the correlation coefficient ($r = 0.401$) should be interpreted as a *moderate association*, indicating that hot work climate is an important but not the sole determinant of work-related fatigue. This suggests that other contributing factors such as shift duration, task monotony, and ergonomic constraints may also play a significant role. However, despite its moderate magnitude, the finding remains practically significant in occupational safety, as even moderate increases in fatigue can substantially elevate the risk of human error and workplace accidents, particularly in tasks requiring sustained attention such as ticket monitoring and transaction handling.

Cross-tabulation analysis showed that the highest temperature occurred during Shift 1 (29.8°C), which coincided with the highest number of respondents experiencing high fatigue (15 people). In contrast, during Shift 2 (26.6°C), 21 respondents experienced moderate fatigue.

In practical OSH terms, this finding implies that interventions should not rely solely on maintaining WBGT below TLV, but must also consider work organization strategies. Specifically, booth design improvements (enhanced ventilation, shading, or cooling systems), rotation of workers between

shifts, and structured work–rest cycles are necessary to reduce cumulative heat exposure. Additionally, prioritizing high-risk shifts (such as Shift 1) for preventive measures is essential, as even sub-threshold thermal exposure can lead to meaningful increases in fatigue and associated safety risks.

Heat exposure not only poses a risk of dehydration and decreased productivity but also triggers serious acute disorders. Conditions such as heat stroke and heat exhaustion can attack the body's vital systems, including the central nervous, cardiovascular, and musculoskeletal systems (Aulia et al., 2025). These findings are consistent with the study by Alviantika (Alviantika & Rifai, 2020), which found a significant correlation between a hot work climate and feelings of fatigue (p = 0,001)Their results showed that 63.2% of workers experienced severe fatigue, and 57.9% worked in hot environments that did not comply with the TLV. This indicates that workers exposed to a hot climate are highly likely to experience severe fatigue. This is further supported by Aprilina (Aprilina, 2021), who found a correlation between a hot work climate and work fatigue among construction workers. This implies that as the temperature in the work environment rises, the level of fatigue becomes more severe, underscoring the vital need for heat control measures, improved ventilation, and appropriate work–rest schedules to mitigate occupational fatigue.

4. Conclusion

This study provides evidence that parking ticket attendants in the Megamas Manado area are exposed to a hot work climate (mean WBGT 29.8°C), approaching regulatory limits for light workloads, and that such exposure is associated with significant levels of work-related fatigue. The observed moderate correlation (r = 0.401; p = 0.001) suggests that thermal exposure constitutes an important occupational risk factor, although fatigue is likely influenced by multiple interacting determinants. Importantly, fatigue was evident even when WBGT values remained below the threshold limit, highlighting the limitations of relying solely on regulatory benchmarks without considering real-world working conditions, including prolonged exposure, restricted workspaces, and inadequate ventilation. These findings have practical implications for occupational health policy and workplace design, emphasizing the need for integrated heat mitigation strategies, including engineering modifications, adaptive work scheduling, and worker-centered monitoring systems. The study's limitations—namely its single-site design, limited exposure variability, and reliance on self-reported fatigue—should be acknowledged. Future research should prioritize multi-site and longitudinal approaches, alongside objective physiological measurements, to better inform evidence-based occupational health interventions.

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