


Heat Stress-Related Symptoms among Bakery Workers in Lebanon: A National Cross-Sectional Study

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Abstract

Heat exposure is linked to a range of heat-related illnesses and injuries. This study assessed the association between workers' perceptions of the work environment and reports of heat stress-related health symptoms in bakery workers in Lebanon. A national cross-sectional survey of workers was carried out in 504 bakeries in Lebanon. One worker in each bakery was interviewed using questions relating to the workplace environment and heat stress-related health symptoms. Heat and humidity measurements were recorded in bakeries. Descriptive analyses were performed, and logistic regression assessed relationships between the workplace environment, worker perceptions, and reports of heat stress-related health symptoms. In total, 47.2% of workers experienced heat stress-related symptoms, 83% perceived workplace temperatures as hot, and 48% perceived these temperatures as affecting their health. Humidex readings showed that 49% of bakeries had conditions unsafe for routine work tasks. Working under pressure (AOR = 1.65; 95% CI = 1.12-2.43), job dissatisfaction (AOR = 1.76; 95% CI = 1.12-2.79), and perceptions that high temperatures negatively affected health (AOR = 2.73; 95% CI = 1.87-3.99) were all significantly correlated to reports of heat stress-related symptoms. Females were more likely to experience heat stress-related symptoms (AOR = 1.96; 95% CI = 1.13-3.39). Workers who reported low levels of water consumption at work were also more likely to experience heat stress-related health symptoms. We conclude that heat exposure potentially impacts workers' health in Lebanese bakeries. Improvements in workplace conditions, adequate infrastructure, and workers' training are key interventions for maintaining workers' health.

Keywords

bakery worker, heat exposure, heat stress, Lebanon, occupational health and safety, cross-sectional studies

What do we already know about this topic?

Occupational heat stress has been linked with various heat-related health conditions and has been associated with occupational injuries caused by fatigue, reduced alertness, and decreased psychomotor performance. Heat stress at work is gaining more attention due to rising global temperatures attributed to climate change. Although heat stress is mostly observed and studied in outdoor work environments, heat-related illnesses are also a concern in indoor work environments due to high levels of heat radiating from ovens, stoves, and other heat-generating machinery.

How does your research contribute to the field?

Most of the literature on bakery workers has focused on ergonomic hazards, respiratory illnesses, and burn injuries in industrialized bakeries. However, there is a dearth of research focusing on heat stress in traditional bakeries, which are different from industrialized bakeries in terms of working conditions and occupational environment. To our knowledge, this is the first research to study heat stress among bakery workers in Lebanon.

What are your research's implications toward theory, practice or policy?

Our study found that job dissatisfaction, working under pressure, and perceptions that high temperatures negatively affected health were all significantly correlated to reports of heat stress-related health symptoms among bakery workers in Lebanon. Our findings provide evidence to guide occupational health practitioners and policy-makers in implementing comprehensive intervention programs that focus on heat stress in the understudied population of bakery workers in Lebanon.



Introduction

Occupational heat exposure is of growing concern globally with climate change drawing more attention to this issue.¹ Whether in outdoor or indoor settings, working in excessive heat environments (ie, temperatures exceeding 35° Celsius) poses risks to workers' health and reduces labor productivity.^{2,3} Excessive heat exposure constitutes an occupational hazard of high concern, particularly in indoor and outdoor workplaces lacking effective climate control.² It has been estimated that about 20% of the workforce hours in South East Asia were lost as a result of heat exposure.⁴ Projections for the year 2030 estimate a loss of about 70 million work-life-years in labor productivity due to heat exposure and a loss of 880 000 work-life-years due to occupational heat stroke mortality, in indoor and outdoor workplaces.⁵

Occupational health studies have focused on heat stress in outdoor workers in the field of agriculture, construction, farming, and fishing, who are particularly vulnerable due to constant exposure to heat, especially in hot or humid weather conditions.⁶ Indoor workers are also at risk if temperatures in their work environment are poorly regulated.^{2,7} The Occupational Health and Safety Administration (OSHA) has identified indoor industries at risk of experiencing heat-related illnesses due to the presence of heat-generating appliances; these include bakeries, kitchens, laundries, and furnaces.⁸

Few studies have reported evidence of heat-related outcomes among indoor workers.⁹⁻¹¹ Further research is needed to quantify the risk of heat exposure and heat-related illnesses among indoor workers in various professions, including bakery workers. In addition to measurements of indoor temperatures, additional assessments are needed, such as personal factors and work tasks that may impact risks associated with indoor heat exposure.

Heat stress experienced in hot working environments occurs when the body temperature exceeds 38°C, resulting in health symptoms, such as dry skin, chills, high body temperature, confusion, dizziness, fainting, fatigue, weakness, nausea, and muscle cramps.¹²⁻¹⁴ Other heat stress-related health conditions include heat stroke, heat exhaustion, heat syncope, and heat cramps.^{12,13,15} In addition extreme heat has been associated with mental health effects.¹⁶ A systematic review conducted in 2018 shows evidence of a positive relationship between heat exposure and occupational injuries, mainly caused by fatigue, reduced psychomotor performance, loss of concentration, and reduced alertness.¹⁷

Despite the risks posed by heat stress, work systems have increasingly encouraged workers to ignore symptoms of heat-related illnesses, to maintain the work pace and avoid breaks and work interruptions.¹⁴

Temperatures and humidity in indoor work environments may increase during hot and humid seasons, especially in workplaces that lack adequate ventilation or air conditioning. The presence of drinking water and emergency procedures are also factors affecting workers' responses to heat exposure.^{18,19} Risk factors for heat stress include individual susceptibility, such as age and gender, along with workers' hydration levels, workplace and environment temperature levels, and work rate and activities.^{13,14,20-22} Moreover, the effects of hot and humid working conditions may exacerbate if workers are unaware of heat-related illnesses and their prevention.

The management of heat-related occupational exposures must involve risk assessment and control measures at the level of the work, the workers, and the work environment.¹⁸ However, regulations in low and middle-income countries (LMIC) are challenged by socioeconomic factors and lack of adequate infrastructure, frameworks, and technical expertise.²³ Moreover, the tasks performed in bakeries subject workers to high levels of heat exposure resulting in health impacts if not properly controlled.²⁴

Most of the literature on bakery workers have focused on industrialized bakeries studying the respiratory effects of exposure to flour dust²⁵⁻²⁸ or skin irritation and allergies.²⁸ Other publications have also studied and assessed ergonomic hazards, mainly musculoskeletal disorders, and mental and self-rated health among bakery workers.²⁹⁻³¹ Studies have also assessed burn injuries,³² cataracts due to long-term exposures to kerosene and biomass stoves,^{33,34} chronic venous disease,^{35,36} and oxidative stress and hematological parameters³⁷ among bakery workers.

Few studies exploring heat exposure among bakery workers documented elevated heat stress exposures among those workers.^{11,38-44} Research has also distinguished the working conditions and risks between traditional bakeries^{40,42,44} and industrialized bakeries.^{38,42,45,46} A recent study showed that workers in traditional bakeries are exposed to higher levels of heat stress when compared to workers in industrial bakeries.⁴² In addition, the incidence of heat stress among bakery workers in traditional bakeries has been shown to be 3.3% higher than those in industrial bakeries.³⁸

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Despite the temperate Mediterranean weather conditions prevailing in Lebanon,⁴⁷ preliminary observations in Lebanese traditional bakeries showed poor working conditions prevail in most Lebanese bakeries. Workers in traditional Lebanese bakeries stand long hours in front of an open fire oven, are exposed to elevated heat stress, are not equipped with adequate ventilation, and take minimal precautionary measures. They work under pressure for long shifts that extend 12 h a day, and they earn low wages.²⁹ The physically strenuous tasks performed by bakery workers under precarious working conditions exacerbate heat-related illnesses. To this end, we assessed the association between workers' perceptions of the work environment and reports of heat stress-related health symptoms during the warm and dry summer days in a random sample of bakeries in Lebanon.

Materials and Methods

A national cross-sectional study using a structured questionnaire and standardized methods of data collection was carried out to study heat stress among bakery workers in Lebanon and their perceptions of the workplace environment.

Study Population

A list of 1960 bakeries distributed throughout 5 governorates was acquired from a GIS company. The sample size was selected proportionate to the number of bakeries within each governorate. In other terms, the number of bakeries selected from each governorate was proportional to the density of bakeries in that governorate compared with the total number in the country, resulting in a sample of 582 bakeries. Data were successfully collected in 504 bakeries leading to an 87% response rate. From each of the 504 randomly selected bakeries, 1 bakery worker was included in the study. We interviewed the worker that was on duty at the time of the field visit regardless of age and gender. Non-participation was due to a variety of reasons mainly: many bakeries were not found (permanently closed) or their owners refused to participate for reasons of lack of time or mistrust. Details of this national project on bakery workers have been described elsewhere.^{29,31}

Data Collection

Data were collected through a quantitative survey using a structured questionnaire in a face-to-face interview with 1 worker from each randomly selected bakery. Written informed consent from employers and workers was obtained. The survey included questions on heat-related symptoms, mental health, absenteeism due to illness, working under pressure, perceptions relating to heat and heat-related illnesses, as well as socio-demographic variables. The study was approved by the Institutional Review Board (IRB) at the American University of Beirut (no. FHS-RH1.03).

Main Outcome

Heat stress-related health symptoms were assessed by asking bakery workers to report whether they experienced any of the following 7 symptoms while working at the bakery: fainting or dizziness, nausea, weakness, confusion, muscle cramps, hot dry skin, and chills.^{12,48} Bakery workers who reported any of the 7 symptoms were categorized as having experienced heat stress.

Independent Variables

Data was also collected on worker's perceptions of their work environment, specifically the effect of heat on their health, job satisfaction and security, and work pressure. Other workplace variables such as duration of work, hours spent at the job, work with hot equipment, and frequency of drinking water were also collected. Mental Health was also evaluated using the 5-item Mental Health Inventory (MHI-5), which is a brief, valid, and reliable international instrument for assessing mental health in adults.⁴⁹⁻⁵¹

The "Humidex" index was used to assess relative discomfort and danger caused by temperature and humidity at the workplace.⁵² Both temperatures in °C and humidity percentages were measured inside the bakeries and next to the ovens working space after receiving consent from the bakery owners. In cases where the owner refused, the measurements were calculated by using the average of all other measurements taken in bakeries in the same district and on the same day of data collection. A Humidex figure was then calculated using the equation^{53,54}:

$$\text{Humidex} = \text{Air Temperature} + 0.5555 \times (6.11 \times e^{5417.7530} \times (1/273.16 - 1/\text{dewpoint}) - 10)$$

When the humidex readings ranged (1) between 20 and 29, the degree of comfort is "comfortable", (2) between 30 and 39, the degree of comfort is "some discomfort", (3) between 40 and 45, the degree of comfort is "great discomfort, avoid exertion", and (4) above 45, the degree of comfort is "dangerous, heat stroke possible".⁵²

Statistical Analysis

Univariate and Bivariate analyses were carried out to examine the associations between experiencing heat-related symptoms at work with other independent variables. Subsequently, a logistic regression model was fitted with the variables that were significant at the bivariate level ($P < .05$) adjusting for both age and Humidex. The variables included in the model were "gender", "work under pressure", "job satisfaction", and "perception that hot temperature at work negatively affects worker health". In the analysis, variables with missing participants responses were categorized as a negative response. Specifically, for the 2 variables with missing responses missing responses—"working under pressure" and "perception that hot temperature at work negatively affects worker health"—were categorized as "no".



Figure 1. A traditional bakery in Lebanon.

Adjusted odds ratio (AOR), 95% confidence intervals (CI), and *P*-values were reported in Table 2. We considered an alpha value of 0.05 as statistically significant and carried out data analysis using SPSS 20.0. The goodness of fit of the models was assessed using the Hosmer and Lemeshow Test,⁵⁵ which indicated no lack of fit. A test for first-term interactions, including the main effect, was done; no significant terms were found.

Results

Out of the 504 bakery workers, the vast majority were men (86%), almost half were 40 years or older (44%), 32% had remained in school beyond the intermediate level, and 81% perceived themselves as having low economic status. Three-fourths had worked in bakeries for more than 5 years for an average of 64 h per week (or 9 h per day on a 7-day week). Figures 1 and 2 show workers baking the bread in traditional bakeries in Lebanon. About 22% reported job dissatisfaction, while around 40% reported job insecurity, and 34% had poor mental health. Only 13% reported taking sick days due to illness, with 9% suffering a health problem that prevented them from continuing their daily work tasks. Nearly half of the bakery workers (47.2%) experienced heat stress-related symptoms ($n=238$), as shown in Table 1. The majority (83%) perceived workplace temperatures as hot (not shown in table), and 48% perceived these temperatures as affecting their health.

Figure 3 shows the distribution of workplace temperature/humidity on the Humidex index with temperatures and humidity taken at the location of the interview. In total, 8% of readings showed “no discomfort”, 15% returned “slight discomfort”, and 28% showed “strong discomfort” Humidex



Figure 2. Baking Pita bread in a traditional bakery in Lebanon.

conditions. Moreover, 28% of the readings registered as “strong indisposition”—where people should avoid strenuous exertions—and 15% were categorized as “serious danger”, where any physical activity is not recommended. A startling 6% of readings registered as “death danger”, reflecting an imminent risk of heatstroke.

Figure 4 shows temperature distributions taken at the oven, where workers spend most of their time. As might be expected, Humidex readings taken near the oven, where workers spend much of their time, were much more alarming than those taken elsewhere in the bakery. Less than 1% of readings showed “no discomfort”, 9% returned “slight discomfort”, and 12% showed “strong discomfort” Humidex conditions. Forty-three percent of the readings registered as “strong indisposition”—where people should avoid strenuous exertions—and 36% were categorized as “serious danger” and “death danger”, where any physical activity is not recommended.

Further analyses (shown in Table 2) showed that working under pressure, job dissatisfaction, and perceptions that hot temperatures negatively affected health were all positively correlated to reports of heat stress-related symptoms. Females were more likely to experience heat-related symptoms (AOR=1.96; 95% CI=1.13-3.39). Working under pressure and job dissatisfaction increased the likelihood of reporting heat-related symptoms (AOR=1.65; 95% CI=1.12-2.43 and AOR=1.76; 95% CI=1.12-2.79, respectively). Meanwhile, workers who perceived workplace temperatures as affecting their health were more likely to experience heat-related health symptoms (AOR=2.73; 95% CI=1.87-3.99). Moreover, workers who reported low levels of water consumption at work (35.5%) were more likely to report heat-related health symptoms when compared to those who frequently drank water (not shown in Table 2).

Table I. Socio-Demographic, Work, Health, and Heat-Related Perceptions of Surveyed Lebanese Bakery Workers (N= 504).

	N	%
Socioeconomic and demographic variables		
Age (years)		
≤18	10	2.0
19 to 30	128	25.4
31 to 40	139	27.6
41 to 50	118	23.4
51 to 60	62	12.3
> 60	40	7.9
No answer	7	1.4
	Mean age (39.78)	
Gender		
Male	434	86.1
Female	70	13.9
Marital status		
Married/Engaged	362	71.8
Single/Widowed/Divorced	142	28.2
Education		
Primary level or below	185	36.7
Intermediate level	157	31.2
Secondary level or University	162	32.1
Worker perception of Economic Status		
Low	408	81.0
Good	88	17.5
Missing	8	1.6
Workplace variables		
Duration of work in current job at bakery		
≥5 years	378	75
<5 years	121	24
No answer	5	1
Hours per week spent at job	Mean h (64.24)	
Job security		
Secure	299	59.3
Unsecure	202	40.1
No answer	3	0.6
Job satisfaction		
Satisfied	391	77.6
Dissatisfied	113	22.4
Work under pressure		
No	304	60.3
Yes	192	38.1
No answer	8	1.6
Works with oven or stove or other hot equipment		
Yes	469	93.1
No	32	6.3
No answer	3	0.6
Frequency of drinking water at work		
Frequently	325	64.5
Sometimes/Rarely	179	35.5

(continued)

Table I. (continued)

	N	%
Heat and health		
Worker suffered heat-related symptoms at work		
No	266	52.8
Yes	238	47.2
Heat-related symptoms		
Confusion	101	20.0
Weakness	89	17.7
Fainting or dizziness	78	15.5
Hot or dry skin	71	14.1
Muscle cramps	62	12.3
Nausea	59	11.7
Chills	54	10.7
Perception that hot temperatures at work negatively affects worker health		
No	259	51.4
Yes	240	47.6
No answer	5	1.0
Absenteeism in the past year because of illness		
No	437	86.7
Yes	67	13.3
Suffered symptoms that prevented continuation of daily work tasks		
Yes	44	8.7
No	457	90.7
No answer	3	0.6
Mental health		
Good	322	63.9
Poor	170	33.7
No answer	12	2.4

Discussion

The Humidex findings revealed a troubling reality for the bakery workers: 49% worked inside shops with heat conditions that might lead to serious health problems, while over 79% were exposed to heat near open fire ovens, posing potential threats to their health. These findings on elevated heat exposure in the surveyed population echo findings in the literature on workers in similar traditional bakeries.^{38,40,41} While it is a possibility that many of workers in the study sample are somewhat acclimatized to the working conditions in bakeries, the Humidex readings point to their exposure to extreme heat during their working hours like in other studies of bakery workers.^{40-42,44} The precarious working conditions of low-paid workers like those surveyed in this study are often invisible in local policy debates.

The findings on low absenteeism due to illness may suggest that many of the surveyed bakery workers in Lebanon continue to work despite experiencing heat-related health symptoms, and like in previous studies,^{31,56,57} refrain from taking leave of absence due to job insecurity. In fact, around 40% of the surveyed bakery workers felt their job was

Table 2. Association between Workers’ Perceptions of Work Environment and Reports of Heat Stress-Related Health Symptoms in Surveyed Lebanese Bakeries (N= 504).

	Reporting heat stress-related health symptoms			
	Unadjusted		Adjusted*	
	COR (95% CI)	P-value	AOR (95% CI)	P-value
Gender				
Male				
Female	1.82 (1.09-3.05)	.022	1.96 (1.13-3.39)	.017
Work under pressure				
No				
Yes	1.57 (1.09-2.25)	.015	1.65 (1.12-2.43)	.011
Job satisfaction				
Satisfied				
Dissatisfied	1.96 (1.28-3.01)	.002	1.76 (1.12-2.79)	.015
Perception that hot temperatures at work negatively affects worker health				
No				
Yes	2.90 (2.02-4.17)	.000	2.73 (1.87-3.99)	.000

*Adjusting for age and Humidex.
P < .05 was considered significant.

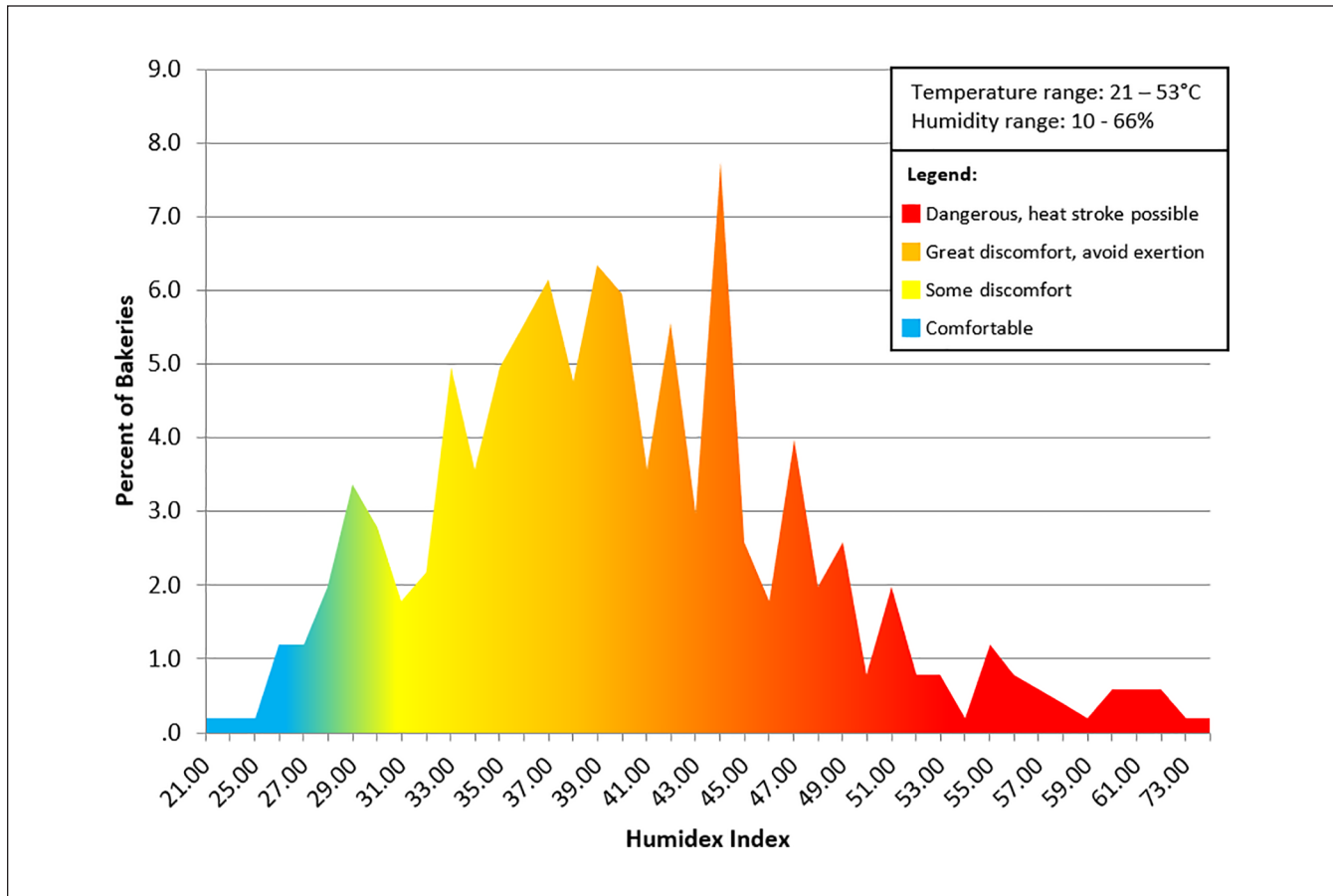


Figure 3. Distribution of Humidex index inside surveyed bakeries (N=504).

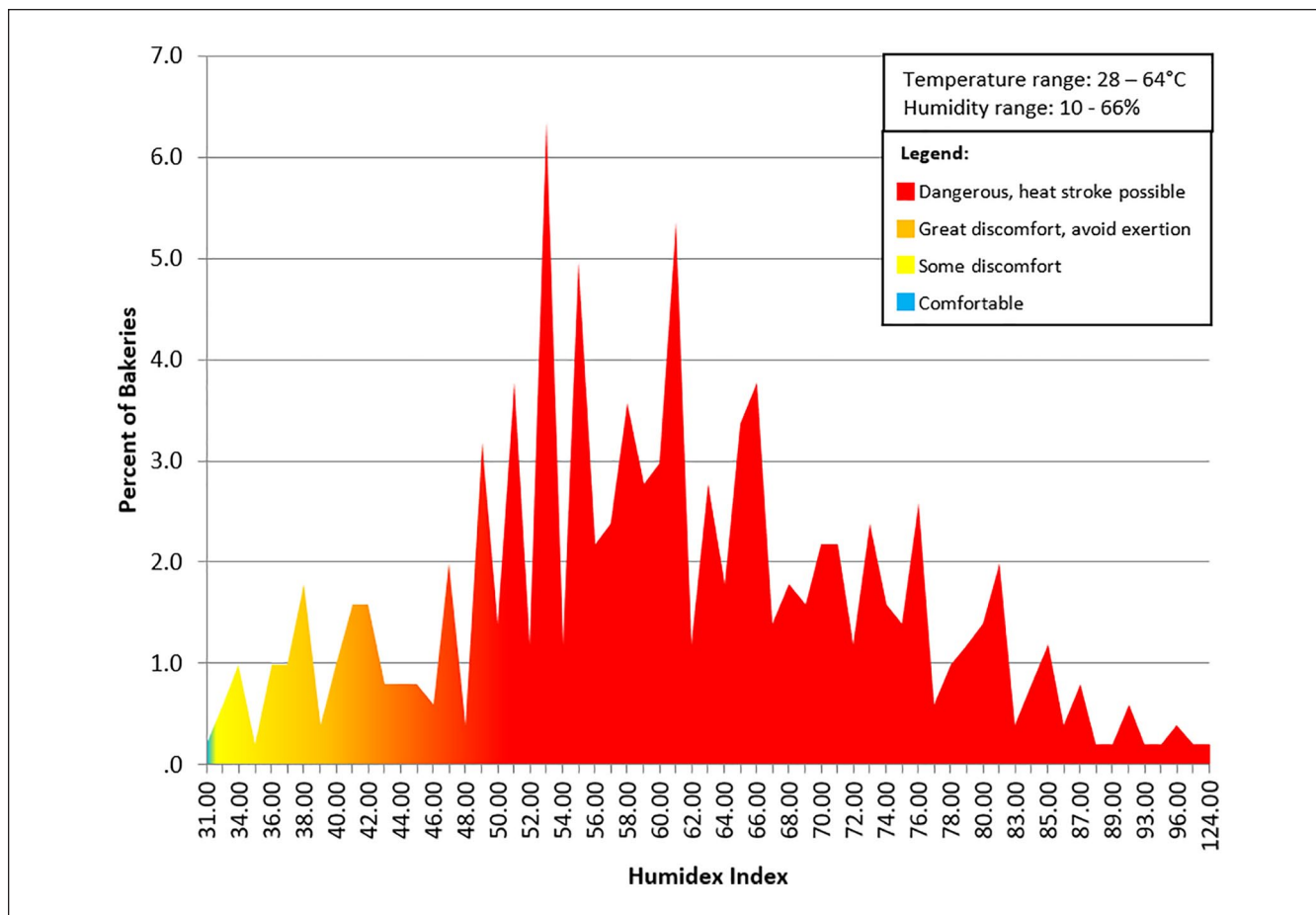


Figure 4. Distribution of Humidex index next to ovens in surveyed bakeries (N=504).

insecure in the case of an extended medical leave of absence (of 3 months or more), and working under pressure was positively correlated with reporting heat-related health symptoms (AOR = 1.65; 95% CI = 1.12-2.43). Moreover, the majority of our respondents are less than or equal to 50 years of age (78.4%). The younger the workers are, the healthier they are and the more tolerant of heat stress they can be. Consequently, adjusting for age as a confounding factor was adopted in the analysis.

The study showed that surveyed bakery workers who perceived that hot temperatures at work negatively affect their health were more likely to report heat-related symptoms. Similar findings have been reported in another study,⁵⁸ in which steel plant workers reported increased levels of fatigue as levels of heat exposure increased. Workers' perceptions that occupational temperatures affected their health may have also been related to real-time conditions within the bakery when the survey was conducted. Job dissatisfaction and heat-related health symptoms were positively correlated (AOR = 1.76; 95% CI = 1.12-2.79), as was shown by a study on metalworkers, which associated job satisfaction to the temperature at the workplace.⁵⁹

The study findings showed that more than one-third of the surveyed workers exhibited a low frequency of drinking

water at work. Studies have showed that poor hydration levels are fairly common among working populations,^{60,61} even when water is readily available.^{62,63} Sufficient water intake to meet the fluctuations in daily temperature, humidity, and work tasks, may not be consumed by workers.^{60,64} Our analysis showed that lower levels of water consumption at work were positively associated with reports of heat-related health symptoms. Other studies have confirmed that dehydration is an important risk factor for heat-related symptoms and illnesses.^{22,61,64} A study conducted in Lucknow, North India showed that kitchen workers, who are continuously exposed to heat, had notably higher urine specific gravity, an indicator of dehydration, compared to the control group.⁶⁵

In general, the temperatures in workplaces prone to heat exposures are expected to increase due to global warming.⁶⁶ The World Health Organization (WHO)¹⁴ assigned 0.2% of the annual global mortality to climate change, of which all are climate-sensitive outcomes liable to increase with a warmer or changing climate, including heat-related illnesses.¹⁴ Studies have shown that heat waves can cause death either directly through heat-related illness or by aggravating pre-existing heat-sensitive medical conditions, possibly resulting from occupational hazards.^{67,68} Globally, heat waves are expected to increase in severity, frequency, and

duration.¹⁴ According to the Inter-Governmental Panel on Climate Change (IPCC), the mean global temperature will increase by 1.8°C to 4.08°C by 2100, affecting workers' health.¹⁴ Temperatures are also on the rise in Lebanon affected by climate change.⁶⁹ Risks will continue to increase markedly, even if the 1.5°C goal of the Paris Agreement is achieved; however, achieving this goal would reduce the overall impact of a higher increase in temperatures and would make adaptation measures more feasible.² Thus, the potential health impacts of climate change require that governments take adaptive measures to protect the health of their populations.⁷⁰ Given the lack of infrastructure, resources and technical expertise in LMIC, such as Lebanon, international organizations, such as the International Labour Organization, might consider concentrating their efforts on building the capacity of local and regional stakeholders and assisting them in the implementation of adaptive measures.^{68,71}

Limitations

This study was limited by its cross-sectional design. The survey did not rely on the medical diagnosis of the reported symptoms. Our survey relied on self-reported information directly obtained from the bakery workers. Self-reported health symptoms may have also led to underreports of some heat-related health symptoms due to recall bias. Potential confounders, such as smoking and alcohol, were not accounted for in this study. Finally, the study was unable to analyze the association between gender, workplace experience, and health symptoms due to the low number of female participants. Future qualitative studies of bakery workers might prioritize the participation of female bakery workers to represent their experiences more accurately. Furthermore, longitudinal studies assessing heat exposure among bakery workers would provide more information on the conditions experienced by bakery workers and help in identifying specific climatic risk factors that require workplace interventions.

Conclusions and Recommendations

The study found that working under pressure, job dissatisfaction, and perceptions that high temperatures negatively affected health were all significantly correlated to reports of heat stress-related symptoms. To our knowledge, this is the first study to focus on heat-related symptoms among bakery workers in Lebanon. Our findings provide evidence to guide policymakers in implementing comprehensive intervention programs that target heat stress in this workforce. A comprehensive and effective national occupational health and safety program that includes relevant policies, decrees, and proper enforcement is needed to ensure the worker's safety and health both in the formal and the fast-growing informal sectors. These findings are all the more relevant, given the increasing economic, social, and political deteriorations in Lebanon. Future research might

explore contextually appropriate intervention strategies that address heat stress and occupational security among bakery workers at a national level to reduce the financial burden and health outcomes associated with it.

Workers exposed to extreme heat conditions must be made aware of the seriousness of heat stress and should be provided with protective measures for their health and safety. About half of the surveyed bakeries had unsafe conditions for routine work tasks. Humidex readings point to the need for immediate interventions for workplace improvements including ventilation, air conditioning, safer ovens and the provision of appropriate clothing.^{12,13} Such adaptive strategies to limit heat exposure are required to prevent harmful health effects. Our results indicate a need for joint efforts from the government and other stakeholders to design and implement national policies and legal frameworks to address workplace heat exposures and improve the health and safety of workers. A national occupational health and safety program, which covers the fast-growing informal sector, should include adequate infrastructure and effective implementation of safety standards, along with proper enforcement to ensure compliance and safety of workers. Improving working conditions is part of the goals of the 2030 sustainable development agenda,⁷² whereby sustainable development goals 3 (health and wellbeing) and 8 (decent work and economic growth) go hand in hand to safeguard the health of workers. Working at high temperatures increases the risk of cardiovascular and chronic kidney diseases, mental health problems, and injuries from accidents; it also reduces the working capacity and the productivity of the workers.^{2,10} Simple measures, such as scheduling work at cooler hours of the day, implementing mandatory hydration protocols and providing sufficient quantities of water, and training workers on recognizing and managing heat exposure, can help reduce and prevent exposure to heat.^{14,41} Our findings suggest that policymakers must promote awareness efforts and workplace interventions in bakeries to support adequate hydration and minimize risk for heat-related illnesses. In fact, heat stress awareness programs and policies, including training workers and their supervisors, have shown to effectively decrease the severity and frequency of heat-related illnesses.^{73,74} Efficient and inexpensive administrative improvement, including working hours, frequent breaks, dress codes (light color clothing), and Personal Protective Equipment, can also improve working conditions. According to Notley, Flouris, Kenny,²⁰ the existing "one size fits all" guidelines to manage heat stress at the workplace have failed to consider the inter-individual (age, sex, disease, others) and intra-individual (medication use, fitness, hydration, others) factors that cause extensive variability in physiological tolerance to a given heat stress. Therefore, recognition of the importance of individual risk factors and characteristics of the workers plays a fundamental role in addressing health and safety issues at the workplace. Moreover, rigorous job demands placed on workers call for policy changes beyond the workplace, including

labor guarantees that protect workers in case of serious health complications. Pressures to continue work regardless of health status are worth further investigation among this population, especially among older workers who may experience chronic and acute illnesses.

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Authors' Contributions

RRH secured funding, conceived, designed and implemented the study. RRH and SH contributed to the literature review for the design of the instruments. SH contributed to the statistical analysis. RRH, SH, and KEZ contributed to the interpretation of the results. RRH, NWE, DAH, KEZ, SH contributed to the writing of the first and revised drafts of the manuscript. All authors approved the final version of the manuscript.

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