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Assessment of Heat Stress Exposure among Outdoor Cleansing Workers in Helwan University

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ABSTRACT

Background: Heat stress is considered a well-established phenomenon from extreme heat exposure for long time without taking safety measures. Heat stress is determined by various symptoms, such as fatigue, nausea, vomiting, dizziness, and giddiness. **Objective:** The current study aimed to assess heat stress exposure among outdoor cleansing workers in Helwan University.

Patients and methods: *Design:* Descriptive research design. *Sample:* A convenience sample for consists of 100 outdoor cleansing workers that had been worked outdoor in Helwan University, Egypt. *Setting:* The study was conducted in outdoor at Helwan University. *Tools:* Data were collected by two tools; the 1st tool included demographic characteristics, workers` knowledge about heat stress, and workers` reported practice regarding heat stress, and the 2nd tool included standardized observational checklist for heat stress risk assessment.

Results: Up to 80% of workers were exposed to sun burn and 90% of them were exposed to sun stroke in the last 12 months. Also, they had poor level of knowledge, inadequate reported practices regarding heat stress with highly statistically significant differences between correlation of total knowledge, total reported practice and standardized observational checklist for heat stress risk exposure. There was a highly significance correlation between workers'total knowledge and workers' total reported practice, together with a highly significance correlation between workers' total knowledge, workers' total reported practice and standardized observational checklist for heat stress risk exposure.

Conclusion: Continuous health education program for outdoor cleansing workers regarding prevention of heat stress is essential.

Keywords: Heat stress, Outdoors workers, Cleansing workers.

INTRODUCTION

Heat stress is regarded as a well-known phenomenon that results from prolonged exposure to excessive heat without taking appropriate precautions. The effects of heat stress, which are considered a worldwide problem that transcends socioeconomic level, include lower worker productivity on seasonal timeframes, incapacitation, illness, and death, and weekly to sub-daily timescales. It happens when the body is unable to naturally release extra heat into the environment and the thermal balance cannot be maintained. In 2021, the American Conference of Governmental Industrial Hygienists (ACGIH) warned employees that they shouldn't be allowed to operate in hot surroundings if their interior temperature is more than 38 °C [(1)].

There has been prior research linking working people's exposure to hot environments to heat-related health effects such respiratory, heart, and renal illnesses. Even in healthy people, heat stress has the potential to produce acute kidney damage through volume depletion. Numerous heat-related symptoms, including exhaustion, headaches, muscle cramps, weakness, nausea, vomiting, tachycardia, hyperventilation, and chest pain that may be mild or severe depending on severity, ataxia, hypotension, syncope, and momentary changes in mental status, can all be signs of heat stress [(2,3)].

It is well known that depending on individual circumstances, outdoor workers' tolerance or reaction to heat exposure varies. An individual's physiological reaction to occupational heat stress exposure is thought to be influenced by personal factors, including age. According to research, older adults are less able to adjust to fluctuations in body temperature than younger adults, which renders them more susceptible to heat exhaustion. This is attributed to a number of factors that affect their capacity to regulate their body temperature, such as decreased aerobic capacity, decreased sweating rate, decreased stroke volume, decreased cardiac output, decreased skin blood flow, as well as potential changes in body fluid distribution and thirst perception [(4)].

Inadequate health care, a lack of safety training regarding the use of semipermeable or impermeable protective clothing, poor supervision, limited access to cooling techniques and hydration supplies, inadequate on-site restroom and resting facilities, a lack of rest periods, and productivity incentives are organizational factors that may increase the risk of occupational heat stress (piece-rate pay, or payment per amount of work done). Other variables include social/economic ones including low levels of education and decreased knowledge, poverty and low incomes, a lack of health insurance, subpar housing, and a lack of job opportunities. Conditions related to the job, such as extreme temperatures, a lack of shade or air conditioning, exposure with nephrotoxins, and hard exercise while assuming the wrong posture. Climate elements include droughts, heat waves, high humidity, and rising temperatures [(5)].

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In occupational work situations, there are a number of factors that directly affect heat stress. They are often classified under two major human factors, such as clothing insulation and metabolic rate, as well as four environmental parameters, including ambient temperature, humidity, radiant temperature, and air movement. To keep the worker's thermal balance in a hot environment and enable him to continue doing his work duties, these factors should be changed [6,7].

Street cleaners are accountable for all aspects of street cleaning, outdoor building, and trash management to maintain a clean outdoor environment, while landscaping employees are accountable for mowing lawns, trimming hedges, bushes, and trees, growing and planting new vegetation, and raking leaves. To maintain the strength and health of the trees, bushes, and plants, they also fertilize and water them. The first people to experience the consequences of climate change are frequently the outside cleaning employees. They could be exposed for longer periods of time and with higher levels of intensity, which over time might increase the prevalence and severity of established occupational hazards and exposures as well as lead to the creation of new ones [8].

With climate change, there are more heat-related fatalities, especially for people who work hard outside in the summer. In the United States, there were averages of 702 heat-related fatalities every year from 2014 through 2020. In addition to chronic medical issues, alcohol poisoning, and drug overdoses, extreme heat was a factor in some fatalities. Extreme humidity and unusually high maximum and minimum temperatures in Japan between July 2020 and July 2021 caused a considerable increase in heat-related mortality among workers, reaching 401 deaths. Over 166 000 individuals died from heat-related illnesses between 1998 and 2021, including more than 70 000 during the 2003 heat wave in Europe [9,10].

The prevention, early identification, and management of heat stress are critical tasks for occupational health nurses. Additionally, they collaborate with interdisciplinary teams to instruct employees on how to lower the risk of heat illness. Regardless of the underlying reason, it is essential to get out of the heat and cool down quickly since the severity of morbidity is directly connected to the level and length of hyperthermia. Prior to beginning more targeted cooling therapy, all treatment in the field is focused on stabilising the patient's airway, breathing, and circulation [11].

Each year, heat stress is to blame for tens of thousands of occupational accidents, illnesses, and fatalities worldwide. It's one of the major risks that outdoor cleaners face, especially in the summer. The health risks, injuries, and other health issues that outdoor cleaning employees encounter have a negative influence on their physical, mental health, and productivity [12].

The population of Egypt is particularly susceptible to the impacts of climate change and fluctuation, especially those who work outside. In 2022, the Egyptian Ministry of Health reported that 76 people had died, and that 447 others had been admitted to hospitals across the nation as a result of heat exhaustion brought on by the current heat wave. Additionally, the Crisis Room of the Egyptian Ministry of Health reported in 2020 that there were 95 cases of fatal heat stroke and 1400 injuries [13]. Community health nurses can play a significant role in the prevention of heat stress by instructing outdoor cleaning crews on how to manage the hot weather to decrease or prevent heat stress, such as adjusting schedules and workload to stay below established heat stress limits, scheduling frequent breaks in a cooler location as shade or air conditioning, providing water or electrolyte-containing beverages, adhering to applicable state workplace heat regulations, and providing extra water or electrolyte-containing beverages [14]. Therefore, this study was done to assess heat stress exposure among outdoor cleansing workers in Helwan University to improve worker's knowledge and practice to decrease or prevent heat stress.

The aim of the current study is assessment of heat stress exposure among outdoor cleansing workers in Helwan University through (1) Assessing worker`s knowledge about heat stress, (2) Assessing worker`s reported practice about heat stress and (3) Assessing worker`s risk regarding the heat stress exposure.

SUBJECTS AND METHODS

Study design: Descriptive research design.

The study setting: The study was conducted in outdoor at Helwan University.

Study Subjects

Sample type: Convenience sample for all outdoor cleansing workers that had been worked outdoor in Helwan University during the period of data collection.

Sample size: The participants of this study included 100 outdoor cleansing workers.

Tools for data collection: Data was collected through using the following tool:

1st Tool. A structural interviewing questionnaire:

The questionnaire was designed by the investigator after extensive reviewing of the related literature and approved by supervisors. It is divided to 3 parts:

Part I. Demographic Characteristics: It was used to collect data about outdoor cleansing workers. It consists of includes: age, gender, marital status, educational level, residence, monthly income, cigarette smoking, type of clothes worm during work, place of work, training program about hazards of heat stress, time of heat exposure, history of sun burn (last 12 months), and history of heat stroke (last 12 months), (Q1- Q14).

**Part II. Worker`s knowledge about heat stress:** It was used to collect data about worker`s knowledge about heat stress. It was developed by the investigator and is divided into three parts, the 1st part was worker`s knowledge about heat stress, the 2nd part was workers` knowledge about effect of sun and the 3rd part was workers` knowledge regarding sun care issues (Q1-Q15).

Scoring system: The answers to these questions were scored as "2" for the correct answers, "1" for the correct answer, and "0" for don't know.
The score of each item stumped up and then converted into percent score.

- Poor knowledge ≤ 50%.
- Average 50-70%.
- Good knowledge >70%.

**Part III. Worker`s reported practice about heat stress**: It was used to collect data about worker`s reported practice about heat stress. It includes, work and breaks, shade, hydration, clothes, hat, gloves, sun glasses and sun screen (Q1- Q16).

Scoring system for assessment of worker`s reported practice about heat stress designed to be answered by done, not done, and not applicable. Scores of each item ranged from three to one (done 2, not done 1, not applicable 0).
The score of each item stumped up and then converted into percent score.

- 60% < Unsatisfactory practice
- 60% > Satisfactory practice

2nd tool: A standardized observational checklist:
A standardized observational checklist was used for assessment of heat stress risk assessment. It was developed by **Bethea and [15]**, it includes clothes and the following parameters: air temperature, radiant temperature, air velocity, humidity, and the like.

Reliability:
Testing the reliability of tools through Alpha Cronbach Reliability analysis.

Items	Cronbach's Alpha
Worker`s knowledge	0.89
Worker`s reported practice	0.803

Validity: Five community health nursing specialists from Helwan University evaluated the proposed tool to determine its content validity and made any necessary improvements.

Operational item: The operational component consists of the planning stage, testing for tool reliability and validity, a pilot study, and fieldwork.

The preparatory phase: In order to create methods for data collecting, it involved researching pertinent literature and theoretical understanding of many study-related topics utilising books, papers, the internet, and periodicals.

Pilot study: A pilot study has been carried out to evaluate the tool's usability, applicability, and clarity. It was tested on 10% of the workforce (10 workers). They were recruited from environments that resembled those used for the study. The interview questions and time frame were improved as a consequence of the pilot study's findings. The primary study sample includes the pilot study's participants (100 workers).

Field work: The head of personnel affairs at Helwan University received a letter of formal consent from the dean of the nursing faculty prior to conducting the study. To get their participation and agreement, the purpose of the study and its methodology were described to them. The investigator filled up an interview questionnaire sheet for each employee. Throughout 3 months of the academic year 2021–2022, data were gathered three days per week until the required sample was obtained.

Administrative Item: The head of personnel affairs at Helwan University and the dean of the nursing department both gave their approval for this project to go forward.

Ethical considerations:

The Scientific Research Ethics Committee of Helwan University granted official approval for the proposed study's conduct. Before giving their informed consent, individuals were fully informed about the study and their involvement in it. Participation in the study is completely optional. The ethical concerns included disclosing the goal and methodology of the study, making clear that participants might opt out at any moment, and maintaining the confidentiality of the data so that no one else could access it without the participants' consent. Respect was shown for morals, values, culture, and beliefs.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 20 for windows. Qualitative data were defined as numbers and percentages. Chi-Square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as means and SD, and independent sample t-test was used for comparison between groups. Analysis of correlation using Pearson's method was applied to determine how strongly two quantitative variables are associated. P value ≤0.05 was considered to be statistically significant.

RESULTS

Table 1 summarizes the sociodemographic data of the studied participants. Up to 55% of their kind of work was building clean services and 45% of them were exposed to heat between 10 am – 3 pm.

Table (1): Descriptive analysis of the socio-demographic characteristics of the studied sample, (n=100).

Characteristics	No.	%
Age		
- <20 – years	40	40
- 20 < 40 years	35	35
- >40 years	25	25
Mean ± SD: 19.83± 7.34 Range (20-40)		
Sex		
- Male	25	25
- Female	75	75
Marital status		
- Single	5	5
- Married	65	65
- Widow	5	5
- Divorced	25	25
Level of education		
- Don't read &write	30	30
- Read and write	40	40
- Basic education	20	20
- Diploma / Secondary education	10	10
Residence		
- Urban	75	75
- Rural	25	25
Monthly income		
- Enough	2	2
- Not enough	98	98
- Enough and saved	0	0.0
Cigarette smoking	15	15
Type of clothes worm during work:		
- Cotton	20	20
- Polyester	35	35
- Cotton and polyester	45	45
Kind of work		
- Landscape	45	45
- Building clean services.	55	55
Training program about hazards of heat stress	0	0.0
Time of heat exposure		
- Not exposed	0	0.0
- <10 am	30	30
- Between 10am-3pm	45	45
- After 3pm	25	25
History of sun burn (last 12 months):	80	80
History of heat stroke (last 12 months):	90	90
Family history of skin cancer	60	60

Figure 1 illustrated that 60% of studied sample had poor knowledge, while 10% of them had good knowledge.

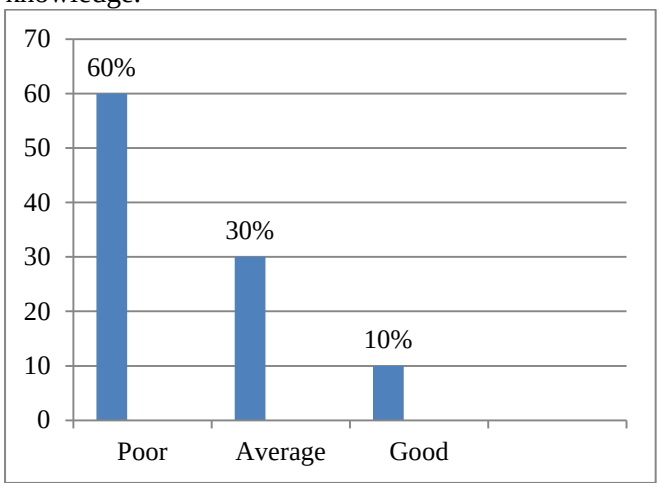

Figure (1): Distribution of Total Score of Workers' Knowledge about Heat Stress (n=100).

Figure 2 illustrated that 60% of workers done unsatisfactory practice, while 40% of them done satisfactory practice.

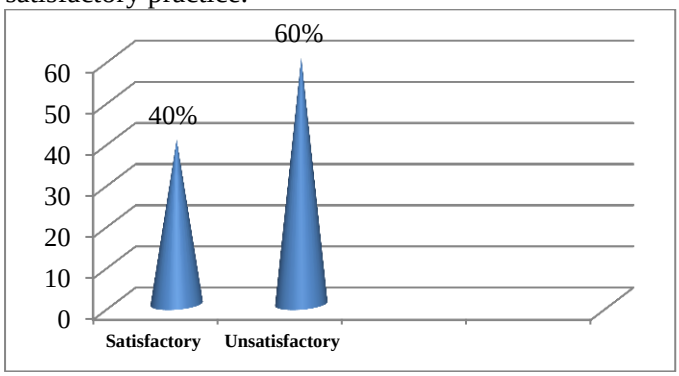

Figure (2): Distribution of Total Score of Workers` Reported Practice about Heat Stress (n=100).

Figure 3 illustrated that 60% of workers exposed to personal parameters that cause heat stress and 40% of them exposed to environmental parameters.

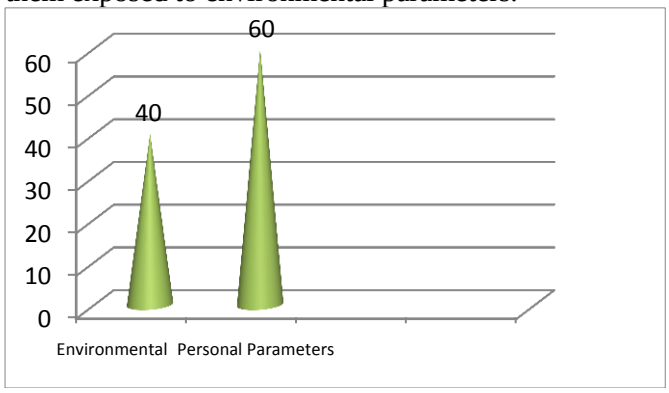

Figure (3): Distribution of Total Workers Risk Exposure about Heat Stress, (n=100).

Table 2 illustrated that there was correlation between workers knowledge and total reported practice regarding heat stress with highly statistical significance difference.

Table (2): Correlation between Total Knowledge and Total Reported Practice, (n=100).

Variable	Total knowledge (*N*=100)	
	R	P value
Total reported practice	0.49	<0.001**

DISCUSSION

Each year, exposure to working conditions with high temperatures causes hundreds of outdoor cleaning employees to get sick. Most of these workers who are subjected to high heat levels acquire chronic ailments, while others develop heat allergies. When working circumstances are poor, employees often perform ineffectively. There is a significant possibility of heat rise due to routine metabolic processes and heat from the sun when working in a hot area, as evidenced by research showing that employees respond differently when exposed to varied situations [(12)].

Regarding to socio-demographic characteristics of the study sample, the finding of the current study revealed that, approximately half of the workers their age were <20 years, with the mean age 19.83 and about two-thirds of them were females. These results were contradicted with the results of **Venugopal *et al.*** [(16)] from South India, who revealed that only one third of the studied sample was female and had a mean age of 36.8 years. In addition, the findings diverged with those of **Nunfam *et al.*** [(17)], in Ghana, who found that two thirds of the respondents were men with a mean age of 35.1 years. According to the investigator, the majority of the sample was made up of women because males don't favour this line of work due to the low pay for cleaning staff.

In relation to the educational level of the studied outdoor cleansing workers, they were found that, about quarter of them had a basic education according to study results. This conclusion was consistent with research by **Venugopal *et al.*** [(18)], in India, who found that about fewer than half of the workers had at least a high school diploma. The research's findings contrasted with those of **Nunfam *et al.*** [(17)], who found that fewer than half of respondents had a secondary education in their study. According to the researcher, the majority of the sample consisted of girls who lived in rural areas with low family incomes and little opportunities for further education.

Concerning the smoking, the current study reported that more than two thirds of the studied workers were non-smokers and only few ones that smoke. According to a research by **Venugopal *et al.*** [(18)], done in India, three-quarters of the study populations were non-smokers. This result was consistent with their findings. Additionally, this outcome was consistent with that of a research conducted in the Netherlands by **Keurentjes *et al.*** [(19)], revealed that the majority of the employees were non-smokers and just 15% of them were smokers. According to the researcher, smoking is not a common practise among women, particularly rural women, who make up more than two thirds of the sample.

Regarding the monthly income of studied outdoor cleansing workers, the finding of the current study revealed that, almost all the workers said that their monthly income not enough. This conclusion is consistent with a research conducted in Lebanon by **Habib *et al.*** [(20)], which revealed that more than three-quarters of the workers believed they had a poor socioeconomic position and insufficient money. According to the investigator, Egypt's rising quality of living and declining monthly revenue have left Egypt with an inadequate monthly income to cover its basic demands.

Concerning attending training program about hazards of heat stress, the outcomes of the current study showed that, all outdoor cleansing workers didn't attend any training program about hazards of heat stress. This result contrasted with **Han *et al.*** [(21)], a study from China, who found that more than half of respondents indicated that they had attended heat-related training at work. This outcome might be the consequence of inadequate knowledge of the dangers of heat stress, which led to poor heat stress adaptation and increased risk for workplace accidents.

Regarding the history of sun burn, according to the current study, there were more than two thirds of studied sample had history of sun burn. This outcome was consistent with that of a study conducted in the Netherlands by **Keurentjes *et al.*** [(19)], which revealed that the majority of outdoor construction workers had not experienced sunburn while at work in the previous three months. This outcome can be a result of people not understanding how important it is to wear sunscreen during the day.

According to the study's findings, there is a statistically significant relationship between outdoor cleaning employees' total knowledge and practise of heat stress. This is in reference to the link between total reported knowledge and total knowledge, as well as total reported practise. The study was in line with a study by **Khorsandi *et al.*** [(22)], in Iran, who found a statistical correlation between outdoor workers' knowledge and practise of heat stress. Also these results were in contrasted with previous study done by **Terzi *et al.*** [(23)], in Turkey, who stated that although the satisfaction level of knowledge of participants, didn't effect on their practice for sun protection and heat stress prevention. From our point of view this result emphasizes the need for importance of education programs to raise workers awareness about effects of heat stress and to highlight the significance of using all protective measures during sun exposure which lead to improve practice and increasing the number of cleansing supervisors.

CONCLUSION

On the light of current study result and answer the research questions, it can be concluded that: there was 60% of studied workers had poor knowledge, while 10% of them had good knowledge regarding heat stress. Regarding workers' total reported practice, 60% of them done unsatisfactory reported practice, and while 40% done satisfactory reported practice. As regard to standardized observational checklist to assess of workers heat stress risk exposure, 60% of workers exposed to personal parameters that cause heat stress and 40% of them exposed to environmental parameters.

RECOMMENDATIONS

Implementation of continuous health education program for outdoor cleansing workers regarding prevention of heat stress is essential. Dissemination health education booklets to increase outdoor cleansing workers awareness about heat stress and its protective practice are recommended.

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