

Correlation between Heat Stress and Incident of Dehydration among Outdoor Workers at Parking Area and Security in a Private Hospital in Palembang

Ardi Artanto¹, Ernes Putra Gunawan¹, Dennisa Luthfiah Fadilah²

¹ Faculty of Medicine, Muhammadiyah Palembang University, Indonesia

² Undergraduate Program, Faculty of Medicine, Muhammadiyah Palembang University, Indonesia

Abstract:

A combination of metabolic heat and environmental variables causes heat stress (the temperature of the local air, humidity, air velocity rate, heat radiation temperature). Sweating is induced by fluid loss through evaporation in response to heat stress. Dehydration can occur if the conditions of loss or loss of water or excessive bodily fluids and fluid intake are not restored, which can have an influence on the occupational health of outdoor workers. Analytic observational study was conducted using a Cross Sectional Study technique. All of the participants in this study were outdoor workers at parking area and security guards at a private hospital in Palembang. Using the total sampling approach, 46 samples were acquired that fulfilled the inclusion criteria but did not match the exclusion requirements. 43.5 percent of outdoor employees were exposed to heat stress. The results showed that 67.4 percent were dehydrated and 32.6 percent were not dehydrated. With a p-value of 0.009 ($P < 0.05$), there is a significant correlation between heat stress and incidence of dehydration in outdoor workers in the parking and security departments of a private hospital in Palembang city.

Keywords: Heat Stress, Dehydration, Outdoor Workers

1. Introduction

According to the American Conference of Governmental Industrial Hygiene (ACGHI), heat stress is a combination of the body's metabolic heat and environmental factors (the temperature of the local air, humidity, air velocity rate, and heat radiation temperature).¹ In Southeast Asian especially in Thailand, there were 10,784 of 58,495 workers who work in a high climate environment felt discomfort while working.² Working environmental conditions with exposure to the sun's heat are a factor in the occurrence of heat stress in outdoor workers.³ The effect of heat stress occurred as a result of the body's metabolism in maintaining body heat is in the form of sweating.¹ Because of this condition, there was loss of fluid through evaporation of the skin as the result of the process of releasing heat from the body. The conditions of water loss or excessive body fluids and insufficient fluid intake can cause dehydration.^{4,5} The general impact of dehydration that can occur on the body is the disruption of the body's physiological functions to maintain body balance or thermoregulation, thirst, dry mouth, discomfort, headache, drowsiness, decreased concentration, numbness or tingling, numbness in the legs, even fainting. The further impact that can occur in unsolved dehydration is electrolyte imbalance, kidney failure, heat injury and hypovolemic shock.

2. Methods

This study is an analytic observational study using a cross-sectional research design. This research was conducted from December to January 2022 with the research location in a private hospital in Palembang. The population in this study were all outdoor workers in the parking area and hospital security guards. The sample in this study were 46 people who were taken by total sampling. The independent variable in this study is heat stress, while the dependent variable is the incidence of dehydration. Data collecting was performed with a questionnaire that already being validated. Univariate analysis is presented in the form of narrative and distribution tables, while bivariate analysis used chi-square.

3. Results

In this study, from 46 respondents who were outdoor workers in the parking area and hospital security guards who had filled out the questionnaire, most of them were in late adulthood (46-55 years), namely 17 respondents (37%). The most occupation was security guard, namely 30 respondents (65 years) (65,2%) and the most gender is men, namely 30 respondents (76.1%).

A. Univariate analysis

a. Heat stress exposure

Based on table 1, the results showed that the most exposure for heat stress was yellow zone heat strain, namely 20 respondent (43,5%).

b. Dehydration incident

Based on table 2, the results showed that 31 respondent (67,4%) who suffered dehydration.

Table 1: Frequency Distribution of Heat Stress Exposure among Outdoor Workers in the Parking area and Security in a private hospital in the city of Palembang

Heat Stress Exposure	Frequency (n)	Percentage (%)
Not Heat Strain	10	21,7
Heat Strain Yellow zone (medium)	20	43,5
Heat Strain Red Zone (High)	16	34,8
Total	46	100

Table 2 : Frequency Distribution of Dehydration Incident among Outdoor Workers in the Parking area and Security in a private hospital in the city of Palembang.

Heat Stress Exposure	Frequency (n)	Percentage (%)
Not dehydration	15	32,6
Dehydration	31	67,4
Total	46	100

Tabel 3. Correlation between Heat Stress Exposure with Incident of Dehydration

Heat Stress	Dehydration						P
	No		Yes		Total		
	n	%	n	%	n	%	
Not heat strain	7	70	3	30	10	21,7	0,009
Heat Strain Yellow zone (medium)	6	30	14	70	20	43,5	
Heat Strain Red zone (heavy)	12	12,5	14	87,5	16	34,8	
Total	15	32,6	31	67,4	46	100	

B. Bivariate analysis

Based on table 3, the results showed that the most case of dehydration was the workers at yellow zone heat strain (moderate) with 14 respondents and red zone heat strain (severe) with 14 respondents. P value = 0,009 in other words there is a correlation between heat stress and the incidence of dehydration among outdoor workers in parking area and security guards in hospitals.

4. Discussion

A. Univariate analysis

a. Heat stress exposure

Based on the results of this study, it was found that the workers who were exposed with heat strain were in the yellow (moderate) zone, as many as 20 respondents (43.5%). These results were in accordance with the study by Ariyanti, S., et al (2018) where 32 blacksmith workers in Hadipolo Village were dehydrated (76.2%) and from measuring heat stress using a heat stress meter, the average result was 32.29°C.⁸ The measurement shows that the heat stress exceeds the threshold value, which indicated the factor of the occurrence of heat stress in the working environment. The results of this study indicate that workers experience heat strain yellow zone (moderate) indicating the presence of heat stress exposure to workers.⁸

b. Dehydration incident

Based on the results of this study, it was found that 31 respondents (67.4%) were dehydrated. The results were in line with study by Ariyanti, S., et al (2018) where 32 workers in Hadipolo Village blacksmith workers were dehydrated (76.2%).⁸ Hot and humid air can make the workers become sweaty so they need additional water.⁹ If the workers had been exposed with heat stress while working, especially outdoor workers with exposure of extreme weather, this condition can cause heat stress to occur as a result of the body's metabolism in maintaining body heat didn't succeed to form sweating condition. Excessive sweating and without fluid replacement into the body will cause dehydration.¹⁰

B. Bivariate analysis

Based on the results of statistical analysis using the Chi-square test, a significance value of p-value = 0.009 (p<0.05) was found. This result showed that there was a correlation between heat stress and the incidence of dehydration in outdoor workers in parking area and security guards at a private hospital in Palembang city. This was in line with research conducted by Ariyanti, S., et al (2018) blacksmith workers in Hadipolo Village where the test results obtained was a P-Value of 0.036. In other word it could be concluded that the heat stress was a risk factor for the occurrence of dehydration levels in workers.¹⁰ The results of this study are also in accordance with the study by Kurniawati, E., Marisdayana, R., & Entianopa (2020) where there was a correlation between hot working climate and dehydration at the PT. Angkasa Raya Djambi in 2020. The higher the work climate, the higher the dehydration status of the respondents.¹¹ Research conducted by Arianto M.E., Prasetyowato D.D. (2019) showed that there was a correlation between a hot work environment and complaints of Heat Related Illness (Heat Cramps, Heat Exhaustion, Dehydration) where the workers in hot work environments experienced Heat Related Illness (Heat Cramps, Heat Exhaustion, Dehydration).¹² When the ambient temperature rises, so does the body temperature, and the hypothalamus gland activates the body's heat regulation mechanism by responding to fixed adaptation (acclimation) by balancing the heat from external body by losing heat from within the body via evaporation, namely breathing and sweating. Sweating causes loss of body fluids via evaporation (evaporation) through the skin. This condition of excessive sweating and no intake for fluid replacement could cause dehydration. The work environment was at outdoor, so the workers are exposed to heat directly and continuously. High or extreme weather conditions cause the expenditure of body fluids through breathing and sweating to increase, resulting in dehydration. In other words, the dehydration experienced by workers was caused by increased fluid demand due to environmental temperature factors and inadequate fluid intake.

5. Conclusion

Based on the research that has been carried out, it was found that the heat stress among outdoor workers at parking area and security guards in a private hospital in Palembang was in the yellow zone heat strain (medium) category for the most (20 respondent; 43.5%), the most incidence of dehydration among outdoor workers at parking area and hospital security guards were found in 31 respondents (67.4%). In other words, it could be concluded there was a correlation between heat stress and the incidence of dehydration in outdoor workers at parking area and security guards in these hospital.

6. Acknowledgement

The authors would like to thank the Palembang Muhammadiyah Hospital, the Faculty of Medicine, Muhammadiyah University, and all the people who assisted in the process of this study.

References

1. American Conference of Governmental Industrial Hygienists (ACGIH). 2016. Heat stress TLV. [internet]. [Accessed in September 2021]. Available from: <https://www.acgih.org/heat-stress-and-strain-2/>
2. B. Tawatsupa, V. Yiengprugsawan, T. Kjellstorm, J. Breceki-Gisolf, SA. Seubsman, and A. Sleigh, Association Between Heat Stress and Occupational Injury among Thai Workers: Finding of the Thai Cohort Study. *Industrial Health*, Vol. 51, No. 1, p. 34-46, 2013.
3. A. P. C. Chan and W Yi, Heat Stress and its Impacts on Occupational Health and Performance. *Indoor and Built Environment*. Vol. 25, No. 1, p. 3–5, 2016.
4. C. Guyton and J.E Hall, *Buku Ajar Fisiologi Kedokteran*, 12th ed, Jakarta: EGC, 2016.
5. National Institute for Occupational Safety and Health. 2017. Heat Stress Risk Factors. DHHS (NIOSH) Publication No. 2017-125. [internet] [Accessed in 14 September 2021] Available from: <https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/2017-125.pdf>
6. A. Amir, I. Hardi, and M. Sididi, Faktor Yang Berhubungan Dengan Heat Strain Pada Pekerja Divisi produksi PT. Industri Kapal Indonesia (PERSERO) Makassar. *Window of Public Health Journal*, Vol. 1, No. 6, p. 785-796, April 2021.
7. E. Leksana, Strategi Terapi Cairan pada Dehidrasi. *Cdk-224*, Vol. 42, No. 1, p. 70–73, 2015.
8. S. M. Ariyanti, Y. Setyaningsih, and D. B. Prasetio, Tekanan Panas, Konsumsi Cairan, dan Penggunaan Pakaian Kerja dengan Tingkat Dehidrasi. *HIGEIA (Journal of Public Health Research and Development)*. 2(4), 634–644. <https://doi.org/10.15294/higeia.v2i4.25095>
9. Gustam, Faktor Risiko Dehidrasi pada Remaja dan Dewasa, *Jurnal Repository IPB*. Vol. 4, No. 2, p. 30-37. 2012
10. Suma'mur, *Higiene Perusahaan Dan Kesehatan Kerja (Hiperkes)*, Jakarta: Sagung Seto, 2013
11. Kurniawati, E., Marisdayana, R., & Entianopa. 2020. Pengaruh Iklim Kerja Panas Terhadap Dehidrasi Pada Pekerja di Bagian Dryler di PT. X. *Sekolah Tinggi Ilmu Kesehatan Harapan Ibu Jambi*. Hal 509-606
12. M. E. Arianto, and D. D. Prasetyowati, Relationship Between Hot Work Environment With Complaints of Heat Related Illnes (Heat Cramps, Heat Exhaustion, Dehydration) in Tofu Home Industry Workers in Janten Hamlet, Ngestiharjo Village, Kasihan, Bantul. *Jurnal Ilmiah Kesehatan Masyarakat*, Vol. 11, No. 4. p. 318–324, 2019