Correlation of Hot Work Climate with Dehydration on Bricks Workers

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Abstract

Each workplace must have its own source of danger which can cause health problems or occupational diseases due to the exception of informal sector workers such as brick workers. Health problems that can be experienced are dehydration caused by exposure to hot working climate. Incidence of dehydration can cause workers to get tired quickly and decrease productivity. The purpose of this study was to analyze the correlation between hot working climate with dehydration on bricks workers in one of Mojosulur's brick home industries. Methodes of his research is an analytic observational study, with cross sectional design. The subjects of this study were all brick workers in one of the brick home industries in Mojosulur by 30 respondents. The results of the study showed that most brick workers were dehydrated, varying in level, both moderate and severe dehydration. The results of statistical analysis show that the correlation coefficient (r = 0.638) which can be interpreted as a work climate factor has a strong correlation with the incidence of dehydration Conclusion of this research on work climate and dehydration of brick workers in one of Mojosulur's brick home industries have a very strong correlation.

Keywords: *bricks, dehydration, work climate, workplace,*

Introduction

The progress of science and technology in Indonesia is currently taking place very rapidly, as is the process of industrialization of Indonesian society which is increasingly increasing. The development of industry in Indonesia is marked by the increasing number of small-scale industries that have sprung up both in the formal and informal sectors. But often the occupational safety and health of informal sector workers receive less attention, therefore there is a need for labor protection to be done to protect workers from work-related hazards [1].

The Central Statistics Agency in February 2018 released official statistics on employment in Indonesia, and based on the data released 58.22% or 73.98 million people worked in the informal sector and 41.78% were workers in the formal sector [2]. from the results these calculations show that in Indonesia more workers are working in the informal sector. One example of work in the informal sector includes the home industry making red bricks.

Each workplace must have its own source of danger which can cause health problems or occupational diseases due to the exception of informal sector workers such as brick workers. Based on research conducted by Wahyuni in 2016 on hazard analysis and the assessment of the need for personal protective equipment in brick workers in Demak, it was found several hazards, one of which was the danger of hot working climate and exposure to solar radiation caused by the presence of outdoor work climate and the presence of the process of burning bricks carried out in a long time [3]. This makes dehydration and heat stress possible for workers.

Dehydration is a condition of lack of fluids in the body and can have an impact on the existing regulatory processes in the body [4]. This is because there is exposure

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to hot temperatures at work followed by excessive sweating. Based on research conducted by THIRST (The Indonesian Regional Hydration Study) in Indonesia shows that many Indonesian people experience mild dehydration, especially in the group of adolescents aged 15-18 years and adults aged 25-55 years [5]. That mattersupported by research conducted by Hardinsyah which states that as many as 46.1% of Indonesian people experience mild dehydration, and among them are people who live in low-lying areas such as in Jakarta, Surabaya and Makassar [5].

In addition, Indonesian people's water consumption is still relatively low, this is indicated by the results of research conducted by The Indonesian Regional Hydration Study (THIRST) which also shows that as many as 49.1% of research subjects experienced less water or mild hypovolemia, and in adults reached as many as 42.5% [5]. Also reported that 43% of adults are in a state of dehydration at work [6].

The condition of dehydration that takes place continuously can cause a person experiencing muscle spasms [1]. Fatigue in workers is also one of the effects caused by the occurrence of dehydration, someone who experiences fatigue makes the body become weak and lazy to do physical activity. If the condition is left and continues to increase the risk of kidney stone disease, urinary tract infections, cancer, colon, obesity constipation, cerebral vascular stroke and other health problems [7]. The Other studies mentioning that if the body experiences a lack of fluids reaching more than 2% of the total fluids in the body will affect the quality of work done by the worker [8] and if dehydration reaches 3.1% can reduce the quality of someone at work by 48%. In the study also mentioned that. If someone does not consume fluids during their activities for 6 hours can cause dehydration of 6.4% and reduce the quality of work by 25% [8].

Decreased cognitive performance, decreased physical and psychomotor endurance are also one of the effects of dehydration [9]. Dehydration with weight loss of 1-2% has been shown to reduce short-term memory [10] and the decline in cognitive function including short-term memory will cause a person's difficulties in working and completing tasks [11].

Unnoticed dehydration can be experienced by people who perform physical activities exposed to heat and exposed to hot climate in the workplace [12] the working climate is the result of a combination of temperature, humidity, speed of air movement and heat radiation due to the level of heat expenditure from the body of the workforce as as a result of his work [13]. Weather or work climate that is not comfortable and not in accordance with labor standards and provisions that have been in force will result in a decrease in the capacity of workers, causing a decrease in work efficiency and productivity [14].

According to Tarkawa excessive hot work climate can cause fluid in the body to come out through sweat continuously and experience an increase can result in dehydration and other health problems [15]. In addition, workers who carry out their work without realizing it can experience a decrease in fluid intake by losing a lot of body fluids such as sodium and this can lead to dehydration [16].

Regarding several studies Regarding the status of dehydrated workers. Research conducted by Sari shows the effect of heat work has a significant effect on the incidence of dehydration. This is indicated by the number of 66.67% or 10 respondents who experienced mild dehydration in the boiler section and the results of the Man Whitney test showed a related effect of heat work on dehydration ($p = 0.023$) [17]. Subsequent research conducted at PT Indo Acidatama Tbk, Kemiri showed that respondents who were dehydrated based on measurements of the concentration of urine color in hot work climates that exceeded the NAV were more numerous than the number of respondents who were not dehydrated. This is indicated by the results of the study that there are 6 workers who are dehydrated and 4 other respondents are not dehydrated [18].

Brick artisans are one example of industrial workers in the informal sector. Making bricks is one type of work that most of the activities carried out in the outdoor environment, it is possible for workers to be exposed to heat in each production process, especially in the process of grinding, drying, molding, structuring and burning. In addition to basic materials, the quality of bricks also depends on the combustion process carried out. The burning process that lasts for a long time can even take

up to 1 day. During combustion it is necessary to have adequate heat and the flame must always be considered to produce good quality and not cause a fire, this results in workers being required to work watching the fire all day. Continuous exposure to heat from the sun at work, especially at milling, structuring, drying and burning processes can enable workers to become dehydrated, in addition to that found several symptoms in brick craftsmen such as dry skin, dry mouth and sometimes feel very thirsty Based on these data, the researchers are interested in conducting research on the correlation of hot work climate with dehydration events

Methods

Research carried out including observational research types, with cross sectional approach because it is carried out at a certain time. The location of data collection was carried out in one of Mojosulur's brick home industries in Mojokerto Regency. The population of this study is all workers, amounting to 30 people.

In this study there are two variables in the independent variable, namely the work climate and the dependent variable dehydration events. Collecting work climate data using heat stress apparatus questemp 36. The measurement results will produce a wet ball temperature index (ISBB) that exceeds or is less than the NAV must be considered by looking at the workload of workers and working hours settings applied at the workplace. Then adjusted to the ISBB Table contained in Minister of Manpower Regulation 2018 *Number 5 Year 2018*. Dehydration in workers is measured by taking a urine specimen shortly after work and compared with a urine color indicator card by Amstrong [19]. The measurement results are then recorded and categorized into 4 criteria: no dehydration, mild, moderate and severe dehydration in accordance with the card indicators listed. The more concentrated the color of urine the heavier the person is dehydrated. The questionnaire distributed was used to obtain supporting data about the characteristics of the respondents. Observations, interviews and secondary data used to find out about the general description of the Mojokerto Bricks industry.

The research data that has been obtained will then be analyzed by statistical tests to determine the relationship between variables. In this study there are 2 variables: work climate as an independent variable and dehydration as the dependent variable. Based on the objectives of the research conducted, this study uses the Spearman correlation test. The test is used to determine the strength of a relationship between variables by analyzing the value (r) of the correlation coefficient, so that it can be determined the strength of the relationship between the work climate and the dehydration status of workers.

Findings

Overview Bricks Home Industry Mojosulur

Home Industry Mojosulur Bricks is one of the small industries that produce red bricks that have been established since 2002. Home Industry Mojosulur Bricks. This Home Industry manufactures brick presses labeled MRH and still uses traditional methods This Home Industry is located on Jl. Teuku Umar RT 01 / RW 07 Mojosulur Village, Mojosari District, Mojokerto. In the process of making red bricks in the home industry entirely using human labor from the stage of processing land and raw materials to the finishing process. There are 5 stages in the process of making bricks including the process, mixing materials, grinding, molding, drying and burning bricks. The bricks produced by this home industry have several advantages, which are high density, more economical, durable and have good adhesion and are suitable for all soil textures.

Identification of Respondent Characteristics

Identification of Respondent Characteristics The results of the questionnaire showed that there were 5 people (16.7%) who were aged in the 26-35 years age group. There were 10 people (33.3%) who were around 36-45 years old, there were 12 people (40%) who were around 46-55 years old, and 3 people (10%) were in the 56-65 years age group. The age of workers in the Mojosulur brick industry is the most workers in the age group of 46-55 years with a total of 10 people (33.3%). The results of the questionnaire based on gender showed that in the brick brick home industry there were more male workers as many as 19 people (63.3%) and 11 people (36.7%) were female workers. Based on the results of interviews with respondents as many as 20 people (66.7%) have worked> 2 years and 10 people (33.3%) worked ≤ 2 years.

The Frequency Distribution of Work Climate

The measurement of the working climate is done by using the Temp Temp 36 tool and the measurement is done at 5 points, namely at each stage of the brick making process, Point A is located at the mixing point of the brick material. Point B is located in the brick material mill. Point C is located at the place where the brick material is placed, Point D is located at the

brick drying area and point E is located at the brick kiln.

Table 1. Work Climate Mesurement on the Mojosulur Home Bricks Industry 2020

	Sb (oC)	Sk (oC)	Sg (oC)	ISBB (oC)	RH (%)
Material Mixing	27,2	31,4	43,6	31,1	61
Material Milling	27,8	33,0	45,2	31,8	43
Material Forming	26,2	31,6	33,5	28,4	58
Bricks Drying	27,8	32,5	43,4	31,4	49
Bricks Burning	26,9	32,9	48,9	31,9	47

From the measurement results on Table 1, it can be seen that the highest ISBB is at point E where the brick kiln process is 31.9 **ºC**. This is due to the additional heat from the brick kiln and

the lowest ISBB is 28.4 **ºC** at point C, which is located at the site the process of laying bricks which is indeed a workplace is an indoor workplace.Setting working hours in the brick brick home industry is an average of 50-75%. Thus the NAV for hot working climate is 31.0 **ºC** in the category of light workloads, 29.0 **ºC** for workers with moderate workloads, and 27.5 **ºC** for workers with workloads hard.

Table 2. The Frequency Distribution of Work Climate (NAV)

Category	Frequency	Percentage (%)
≤NAV	10	33,3
>NAV	20	66,7
Total	30	100,0

From table 2, It can be seen that the results of ISBB NAV determination in Mojosulur brick home industry are 20 respondents (66.7%) who are exposed to heat > NAV and 10 respondents (33.3%) are exposed to heat temperature ≤NAV.

The Frequency Distribution of Dehydration

Dehydration measurement is done when the worker has finished his work, and will move home from work. Dehydration measurement is done by asking the worker urine sample and seeing the urine color density which is then compared with the urine color indicator which has 8 colors and then categorized into 4 categories not dehydrated, mild, moderate and severe dehydration. Following are the results of the distribution of respondents based on the measurement of dehydration level showed on table 3.

Table 3. The Frequency Distribution of Dehydration

Category	Frequency	Percentage (%)
No Dehydration	7	23,3
Mild	7	23,3
Moderate	8	26,7
Severe	5	16,7
Total	30	100,0

From the results of dehydration measurements in table 3 shows that as many as 7 people (23.3%) experienced mild dehydration, 8 people (26.7%) experienced moderate dehydration, 5 people (16.7%) experienced severe dehydration. This shows that the highest number of brick craftsmen workers is moderate dehydration, namely as many as 8 people (26.7%)

Correlation of work climate with dehydration

Based on the work climate measurement results are grouped into 2 namely for setting working time 50-75 ≤ NAV (For light workloads ≤ 31.0 ° C, moderate workloads ≤ 29.0 ° C, and heavy workloads ≤ 27.5 ° C) and> NAV (For light workloads> 31.0 ° C, moderate workloads> 29.0 ° C, and heavy workloads> 27.5 ° C) While work dehydration status is categorized into 4 categories namely no dehydration, dehydration mild, moderate dehydration, and severe dehydration. Below is a cross tabulation between the hot work climate and the dehydration of Mojosulur's brick home industry workers showed on table 4.

Table 4. Cross Tabulation corellation between Hot Work Climate and Occurrence of Dehydration Occupation in home brick workers in Mojosulur 2020

Work Clima-te	Dehydration Level								Total	
	No		Mild		Moderete		Severe			
	n	%	n	%	n	%	n	%	n	%
≤NAB	6	60	3	30	1	10	0	0	10	100
>NAB	3	15	4	20	7	35	6	30	20	100
Total	9	30	7	23,3	8	26,7	6	20	30	100

Based on the table above shows that in the measurement of hot work climate ≤ NAV many workers experienced mild work dehydration, namely as many as 3 workers with a percentage of 10%. Then in the measurement of heat stress> NAV experienced the most moderate dehydration as many as 7 workers with a percentage of 23.3%.

Table 5. Correlation Between Work Climate And Dehydration

		Dehydration	**Conclusion**
Work Climate	Value Spearman Correlation	0,638	Verry Strong

Analysis conducted using statistical calculations, based on the Spearman correlation test that has been done, the results obtained correlation coefficient (r) = 0.638. These results indicate the resulting correlation coefficient approaching 1 which means that there is a strong relationship between the hot work climate with the incidence of dehydration in home brick workers in Mojosulur, Mojokerto Regency.

Discussion

Work Climate

In the Heat Stress measurement using the ISBB (Ball and Wet Temperature Index) method using the Questemp 36 at 5 points in accordance with the worker's job. The lowest Ball and Wet Temperature Index results are obtained at 28.4 ºC at Point C, where the brick laying process is included in the indoor work area and the highest Ball and Wet Temperature Index at 31.9 ºC is at point E, at the outdoor work area. who worked on the brick burning process. According to Permenakertrans No. 5 of 2018 concerning NAV (Threshold Value) Physical and Chemical Factors in the Workplace, the NAV of the working climate is determined by measurement, workload and also work time. The working time in the brick brick home industry in Mojosulur is 50-75% due to workers not working full hours 8 hours a day. So for NAV that is in accordance with the workplace conditions in the brick brick home industry for light workloads of 31.0 ºC, medium workloads of 29.0 ºC, and heavy workloads of 27.5 ºC. Therefore, it can be concluded that the most measurement is> NAV of 20 people (66.7%).

The temperature at work can be influenced by work processes and work environment factors themselves. As long as the worker's body is active, the body will directly try to keep up with the temperature in the environment and try to balance the heat temperature environment received by the body with the heat in the body through the process of heat loss in the body. A comfortable temperature for Indonesians at work is between 24-26 ºC. A hot work climate can cause heat stress to be received by workers who are working in the workplace environment as an additional heat load (in addition to the heat load generated by the body which can result in many negative effects on workers in the form of work disorders or health problems such as dehydration, increased pulse, dizzy headaches, dizzy eyes, rapid stomach nausea Tired [20]. When workers are exposed to hot temperatures it will reduce agility, extend reaction time and slow down decision-making time, interfere with brain work accuracy, interfere with coordination motor sensory nerves, and make it easier for emotions to be stimulated [21].

Dehydration

Dehydration is a condition in which the lack of fluids in the body due to the amount of fluid that exits is greater than the amount of fluid that enters. If the body loses a lot of fluids, the body will become dehydrated [22]. Measurement of dehydration work done on brick workers in the Mojosulur brick home industry was carried out by the observation method through observing the color of the workers' urine, then categorized as not dehydrating, mild dehydration, moderate dehydration and severe dehydration. Then the measurement results obtained are 7 people (23.3%) not dehydrated status, 7 people (23.3%) mild work dehydration status, 8 people (26.7%) moderate dehydration status, and severe dehydration status 5 people (16.7%).

A worker who is exposed to heat and without using proper personal protective equipment will be disturbed by his endurance. The body will neutralize body heat by sweating which results in reduced fluid and electrolyte salts in the body. Consumption of adequate drinking water can reduce the effects of dehydration due to heat pressure. This is because in drinking water there are electrolyte salts in the form of cations and anions needed by the body. The main cations contained in drinking water are sodium (Na +) and Potassium (K +) while the main anions are chloride (Cl-) [15] One of the dangers of brickworkers' workplaces is hot workplace temperatures due to direct exposure to sunlight and the additional heat from the combustion process so as to accelerate the dehydration experienced by workers. Therefore there is a need for control by home industry owners so that work dehydration can be reduced so that there is no decrease in work productivity.

Relationship of Work Climate with Dehydration

According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number 5 Year 2018 Regarding NAV Physical and Chemical Factors in the Workplace, the NAV of the working climate with a working time of 50% - 75% ie 31 ° C for light workloads, 29 ° C for moderate workloads and 27.5 ° C for heavy workloads [13]. Based on work climate measurements that have been made on the Mojosulur Bata Home Industry workers there are 20 respondents (66.7%) who work in working climate conditions> NAV and 10 respondents (33.3%) who

work in working climate conditions ≤ NAV. Workers who work in working climate conditions> NAV are more dehydrated, compared to workers who work in working climate conditions ≤ NAV. In working climate conditions> NAV

Using statistical calculations, based on the spearmen correlation test, the result (r) = 0.638 shows that there is a strong correlation between hot working climate and dehydration events. This is in line with the results of research conducted by Megayani Puspita Sari. The results of the analysis obtained information on the value of Pearson chi square with sig 0.00 <0.05 so that Ho was rejected that's mean there have correlation between hot working climate and dehydration [23]

In addition there are other studies that are in line with the results of this study, namely research conducted by Nensi which shows that there is a correlation between environmental physical conditions, namely between temperature and humidity at work with dehydration levels with the results of the value of the temperature contingency coefficient and dehydration level of 0.603 which means that the correlation between temperature and dehydration is very strong [24]

According to Suma'mur, workers who work in a workplace that exceeds the NAV of the working climate can experience the effects of heat stress [1]The effect of heat stress occurs as a result of the body's process of maintaining body heat to no avail. The effect of heat stress can be in the form of subjective complaints due to heat stress such as complaining of heat, lots of sweat, always thirsty, feeling bad and loss of appetite caused by loss of fluid from the body by evaporation of sweat. Exposure to a physical work environment such as a hot work environment that continues can lead to health problems, one of which is dehydration

Conclusion

Conclusion Based on the results of research conducted showed a strong correlation between the work climate with the dehydration incident experienced by workers at the Mojosulur Brick Industry, Mojokerto Regency. Most workers in the Mojosulur brick home industry are dehydrated in the moderate category, and only 7 workers are not dehydrated. Suggestions for home brick industry owners need to provide additional protection in a workplace that has a work climate that exceeds the Threshold Value so workers are not exposed to direct sunlight and the hot work climate can be reduced to less than the Threshold Value and needs to provide some a place for workers to take their drinks close to their work area so that when workers are feeling thirsty or dehydrated they can easily take the drinking water and drinks can be added with electrolyte salt.

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References

1. Suma'mur PK. Higiene Perusahaan dan Keselamatan Kerja. Jakarta : CV Haji Mas Agung. Jakarta: CV Haji Mas Agung; 2009.
2. Badan Pusat Statistik (BPS). Februari 2018: Tingkat Pengangguran Terbuka (TPT) sebesar 5,13 persen, Rata-rata upah buruh per bulan sebesar 2,65 juta rupiah [Internet]. 2018 [cited 2020 Jun 7]. Available from: https://www.bps.go.id/pressrelease/2018/05/07/1484/februari-2018
3. Wahyuni I. Analisis Bahaya dan Penilaian Kebutuhan Alat Pelindung Diri pada Pekerja Pembuat Batu Bata di Demak, Jawa Tengah. Jurnal Kesehatan Masyarakat (e-Journal). 2016;10(1):22–7.
4. Shirreffs SM. The importance of good hydration for work and exercise performance. Nutrition reviews. 2005;63(suppl_1):S14–21.
5. Hardiansyah, Briawan, Hartati A, Thaha. Kebiasaan minum dan Status Dehidrasi pada remaja dan Dewasa di Beberapa Daerah di Indonesia-THIRST. Bogor: Perhimpunan PeminatGizi dan Pangan Indonesia (PERSAGI)Departemen Gizi Masyarakat FEMA IPB; 2010.
6. Biggs C. The prevalence and degree of dehydration in rural South African forestry workers. Diss. University of Kwazulu-Natal, South Africa; 2008.
7. Permanasari I. Keluarga Sehat Keluarga Bahagia [Internet]. 2010 [cited 2020 Jun 7]. Available from: https://keluargasehat.wordpress.com/2010/04/08/jangan-abaikan-dehidrasi/

8. Ritz P, Berrut G. The importance of good hydration for day-to-day health. Nutrition reviews. 2005;63(suppl_1):S6–13.
9. Grandjean AC, Grandjean NR. Dehydration and cognitive performance. Journal of the American College of Nutrition. 2007;26(sup5):549S-554S.
10. Gopinathan PM, Pichan G, Sharma MA. Role ofdehydration in heat stress-induced variations in mental perfor-mance. Archives of Environmental Health: An International Journal. 1988;43(1):15–7.
11. Masento NA, Golightly M, Field DT, Butler LT, van Reekum CM. Effects of hydration status on cognitive performance and mood. British Journal of Nutrition. 2014;111(10):1841–52.
12. D'anci KE, Mahoney CR, Vibhakar A, Kanter JH, Taylor HA. Voluntary dehydration and cognitive performance in trained college athletes. Perceptual and Motor Skills. 2009;109(1):251–69.
13. Minister of Manpower Regulation. Number 5 Year 2018, Concerning Safety and Health. Jakarta: Ministry of Manpower Republic of Indonesia.; 2018.
14. Subaris H. Hygiene Lingkungan Kerja. Jogjakarta: Mitra Cendikia; 2008.
15. Tarkawa, Bakri SH, Sudiajeng L. Ergonomi untuk Keselamatan, Kesehatan Kerja dan Produktivitas. Surakarta: UNIBA Press; 2014.
16. Triyana YF. Teknik Prosedural Keperawatan. Yogyakarta: D-Medika; 2012.
17. Sari NP. Pengaruh Iklim Kerja Panas terhadap Dehidrasi dan Kelelahan pada Tenaga Kerja Bagian Boiler di PT Albasia Sejahtera Mandiri Kabupaten Semarang. Diss. Universitas Muhammadiyah Surakarta; 2014.
18. Apriyani A. Pengaruh Iklim Kerja Terhadap Dehidrasi Pada Karyawan Unit Workshop PT. Indo Acidatama Tbk, Kemiri, Kebakkramat, Karanganyar. Diss. Universitas Muhammadiyah Surakarta; 2014.
19. Singh N, Armstrong DF, Lipsky BA. Preventing Foot Ulcers in Patients With Diabetes. JAMA. 2005;293(2):217–28.
20. Soeripto M. Higiene Industri. Jakarta: Balai Penerbit FKUI; 2008.
21. Suma'mur PK. Kesehatan Kerja dalam Prespektif Hiperkes & Keselamatan Kerja. Jakarta: Erlangga; 2014.
22. Rismayanthi C. Persepsi Atlet Terhadap Macam, Fungsi Cairan, Dan Kadar Hidrasi Tubuh Di Unit Kegiatan Mahasiswa Olahraga Universitas Negeri Yogyakarta. Medikora. 2015;IX(1).
23. Sari MP. Iklim Kerja Panas Dan Konsumsi AIr Minum Saat Kerja Terhadap Dehidrasi. HIGEA Journal Of Public Health Research And Developmentd Development. 2017;1(2):108–18.
24. Ningsih NK. Hubungan Suhu dan Kelembapan dengan Tingkat Dehidrasi pada Pekerja Pengasapan Ikan. The Indonesian Journal of Occupational Safety and Health. 2019;14 (1):69–79.