

# Hydration Status and Related Factors: A Cross Sectional Study of Urine Color in Brickmakers in Demak, Central Java, Indonesia

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**Abstract**— *Background: Heat from the production process can spread throughout the work environment. This will increase the air temperature and humidity in the work environment. Exposure to heat in the work environment that occurs continuously will affect the increase in fluid expenditure through sweat and if it is not accompanied by adequate fluid intake it will cause dehydration. Purpose: To analyze the correlation between age, gender, type of work, smoking habits, type of clothing use, amount of drinking water consumption and heat stress with the level of dehydration in Home Industry Center for Bricks in Candisari Village, Demak, Central Java, Indonesia. Methods: This type of research is observational with a cross sectional approach. The sample size is 32 respondents. The variables studied were age, gender, type of work, smoking habits, type of clothing use, amount of drinking water consumption, heat stress and level of dehydration. Data analysis was univariate and bivariate using chi-square test. Results: A total of 62.5% of workers are less than 40 years old, 84.4% are male, 65.5% of workers are exposed to heat, workers have a smoking habit of 71.9%, most of them do not meet the requirements in the use of the type of clothing 75% , 84.4% of workers consume less drinking water, 100% of heat stress results are above the NAV and 87.5% of workers experience severe dehydration. There is a correlation between the type of clothing use (p value = 0.039) and amount of drinking water consumption (p value = 0.008). Conclusion: The level of dehydration in tofu production workers in Jomblang Village, Candi Sari District, Semarang, is influenced by several related factors, namely the type of clothing used and heat pressure.*

**Keywords**— *Bricks production, dehydration level, workers exposed to heat.*

## I. INTRODUCTION

Dehydration is the excessive loss of fluid through the skin, lungs, kidneys and digestive tract caused by the absence of fluid balance in the body<sup>1</sup>. The Ministry of Health states that 1-2% dehydration will result in weakness and lack of energy due to insufficient energy production<sup>2</sup>. Fluid loss >6% can increase the risk of health problems, such as muscle stiffness and collapse, when the body loses fluid by 7% to 10% it can reduce blood volume and result in kidney failure when the body loses fluid by 11%<sup>3</sup>. Brick making workers are one of the informal industries whose work process is exposed to heat. Exposure to heat in the work environment that occurs continuously will affect the increase in fluid expenditure

through sweat and if not accompanied by adequate fluid intake it will cause dehydration<sup>4</sup>. Dehydration is excessive fluid loss through the skin, lungs, kidneys and digestive tract caused by the absence of fluid balance in the body<sup>1</sup>.

Workers in Australia doing outdoor work were dehydrated at 79%<sup>5</sup>. Similarly, eleven soldiers aged between 20-25 years from the tropics in India experienced mild and moderate dehydration<sup>6</sup>. The incidence of mild dehydration in Indonesia according to The Indonesian Hydration Regional Study (THIRST) showed that 42.5% of adults experienced mild levels of water deficiency<sup>7</sup>. Blacksmith workers in Hadipolo Village who work with heat exposure ranging from 30°C-35°C experience severe dehydration. This is because workers do not consume enough fluids, which is less than 1 litre<sup>8</sup>. Cognitive performance in humans will decrease by 2% due to body water loss<sup>6</sup>.

Dehydration is caused by several factors, including heat stress, fluid consumption<sup>9,10</sup>, clothing use<sup>8</sup>, age, gender, temperature, environmental humidity, illness and physical activity<sup>11</sup>. Older workers or those over 40 years of age will absorb more heat than younger workers. This risks causing dehydration due to the body's slow response to drain the skin's core body heat<sup>12</sup>. The amount of fluid and electrolyte needs of men and women differ, and the use of clothing in the workplace can affect the amount of sweat that is released<sup>13</sup>.

Demak, which is a district in Semarang, ranks 4th in Central Java with the highest number of brick workers. According to data from the Central Statistics Agency (BPS) in 2021, there were 12,000 brick workers in Demak Regency. This constitutes 10% of the total workforce in the manufacturing industry sector in Demak Regency<sup>14</sup>. One of the villages in the brick-making industry sector is Candisari Village. The heat source comes from two sources, namely solar heat and the combustion process that produces steam for burning bricks. The production process is still carried out traditionally using human labour and makeshift equipment, with a target of producing an average of 1,000-1,500 pieces of bricks per day, lasting for an average of 9 working hours. Based on these important knowledge gaps for

addressing sun exposure and heat stress emergencies, the aims of this article are to analyzing the relationship between age, gender, type of work, smoking habits, type of clothing used, amount of drinking water consumption and heat stress with the level of dehydration in brick makers at the Candisari Village Home Industry Center, Demak, Central Java, Indonesia.

II. METHOD

This type of research is observational with a cross-sectional study design. This research was conducted in a brick-making home industry, Candisari Village Home Industry Center, Demak, Central Java, Indonesia. All workers who meet the criteria as brick-making workers became respondents in this study, namely 32 workers.

The independent variables are age, gender, type of work, smoking habits, type of clothing, and amount of drinking water consumption. While the dependent variable is the level of dehydration. The variables are measured using a general questionnaire containing questions about age, gender, type of work, smoking habits, and amount of drinking water consumption. While the observation sheet is used to monitor the type of clothing used by workers. Ala heat stress meter is used to measure heat stress in the work environment. The dehydration level variable is measured using a urine color indicator by examining urine.

Urine collection is carried out by taking urine at any time, namely urine can be taken at any time. In this measurement, urine samples are taken after 4 hours of work and after finishing work for 7 hours. Urine is placed in a 200 ml container that has been provided. Urine color analysis was carried out by comparing it to the urine color indicator card at the Environmental Health Lab, FKM Unimus.

This research has received ethical approval from the Ethics Committee for Health Research, Faculty of Nursing and Health Sciences, University of Muhammadiyah Semarang, with certificate number 417/KE/06/2024. This study began with filling out and signing the informed consent, after which a questionnaire interview was conducted, and ended with heat stress measurements, urine collection and observation of clothing types.

The data analysis used was univariate analysis which explained the results of the frequency distribution of each variable and bivariate analysis was used to analyze the relationship between risk factors and dehydration levels tested using Spearman rank correlation and chisquare test. The software for data analysis was carried out using IBM SPSS Statistics 21.

III. RESULTS AND DISCUSSION

Based on the results in table 1, the frequency distribution of age in brick making workers is mostly less than 40 years old, as many as 62.5%. Most of them are male, 84.4%. Type of work 65.6% exposed to direct heat. Workers who have smoking habits 71.9%. The number of workers who did not fulfil the requirements in using clothing when working in a brick maker was 75.0%. Workers consumed less drinking water 84.4%. The heat stress received by brick-making workers is mostly above the Threshold Value (NAB) of 100%.

Workers who experienced severe dehydration levels were 87.5%.

TABLE 1. Frequency distribution

Variabel	Kategori	f	(%)
Age	< 40 tahun	20	62,5
	≥ 40 tahun	12	37,5
Gender	Man	27	84,4
	Woman	5	15,6
Type of work	Do not expose to direct heat	11	34,4
	Exposed to direct heat	21	65,6
Smoking Habit	Yes	23	71,9
	No	9	28,1
Types of Clothing Use	Qualify	8	25,0
	Not eligible	24	75,0
Amount of Drinking Water Consumption	Good	5	15,6
	Not Enough	27	84,4
Heat Stress	exceeding the threshold value	32	100
	Normal	1	3,1
Dehydration Level	Mild Dehydration	3	9,4
	Severe Dehydration	28	87,5

The results show that there is no relationship bztween the age of workers and the level of dehydration. This is shown from workers who are severely dehydrated at the age of less than 40 years and more than 40 years both show a high percentage. 90% of workers aged less than 40 years were severely dehydrated and 83.3% of workers aged more than 40 years were severely dehydrated.

In addition, the results also explain that there is no relationship between gender and the level of dehydration in workers. All female respondents were 100% severely dehydrated. In male respondents, 3.7% of them did not experience dehydration, 11.1% of them experienced mild dehydration and 85.2% experienced severe dehydration. Then on the type of work factor, the test results show that there is no relationship between the type of work and the level of dehydration. The table shows that 81.8% of respondents with types of work that are not exposed to direct heat are severely dehydrated and respondents with categories of types of work exposed to direct heat 4.8% of them are not dehydrated, while 90.5% are dehydrated.

The results of the cross table between smoking habits and the level of dehydration of brick making workers have no relationship, it can be seen that the percentage of workers who have a habit of smoking who experience mild dehydration levels is 13.0%, severe dehydration levels are 82.6% and those who are not dehydrated are 4.3%. In workers who do not have a smoking habit, 100% experience a severe level of dehydration.

The test results show that there is a relationship between the type of clothing used and the level of dehydration in workers. This is evidenced by the results in the table above that respondents who always and qualify to use clothes 25.0% are mildly dehydrated, 62.5% of them are severely dehydrated and 12.5% are not dehydrated. Respondents who did not meet the requirements for wearing clothes 23% were mildly dehydrated and 95.8% were severely dehydrated. It can be

seen in the results of the table above that there is a relationship between the amount of water consumption and the level of dehydration. The level of dehydration in brick making workers

with insufficient water consumption was 87.5% severely dehydrated.

TABLE 2. Relationship of factors with the level of dehydration

Variable	Dehydration						Amount		P value*
	Normal		Mild Dehydration		Severe Dehydration		F	%	
	f	%	F	%	f	%			
<b>Age</b>									
< 40	0	0,0	2	10,0	18	90,0	20	100	0,715
≥ 40	1	8,3	1	8,3	10	83,3	12	100	
<b>Gender</b>									
Man	1	3,7	3	11,1	23	85,2	27	100	1,000
Woman	0	0	0	0	5	100	5	100	
<b>Type of work</b>									
Do not expose to direct heat	0	0	2	18,2	9	81,8	11	100	0,528
Exposed to direct heat	1	4,8	1	4,8	19	90,5	21	100	
<b>Smoking Habit</b>									
Yes	1	4,3	3	13,0	19	82,6	23	100	0,668
No	0	0	0	0	9	100	9	100	
<b>Types of Clothing Use</b>									
Qualify	1	12,5	2	25,0	5	62,5	8	100	0,039
Not eligible	0	0	1	4,2	23	95,8	24	100	
<b>Amount of Drinking Water Consumption</b>									
Good	1	20,0	2	40,0	2	40,0	5	100	0,008
Not Enough	0	0	1	3,7	28	87,5	27	100	

\*Chi square test

The relationship test above in table 3 using the spearman rank test obtained sig = 0.339 which means there is no relationship between heat stress and hydration status in brick making workers.

TABLE 3. Heat stress relationship test with dehydration

Variable	Sig *Rank Spearman
Heat Stress	0,339

\*Rank Spearman Test

The results of the relationship test in this study concluded that there was no relationship between age and the level of dehydration, this is because most workers are less than 40 years old and workers at that age are placed in the position of cooking tofu, causing longer exposure to heat and less rest hours compared to other work positions, this is because the cooking process must continue during the production process. Basically, the younger age group will be faster to acclimatise so that the risk of dehydration is smaller. Younger workers start secreting sweat 15 minutes after entering a hot room. Older workers take 29 minutes and are at risk of dehydration due to the body's slow response to transfer heat from the body's core to the skin<sup>15</sup>.

Although workers less than 40 years of age have a lower risk of dehydration, it is not recommended that they stay too long in high-temperature workplaces as it will adversely affect their health. Basically, dehydration can be experienced by anyone, which is why young people can also experience dehydration if they do not consume enough fluids, but the groups that are vulnerable to dehydration are children and the elderly<sup>16</sup>. This study is in line with previous research on bead artisan workers in Jombang Regency that there is no relationship between age and dehydration level<sup>17</sup>.

The results in this study indicate that there is no

relationship between gender and the level of dehydration in brick making workers. This study is in line with research conducted on workers of Unit P2 Section (Wood Working 1) WW1 PT KTI Probolinggo that there is no relationship between gender and hydration status<sup>18</sup>.

In theory, women will be more likely to experience fluid deficiency, because most women's bodies have more fat than men<sup>32</sup>. The absence of a relationship between gender and dehydration levels in this study may be due to unbalanced gender data. The number of men far exceeds the number of women so statistically distributed unevenly. In addition, all female workers in this place are placed in the cutting section which is some distance from the source of heat exposure. In addition, physically men have better resistance to heat than women. Female workers will give peripheral reactions such as weakness in the hands and feet if they work in a place with a hot working climate<sup>10</sup>.

The results explain that the type of work is not related to the level of dehydration. This is because although each job occupies a separate location, the distance between sections is not too far from the heat source, which is an average of 1-2 metres. Thus, heat exposure can still be received in each type of work.

This study explains that workers who are not exposed to heat are immediately dehydrated. This is evidenced by one industry where the type of work is not directly exposed to heat but is severely dehydrated due to the position when working close to the type of work that is directly exposed to heat. A different industry where the type of work that is not directly exposed to heat is mildly dehydrated due to the position of the type of work that is far away from the type of work that is directly exposed to heat. Workers exposed to direct heat are more at risk of dehydration due to the heat received by workers which causes fluid expenditure in workers. The direct

heat exposure of each industrial site is different because the position and workplace of each type of work is different.

Based on the results of the study, there was no relationship between smoking habits and the level of dehydration. This is because this study only analysed smoking habits without taking into account the number of cigarettes consumed and the length of smoking history. Theoretically, the longer and greater number of cigarettes consumed will cause complaints such as dry mouth and thirst. So that this is what causes the balance of fluids in the body and the level of thirst in workers to vary.

Heavy smokers will feel thirsty more often than non-smokers, this happens because the salivary glands in the mouth do not produce enough saliva, which will cause the mouth to feel dry and will feel thirsty even though they have drunk. This condition is included in the symptoms of moderate dehydration, where at this stage the body will experience a fluid deficiency of 3-4%. Symptoms and signs that will appear in people with moderate dehydration are dry skin, dry mouth and throat, reduced urine volume<sup>3</sup>. Research on the effect of long-term smoking on oral salivary flow rate and oral health states that smoking can increase thirst<sup>19</sup>. This study did not examine the amount of smoking consumption and the duration of smoking.

The factor of type of clothing use has a relationship with the level of dehydration of workers. Clothing is useful as a body protector, in workers who are exposed to heat. Qualified clothing can absorb sweat so as to reduce body temperature and reduce sweat output, thus dehydration can be suppressed. The type of clothing that meets the requirements is the type of clothing that can absorb sweat such as cotton clothing with short sleeves sleeveless cotton with good thermal comfort then the sweat that comes out will be absorbed by the fibres of clothing that will reduce body temperature, so it will reduce sweat output. Based on the data in this study, of the 8 workers who used eligible types of clothing, 12.5% of workers were not dehydrated, 25% of workers were mildly dehydrated and 62.5% of workers were severely dehydrated.

The majority of workers do not fulfil the requirements in using clothing, workers use non-cotton types of clothing, long-sleeved types of clothing and do not use clothing. If workers do not wear clothing or use clothing with inappropriate and tight materials, it can cause unexpected levels of sweating, resulting in the need for more fluids<sup>20</sup>. Excessive sweat output will cause workers to become dehydrated. Then, it is exacerbated by some workers who do not wear clothes while working. Workers who do not wear clothes while working will facilitate heat transfer to the worker's body because there is no barrier to heat transfer and perspiration on the skin surface<sup>21</sup>. This study is in line with research conducted on blacksmith workers that there is a relationship between the use of clothing and the level of dehydration<sup>8</sup>.

The results of the study explain that there is a relationship in the variable amount of drinking water consumption. Insufficient water consumption is unable to replace body fluids in the form of sweat that comes out due to heat exposure, in this study 84.4% of workers consumed less than 5,760 ml of drinking water during 8 hours of work, there were

87.5% of workers experiencing severe dehydration. Factors that influence the lack of respondents to consume water are not feeling thirsty, dislike of drinking water and prefer to consume non-water drinks such as tea, coffee, and syrup.

Consuming water before, during and after work is very important<sup>22</sup>. Workers who work in hot places, will release fluids in the form of excessive sweat expenditure. The sweat expenditure causes workers to lack fluids. The lack of fluid in the body that is not balanced by the amount of water entering will cause workers to experience dehydration. This study is in line with previous research on weaving workers explaining that there is a relationship between water consumption and dehydration<sup>9</sup>.

The factor of heat stress level in this study is related to the level of dehydration. Exposure to heat received by the body will increase body temperature, causing stimulation of the hypothalamus which commands to dissipate heat, as a final response there will be vasodilation of the skin's blood vessels, so that heat will be discharged through the skin by sweating excessively, so that the body loses large amounts of fluid. A body that loses excessive fluid without being balanced by adequate fluid consumption will result in dehydration. In line with previous research which explains that there is a relationship between heat stress and the level of dehydration of blacksmith workers<sup>8</sup>. In addition, research on PT X workers explained that there was a relationship between heat stress and dehydration in Dryler workers<sup>23</sup>.

#### IV. CONCLUSION

The frequency distribution of factors associated with the level of dehydration in brick-making workers is 62.5% of workers aged less than 40 years, 84.4% male, 65.5% of workers exposed to heat, workers have a habit of smoking 71.9%, most do not meet the requirements in the use of the type of clothing 75%, 84.4% of workers consume less drinking water, 100% of the results of heat stress above the NAB and 87.5% of workers experience severe dehydration. The level of dehydration in workers making bricks at the Candisari Village Home Industry Centre, Demak, Central Java, Indonesia, is influenced by several related factors, namely the type of clothing used and the amount of drinking water consumption. However, for other factors examined in this study such as age, gender, type of work, heat stress, smoking habits are not associated with the level of dehydration of workers. This is because the group of workers who fall into the non-risk category is more than the workers who are at risk of dehydration. Industry owners should provide more water, especially water in the workplace and remind workers to always consume water and also use clothing when working. Workers should pay more attention to the intake of drinking water consumption in accordance with the recommendation that workers in hot working environments should consume 240 ml of liquid every 20 minutes and workers should have individual drinking bottles to know the amount of water that has been consumed and use the type of clothing that can absorb sweat.

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