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# MALAYSIA CONSTRUCTION WORKER PERCEPTION ON HEAT STRESS AND ITS IMPACT ON WORK PERFORMANCE

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## Abstract

Global climate change has gradually increased Malaysia average temperature. This situation increases the risk of heat stress for Malaysian construction workers who mostly work under the sun. Thus, this study aims to examine Malaysian construction worker's perception to-wards heat stress at construction site and its impact on work performance. A perception survey through Google Form was distributed to 53 construction workers. Participants that are selected for conducting this research have age range of 31 years to 40 years old, have one to three years of working experience and have knowledge of heat stress. Descriptive analysis results indicate respondents experience heat stress at construction site. The air temperature and radiant temperature was perceived as hot. The respondent also stated its uncomfortable to touch any surface area at the workplace and the warm environment make respondent throat feels dry and sweat profusely. However, the respondent does not perceive any negative implication of heat stress towards work performance. There was no symptom of heavy breathing while working; respondent feel motivated to work daily, don't think they need longer break and even eager to work overtime. Nonetheless, respondents state they do experience joint pain and difficulties in finishing daily task occasionally.

**Keywords:** Heat Stress, Construction Worker, Work Performance, Malaysia Construction Industry.

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## 1. INTRODUCTION

In swine production, besides the requirement for growth, pork consumers and market traders require polyunsaturated fatty acids to improve meat quality and disease resistance. As the climate change is occurring, Malaysia is gradually seeing an increase in average temperature [1].

The rising temperature will eventually cause humans to be exposed to more heat, endangering their health and lowering their ability to do their jobs [2]. Body's diminished capacity to regulate core body temperature was the cause of these adverse effects [3]. A person is more likely to experience heat stress, also known as heat load, if there is the great rate of hot weather and the environmental conditions are overall humid for a protracted period of time [4]. Since most construction workers in Malaysia are employed outside and exposed to the sun, heat stress has prominent effects on the business.

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## 2. HEAT STRESS IMPACT ON WORKER PERFORMANCES

Various aspects related to the construction sites typically affect construction labor productivity, or CLP. A study written by writers, named Wagner and Grimm within the field environment in 1974 led Yi & Chan to claim that CLP was linked to hot environments [5]. Research investigated the relationship amid CLP and thermal environmental elements like air temperature and relative humidity. Results of the Moohialdin study show that humidity is a crucial environmental factor, whether it is low or high outside temperature [6]. Furthermore, when temperatures are very high, there has been a noticeable decline in work quality. Temperatures between 24 and 26 degrees Celsius are associated with lower labor productivity, and as the temperature rises to 33 to 34 degrees Celsius, productivities of employees will get reduce to become less at levels of moderate work intensity [7]. A temperature increase to 39°C will also result in a significant decline in productivity and the possibility of fatalities [9].

According to a Flourish assessment, 35% of workers who have the exposure of the stress of heat within the environments will experience occupational heat stress, whereas 30% employees will experience decreased productivity [10]. When WBGT exceeds 22 degrees centigrade for work with an strong workload and WBGT exceeds 25 degree centigrade for work with the workload which is not very intense, workers begin to experience heat stress. At the conclusion of their shift, the employee will notice a noticeable impact from the heat stress. Additionally, Luo et al. [13] mentioned that the ideal conditions for construction worker productivity are 20°C, a PMV of -0.21, and a clog of 1.16 [11].

Studies by Li et al. [12] on the productivity of rebar labor within China correspondingly revealed a negative correlation amid elevated temperatures and productivity. Rebar employee's DWT (direct work time) decreases to about 0.57 percent for every 1-degree Centigrade surge in WBGT, according to research. On the other hand, Non-Productive Time or NPT increased by 0.74% for each degree that

WBGT rose. When there is the elevation of air temperature above 34.9°C, linear reduction take place in the productivity of Indian female brick workers, according to Sett & Sehu [13].

In addition to a high temperature, other environmental aspects, integrating humidity, air speed, and radiant temperature, can affect a construction worker's thermal comfort [14,15]. Additionally, it has been demonstrated that both increased air temperature and thermoregulation affect employees' physical and mental performance [16, 17]. Moreover, individual factors like metabolic rate and clothing insulation have an impact on workers' body temperatures [18].

According to Dunne et al[19] assessment of physiological models, heat exposure will cause an up to 80% reduction in global labor capacities by 2050. Hot climate regions like South East Asia, which are expected to lose 11–27% of their productivity, will be the most affected. According to a study by Altinsoy & Yildirim [20] conducted in Turkey, the hot weather will cause a 52% decrease in productivity in the construction and agriculture sector. The study's emphasis on manual labor, specifically outdoor work, provides a clear picture of how heat stress affects worker performance.

## 3. HEAT STRESS IMPACT ON HEALTH

Acute health conditions are linked to a hot and stressful work environment [21]. According to the Rowlinson survey findings, prolonged overexposure to the heat among construction workers may result in conditions such as the rashes due to heating, increased exhaustion, heat stroke, fainting syncope, or the cramp [22]. In addition, Li et al's mentioned that when WBGT is at its highest, the heart rate of construction workers reaches danger level of  $109.37 \pm 1.23$ . [23] The study by Sett & Sehu [24] found that the net cardiac cost (NCC), Increased level of heart rate, relative cardiac cost, and recovery heart rate (RHR) of female brick workers were all significantly higher on hotter days, supports this conclusion.

Occupational Safety and Health

department of Malaysia reported that construction business is one of sectors with elevated accidents for 2018 after fishery, forestry, agriculture, and the negative effects of extreme temperatures on construction workers should be taken seriously [25]. Construction workers also have a heavy workload that must be completed in a limited amount of time [26]. To get some extra money, many workers place themselves to the limit instead thinking about their health [27]. This might exacerbate the negative effects of heat exposure and will eventually result in poorer performance. Therefore, extensive studies are required to measure and analyze how the environment at a construction site affects worker performance and health.

Additionally, following prolonged heat exposure, Miliaria rubra instances were discovered on the ankle and knee of miners [28,29]. Furthermore, people with BMIs above the median of 29.6 had an increased risk of developing heat exhaustion and cramps [30]. According to Vandetorren et al. [31], individuals suffering through cardiovascular and cardiac disease are to greater extent susceptible to and at an elevated risk of developing heat-allied illnesses as a result of global warming. Aging also affects a worker's capacity for the purpose of maintaining the homeostasis within the heat stress situation, according to Vandetorren.

According to Gubernot et al. [32], American construction workers are more likely than employees in other industries to pass away from heat-related illness (HRI). As stated by Gubernot, the risk of fatalities is 13 times greater for construction employees, including road and roofer's builders. Exertional heat stroke, which can result in confusion, erratic behavior, poor coordination, collapsing, vomiting, convulsions, and consciousness loosening, is also a serious risk for workers exposed to temperatures exceeding 39.5 °C [33]. Additionally, a study by Tawatsupa et al. [34] in Thailand found that male employees who are unswervingly exposed towards the sunlight experience 10% higher occupational injuries than those who are not.

## 4. METHODOLOGY

A perception survey through Google Form was conducted to assess stress of heat and the affects generated by these effects on performance of work. The survey was adapted and modified from Heat Strain Score Index study by Habbolah Deghan et al (2015), (HOTHAPS) by Kjellstorm et al (2016) and Individual Work Performance Scale by Ramdani et al (2019). Google Form link was distributed to 53 construction workers through WhatsApp Group application. The online questionnaire had five sections; demo-graphic, air temperature, humidity, radiant temperature, and work performance. Likert scale of the 5 points embrace different ranges integrating Strongly Dissatisfied to Strongly Satisfied was used to measure respondent perceptions.

## 5. FINDINGS

### 5.1 Demographic Profile

Majority of the respondent was male (n=46, 86.8%) and only handful of females (n=6, 13.2%). The age distribution of respondent was as followed; 23 (43.4%) were 31 to 40 years old, 13 (24.5%) were 41 to 50 years old, 9 (17.0%) were 51 years old and above and 8 (15.1%) were 21 to 30 years old. Most of the respondents have 1-3 years (n=15, 28.3%) work-ing experience, followed by 4-6 years (n=10, 18.9%), more than 15 years (n=10, 18.9%), 10-15 years (n=8, 15.1%), 7-9 years (n=5, 9.4%), and less than 1 year (n=5, 9.4%). Finally, large portion of the respondents had knowledge on heat stress (n=41, 77.4%) compared to those that doesn't know (n=12, 22.6%).

### 5.2 Perception on Heat Stress

Perception on heat stress were assessed though air temperature, humidity and radiant temperature. Majority of the respondents perceives the temperature to be high as shown in Figure 1. This is reflected through 15.1% (n=8) stating its very hot, 17% (n=9) for hot, 22.6% (n=12) for warm and 22.6%(n=12) for a little bit warm. Only 17% (n=9) of the respondent stating the temperature was normal and 5.7% (n=3) with cold.

Moving on to radiant temperature which refer to perceptions towards temperature of working area surface as shown in Figure 2. Large number of respondents said the surface area at construction site were warm when touched, which constitute 60.4% (n=32). Most of the respondent (n=14, 26.4%) feels the surface area was slightly warm when touched. Followed by warm but have no risk of burn (n=10, 18.9%), hot when touched and can't with-stand the temperature (n=4, 7.5%) and very hot when touched and can cause burn (n=4, 7.5%). On the other hands, 39.6% (n=21) of the respondent said the surface temperature was neither hot nor cold when touched.

Respondent was not comfortable with construction site humidity, which constitute 75.5% (n=40) of total response. Figure 3 shown aspects that constitute the uncomfortable sensations, such as dryness feeling inside the mouth and throat area (n=27, 50.9%), 5.8% (n=3) of respondents said their cloth stick to their wet skin, 9.4% (n=5) said their skin are totally humid, and 9.4% (n=5) said their skin was very wet due to sweat. On contrary, small portion of respondents (n=8, 15.1%) said they are comfortable with the humidity and 9.4% (n=5) mentioned their skin is barely humid.

In conclusion, majority of the respondents perceived construction site air temperature to be warm, radiant temperature of work surface to be hot when touched and uncomfortable humidity to skin and dryness for inside mouth and throat area.

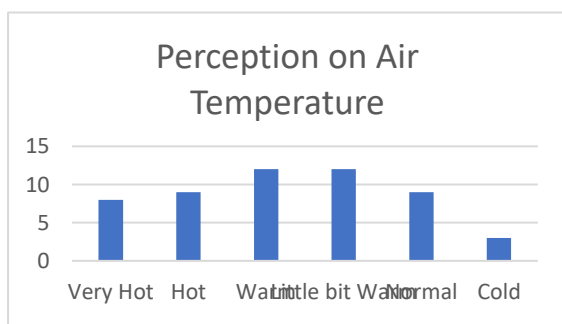


Figure 1: Respondents' perception on Air Temperature

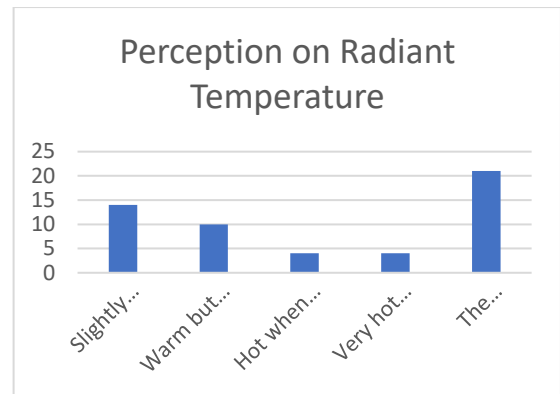


Figure 2: Respondents' perception on Radiant Temperature

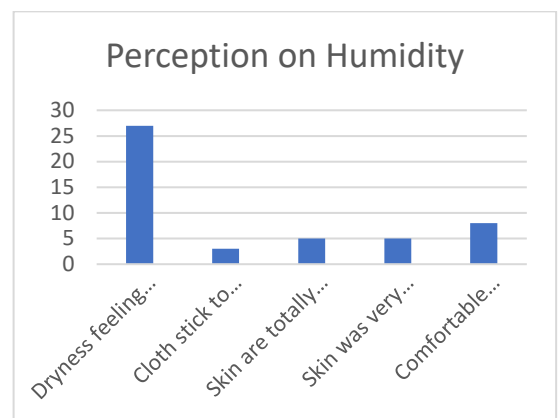


Figure 3: Respondents' perception on Humidity

### 5.3 Perception on Work Performance

Most of the respondent (n= 32, 59%) mentioned they have not experienced heavy breathing while working at construction site in the span of 15 days. On the other hands, handful of respondents experienced heavy breathing (n=14, 26%) every 1 to 5 days. Next, majority of respondents (n= 27, 51%) said they experienced joint pain at any body part every one to five days. Followed by not experiencing any at all while working (n=20, 38%). Almost all respondents said they never lost interest with working (n=35, 66%) and only small numbers of them say they lost interest once in a while (n=14, 26.4%). Next, respondents are fairly distributed on the aspect of failure to finish daily work. Where half of them (n=26, 49%) say they never fail to finish daily work and the other half (n=20, 38%) does fail once every one to five days.

On the other hands, respondents state

they want to work overtime when given the chance (n=24, 45%). While a handful (n=20, 38%) of respondents said they don't really prefer working overtime. Lastly, majority (n=26, 49%) of respondent emphasize said they don't need longer work break or have break more frequently while working.

To summarize, respondent experienced joint pain while working but not heavy breathing. In addition, respondent have strong motivation to work and eagerly want to work overtime. Thus, we can place the conclusion that negative adverse impact of stress due to heat towards respondents are related to joint pain. While there is no major impact on motivation to work. However, there is slight impact on ability to finish work daily.

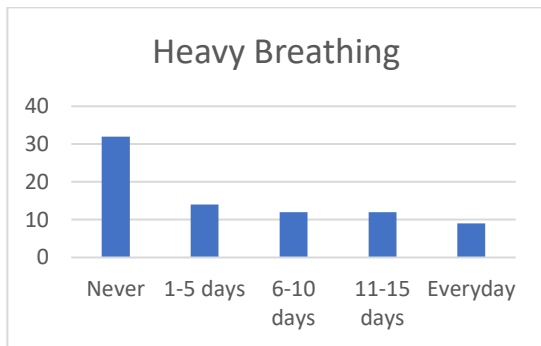


Figure 4: Respondents' perception on Heavy Breathing



Figure 5: Respondents' perception on Losing Interest on Working

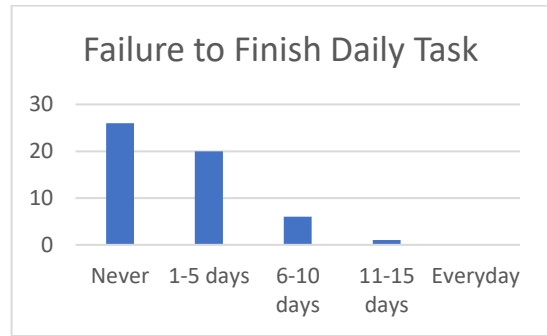


Figure 6: Respondents' perception on Losing Interest on Working

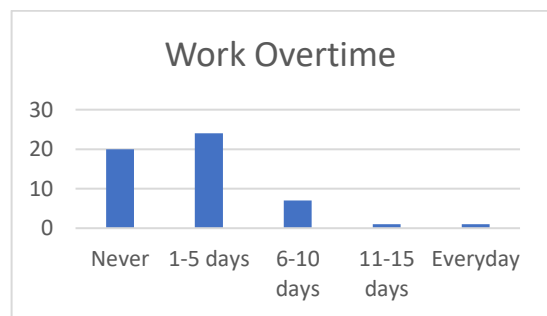


Figure 7: Respondents' perception on Working Overtime

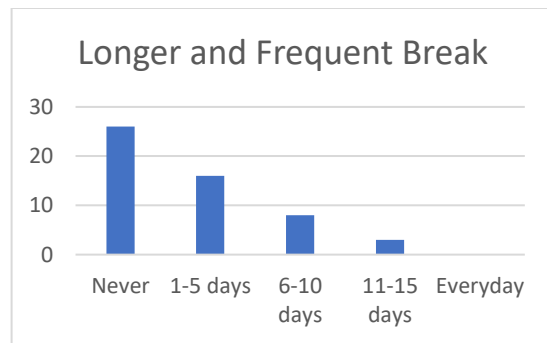


Figure 8: Respondents' perception on Working Overtime

## 6. DISCUSSION

Respondent in this study experience heat stress which is similar to other study for Malaysia construction industry [35]. Especially on the aspect of air temperature where re-respondent perceive as hot. This finding is aligned with other outdoor studies in Malaysia that found out the temperature is too high and make construction workers feel uncomfortable [36]. Besides that,



respondent perceive surface temperature is too hot when they touch it and, in some cases, it can cause burn. This reflects the high air temperature have caused surface temperature of ground, equipment, machinery and materials to become warm. Thus, making them feel uncomfortable to touch it. Moving on to the aspect of humidity, which is stated to be highly uncomfortable by respondent. The high air temperature has made the environment dry and this leads to dry throat and mouth. Several other studies have also come to the same conclusion, where construction workers start to feel dryness in their throat when air temperature is at its peak [37, 38].

Despite experiencing heat stress, respondent don't feel negative implication on work performances. Respondent does not feel out of breath while working, don't lost motivation to work, does not need longer work break and in fact eager to work overtime. This finding is not aligned with other studies that shows there is correlation between heat stress and work performances [39]. However, work performance in this study was not examined through quantifiable method. This means the respondent might perceive they are motivated to work, however in reality, their construction labor productivity decreases as the temperature increase. On contrary, majority of respondents does experience joint pain at any body part which is aligned with other studies that mentioned there is association be-tween heat stress and body pain [40].

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