COLLEGE OF HEALTH SCIENCE
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF PREVENTIVE MEDICINE
ENVIRONMENTAL AND OCCUPATIONAL HEALTH UNIT

Assessment of the Prevalence of Heat Stress Related Illness among outdoor Sugar Factories Workers in Ethiopia.

Investigator: - Teklu Hailu (BSc.)

A research thesis to be submitted to Addis Ababa University School of Public Health, Department of Preventive Medicine, in partial fulfillments of the requirements of Master Degree in Master of Public Health with a specialty in Environmental and Occupational health**.**

June 2018
Addis Ababa, Ethiopia

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DECLARATION

I the undersigned, declare that this thesis is my original work, has never been presented in this or any other university, and that all the resources and materials used for the thesis development are recognized and cited, and people who involved in are acknowledged.

Name: Teklu Hailu (BSc.)

Signature: _____

Date of submission: _____

1. Advisors

The thesis entitled "Assessment of the Prevalence of Heat Stress Related Illness among outdoor Sugar Factories Workers in Ethiopia." is submitted in partial fulfillment of the requirements for the degree of MPH with specialization in "Environmental and Occupational health" to the Graduate Program of the School of Public Health at Addis Ababa University and has been carried out by **Teklu Hailu** under our supervision. The student has fulfilled the thesis requirements and hence here by can submit the thesis to the school. This thesis work has been submitted for examination with my approval as University primary advisor.

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By: Teklu Hailu (BSc.)

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Approved by the examining board

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Examiners

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
CDC	US Communicable Disease Center
HOTHAPS	High Occupational Temperature Health and Productivity Suppression
HSE	Health and Safety Executive
HRI	Heat Related Illness
IPCC	Intergovernmental Panel on Climate Change
MOH	Ministry of Health
MOLSA	Ministry of Labor and Social Affairs
MSD	Musculoskeletal Disorder
MSF	Metahara Sugar Factory
NIOSH	National Institution of Occupational Safety and Health
OSH	Occupational Health and Safety
OSHA	Occupational Health and Safety Administration
SDG	Sustainable Development Goal
WBGT	Wet Bulb Globe Temperature
WHO	World Health Organization
WSSF	Wonji Shoa Sugar Factory

Abstract

Background: Temperatures are increasing around the globe, exacerbating the existing heat burden of tropical areas for outdoor work environments. Exposure to extreme heat stress can overwhelm the body's coping mechanisms leading to a serious condition such as heat stroke, heat exhaustion, heat cramps, heat rashes, and heat syncope. Sugarcane harvesting is an intense job that involves constant exposure to heat and sunlight.

Objective: - The main aim of this study was to assess the prevalence of heat related illness and current adaptation strategies among outdoor Sugar Factories workers in Ethiopia.

Methodology: - Institution based Cross-sectional study was conducted from March 25, 2018, to April 30, 2018, among 143 Wonji Shoa and 261 Metahara Sugar Factories workers, Central Ethiopia. Standardized High Occupational Temperature Health and Productivity Suppression questionnaire was used to assess the prevalence of heat related illness among outdoor sugar cane workers and observation checklist and key informants' interview was used to collect data for adaptation strategies. Air temperature and Relative humidity records obtained from Metahara and Wonji Shoa research center were used to calculate Wet Bulb Globe Temperature.

Results: - The Prevalence of Heat Related Illness in the study population was 299/401 (74.6%). The Heat related symptoms most experienced were sweating by 394(98.3%) and thirst by 393(98%). The Wet Bulb Globe Temperature was highest in March and April reaching, 27 °C and 22 ^{o}C in Metahara and Wonji Shoa sugar Estate respectively. Cooling and hydration, taking break/resting, wearing a light cloth during hot day were currently adopted coping strategies to reduce heat stress.

Conclusions: Metahara and Wonji Shoa Sugar factories workers had high prevalence of heat related illness. Even if the weather data shows a low risk of heat index, work rate and lack of adequate coping strategies lead workers in high risk of heat stress. Appropriate coping mechanism also needs to be designed for outdoor Sugar Cane workers whose health is negatively impacted by heat stress.

Key Words: - Heat-Related Illness, Sugarcane workers, Level of heat stress, Adaptation strategies, Wonji Shoa, Metehara**,** Wet Bulb Globe Temperature

1. INTRODUCTION

1.1 Background information

There is now a reasonable scientific consensus that the globe is warming because of increased man-made emission of greenhouse gases. Global warming is the rise in the average temperature of the surface of the earth (1).

The increase in temperature raises environmental as well as human health concerns (2). Increase in local ambient temperature means higher human exposure to heat, which can affect human health and wellbeing. This problem can get worse, particularly when the increase in temperature occurred during hot seasons in hot parts of the world without air conditioning or other cooling facilities particularly on workers carrying out heavy labour (3, 4).

Exposure to extreme heat level can overwhelm the body's coping mechanisms leading to a serious condition such as heat stroke, heat exhaustion, heat cramps, heat rashes, and heat syncope or possibly fatal (4,5,6). The research done on heat stress among workers in different workplace shows that, there is significant correlation between high environmental temperature and negative impact on workers' health (7).

Workers who spend their entire work in a variety of indoor and outdoor hot environments that may become hotter because of rising ambient temperature. The workgroup affected most by increased temperature includes: agricultural workers, construction workers, emergency responders, firefighters, transportation workers, and other workers exposed to outdoor weather conditions, particularly those performing physically demanding work for extended periods, like sugarcane cutters (8, 9).

Africa is one of the most vulnerable continents to climate variability and change because of multiple existing stresses and low adaptive capacity. Existing stresses include political conflicts and ecosystem degradation. When the US Communicable Disease Center (CDC) compared heat-related impacts across different categories of urbanization and income, it found that in general, weather-related death rates (including those from floods, storms, and lightning) were 2–7 times higher in low-income counties than in high-income counties (10).

Studies suggest that heat-warning systems may be effective in preventing classical Heat Related Illness (HRI) in the general population (3, 11) but less work has been done to develop and

evaluate heat-warning systems, tailored to agricultural workers that aim to reducing the risk of Heat Related Illness.

The Wet Bulb Globe Temperature has been adopted in workplace heat safety guidelines published by the American Conference for Governmental Industrial Hygienists (13), where it serves as a measure of heat stress when considered together with activity and clothing. Wet Bulb Globe Temperature at the worksite is appropriate measure level of environmental heat stress to guide the choice of the appropriate work–rest cycle. The Wet Bulb Globe Temperature can also be estimated, with varying levels of accuracy depending on circumstances and specific methods, from standard meteorological data (12).

The production and processing of sugarcane is a major source of employment for both skilled and unskilled workers (14). It is likely; the sugar cane industry in Ethiopia is an important contributor to the national economy including serving as a major source of employment firm.

In Ethiopia currently there are Six (6) sugar-producing factories and there are seven sugar projects to be inaugurated in the future. Wonji, Metahara, Arjo Dedessa, Finchaa, Tendahoo, and Kessem are in production (15). The number of sugarcane cutter involved in sugarcane factories is estimated to more than 35,000 annually.

In Ethiopia, sugar cane harvesting is done manually using machetes. Sites for sugar cane plantation lie within warm zones "Kola" of Ethiopia with dominant sub-tropical climate (16). Workers employed in the Wonji Shoa and Metehara farm are exposed to intense sunlight and heat while working on sugarcane harvesting and cutting. Usually, they work from 5:00 am to 3:00 pm or 4:00 pm, but some take more time and finish around 5:00 pm.

1.2 Statements of the problems

Increased temperature has become one of the most visible environmental concerns of the 21st Century. Recent research shows that the overall risk of heat-related illness or death has climbed steadily since 1980, with around 30% of the world's population now living in climatic conditions that deliver extreme hot temperatures persisting several days to weeks a year (17). Between 2000 and 2016, the number of vulnerable people exposed to heat wave events has increased by approximately 125 million (2).

Climate change in terms of increased temperature can affect human health both directly and indirectly (18). Workers, especially outdoor workers, in particular, have been considered at high risk of adverse impacts heat related illness than a general public in part because of their increased exposure to heat and humidity for a long durations and at greater intensities and the nature of the work that involves heavy exertion **(**19). Outdoor workers are exposed to two forms of heat stress, which includes internal metabolic (body) heat generated by exertion (hard physical labor) and environmental heat arising from working conditions.

When the body becomes overheated, a condition of heat stress exists. Heat stress can lead to a number of heat-related illnesses such as heat exhaustion, heat stroke, heat cramps, fainting, or heat rash (20, 21). When working condition is extremely hot the body temperature regulation system breaks down and body temperature rises rapidly, causing heat stroke and death (22).

Occupational heat stress risk is projected to become particularly high in the middle- and low-income tropical and subtropical regions, where optimal controls may not be readily available (23). With a warming climate and more frequent extreme weather events predicted, heat exposure and heat stress are becoming a prominent employee safety issue. According to Occupational Health and Safety Act, 2000 the employer has a legal obligation to ensure the health, safety, and welfare at work of all employees including preventing or decreasing heat stress (24).

The combined heat stress, physical exertion, and recurrent dehydration seem the most plausible origins of the chronic kidney disease (CKD) etiology. A CKD epidemic in Central America (Mesoamerican nephropathy) has killed over 20,000 people since 1990. Outdoor workers, in particularly sugarcane cutters, are the most affected (25; 26; 27). Proper rehydration with water

and other interventions may reduce heat stress and reduce ergonomic hazards (28). The heat-related illness may occur if appropriate welfare activities, rest areas, and drinking water are not provided (29).

In Ethiopia, some studies assessed the impacts of increased temperature on economy, agricultural and public health, however, research on the non-fatal impacts of direct heat exposure on worker particularly on those working outdoors such as sugar cane workers were absent. Therefore, the aim of this study is to assess the prevalence of direct heat related illness among workers and level of heat stress and adaptation strategies to the changing temperature in sugar factories in Ethiopia.

1.3. Significance of the Study

It is known that outdoor workers are exposed to various weather and environmental factors, such as high heat and humidity, which may increase their risk of adverse health effects. In Ethiopia, there is no evidence on outdoor workers health condition in relation to working in hot environment. Besides to this, there is no data showing how employees and employers cope with changing environment. This study can provide essential information about the level and direct health effects of temperature on worker's health for concerned bodies such as labour and health policy makers, safety and health practitioners, owners of the company including workers and the public. In addition to this, the study suggested possible prevention and adaptation strategies to reduce the effect of increasing temperature on worker's health.

2. LITERATURE REVIEW

2.1 Effects of Intense Heat on Health and Well-Being

Occupational heat stress has been an issue for ages and it is quite clear that problems will aggravate leading to a very difficult future ahead and, will become the nearly impossible task to tackle if global temperatures keep rising (30). Occupational heat-related illness is an important direct health hazard related to climate conditions and climate change. Heat stress refers to heat received in excess than the body can tolerate, without physiological impairment. It is an important facet of the impact of climate change on human health (31).

Adverse health effects due to exposures to excessive ambient heat (termed here heat exposure) already occur in many parts of the world, not only during heat waves but also due to the need for intensive manual work in hot daily conditions. Climate change has reported increasing both the incidence and the severity of these effects (32). The body core temperature is 37°C and an air temperature or radiant temperature higher than body core temperature will transfer heat from the environment to the body. When a person is involved in physical activity (e.g. while working, walking or bicycling), the muscular work creates major heat production inside the body (4).

It was also reported that heat exposure also affects workers' capability to undertake physical activities without harm; in hot conditions, work capacity falls, leading to a decrease of labor productivity. Although the human body is remarkably capable of maintaining its core temperature around 37^{o}C, a combination of conditions such as high environmental temperature and high humidity (which decreases the efficiency of sweating), clothing that increases core temperature (and reduces the ability to sweat), physical exercise and dehydration can disturb the equilibrium. This can result in heat stress and, when severe, can cause heat stroke and death (33). These effects highlight the need for better analysis of the heat/health interface.

A study showed that migrated sugarcane harvest workers of Ahmednagar, Maharashtra are suffered from ill health. Well-defined policy, medical care, and integrated approach will improve the conditions of the workers according to Somsundaram and Bengal (34).

Another finding showed that malnutrition, musculoskeletal and dermatological diseases are also common among the migratory workers of Maharashtra, India. Also, the prevalence of knee (80%) and lower back (73.3%) pain were found among the sugar mill workers aged between 30-60 years carrying and lifting more than 50kg load in Punjab, India (35).

According to the study in North-West Nicaragua, more than 70 deaths per 100,000 sugarcane workers are due to chronic kidney problems. 95% has been suffering from CKD. Estimated glomerular filtration rate (eGFR) is decreased during the harvest varying from (28.6 ml/min/1.73 m2) to (25.0 ml/min/1.73 m2) depending on the category of a job as compared with other factory workers (9).

A study showed that an Epidemic of kidney failure has been present since 1999 among the workers of sugar cane field along the Pacific Ocean from Mexico to Costa Rica. On other hands, Cardiac strain with dehydration during six months of sugarcane cutting may be the cause of illness of the sugarcane cutters from El Salvador of ages varying from 18 to 54 years (36, 37).

Garcia et al (8) described a decrease of volume with occupational heat stress is the main factors for the kidney diseases among the sugarcane workers in Nicaragua. Young sugar cane workers have a very high rate of serious chronic kidney disease, which is often fatal. Daily dehydration due to heat and sweating, and without sufficient drinking water supply in the farm fields is a likely contributing cause, but other causes are being investigated. However, diabetes and hypertension cannot explain the high rates of this disease in this population. Prevalence of decrease pre-shift glomerular filtration rate is observed on the test of Biomarkers of kidney injury among the sugarcane cutter in El Salvador (25).

A cross-sectional study conducted in Indian sugarcane cutter showed that high rates of the lower back (50%) and knee joint pain (29%) are observed among the sugarcane workers of Ahmednagar (27).

2.2 Increase Temperature and Occupational Health

A study showed that health hazards associated with outdoor workplace heat exposure are linked to air temperature and humidity, air movement (wind speed) and heat radiation usually from the sun (6). The direct health impacts of heat exposure are generally analyzed principally in terms of mortality or hospital admissions (39).

A cross-sectional study among the workers of Iranian sugar-producing factory showed the level exposure to MSD risks particularly knee (58.6%) and lower back pain (54.3%) (40).
Higher risk of heat stress was found among the sugarcane workers in Costa Rica. Stress in sugarcane cutters increased from pre-harvest (34.2%) to post-harvest (46.1%) whereas for urban workers, stress decreased from pre-harvest (44.0%) to post-harvest (42.0%) as obtained from a study in Mendonça, Brazil (38;41;42).

Study conducted to determine the prevalence of heat-related illness in palm oil mill workers who are under heat stress found Heat exhaustion (84.2%) is the highest prevalence of heat-related illness reported, followed by dehydration (76.8%), heat cramps (58.9%), heat rashes (36.8%), heat syncope (27.4%) and heat stroke (5.3%) among Palm Oil Mill Workers in Malaysia (43).

Sugar cane cutters' health is conditioned by social, economic, technological and organizational factors related to the profile of production and consumption, as well as by physical, biological, mechanical and ergonomic risk factors existing in the work processes (38). Poverty, repetitive work, quality of life along with environmental parameters are the determinant factors of occupational health as obtained from a survey of sugarcane workers of Brazil. Moreover, sugar cane cutters are less prone to hand or wrist pain than office workers or nurses (14).

In 2013 Lundgren reported that the main factors to exacerbate heat stress in the current and future workplace are the urban 'heat island effect', physical work, individual differences, and the developing country context where technological fixes are often not applicable (44).
Factors such as pre-existing disease, clothing, age, gender, an ability for heat acclimatization, level of physical activity, and body size, can influence the health impact of heat stress. Also, the

most powerful form of human thermoregulation is behavioral and includes measures such as less movement, clothing and seeking shade (45).

2.3 Prevention and Control

A working person creates heat internally in the body (particularly through muscular work), which is more difficult to dissipate in hot environments. If cooling methods in a workplace are insufficient and workers already wear light clothing, the only way for a working person to reduce heat stress is to take breaks or slow down their work (4; 46). Local people in any part of the world need to adopt heat exposure through cultural practices such as "siesta" during the hottest part of the day, reduced work intensity, and the use of hats and other appropriate clothing particularly when engaged in outdoor works (4).

Omusulah reported that low average mean of 2.80 dissatisfied about the safety training and safety education (47) perceived the influence of occupational health and safety practices on job satisfaction among employees in Chemelil sugar Worker Company in Kenya. A study conducted in El Salvador also shows that when Water–Rest-Shade programme (OSHA) applied on the sugarcane workers of Central America, it significantly reduce health problem related to heat stress and dehydration without decreasing productivity (48).

Research done on Intervention to reduce heat stress and improve efficiency among sugarcane workers in El Salvador adds that appropriate access to water, rest and shade during each workday offers important relief from the high level of heat stress experienced by sugarcane cutters. In addition, added rest can be provided effectively while applying ergonomic principles to maintain adequate productivity. Physically demanding jobs in hot climates require appropriate access to water, rest and shade, especially in the context of global climate change (48).

In El Salvador, a mixed-method intervention study introduced continuous and hands-free hydration, mobile shaded rest areas, scheduled rest periods, ergonomically improved machetes, and effective strategies for sixty sugarcane cutters, aimed to reduce heat stress and dehydration without decreasing productivity (48). While daily production increased by 43 percent, more than other cutting groups, water consumption among workers increased only 25 percent and symptoms decreased. The ILO recommends that immediate improvements should be agreed on

through group work, including welfare facilities (WASH among them) and work organization (49).

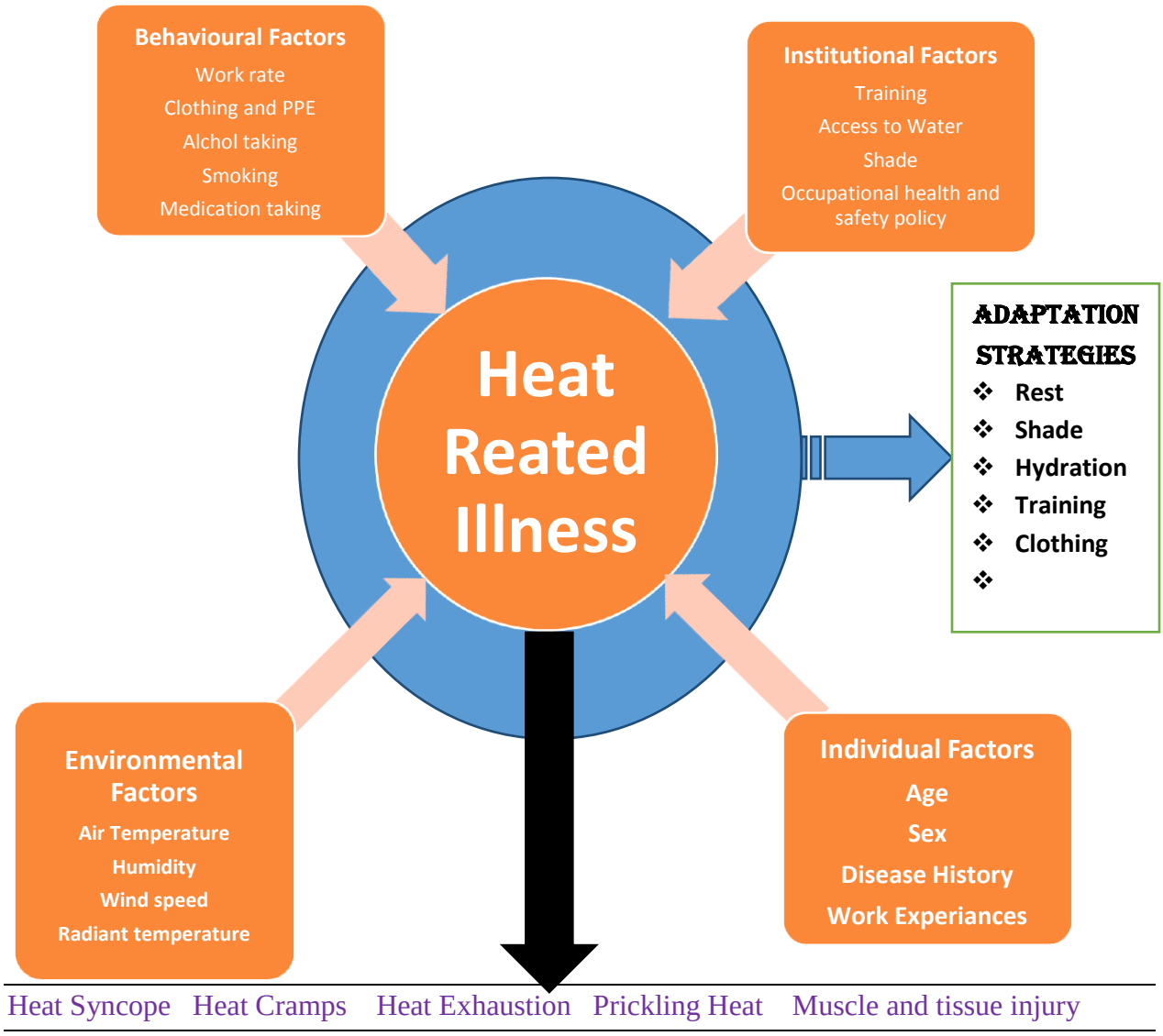


Figure 1 Schematic description showing pathways from heat exposure to direct health impacts

3. OBJECTIVES

3.1. General Objectives

The main aim of this study was to assess prevalence of Heat-Related Illness among outdoor workers and adaptation strategies in Wonji-Shoa and Metahara sugar factories in Ethiopia 2017/2018.

3.2. Specific Objectives

The specific objectives of the study were

1) To determine the prevalence of direct Health Related Illness and level of heat stress among outdoor Sugarcane workers in Wonji-Shoa and Metahara Sugar factories.
2) To assess the current adaptation strategies to cope with hot environment in Wonji-Shoa and Metahara Sugar Factories.

4. METHODOLOGY

4.1. Study Area

Wonji Shoa and Metahara Sugar factories are found in Oromiya Regional State at distance of 112 Km and 200 Km from Addis Ababa respectively. Both sugar factories are large size sugar Estate sites in Ethiopia lies downstream of the Koka dam in the central Rift Valley of Ethiopia in the Awash River basin (50).

Table 1 Meteorological, geographic and work force information in Wonji-Shoa and Metahara sugar factories 2017/2018 Production year.

Metrological data	Annually observed	Wonji Shoa	Metahara
Temperature	Max	27.7 0C	32.35 0C
	Min	12.98 0C	15.46 0C
	Mean	**20.34 0C**	**23.9 0C**
Precipitation	Average RF	831.2 mm	554 mm
Altitude **(m.a.s.l)**		1550	950
Geographic Location		8º31'N and 39º12'E	$8^0$51'N and $39^0$52'E
Annual Production capacity		80,000 tons	115,000 tons
Outdoor workers		1797	3510
Total Concession area		7279.8 hectares	9919 hectares
Year of Commencing production		1954	1970
Month of commencing production for 2017/18		Nov 17, 2017	Nov 18, 2017

Note: RF=rainfall; m.a.s.l= meter above sea level; mm= millimeter; Min=minimum; Max=maximum.

Metrological data were obtained from Ethiopian Sugar Research Center and For other data see ref. #50

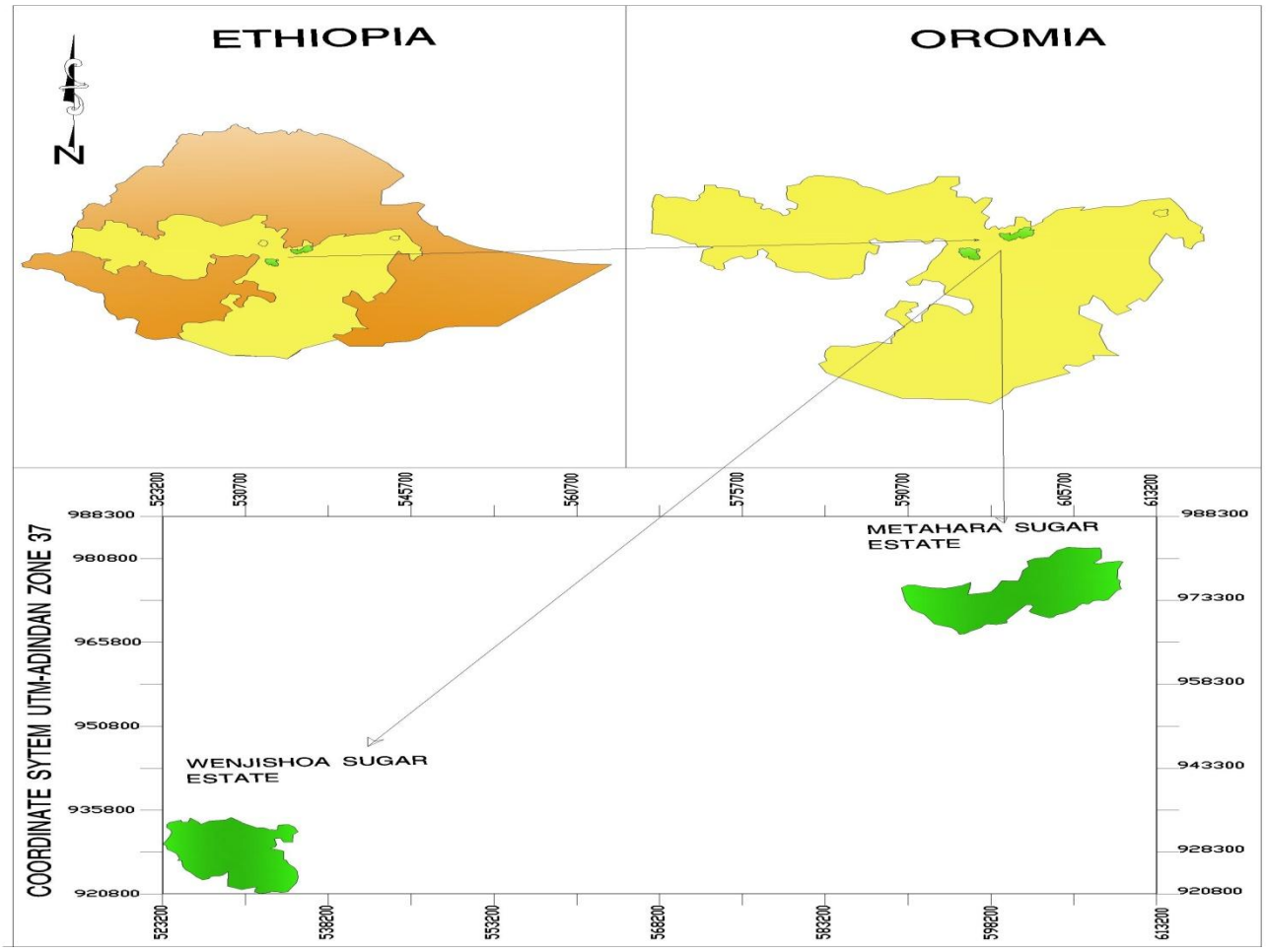


Figure 2 Geographical location map of Wonji-Shoa and Metahara Sugar Estate, 2017/18

4.2. Study Design and Period

Institution based cross-sectional study was conducted from March 25, 2018 to April 30, 2018.

4.3. POPULATIONS

4.3.1. Source population

Outdoor workers working in Wonji shoa and Metehara Sugar factories were the source of population for this study.

4.3.2. Study Population

Sampled sugarcane cutter/collectors were study population for this study.

4.4. Inclusion and Exclusion Criteria

Inclusion criteria: -Workers who had direct involvement in sugarcane cutting and collecting was included.

Exclusion criteria: - Field supervisor, field capo, loading and unloading workers, guard, drivers and others who had not engaged in sugarcane cutting was excluded.

4.5. Sampling Techniques and Sample Size Determination

4.5.1. Sample Size Determination

1. For first objectives, the Sample size was determined employing single population formula with 95% confidence interval formula to estimate a population proportion.

- ✓ Assumptions: Because there is no prior, national or local data in similar setting on the possible health effect of heat stress on sugarcane cutter in sugar factories. The primary Investigator assumes the prevalence of 50 % in order to maximize the sample size. p=q=0.5

$$n = \frac{(z_{\alpha/2})^2 \times pq}{d^2}$$

Where: n = Sample size

d = Margin of error

Z = Level of Confidence

P= Population proportion

q= Degree of accuracy desired

The sample size was determined by directly substituting values for inductions as:-

n=? d=0.05 z= 1.96 (Z^2 = 3.48)

P=0.5 q=0.5

To the formula $\frac{n = Z^{2*}p*q}{d^2}$

$$\frac{(1.96)^2\ (0.5)\ (0.5)}{(0.05)^2}$$

$$= \frac{0.87}{(0.05)^2} \rightarrow \mathbf{\underline{384}}$$

- ♣ 10% of anticipated non-respondent rate was added and the sample size becomes:-
  - ➢ 384 x10% = 38.4

    384+38=**422**

- According to the November 2017 G.C Sugar corporation report, Wonji Shoa Sugar Factory has 1797 workers and Metehara Sugar Factory has 3510 workers.

Total number of worker in both Factory = 1797 + 3510 = **5307**

Therefore, the sample size for each factory becomes;

- For WSSF = 1797*422/5307 = **143**
- For MSF = 3510*422/5307 = **279**

  Accordingly, the **143** and **279** samples were proportionally assigned for WSSF and MSF, respectively. Finally, the study participants of each factory were selected using simple random sampling.

2. For the second objective **6** key informants (Plant Manager, Plant Health safety and Environment expert, and workers representative) from Metehara and Wonji shoa sugar factories were involved. 2017/2018 harvesting year (6 months) weather data, relative humidity and Mean average temperature, was used. This is because 2017/2018 harvesting year was started in November and hence the worker are season, there is no work in summer season.

4.5.2 Selecting sugar factory and Sampling Techniques

Currently, in Ethiopia, there are five sugar factories in production. Considering their year of commencing production to calculate level of heat stress, the researcher wants to study Wonji Shoa and Metahara sugar factories. Both study areas were chosen because of large work force in these two factories compared with other sugarcane factories in Ethiopia. The sample size was distributed proportionally for size (number of workers) of the sugarcane factories.

The worker's Attendance sheet was used as a framework, and then participant was selected by using stratified random sampling. Every (N/n) outdoor agricultural worker was included in the sample. The first worker was selected by lottery method.

4.6. Data collection methods

- For the first objective data was collected using a modified standardized High Occupational Temperature Health and Productivity Suppression (HOTHAPS) questionnaire (51). The questionnaire was focused on collecting the general information,

work profile, and its impacts on health, and coping mechanisms the workers use. The questionnaire also included an elaborate section on self-reported heat-related illnesses symptoms. Any personal remarks or comments of the study participants were also recorded in the comments section of each question.

- For the second objectives, direct observations and exploratory interviews with the Key informant was conducted. A semi-structured open-ended checklist was used to collect information from key informant's interview. The interviews were recorded on checklist format, notes from an observation and supportive photo was taken.
- The 2017/2018 harvesting year, (November 2017 - April, 2018) air temperature and Relative humidity values obtained from Metahara and Wonji Shoa research center were used to calculate WBGT, to determine heat stress level.

4.7. Study variables

4.7.1. Independent variables:-

A. Environmental risk factors

- Air temperature
- Relative humidity
- Radiant heat from the sun
- Air movement

B. Personal risk factors

- Age
- Protective clothing
- Educational status
- Work experience
- Workload
- Disease History

C. Institutional factors

- Presence of Occupational health and safety policy
- Heat related Training

D. Behavioral factors

- Amount of Water drink daily
- Alcohol consumption habit
- Smoking habit

4.7.2. Dependent Variables:-

Heat-related Illness

Adaptive strategies

4.8. Data management

The data was organized and coded and lastly, the data was validated and an appropriate conclusion was drawn from findings.

4.9. Data processing and analysis

- Concerning quantitative data to determine the prevalence of HRI prior to data coding, the collected data was entered into a database using Epidata version 4.2 and was exported. The exported data was cleaned (for any inconsistencies and missing values) and analyzed using SPSS (Statistical Package for Service Solution) version 22.0. Finally, the data was analyzed using descriptive statistics including frequencies and percentages. The range and mean was calculated and appropriate tables and percentage details were displayed.

  For the descriptive data, single proportions like prevalence of heat stress and heat-related health problems was tested for significance using the chi-square test and odds ratio (OR). A standard cutoff of 0.05 were used to interpret the significance of the *p*-values for all analysis.
- Then the data were analyzed using descriptive statistics including frequencies, percentages, and standard deviations. Multivariable logistic regression model was used including all variables with significant association during the univariate analysis to control the potential confounders.
- Meteorological data obtained from Wonji shoa and Metahara research center was captured into Microsoft Excel 2010 spreadsheet following the days of the year (DOY) entry format in order to make it ready for data quality test. Using air temperature and Relative humidity values obtained from Metahara and Wonji Shoa research center an estimation of the WBGT were made considering radiant temperature and wind speed condition as 'moderately sunny' day with 'light winds'(4, 52).

- For qualitative the responses to questions by each individual were recorded on interview forms, and all responses were aggregated and summarized. The investigator then transcribed the data. The translated data was carefully read and divided in to meaningful analytical segments and was coded with descriptive words.

4.10. Data Quality Control

For quantitative data collection tool in order to evaluate clarity of the questionnaire, validity of the instrument and reactions of the respondents to the questionnaire, a pretest was conducted prior to the actual data collection on 10% of the study population, i.e. about **42** workers by the enumerators, in an area different from the study area, but with the similar work behavior and socioeconomic pattern. Prior to data collection, primary investigator make a brief orientation on the questionnaires and how to go for data collection. To avoid biasing information and variables, the questionnaire prepared in the English language was translated into the local native language (Amharic) in order to make it easy to understand and the questionnaire was retranslated to English to check its consistency with original questionnaire.

Concerning qualitative data, Participants were made to give a true answer through explaining the purpose and importance of the study and assuring the confidentiality of the data they are going to provide. Interview and data transcription was done by investigator and obtained data also read carefully and analysis was carried out.

4.11. Ethical Consideration

The study design and the consent process was approved by the ethical clearance committee of the letters written from Addis Ababa University Institutional Research Board (AAU -IRB) to Ethiopian Sugar Corporation. Ethiopian Sugar Corporation write letter to Wonji Shoa and Metehara Sugar Factories to conduct the study and to obtain desired cooperation. Since all the selected respondents are above eighteen years of age, verbal consents were taken from each participant in data collection process. The data collectors expected to inform that miss-understanding & incorrect answer raised by individuals after data collection. Study identification numbers was used instead of participant names and the information collected has kept confidential. The information collected from any participants was not being made available to other participants. The response from all the interviews was de-identified and aggregated into a

report. Data collectors inform as participation is completely voluntary and participants may choose to withdraw at any time and refusal to participate will not impair any existing relationships between the participants and institutions or people involved.

4.12. Dissemination of Results

The final copy of the report with appropriate recommendation will be submitted to Addis Ababa University, School of public health, Department of Preventive Medicine Environmental and Occupational Health Unit. It is hoped that the result of the study will disseminated to Ethiopian Sugar Corporation, Ministry of Health, Ministry of Labour and Social Affairs and other concerned bodies. Finally, effort will be made to publish in national or international journal for dissemination worldwide.

4.13. Operational Definition

Heat Related Illness:- Worker who self-report at least four of the following symptoms: sweating, thirst, Muscle cramps, exhaustion, Fainting, excessive tiredness, weakness/dizziness, headache, nausea/vomiting, prickly heat/rashes, and women developing urinary tract infections (UTI), especially during hot seasons. (52, 53)

Heat syncope: is a transient loss of consciousness resulting from a reduction of cerebral flow preceded by, Characterized by "short duration fainting, headache, dizziness and nausea" symptoms. (20)

Heat Cramps:-Worker who developed painful spasms in limbs and abdominal muscles subjected to intensive work and fatigue while body temperature hardly rises. (20)

Acclimatization - Workers who work for more than six months are considered as acclimatized works (20).

Fainting: - workers who had experienced a brief loss of consciousness sweaty skin, normal body temperature (20).

Heat rash: Worker self-reported symptoms of a red cluster of pimples appear on neck, chest, and elbow considered as heat rasher/heat prickled (2, 20).

Heat exhaustion: - Worker who self-reported the symptoms of a headache, nausea, weakness, Thirst, heavy sweating and increases heartbeat at work this harvesting year are taken as heat exhausted (2, 20).

Adaptation: - adjustment in natural or human systems to a new or changing environment which includes Physiological habituation (acclimatization), Behavioural change, Structural adaptation Public Health interventions and others (56).

Rest – workers who are sitting quietly or with moderate arm movements are taken as on Rest (57).

Light workload – workers who are sitting or standing to control workers or workers performing light hand or arm work (e.g. using a table saw); occasional walking; driving (57).

Moderate workload – workers who are walking about with moderate lifting and pushing or pulling; walking at a moderate pace; e.g. scrubbing in a standing position are classified as Moderate work load(57).

Heavy workload – workers who are on picking and shoveling activities, digging, carrying, pushing/pulling heavy loads; walking at a fast pace; e.g. carpenter sawing by hand (57).

Very Heavy load - workers who are working very intense activity at fast to maximum pace; e.g. shoveling wet sand (57)

5. RESULTS

5.1 Socio-demographic and behavioral characteristics

Out of 422, Four hundred one (401) respondents were participated in this study making the response rate 95%. All respondents were Male. The mean age of the study subjects was 31.59 years. The majority of respondents are being in the age group of 18-27 years (35.2%) and 34-42 (30.4%).

Among the study participants, 261(65.1%) respondents were from Metahara sugar factory and 140(34.9%) were from Wonji shoa sugar factory. Of the participants 278(69.5%) were working in harvesting section and 123 (30.5%) were working in the seed cane preparation section.

The majority of respondents 339(84.5%) had 1-12 years working experience and 291 (72.6%) respondents worked 12 hours per day. Most participants 218 (54.4%) had primary education and only 11(2.7%) participants had College/Higher education. Significant proportion of participants 170 (42.4%) in average drank three liters of water daily.

Majority of the participants, 295 (73.56%) were engaged in very heavy work condition (Table 2).

Table 2 Socio-demographic and behavioral characteristics of the study population 2017/2018

Variables	**Categories**	**All Frequency and percentage (N=401)**	**Metahara Sugar Factory (N=261)**	**Wonji Shoa Sugar Factory (N=140)**
Age	Median Age in years	31.56 (SD=7.86)		
Age group	18-27 years	141 (35.2)	109(41.7)	32(22.85)
	28-33 years	93 (23.2)	61(23.4)	32(22.85)
	34-41 years	122 (30.4)	64(24.6)	58(41.42)
	42-65	45 (11.2)	27(10.3)	18(12.85)
Work section	Harvesting	278 (69.3)	181(69.3)	97(69.2)
	Seed cane Preparation	123 (30.7)	80(30.7)	43(30.7)
Educational Status	Do not attend formal Education	88 (21.9)	51(19.5)	37(26.4)
	Primary (Grade 1-8)	218 (54.4)	139(53.2)	79(56.4)
	Secondary (Grade 9-12)	84 (20.9)	65(24.9)	19(13.5)
	College/higher	11 (2.7)	6(2.2)	5(3.6)
Average Amount of Water Drink daily in liters	1	16 (4.0)	0(0)	16(6.1)
	2	44 (11)	12(8.6)	32(12.3)
	3	170 (42.4)	78(55.7)	92(35.2)
	4	92 (22.9)	32(22.9)	61(22.3)
	5	79 (19.7)	18(12.8)	60(30)
Daily work hour	8 hr.	17(4.2)	8(3.06)	9(6.42)
	9 hr.	34(8.5)	25(9.57)	9(6.42)
	10 hr.	26(6.5)	21(8.04)	5(3.57)
	11 hr.	33(8.2)	33(12.64)	0
	12 hr.	291(72.6)	174(66.66)	117(83.57)
Duration of employment (in years)	1-12 yrs.	339(84.5)	225(86.20)	114(81.42)
	13-24 yrs.	62(15.5)	36(13.79)	26(18.57)
	≥ 25 yrs.	0(0)	0(0)	0(0)
Work load	Light workload	0(0)	0(0)	0(0)

	Moderate workload	11(2.7)	0(0)	11(4.21)
	Heavy workload	95(23.7)	15(10.71)	80(30.65)
	Very Heavy workload	295(73.6)	125(89.28)	170(65.13)
Clothing usually worn at work	Breathable Cotton	175(43.64)	60(42.85)	175(67)
	Thick cotton overall	199(49.62)	67(47.85)	132(50.12)
	Rayon/Nylon	23(5.73)	10(7.14)	13(4.98)
	Other	4 (0.99)	3(3.14)	1(0.33)
Smoking Habit	Currently Smoking	120(29.9)	91(34.86)	29(20.71)
	Currently Non Smoking	236(58.85)	141(54.02)	95(67.85)
	Ex-Smoking	45(11.22)	29(11.11)	16(11.42)
Alcohol Consumption	Currently Drinking	137(34.16)	103(39.46)	34(24.28)
	Currently Non-drinking	211(52.61)	125(47.89)	86(61.42)
	Ex-drinking	53(13.21)	33(12.64)	20(14.28)
Existing Chronic Illness	Diabetes	13(3.2)	3(1.15)	10(7.14)
	Respiratory illness	119 (29.67)	42(16.09)	67(47.85)
	Hypertension	23(5.7)	16(6.13)	1(0.7)
	Other Disease	166(41.1)	120(45.97)	40(28.57)

5.2 Prevalence of Heat-Related Symptoms

The heat related symptoms that most respondents experienced were sweating (98.3%) and thirst (98%) and the least common compliant was Nausea/Vomiting (23.1%). (See table 3)

Table 3 Self-reported prevalence of HRI symptoms among study participants during this harvesting season among Metahara and Wonji shoa sugar Estate, 2018

Symptoms	All prevalence (n=401)	Wonji shoa prevalence (n =140)	Metahara prevalence (n = 261)
Sweating			
Yes	394(98.3)	135(96.42)	259(99.23)
No	7(1.74)	5(3.57)	2(0.07)
Exhaustion			
Yes	385(96.0)	136(97.14)	249(95.40)
No	16(4.0)	4(2.85)	12(4.59)
Tiredness			
Yes	339(84.5)	111(79.28)	228(87.35)
No	62(15.46)	29(20.71)	33(12.64)
Headache			
Yes	243(60.7)	67(47.85)	176(67.43)
No	158(39.40)	73(52.14)	85(32.56)
Dizziness			
Yes	286(71.3)	82(58.57)	204(78.16)
No	115(26.7)	58(41.42)	57(28.39)
Thirst			
Yes	393(98)	139(99.28)	254(97.31)
No	8(2)	1(0.082)	7(2.68)
Nausea/Vomiting			
Yes	93(23.1)	21(15.0)	72(27.58)
No	308(76.80)	119(85.0)	189(72.41)
Increase heartbeat			
Yes	194(48.3)	68(48.57)	126(48.27)
No	207(51.6)	72(51.42)	135(51.72)
Skin, neck and cheat redness			
Yes	132(32.9)	40(28.57)	92(35.24)
No	269(67.08)	100(71.42)	169(64.75)
MSD and Injury			
Yes	103(26.5)	13(9.28)	90(34.48)
No	298(74.31)	128(91.14)	170(65.13)
Muscle Cramps			
Yes	69(17.2)	37(26.42)	32(12.26)
No	332(82.8)	103(73.57)	229(87.73)

Majority of participants 299 (74.6%) experienced four or more of HRI symptoms during this harvesting season, and it was significantly greater in Harvesting 288 (64.9%) than in Seed Cane preparation section 71 (35.1%). In the same way, the prevalence was higher in Metahara 211(80.84%) compared to Wonji shoa 88 (62.85%).

The highest prevalence of heat-related illness complaints among workers when exposed to the heat was heat exhaustion with a prevalence of 376 (93.8%) (Figure 3).

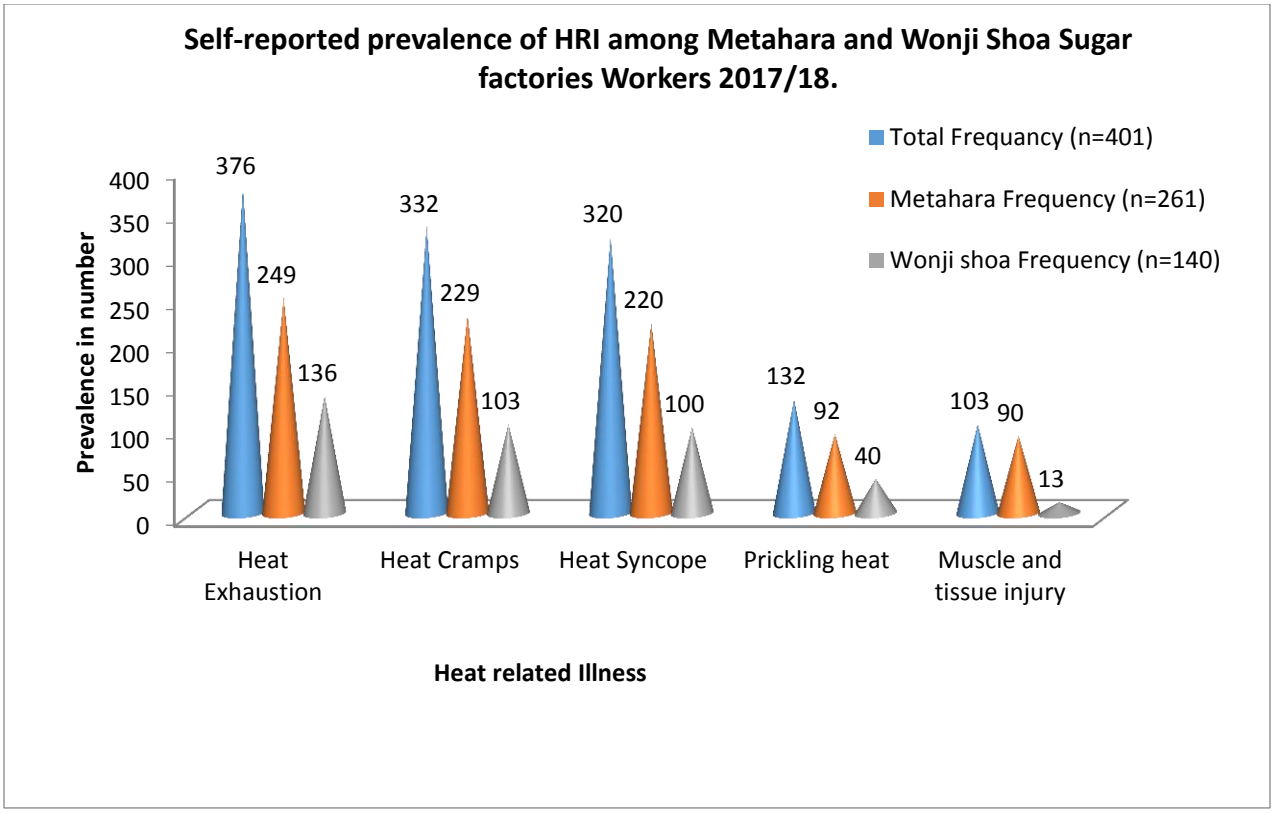


Figure 3 self-reported prevalence of HRI experienced during this harvesting year 2017/2018 Metahara and Wonji Shoa Sugar factories Workers.

5.3 Results of the Logistic Regression Analysis

The results of the bivariate analysis in study participants using the bilateral variable 'presence of Heat stress' as dependent factor and other independent variables are shown in Table 4. The results show that geographic location, Work section, alcohol consumption, educational status and Work type all were significantly associated with risk of developing Heat stress. The detail Bivariate logistic regression information of the respondents is presented in Table 4.

Table 4 Bivariate logistic regression information of the respondents among Wonji shoa and Metahara Sugar factory worker 2018

Variables	**categories**	**Heat Stress**		**COR (95%)**	**P value**
		Yes	No		
Geographic location	Wonji Shoa Metahara	88(29.4) 211(70.6)	52(51) 50(49)	1 2.5 (1.6-4.0)	 0.000 (<0.001)
Work section	Harvesting Seed cane pre.	288(85.20) 71(57.72)	50(14.79) 52(42.27)	1 0.3(0.19-0.48)	 0.000 (<0.001)
Age group	18-27 28-33 34-41 42-65	114(80.85) 27(29.03) 35(28.68) 13(28.88)	27(19.14) 66(70.79) 87(71.31) 32(78.11)	1 0.58(0.3-1.1) 0.56(0.33-1) 0.58(0.27-1.3)	 0.81 0.071 0.169
Educational Status	Didn't attend formal education Primary Secondary Collage/Higher	68(77.27) 114(67.85) 52(70.27) 5(45.45)	20(22.72) 54(32.14) 22(29.72) 6(54.54)	1 0.89(0.5-1.6) 0.83(0.4-1.7 0.25(0.7-0.9)	 0.7 0.6 0.03
Smoking Habit	Non smoking Ex-smoker Smoker	172(72.88) 33(73.33) 94(78.33)	64(27.11) 12(26.66) 26(21.66)	1 1.02 (0.5-2.1) 1.35(0.8-2.3)	 0.95 0.26

Alcohol Consumption	No Ex-Drink Yes	153(72.51) 34(62.96) 112(81.75)	58(27.48) 19(37.03) 25(18.24)	1 0.68(0.36-1.28) 1.7(1-2.88)	 0.23 0.05
Type of Work	Moderate Heavy Very Heavy	5(41.66) 81(68.64) 213(78.59)	7(58.33) 37(31.35) 58(21.41)	1 3(0.9-10.3) 5(1.6-16.8)	 0.07 0.007

To determine independent factors of Heat stress Multivariate analysis was used. All variables (P<=0.05) were entered into a multivariate analysis using an Enter method.

According to the multivariate analysis, being working in Metahara 2.84 times (AOR=2.849 95% CI= 1.694-4.793) more likely associated with risk of Heat stress when compared with Wonji shoa. Working in seed cane preparation is better than working in harvesting section, which means Seed cane preparation workers were 27.4% (AOR=0.274. CI=0.163-0.461) less affected than harvesting preparation Unit. The detail Multivariate Logistic Regression information of the respondents is presented in Table 5.

Table 5 Multivariate logistic regression information of the respondents among Wonji shoa and Metahara Sugar factory worker 2018

Variables	**Categories**	**Heat Stress**		**COR (95%)**	**AOR(95% CI)**	**P value**
		yes	No			
Geographical location	Wonji Shoa Metahara	88(29.4) 211(70.6)	52(51) 50(49)	1 2.5 (1.6-4.0)	 2.849 (1.694-4.793)	 <0.001
Work section	Harvesting Seed cane pre.	288(85.20) 71(57.72)	50(14.79) 52(42.27)	1 0.3(0.19-0.48)	 0.274(0.163-0.461)	 <0.001
Age group	18-27 28-33 34-41 42-65	114(80.85) 27(29.03) 35(28.68) 13(28.88)	27(19.14) 66(70.79) 87(71.31) 32(78.11)	1 0.58(0.3-1.1) 0.56(0.33-1) 0.58(0.27-1.3)	 -- 	 --
Educational Status	Illiterate Primary Secondary	68(77.27) 114(67.85) 52(70.27)	20(22.72) 54(32.14) 22(29.72)	1 0.89(0.5-1.6) 0.83(0.4-1.7	 1.054(0.552-2.014) 0.871(0.398-1.904)	 0.923 0.748

	Collage/Higher	5(45.45)	6(54.54)	0.25(0.7-0.9)	0.447(0.106-1.894)	0.301
Smoking Habit	Non smoking Ex-smoker Smoker	172(72.88) 33(73.33) 94(78.33)	64(27.11) 12(26.66) 26(21.66)	1 1.02 (0.5-2.1) 1.35(0.8-2.3)	--	---
Alcohol Consumption	No Ex-Drink Yes	153(72.51) 34(62.96) 112(81.75)	58(27.48) 19(37.03) 25(18.24)	1 0.68(0.36-1.28) 1.7(1-2.88)	 0.536(0.298-0.963) 0.315(0.144-0.692)	 0.161 0.044
Type of Work	Moderate Heavy Very Heavy	5(41.66) 81(68.64) 213(78.59)	7(58.33) 37(31.35) 58(21.41)	1 3(0.9-10.3) 5(1.6-16.8)	 2.462(0.625-9.697) 4.247(1.103-16.346)	 0.198 0.035

5.4 Heat Stress Level Using Long Term Weather Data

Based on mean average Relative humidity and mean Average temperature Metahara Sugar Estate had high WBGT during March and April, reaching 27 ^{0}C, and relatively low 22 **^{0}C** and 23 **^{0}C** in November and December months (Table 6).

Table 6 Recorded Temperature and Relative Humidity per month in Metahara sugar factories during 2017/2018 harvesting year.

Month	**Temperature in 0c**			**Relative Humidity (%)**			**WBGT**
	Av. Max.Temp	**Av. Min.Temp**	**AVG mean Temp**	**Av. Max. RH**	**Av. Min. RH**	**AVG mean RH**	
Nov.	32.1	12.7	**21.75**	73.9	25	**49.45**	**22**
Dec.	32.8	12.5	**21.5**	82.3	28.9	**55.6**	**23**
January	30.7	14.5	**22.6**	81.8	31.5	**56.65**	**25**
February	31.9	16.2	**24.0**	79	30.0	**54.5**	**24**
March	32.9	17.9	**26.8**	79	28.5	**53.75**	**27**
April	33.7	19.0	**26.75**	79.6	27.0	**53.3**	**27**

Source:- Ethiopian sugar research and development center. Wonji shao, 2018.

For WBGT result, see table in index 1.

In Wonji shoa, the average maximum temperature was highest in February reaching, 21.5°c and November and January months had 56% and 54% average relative humidity, compared with other months. The maximum WBGT was 22 °C **(Table 7).**

Table 7 Recorded Temperature and Relative Humidity per month in Wonji Shoa Sugar Estate during 2017/2018 harvesting year.

Month	**Temperature in 0c**			**Relative Humidity (%)**			**WBGT**
	Average Max. Temp	**Average Min. Temp**	**AVG mean Temp**	**Average Max. RH**	**Average Min. RH**	**Average mean RH**	
Nov.	26.9	11.5	**19.2**	81	31	**56**	**20**
Dec.	25.4	12.6	**19**	83	41	**62**	**21**
January	27.8	12.1	**19.95**	78	30	**54**	**20**
February	29	14	**21.5**	82	31	**56.5**	**22**
March	28.8	13.2	**21**	83	33	**58**	**22**
April	28.3	14.5	**21.4**	89	38	**63.5**	**22**

Source:- Ethiopian sugar research and development center. Wonji shao, 2018. For WBGT result see table in index

In Metahara Sugar factory maximum and minimum monthly WBGT was 27 and 22 ^{0}C, where as in Wonji Sugar factory it is 22 ^{0}C and 20 ^{0}C. The average WBGT in Wonji shoa Sugar factory and Metahara Sugar factory was 21.16 °C and 24.66 °C respectively.

5.5 Findings of Observation and Qualitative

This section covers finding of observation and qualitative study focusing mainly on coping mechanism to reduce heat stress. Some of the coping mechanism used to prevent heat stress mentioned by participants were, water-cooling and hydration, resting, wearing a light cloth and adjusting work condition.

1. Water hydration and cooling system

Majority of respondents recommend their workers to drink water regularly and cool themselves to cope with heat stress. However, they describe, as there is no sufficient water access and water lack quality. One respondent from Metahara Sugar factory express his idea as follow "*Even we recommend our worker to drink water and cool themselves frequently, there is no access to clean water, sometimes the water provided by truck also lacks quality, there is no shower facilities and worker use irrigation water for drinking, washing their clothes and for cooling purposes*".

From the investigator's direct observation, it was seen that there was no access to clean water and cooling facilities, Water at work provided by truck is insufficient. The water container was exposed to sunlight.

Participants from Wonji Shoa Sugar factory respond as they *"Advise worker to drink water regularly, not only when they feel thirsty."*

The respondent from Wonji Shoa Sugar factory also describes cooling and hydration practice as follow *"the worker decide whether to drink water provided at the worksite depend on the amount of water provided daily and whether water appears clean and chemically-treated or not. Based on this because the water provided for worker lack quality as well and it's not usually provided the worker not drink water even when they feel thirsty."*

One respondent from Metahara Sugar factory responds that their worker*s "get home and wet themselves in cold water/take shower at the river."*

From the investigator's direct observation, it was seen that during harvesting workers of Metahara Sugar factory and Wonji shoa Sugar factory take shower at the irrigation canal river.

2. Clothing

Half of the Participants describe that their workers are *"wearing enough clothing" and "using a hat"* to protect themselves from direct sunburns leading HRI. However, half of the participant responds, as their workers are *"not wearing protective clothing" or "not using a hat"* because of wearing personal protective clothing to protect from direct sunburns itself cause overheating and leading workers to HRI.

One participant from Metahara Sugar factory described that when workers are wearing protective clothing to reduce exposures to dust contributes to can result in HRI.

He said that *"Some workers are all covered up including the nose, and being covered up can cause heat illness due to breathing in the hot air."*

From the investigator's direct observation, it was seen that there are workers who are not fully provided personal protective equipment including hat at work.

3. Work condition, Rest/break and shade

Practices to prevent heat illness that were mentioned by workers representatives included instructing workers to stop work when the temperature gets too hot, starting working earlier and asking workers to return in the late afternoon/early evening, providing drinking water and advising workers to wear light clothing for work. Participants also mentioned that they ask workers to protect their skin from the sun.

Some of the study participants mentioned as shade was a major adaptation strategy to cope with heat stress that their workers practice especially for Seed Cane preparation workers. One of the participants expressed this as follows *"workers, mostly rest under the bark of trees planted for wind diversion and lying under the shade of cane to cope and prevent the heat stress."*

The investigator his from observation has also understood that seed cane preparation workers rest under shade.

Majority of Participants reported that as their workers have not take breaks in the shade due to the payment systems for cane cutters, who are paid per tone of cane, harvested. One of the participants expresses his idea, "*workers are responsible to work long hour to finish their quota or to get additional income. Long-term exposure to hot sunlight with insufficient access to water and no shade resulting workers in recurring dehydration".*

The participant from Wonji Shoa Sugar factory responds worker walk long distance to reach their work site, due to lack of enough transportation workers are more exposed to sunlight.

He responds his idea as follows, *"The workers go a long distance to reach work area while walking to home and looking for transportation more they are exposed to HRI."*

Participants also respond as they sometimes limit working hour of the workers to cope with heat stress. However, from participant's response, it is noted that working hours in the sugar industry are long and the majority of workers work for 12 hours per day with only a few breaks.

The participant from Metahara Sugar factory responds, as *"due to high ambient temperature, now workers are unable to harvest the amount of cane required per day for the factory, due to this reason for future factory planed changing the activities to modern technology style, rather than manual harvesting."*

6. DISCUSSION

Workers in harvesting sections had significantly higher HRI symptoms (64.9%) than Seed Cane preparation (35.1%). This might be because harvesting section workers are more exposed to sunlight than seed cane preparation section worker.

This study indicated high prevalence of heat-related illness among workers when exposed to the heat including heat exhaustion (93.8%), heat cramps (82.8%) and heat syncope/fainting (79.8%), followed by low prevalence heat rash/prickly of heat (32.9%) and Muscle and tissue injuries (25.7%). These results are also supported by previous finding where heat exhaustion is the most widely happened in the occupational setting with a prevalence of (84.2%), following by, dehydration (76.8), heat cramps (58.9) heat rashes (36.8%), heat syncope (27.4%) and heat stroke (5.3%) among Palm Oil Mill Workers of Malaysia, where the median WBGT value observed was 29.8°C (61). However, this finding shows lower WBGT, than Palm Oil Mill Workers (61). The difference in WBGT between the two studies might be due to personal behavior and low adaptive capacity practiced to prevent heat related illness. In addition, the difference might be due to WBGT measurement hence WBGT were direct read from instrument in study conducted in Malaysia.

The majority of participants reported drinking three liters water daily 42.4% and only 19.7% of the worker drinks around five-liter water daily. According to, National Institute for Occupational Safety and Health (NIOSH) recommends that employers provide between 5.7 and 9.5 liters of water per day and in severe heat stress conditions all lost fluids should be replenished (up to 1.9 liters of sweat per hour and 12 liters of fluid per day. This indicates that the workers hydrate themselves below of recommended value (31).

The present study indicated that nearly 50% of the worker wear thick Cotton overall. National Institute for Occupational Safety and Health (NIOSH) recommends in the presence of sunshine, the clothing should be light and loosely fitted to the body to better reflect solar radiation and facilitate convective and evaporative heat exchange (31).

Low prevalence of musculoskeletal disorder and injuries are also observed among the seasonal workers of Metahara Sugar factory and Wonji Shoa Sugar factory workers. This finding is consistent with study conducted among sugar factory workers in Iran (44).

WBGT was calculated based on the analysis and comparative measurements of a number of available methods. Lemke and Kjellstrom (15) recommended the method of Liljegren (16) which is calculating level of heat stress for outdoor workers using WBGT in the sun from locally available weather data. In the same manner, WBGT is calculated by the recommended method.

Based on mean average Relative humidity and mean Average temperature Wonji shoa Sugar factory had lower WBGT in almost all months compared to Metahara Sugar factory. This might be the reason for higher prevalence of Heat related illness observed among Metahara Sugar factory compared to Wonji shoa Sugar factory during this harvesting year.

Depending on work load, heat stress management should start when WBGT reaches 18 °C for workers who are not acclimatized, and physical work should be stopped when WBGT is 33 °C or above for those who are acclimatized (17). However there is no organized heat stress management even WBGT reach 27 °C and 22 °C in Metahara Sugar factory and Wonji shoa Sugar factory.

The adaptive strategy practiced was more similar between both study area workers. Both Wonji shoa Sugar factory and Metahara Sugar factory does not have regulations and Occupational Safety and Health Policy addressing heat exposure among outdoor workers. However, OSHA recommends water, rest, and shade for workers working in hot conditions, which is similar with research done by Lam et al, to identify of barriers to the prevention and treatment of heat-related illness in Latino farmworkers (13, 60).

Several participants noted a lack of shade in the harvesting and seed Cane preparation around areas in which they work. Even if, many policies and regulatory provisions are already in place to play roles in the management and control of health impacts of climate change, no policies seem to be in place to connect together increase temperature and workers health. Addition of

workplace shade requirements to regulations should be considered (14). Effective heat exposure warnings and training are needed to be developed that work for a local community.

The assessment has clearly noted there are a number of major constraints in addressing health challenges arise from exposure to high temperature. This finding is in line with research conducted in Maharashtra on living and health conditions of migratory sugarcane harvest workers of Ahmednagar district in. Shortage of PPE, Water, rest shade, training, lack of field occupational health and safety policy that can address outdoor workers, lack of environmental exposure assessment and monitor associated health effects are observable (37).

7. LIMITATIONS

This study has several limitations that should be noted,

1. To determine heat index direct WBGT measurement is more recommended, but due to lack of WBGT instruments, long-term weather data were used to estimate heat index which uses a lot of assumption to calculate WBGT. Real variations of sunshine and wind were not taken into account.
2. All Heat related symptoms data were self-reported and may suffer from recall error.
3. Finally, HRI symptoms are common and general symptoms that are not specific and can be associated with other ailments. However, to increase specificity, participants were asked if they experienced symptoms "while working or spending time outside" in an attempt to specify the event during this harvesting year while working on a hot day.

8. CONCLUSION

The worker exposed to the hot environment and heavy works are at risk of heat-related health illness. Metahara and Wonji Shoa Sugar factories workers had high prevalence of heat related illness. Even if the weather data shows a low risk of heat index, work rate and lack of adequate coping strategies lead workers in high risk of heat stress. Appropriate coping mechanism also needs to be designed for outdoor Sugar Cane whose health is negatively impacted by heat stress.

In addition, research is needed on the development of more effective and cheaper coping and mitigation strategies to protect workers against heat related illness and injury.

9. RECOMMENDATION

From this study, the recommendation is goes to Metahara and Wonji shoa Sugar factories, Ministy of Health, Ministry of Labour and social affairs and the Outdoor Sugar cane workers.

Ministry of Health:-

- Perform environmental exposure assessment associated outdoor work place health effects.

Ministry of Labour and social affairs:-

- Have to set guidelines, regulations, protection programs, and policies on work area Heat stress level.
- Strength health and safety inspection and monitoring programs.
- Have to push Sugar factories in order to recruit flied occupational health and safety officers and have outdoor OSH policy.

Metahara and Wonji shoa Sugar factories:-

- Reduce physical work intensity of their worker and provide rest breaks in cool locations at workplace.
- Implement a standardized system of water break reminders at reasonable intervals on days with high heat/humidity.
- Implement salaried or hourly payment schemes instead of piece rate.
- Provide more breathable suits and appropriate Personal Protective Equipment for workers.
- Provide training for workers how to cope with heat stress at work.
- Factory should change the activities to modern technology style, rather than manual harvesting for future.

Outdoor Worker:-

- Hydrate them self with cold water regularly
- Take break/rest in cool place.

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Annex 1

WBGT monitoring chart and Screening Criteria

In some instances when a WBGT monitoring device is unavailable, a chart like the one shown below can be used to estimate WBGT. It must be noted that these are estimates and are derived only from using temperature and relative humidity and the chart accounts for *full* sunshine and *light* wind conditions.

Wet Bulb Globe Temperature (WBGT) from Temperature and Relative Humidity

Relative Humidity (%) \ Temperature (°C)	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0	15	16	16	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32	32
5	16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	33	33	34	35
10	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	30	30	31	32	32	33	34	35	36	36	37
15	17	17	18	19	19	20	21	21	22	23	23	24	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	39	
20	17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	37	38	39			
25	18	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39					
30	18	19	20	20	21	22	23	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	39							
35	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39								
40	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39									
45	19	20	21	22	23	24	25	26	27	27	28	29	30	32	33	34	35	36	37	38											
50	20	21	22	23	23	24	25	26	27	28	29	30	31	33	34	35	36	37	39												
55	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38													
60	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38														
65	21	22	23	24	25	26	27	28	29	31	32	33	34	36	37	38															
70	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39															
75	22	23	24	25	26	27	29	30	31	32	33	35	36	37	39																
80	23	24	25	26	27	28	29	30	32	33	34	36	37	38																	
85	23	24	25	26	28	29	30	31	32	34	35	37	38	39																	
90	24	25	26	27	28	29	31	32	33	35	36	37	39																		
95	24	25	26	27	29	30	31	33	34	35	37	38																			
100	24	26	27	28	29	31	32	33	35	36	38	39																			

WBGT > 40

Note: This table is compiled from an approximate formula which only depends on temperature and humidity. The formula is valid for full sunshine and a light wind

Figure 4 Wet Bulb Globe Temperature (WBGT) from Temperature and Relative humidity.
Ref. 17, 6

Screening Criteria

Table 8 WBGT reference values in relation to physical work intensity and acclimatization.

Work intensity	WBGT Reference value in 0C	
	Acclimatized person	Non Acclimatized person
Resting	33	32
Low	30	29
Moderate	28	26
Heavy	25 (26) *	22 (23)*
Very Heavy	23 (25) *	18 (20)*

*Values in brackets refer to sensible air movement; values without brackets refer to no sensible air movement
Ref. 17,6

Annex 2

Information sheet for participants in the study in Ethiopian sugar factory

Assessment of the prevalence of heat related illness and heat stress level among outdoor Sugar Factories Workers in Ethiopia

Study Aims.

The study is part of a program of research that is looking at the effect of increasing temperature on health and people's ability to do work. The assessment of the prevalence of heat related illness and heat stress level among outdoor Sugar Factories Workers in Ethiopia is not well known so I hope to contribute to that body of knowledge. I am interested in determining whether two pioneer sugar industries consider the effects of heat to be of importance. How they identify heat stress at work and identify any health effects from working in the heat. Looking at how workplaces manage heat and minimize occupational exposure during hot environmental conditions.

Activities

The study involves collecting climate data i.e temperature Sugar research center to get an idea of the climate of which workers are exposed to. Personal interviews with informants from two industry and workers exposed to heat will be collected. Each interview will take 15-20 minutes and is fully voluntary with participants within these workplaces.

Participation

Participation, as mentioned above is completely voluntary and participants may choose to withdraw at any time. If participants do withdraw any notes or records with the participant's information will be destroyed. Refusal to participate will not impair any existing relationships between the participants and institutions or people involved.

Use of information

Confidentiality is one of the main priorities. The information collected from any participants will not be made available to other participants. The response from all the interviews will be de-identified and aggregated into a report. Your organization's idea on heat stress and workplace issues will be respectfully and accurately portrayed. There will also be a draft of the paper sent out to your organization for proofing before the final document is presented. Personal identifying information (*audio-tapes, photograph*] will be destroyed at the conclusion of the project.

Questions

If you have any queries, questions or concerns about the research please feel free to contact Teklu Hailu on 0920 81 1976 phone number, email tekluhailu82@gmail.com

Consent form for participants

Assessment of the prevalence of heat related illness and heat stress level among outdoor Sugar Factories Workers in Ethiopia

I have read the Information Sheet concerning this thesis and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the thesis is entirely voluntary
2. I am free to withdraw from the thesis at any time without any disadvantage
3. Personal identifying information (audio-tapes, photograph) will be destroyed at the conclusion of the thesis work but any raw data on which the results of the project depend will be retained in secure storage for at least five years
4. This research involves an open-questioning technique. The general line of questioning includes heat exposure and increase temperature within a workplace. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.

I agree to take part in this research:

....

(Signature of participant) (Date)

……

(Participants contact information: phone number and/or email)

Quantitative Questionnaire

1. ID No:
2. Name of the interviewer:
3. Date of interview:
4. Code of the industry

Part 1 General information about person interviewed

Serial number	Question	Response	Go to
101	Age		
102	Age group	1. 20-30 2. 30-40 3. 40-50 4. 50 and above	
103	Sex	1. Male 2. Female	
104	Education	1. Do not attend formal education 2. Primary 3. Secondary 4. Higher /college/ 5. University and above	
105	Designation	1. Worker 2. Supervisory 3. Manager	
106	Smoking	1. Smoker 2. Non-Smoker 3. Ex-smoker	
107	Consuming alcohol	1. Yes 2. No 3. Ex	
108	Any existing illness	1. Diabetes 2. Hypertension 3. Respiratory illness, specify _____ 4. Others, specify_____	
Part 2 Questions concerning the type of work			
201	Type of work:	1. Light 2. Moderate 3. Heavy	

		4. Very Heavy	
202	What were your previous job and where (relating to temp)?	_____	
203	How long you are employed here?	_____years/months (more than 6months means acclimatized)	
204	How many hours per day do you usually work excluding regular break timings?	_____	
205	When and how long are the regular breaks?	_____	
206	Do you work near a direct heat source(naked flame/hot air/outdoors/radiant heat)	1. Yes 2. No	
207	Is the place you work well-ventilated?	1.Yes 2. No	
208	Do you have additional breaks during hot season?	1. Yes 2. No	
209	If yes for question ,	mention no. of hours/minutes_____	
210	Describe the work that you do	_____	
Part 3 Questions in relation to heat exposure at work			
301	Are you comfortable with the workplace temperature?	1. Yes 2. No	
302	How many months do you feel hot /uncomfortably hot in this workplace? a.	1. 1-3 months 2. 4-6 months 3. 7-9 months 4. 9-12 months 5. Never	
303	Is sufficient water and showers available at all times when you need it?	1. Yes 2. No	
304	During hot season how much water you drink daily,	_____	
305	Do you take any traditional special diet to cope with the heat	1. Yes 2. No	
306	If yes for question 308 please specify	_____	
Part 4 Questions concerning impacts of temperature on health			
401	What symptoms do you face during this harvesting year	1. Sweating☐ Yes ☐ No 2. Exhaustion☐ Yes ☐ No	

	while working or spending time outside?	3. Thirst ☐ Yes ☐ No 4. muscle cramps ☐Yes ☐No 5. Tiredness/weakness ☐Yes ☐No 6. dizziness ☐Yes ☐No 7. headache ☐Yes ☐No 8. nausea or vomiting ☐Yes ☐No 9. fainting ☐Yes ☐ No 10. increase heart beat☐Yes ☐ No 11. skin, chest, and neck redness/☐Yes ☐ No 12. Others_____	
405	To achieve production target or complete do you have to work extra hours?	1. Yes 2. No	
Part 5 Questions concerning impacts of clothing on heat stress			
501	Dress material of the workers	1. Breathable cotton 2. Thick cotton overall 3. Rayon/Nylon 4. Plastic PPE 5. Others_____	
502	Do you feel hotter with uniform/ Does the Dress Material increase heat stress?	1. Sure 2. Maybe 3. Not sure 4. No, not at all	
503	Have you taken any training concerning Heat stress?	1. Yes 2. No	
504	If yes when?	_____	

Questions concerning coping mechanisms key informants

S.no	Question	Response
601	What do you do to reduce heat stress level?	
602	If you or your worker feels unwell from HRI how do you/they cope with this?	
603	What do you recommend to cope with heat stress level	

Amharic Version Questioner

አዲስ አበባ ዩኒቨርሲቲ
ጤና ሳይንስ ኮሌጅ
የሕብረተሰብ ጤና ትምህርት ክፍል

በኢትዮጵያ በሉትከቤት ወጭየ ሚሰሩ የስኳር ፋብሪካ ሰራተኞች ላይ በመቅት ማጠን ምክንያት የ ሚመጠ ህመም ስርጭት እና የ መቅት ማጠን ለ ማወቅ የ ዳሰሳ ጥናት ::

መግቢያ
ጤና ይስጥልኝ፡ ስሜ _____ እባላለሁ የመጣሁት አቶ ተክሉ ኃይሉ የተባሉት ለ ሁለተኛ ድግሪ መመረቂያ የሚሆን ጥናታዊ ጽሁፍ በኢትዮጵያ በሉትከቤት ዉጭ የሚሰሩ የስኳር ፋብሪካ ሰራተኞች ላይ በመቀት መጠን ምክንያት የሚመጠ ህመም ስርጭት እና የመቀት መጠን ለማወቅ የዳሰሳ ጥናት መረጃ ለመሰብሰብ ነው። ይህ ለመሰራት ደግሞ በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ትምህርት ክፍል ፍቃድ ኣግኝተዋል።

የጥናቱ አላማ፡
ይህ ጥናት የመቀት መጨመር በሰዉ ልጅ ጤና እና የስራ ብቃት ላይ የሚያመጣ ጉዳት ለመለየት/ለማወቅ ተብሎ እየተሰራ ያለ ነዉ። በአሁኑ ሰዓት የመቀት መጨመር በተለይ የሸንኖራ ቆራኞች ሰራተኛ ጤና ላይ ሚያስከትል ተጽኖ ተለይቶ አይታወቁም። እኔም ይህንን በመረዳት በዘርፉ ያለዉን የእዉቀት ቀዳዳ ለመመላት ይህን ጥናት ለማድረግ ተነሳስቻለሁ።
በዚህም መሰረት በሀገራችን አንጋፋ የስኳር ፋብሪካዎች ላይ የችግሩን መጠን ለማጥናት አቅጃለዉ፤ ይህም እንዴት ድርጅቱ ችግሩን እንደሚቋቋም ፤የችግሩ ስፋት እስከ ምን እንደ ሆነ ለመረዳት ነዉ። በተጨማሪም እንዴት እየተከላለሉ ነዉ፤ አደጋዉን እንዴት እየቀነሱ ነዉ ለምለዉ ጥያቄ መልስ ለማግኘት ነዉ።

የምሰሩ ስራዎች፡
ይህ ጥናት የሰራተኛ ተጋላጭነትን መረጃን ለማወቅ የአየር ሁኔታ መረጃዎችን ከኢትዮጵያ ብሄራዊ ሜትሮሎጅ ኤጀንስ መሰብሰብን ያካትታል። በሁለቱም ፋብሪካዎች በመቀት ተጋላጭ ከሆኑት ሰራተኞች የሰራተኞች የግለሰብ መረጃ ይበበሰባል። ከእያንዳንዱ ሰራተኛ የግል መረጀ እና አስፈላጊ ቃለመጠየቅ ለማከናወን በአማካኝ ከ15-20 ደቂቃ ሊወሰወድ ይችላል። መረጃ መሰብሰብ ሙሉ በሙሉ በፈቃደኝነት ላይ የተመሰረተ ነዉ።

በጥናቱ ላይ መሳተፊ የምችሉ.
ከላይ ለመግለጥእንደተሞከረዉ ተሳትፎ ሙሉ በሙሉ በፈቃደኝነት ላይ የተመሰረተ ነዉ። ማንም ሰዉ በፈለገ ጊዜ ማቋረጥ ይችላል፤ በምያቀዋርጥ ሰዓተ ላይ ግን መረጃዉ አይያዝም፤የጥናቱ አካል አይሆንም። በጥናቱ ላይ አለመሳተፊ ምንም አይነተ ችግር ሰራተኛዉ ላይ አያመጣም።

የመረጃ አጠቃቀም
ይህ መረጃ ለመሰብሰብ የፋብሪካዉን ሃላፊ ያስፈቀድን ሲሆን እርስዎ በፈቃደኝነት ላይ በተመሰረተ የሚሰጡኝ መረጃ ሚስጢራዊነቱ የተጠበቀ እና ለ ጥናቱ ብቻ የሚውል ነው። የግል መረጃዎችን የሚያጸባሩቁ ይህ ጥናት እንዳለቀ እንደሚሰረዙ ሆኖ ነገር ግን ጥሬ ሀቆች የጥናቱን ማለቁ ተከትለዉ ብያንስ እስከ 5 አመት እንደሚያገለግሉ ስለዚ ፍቃደኛ ከሆኑ አንድ አንድ ከጤና ጋር የተያያዙ መረጃዎች ከ 15 ደቂቃ ያልበለጠ እጠይቅዎታለሁ።

ጥያቄ ከለዎት፡
ማንኛዉም ሰዉ በመጠየቁ ዙሪያ ጥያቄ ከለዎ አልያ ተጨማሪ ማብራሪያ ብያስፈልጎ ተክሉ ኃይሉ ብሎ በስ ቁ 0920 81 19 76 ወይም በኢሜል አድራሻ tekluhailu82@gmail.com በማንንዉም ጊዜ መጠየቅ ይችላሉ።

ለተሳታፊዎች የስምማት ሰነድ

ጤና ይስጥልኝ፡ ስሜ _____ እባላለሁ የመጣሁት አቶ ተክሉ ኃይሉ የተባሉት ለ ሁለተኛ ድግሪ መመረቂያ የሚሆን ጥናታዊ ጽሁፍ በኢትዮጵያ በሉትከቤት ዉጭ የሚሰሩ የስኳር ፋብሪካ ሰራተኞች ላይ በመሞቀት መጠን ምክንያት የሚመጠ ህመም ስርጭት እና የመሞቀት መጠን ለማወቅ የዳሰሳ ጥናት መረጃ ለመሰብሰብ በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ትምህርት ክፍል ፍቃድ ኣግኝተዋል። መረጃዉ የሚሰበሰበው ከወንጂ ሸዋና መተሃራ ስኳር ፋብሪካ ሰራተኞች ላይ ነው። እርስዎ ስኳር ፋብሪካ ሰራተኛ በመሆኖ በእጣ በጥናቱ ላይ ተሳታፊ ሁነዋል። ይህ መረጃ ለመሰብሰብ የፋብሪካዉን ሃላፊ ያስፈቀድን ሲሆን እርስዎ በፈቃደኝነት ላይ በተመሰረተ የሚሰጡኝ መረጃ ሚስጢራዊነቱ የተጠበቀ እና ለ ጥናቱ ብቻ የሚውል ነው። የግል መረጃዎችን የሚያጸባሩቁ ይህ ጥናት እንዳለቀ እንደሚሰረዙ ሆኖ ነገር ግን ጥሬ ሀቆች የጥናቱን ማለቁ ተከትለዉ ብያንስ እስከ 5 አመት ልቀመጡ ይችላሉ ስለዚ ፍቃደኛ ከሆኑ አንድ አንድ ከጤና ጋር የተያያዙ መረጃዎች ከ 15 —20 ደቂቃ ላልበለጠ ጊዜ እጠይቅዎታለሁ። ጥናቱ ላይ ለመሳተፍ በፍቃደኝነት ከሆኑ ስጠይቅዎት በመሐል መጠይቅ፤ ብሎም ማስቆም ይችላሉ። እርስዎ በጥናቱ ላይ ስለተሳተፉ የሚደርስብዎት ችግር የለም። እስከ አሁን ከነገርኩዎት ወይም ጥናቱ ላይ በተመለከተ ሊብራራልዎት የሚፈልጉት አለ?
ይህንን ጥናት አስመልክቶ የተዘጋጀን የመረጃ አንብቤ ስለ ምን እንደሆነ ተረድቻለሁ። ያሉኝ ጥያቄዎቼም ተመልሰዉልኛል።መጠየቅ ያለብኝ ጉዳይ ካለም በየትኛዉም ጊዜ ወደ ፊት መጠየቅ እንደምችል ተረድቻለሁ።

አሁን ጥናቱ ላይ ለመሳተፍ ፍቃደኛ ኖት? አዎ አደለሁም

የተጠየቂ ውስም----------ፊርማ----------ቀን----------ስ.ቁ----------

የጠያቂ ውስም----------ፊርማ----------ቀን----------ስ.ቁ----------

ጥናቱ ላይ ስለተሳተፍ አመሰግናለሁ

እዝል 1 መጠየቅ፤

1. የመታወቂያ ቁጥር፡
2. መጠየቁን የሞላ ስም፡
3. የተጠየቀበት ቀን፡
4. የፋብሪካዉ ስም/ኮድ፡

ክፍል 1 የተሳታፊዎች ጥቅል መረጃ መተመለከተ::

ተ.ቁ	ጥያቄ	መልስ	ወደ....ሂድ
101	ዕድሜ	----------	
102	የእድሜ ክልል	1. ከ20-30 / 2. ከ30-40 3. ከ40-50 4. 50 እና በላይ	
103	ጸታ	1. ወንድ 2. ሴት	
104	የትምህርት ደረጃ:	1. ያልተማረ 2. የመጀመሪያ ደረጃ ት/ት 3. ሁለተኛ ደረጃ 4. ኮሌጅ 5. ዩንቨርሲቲያ ከዚያ በላይ	
105	የስራ መደብ:	1. ሰራተኛ 2. ተዎጣጣሪ 3. ሃላፊ	
106	የማጨስ ባህሪይ:	1. አጫሳለሁ 2. አላጨስም 3. ድሮ አጨስ ነበር	
107	አልኮል የመዉሰድ ሁኔታ/የመጠጥ ባህሪዎ:	1. እጠጣለሁ 2. አልጠጣም 3. ድሮ እጠጣ ነበር	
108	የጤንነትዎ ሁኔታ፣ ምን አይነት ህመም አለቦት	1. ስኳር ህመም 2. የደም ግፊት ህመም 3. የማስተንፈሻ አካላት ህመም ግልጽ----------, 4. ሌላ ህመም ከለቦት ይግለጹ፡----------	
<u>ክፍል 2 የስራ አይንትን የሚመለከት ጥያቄዎች</u>			
201	የስራ አይነት:	1. ቀላል 2. መካከለኛ 3. ከባድ 4. በጣም ከባድ	
202	የቀድሞ ስራ ምን ነበር፤ ስራ ቦታስ የሙቃት ሁኔታዉስ ?	_____	
203	እዚህ ድርጅት ከተቀጠሩ ምን ያክል ጊዜ ሆነክ?	_____ አመት/ወር (ከስድስት ወር በላይ ከሆነ ተላምዷል ማለተ ነዉ)	
204	መደበኛ የእረፍት ጊዜዎን ሳይጨምር በቀን ዉስጥ ለምን ያክል ጊዜ	_____	

	ታርታለህ?		
205	መቼ እና ለምን ያክል ጊዜ በመደበኛነት ታርፋለክ?	_____	
206	በምትሰራበት ቦታ ቀጥታ የሙቀት ምንጭ አለ(እሳት/ወባቅ አየር/ቀጥታ ፀሃይ ወዘተ)	1. አዎ 2. የለም	
207	የምትሰራበት ቦታ በደንብ የተናፍሷል/በአየር ተሳፍሷል?	1. አዎ 2. የለም	
208	በሙቀታማ ወቅት ተጨማሪ የእረፍት ጊዜ አለክ?	1. አዎ 2. የለም	
209	ለጥያቄ ቁ 208 መልሶ አዎ ከሆነ ለምን ያክል ሰዓት/ ደቂቃ ነዉ	_____	
210	የምትሰራዉን ስራ ግለጽ እስክ፤	_____	
	<u>ክፍል 3 ለሙቀት መጋለጥን መሰረት ያደረጉ ጥያቄዎች</u>		
301	በስራ ቦታክ ያለዉ የአየር ሁኔታ ለአንተ አምች ነዉ?	1. አዎ 2. አይደለም	
302	በስራ ቦታህ በአመት ዉስጥ ለምን ያክል ጊዜ ምቾት ሳይሰማክ ታሳልፋለክ?	1. ለ1-3 ወራት 2. ለ4-6 ወራት 3. ለ7-9 ወራት 4. ለ9-12 ወራት 5. ምንም ጊዜ ሙቀት አይሰማኝም	
303	አንተ በምትፈለግበት ጊዜ በቂ ዉሃ እና ሻወር ታገኛለክ?	1. አዎ 2. የለም	
304	በሙቀታማ ወቅት ምን ያክል ዉሃ በቀን ትጠጣለክ?	_____ሊትር/ብር ጭቆ	
305	የሙቀት ችግርን ለመቋቋም ለየት ያለ የምትወስደዉ ባህላዊ ምግብ አለ?	1. አዎ 2. የለም	
306	የሙቀት ችግርን ለመቋቋም ምን አይነት ባህላዊ/ሌላ መንገድ ይጠቀማሉ?	_____ _____	
	<u>ክፍል 4 የሙቃት ተጽኖ በጤና ለይ የሚያስከትል ችግር የተመለከቱ ጥያቄዎች</u>		

401	በዚህ ምርተ ዘመን በሙቀታማ ወቁት ምን አይነት ስሜት/ህመም/ምልክት/ ይሰማካል?	1. ማላብ □1 አዎ / □2 የለም 2. አቅም ማነስ□1 አዎ / □2 የለም 3. የዉሃ ጥም □1 አዎ / □2 የለም 5. የጡንቻ ማሸማቀቅ □1 አዎ / □2 የለም 6. ከፍተኛ ድካም □1 አዎ / □2 የለም 7. ራስ ማዞር□1 አዎ / □2 የለም 8. የራስ ምታት □1 አዎ / □2 የለም 9. ማቅለሽለሽ/ማስመለስ □1 አዎ / □2 የለም 10. ራስን መሳት □1 አዎ / □2 የለም 11. የልብ ምት መፍጠን □1 አዎ / □2 የለም 12. የቆዳ፤አንገት፤ደረት ሽፍታ □1 አዎ / □2 የለም 13. ሌላ ከለ ይግለጹ_____	
402	የምርት መጠን እቅድ ለማሳካት አልያም ተጨማሪ ክፍያ ለማግኘት ተጨማሪ ሰዓት ይሰራሉ?	1. አዎ 2. የለም	
	<u>ክፍል 5 የስራ ልብስ ተጽኖ እና የሙቀት ችግርን አስመልክተዉ የተጠየቁ ጥያቄዎች</u>		
501	የሰራተኞች የስራ ልብስ ምን አይነት ነዉ	1. ካክ ጥጥ ልበስ 2. ሙሉ ወፈራም ልብስ 3. የናይለን ጨርቅ /ሀር መሳይ ልብስ 4. ፒላስቲክ መከላከያ 5. ሌላ አይነት ከሆነ ግለጽ_____	
502	የስራ ጋወን በመጠቀማችሁ በስራ ቦታ ሙቀት ይጨምርባቸዋል/ የስራ ጋወን መልበስ እንዲሞቃችሁ ያደርጋል	1. በትክክል 2. ሊሆን ይችላል 3. እርግጠኛ አይደለሁም 4. አያደርገም	
503	የሙቃት ተጽኖ በጤና ለይ የሚያስከትል ችግር አስተመልክቶ ስልጠና/የግንዛቤ ማስጨበጫ ወስዶ ያቃሉ	1. አዎ 2. የለም	
504	መች ነዉ የወሰዱ	_____	

ክፍል *2፡*

ሙቀትን ለመከላከል የምንጠቀምበት ሂደቶች ጋር በተያያዘ ያሉ ጥያቄዎች። ለተመረጡ ሰዎች ብቻ

ተ.ቁ	ጥያቄ	መልስ
601	በሙቀት ምክኒያት ደህንነት የማይሰማዎት ከሆነ አልያም የሙቀት ጭንቅ ስያጋጥም መቀትን ለመቀነስ ምን ያደርጋሉ	
602	ሰራተኞች በሙቀት ምክኒያት ደህንነት/ምቾት የማይሰማቸዉ ከሆነ መቀትን በስራ ቦታ እንዴት ይቋቋማሉ?	
603	የመቀት ችግርን ለመቋቋም ምን አይነት ምን ብደረግ ይመክራሉ?	

Curriculum Vitae

Mr. Teklu Hailu Reta

- **Address**:

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  Email: tekluhailu46@yahoo.com tekluhailu82@gmail.com

- **Qualifications**:

  July 2013: B.Sc.in Environmental Health (with distinction), College of Public Health and Medical Sciences, Jimma University, Jimma, Ethiopia

- **Employment**:

1. **Feb 2016 –now**
   - ✓ Addis Ababa Office Kirkos sub city, Food, medicine and health care administration and control authority of Ethiopia
   - ✓ Position held: **Food, Health, Health related Organization and Industries Environmental Health Quality Assurance Expert.**
2. **May 2016 –January 2017**
   - ✓ **Minaye Packaging PLC**
   - ✓ **Position held**: **Environmental, Health and Safety Expert**
3. **Feb 2014 –April 2016**
   - ❖ **Addis Ababa Office Kirkos sub city woreda 8, Food, medicine and health care administration and control authority of Ethiopia**
   - ❖ Position held: **Food, Health, Health related Organization and Industries Environmental Health Quality Assurance and Inspection Core Process Coordinator.**
4. **July 2013 - Feb 2014**
   - ➢ **Sheka Town Health Unit, SNNP Regional State, Ethiopia**
   - ➢ **Position held**: **Environmental Health Officer and Heath Extension worker coordinator.**

- **Consultancy Service**
  - ❖ **Certified Consultant on Environmental Impact Assessment as Environmental health Expert, Waste Management Expert and Gas Emission control Expert from FDRE Ministry of Environment, Forest and Climate Change.**
  - ❖ **HSE, Hygiene and Sanitation Consultant in different Bottled water manufacturing, Candy manufacturing, plastic and PP bag manufacturing, packaging industries and other manufacturing sectors.**

- **Other trainings**
  - Certified on DANA peer education programs, organized by Jimma University HIV/AIDS prevention and control office with integrating to international NGOs
  - Trained on Community led total sanitation (CLTS), WASH, Children's Hygiene and Sanitation training (CHAST) and participatory hygiene and sanitation transformation (PHAST) organized by Addis Ababa health office, FMHACA and other NGO.
  - Certified **on BS OHSAS 18000:2007 Occupational health and safety management system, organized by Ethiopian Standards Agency.**
  - **Trained and Certified on QMS and FSMS, of ISO 9001:2015 and 22000:2015.**
  - Project monitoring and Evaluation
  - Onchocerciasis elimination in collaboration with Carter Center
- **Publications**
  - Kaliyaperumal Karunamoorthi and **Teklu Hailu** (2014).Insect repellent plants traditional usage practices in the Ethiopian malaria epidemic-prone setting: an ethnobotanical survey, *Journal of Ethnobiology and Ethnomedicine*, 10:22. doi:10.1186/1746-4269-10-22
- **Researches**

- TekluHailu (2013). Insecticidal Activity of *TagetesErecta* against the Bed Bug,*CimexLectularius. Unpublished research thesis.*
- Teklu Hailu and Fanose Bayu (2015). Water handling practices and bacteriological load evaluation in households of Addis ketema woreda 04 residents: Case study for world water day.

- **Other skills**:
  - **Language proficiency**: Can read write and speak **English, Amharic and Afan Oromo** very well
  - **Knowledge of Basic Computer skills** like Office Word, Excel, PowerPoint, publisher, Access, SPSS, Java, and Outlook