2015-10-30

# Prevalence of Hypertension and Associated Risk Factors among Maasai Communities in Simanjiro, Tanzania

Mandha, Juliana

Archives of Current Research International

*Archives of Current Research International*
*2(2): 96-108, 2015, Article no.ACRI.2015.010*
*ISSN: 2454-7077*

**SCIENCEDOMAIN** *international*
www.sciencedomain.org

# Prevalence of Hypertension and Associated Risk Factors among Maasai Communities in Simanjiro, Tanzania

**Juliana Mandha[1], Joram Buza[2], Neema Kassimu[1] and Pammla Petrucka[3*]**

*[1]Department of Food and Nutritional Sciences, Nelson Mandela African Institute of Science and Technology, School of Life Sciences and Bioengineering, Arusha, Tanzania.*
*[2]School of Life Sciences and Bioengineering, Nelson Mandela African Institute of Science and Technology, Arusha, Tanzania.*
*[3]University of Saskatchewan, College of Nursing, Regina, Saskatchewan, Canada.*

***Authors' contributions***

*This work was carried out in collaboration between all authors. Author JM co-designed the study, conducted the data collection and initial analysis, and wrote the first draft of the manuscript. Authors JB and NK reviewed all aspects of the project protocols, assisted with the data analysis, and reviewed all data management and visualization. Author PP provided advice on all phases of the project, reviewed all data analysis and assisted with the data visualization and dissemination including all stages of this article. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/ACRI/2015/22353
Editor(s):
(1) Jack Wong, Department of Cardiovascular Sciences, Institute for Academic Medicine, Houston Methodist Research Institute, USA And Department of Cardiothoracic Surgery, Weill Cornell Medical College of Cornell University, USA.
Reviewers:
(1) Pietro Scicchitano, Hospital "F. Perinei", Italy.
(2) Abiodun M. Adeoye, University of Ibadan, Nigeria.
Complete Peer review History: http://sciencedomain.org/review-history/12048

***Original Research Article***

***Received 29th September 2015***
***Accepted 17th October 2015***
***Published 30th October 2015***

## ABSTRACT

**Aims:** This study was conducted within a rural pastoral community of Maasai in Simanjiro District of Tanzania to determine prevalence of hypertension and its determinants.
**Study Design:** This study was a population based cross-sectional design.
**Place and Duration of Study:** This study was conducted with Maasai pastoral communities in Simanjiro District of Tanzania in mid-2015.
**Methodology:** The study included 561 Maasai participants (175 males and 386 females). Consenting adults (≥ 25 years) were interviewed using the World Health Organization STEPWISE survey instrument, which examined and tested for hypertension related indicators. The average

**Corresponding author: Email: pammla.petrucka@usask.ca;*

age (years) of the participants was 39±13.9. Most of the respondents (46.9%) were in the age group of 25-34 years.

**Results:** The prevalence for hypertension within this sub-population was 21.3%, 95% CI [18,25]. Systolic blood pressure was significantly ($p<0.05$) associated with diastolic blood pressure, heart rate, weight, height, body mass index, waist circumference, abdominal obesity, history of raised blood glucose, fruit servings per day, main work, and vigorous work done. The majority (96.26%) of Maasai participants were physically active, with those in the 24-34 year age group having higher metabolic equivalents (10563.92±7552) than the 65+ group (4852.09±5835.272) ($p< 0.0001$). Hypertensive participants showed lower metabolic equivalents (179.2±107.7) than their non-hypertensive counterparts (297.6±53.1). The majority of participants were within normal weights for both men (57.1%) and women (63.2%), but body mass index differed according to age groupings ($p = 0.0454$) and hypertensive status ($p=0.0063$). A small proportion (0.7%) of participants had a history of raised blood glucose; however, hypertensive participants had significantly ($p=0.0136$) higher blood glucose levels. Fruits and vegetable intake was similar among hypertensive and non-hypertensive participants; however, there was a significant difference across age groups ($p=0.0085$). The awareness rate amongst participants of hypertension was low at 17.5%.

**Conclusion:** Given this key finding that hypertension prevalence among the rural Maasai community was found to be high and awareness rate was low, it is imperative to put strategies in place for primary prevention and targeted treatment of hypertension directed at this sub-population.

*Keywords: Hypertension; Maasai; Rural Tanzania; chronicity awareness; WHO STEPwise™.*

## 1. INTRODUCTION

More than 36 million people die each year due to non-communicable diseases (NCDs); moreover, 80% of these deaths occur in developing countries [1]. In Tanzania, NCDs accounted for 27% of all deaths in 2011 of which 12% were cardiovascular related diseases [2]. The wide prevalence of communicable diseases cause a "double burden" [3]. For instance, a high prevalence of hypertension and diabetes was found in HIV patients in Tanzania [4]. With limited resources in developing countries, hypertension competes for financial investment and political support. According to the World Health Organization (WHO), NCDs require priority health interventions and research for prevention and control. There is sparse data and community based research on NCDs in sub-Saharan Africa [5].

Non-communicable diseases threaten the economic security and physical health of Tanzania citizens [3]. The Maasai, as one of the major pastoralist groups in Tanzania, are especially impacted. They are a Nilotic ethnic group of nomadic people living in Northern Tanzania [6]. The Maasai lifestyle centers on cattle, which is their primary source of food. Maasai mainly feed on high protein rich foods in particular red meat, milk, and blood [7]. Red meat from cows, sheep, and goats has been found to increase the risk of developing cardiovascular diseases and catalyzing weight gain [8].

A recent study compared prevalence of hypertension in rural and urban Maasai from Ngorongoro Conservation Area (NCA) and found a higher prevalence amongst the urban (27.7%) Maasai than their rural counterparts (10.9%) [9]. However, it was argued that due to restrictive regulations on rural Maasai in NCA, which has a bearing on their nutritional status, the hypertension prevalence and risk factors observed may not be representative of rural Maasai living elsewhere. This study investigated the risk factors of hypertension among rural Maasai communities of Simanjiro District, Tanzania.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study considered prevalence and risk factors for hypertension amongst Maasai communities in the Simanjiro District. Simanjiro is one of the 5 districts in Manyara Region in the northeastern part of Tanzania. The sample was drawn from the villages of Olerumo, Irukugit, Narosoito, Madukani, and Mukumbi.

### 2.2 Study Design and Population

This cross-sectional study was conducted among the rural Maasai communities of Simanjiro District. Participants included residents of Simanjiro District of Maasai ethnic origin who consented to take part in the study and were

over 25 years. Exclusion criteria included persons (within the age criterion) inaccessible, ill, incompetent, or non-consenting.

## 2.3 Sampling

Data was collected between March and July 2015. Stratified random samples were drawn from within the geographical areas in Simanjiro District. Five hundred and ten households were selected by simple random sampling. Eligible participants from each household was selected using the Kish method [10] through a pre-assigned table of random number to select the specific interviewees.

## 2.4 Sample Size Calculation

Sample size was calculated from the standard formula for epidemiological studies n= $[Z^2*p*(1-p)]/d^2$; where n is the number of the sample, d is margin of error, and p is the planned proportion estimate population [11]. The level of confidence and margin of error used were 95% and 0.05, respectively. Since the prevalence of hypertension in Simanjiro District was unknown, an estimate of 50% was utilized. A minimum sample of 561 participants was calculated, which provides sufficient power to allow reliable estimations of hypertension prevalence and its determinants.

## 2.5 Data Collection

### 2.5.1 Determination of blood pressure

Blood pressure measurement was carried out by health care professionals. The participants rested for at least five (5) minutes before their blood pressure was measured. The average of two readings taken two (2) minutes apart were used for analysis. Blood pressure was measured using a validated automatic calibrated digital blood pressure measurement system (Omron™ Digital HEM-907, Tokyo, Japan) in order to eliminate bias. Measurement was done on the upper left arm with an appropriate cuff size. The instrument meets the criteria of the British Hypertension Society and the Association for the Advancement of Medical Instruments Approval [12]. Hypertension was defined as measured systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg or self-reported use of anti-hypertensive medications [13].

### 2.5.2 Determination of blood glucose

The One Touch™ Glucose test for fasting capillary blood glucose (FCBG) was conducted. Fasting capillary blood glucose was measured early in the morning between 0700 to 0830 h at the participant's home. The participants were asked not to eat or drink anything except plain water for at least 8 hours. The results were verified by clinical technicians. Readings for FCBG between 5.6 to 6.8 mmol/L were considered to indicate impaired glucose tolerance (IGT) and above 7.0 mmol/L (126 mg/dL) were considered to be diabetic [14].

### 2.5.3 Anthropometric measurements

*2.5.3.1 Body Mass Index (BMI)*

Body weight was measured using validated digital scales to the nearest 0.1 kg precision. Height was measured using a portable stadiometer to the nearest 0.1 cm precision. Regular calibration of the scales was done at the start of each day. Body mass index was calculated as weight (in kilograms) divided by squared height (in meters) and then categorized as per World Health Organization (WHO) [15] standards of: NORMAL (less than 25.0 $kg/m^2$), OVERWEIGHT (25.0 to 29.9 $kg/m^2$) and OBESE (above 30 $kg/m^2$) for both men and women (non-pregnant). Participants were advised to wear light clothing and to remove any footwear.

*2.5.3.2 Waist Circumference (WC)*

Waist circumference was measured using a resistant tension tape to the nearest 0.1 centimeter (cm) after having the participant take 2 to 3 deep breaths. Measurement was taken either directly over the skin or over light clothing. The tape was wrapped snugly at the midpoint between the inferior merging of the last rib and iliac crest.

*2.5.3.3 Waist to Hip Ratio (WHR)*

Hip circumference was measured (in cm) around the widest portion of the buttocks, with the tape parallel to the floor. Waist to hip ratio was a simple calculation of the waist measurement divided by the hip measurement. The nutritional status of individuals was classified as AT RISK with waist-hip ratio readings of >0.90 for men and >0.85 for women [15].

#### 2.5.4 Qualitative data collection

The validated WHO STEPwise™ instrument investigates the levels of each chronic disease risk factor [16]. Pre-study training was provided to the enumerators on use and administration of the tool. The instrument was pre-tested and adapted prior to commencement of the study. Regular monitoring and refresher training was done to ensure quality data collection.

Face to face questionnaires were administered by the trained enumerators. Information on socio-demographic characteristics, smoking habits, alcohol intake, medical and health history, fruit and vegetable consumption, and physical activity were collected. Physical activity was categorized as VIGOROUS-intensity activities when they caused significant increases in the heart rate, such as lifting heavy loads, manual construction work, digging, or running continuously for at least 10 minutes. MODERATE-intensity activities caused measurable but insignificant increases in the heart rate, such as brisk walking, dancing, and doing chores like cleaning continuously for at least 10 minutes. LOW-intensity physical activity was defined as involving mostly sitting for at least 10 minutes. A metabolic equivalent task (MET) score was assigned to each activity on the basis of its energy cost [17]. A participant was considered physically inactive if he/she did not meet the WHO recommendation of > 600 METs per week.

#### 2.5.5 Statistical methods and data management

The crude prevalence of hypertension and other hypertension risk factors were explored and reported using descriptive statistics. Pearson's correlation and linear regression analysis were carried out to reveal potential associations of the predictors of hypertension. Variables considered included gender, age, WC, WHR, smoking, weight, height, BMI, physical activity, FCBG, and number of fruit and vegetable servings per day. Variables included in the final model were significant at a p-value ≥ 0.05. The data was analyzed using Graph Pad Prism™ Software Version 6 (Graphpad Software Inc, Ca, USA).

### 2.6 Ethical Clearance

Ethical clearance was obtained from the National Institute of Medical Research, Tanzania. The goals and benefits of the study were explained to the participants and oral informed consents were obtained from the participants as appropriate for the cultural and literacy considerations. Information on the physical and biochemical examinations were kept confidential shared only with the client and clinical personnel. All participants received individual feedback on the results of their examination and were referred, when necessary, to Simanjiro Health Center for appropriate follow up.

## 3. RESULTS

### 3.1 Population Characteristics

A total of 561 participants (175 men and 386 women) participated in this study. The average age (years) of the participants was 39±13.9. Most of the respondents (46.9%) were in the age group of 25-34 years. All participants were of Maasai ethnicity with 46.7% responding in Kimasaai as their first language, 46.7 % Kiswahili, and only 3.7% used English. Education levels were found to be low with 58.6% of respondents having no formal education (Table 1). The average time spent in formal education was 3±4.0 years. The majority (90.4%) of participants were married.

### 3.2 Prevalence of Hypertension

The overall prevalence of hypertension in this sub-population was found to be 21.4%. Men had a prevalence of hypertension at 22.3% and women 21%, yielding no significant difference in gender prevalence. The prevalence of hypertension generally increased across the age groups both among men ($p = 0.0005$) and women ($p= 0.0003$) (Fig. 1). In both genders, the prevalence of hypertension was highest among the 65+ age group, with rates of 30.4% and 25% men and women respectively. Participants aged 25-34 years had the lowest prevalence (16.4%) in men, whereas the age group 34–44 years had the lowest prevalence (14.9%) in women.

A large proportion (82.5%) of participants with high blood pressure readings during this study were unaware of their condition (Fig. 2). There was a significant difference ($p=0.0005$) in the ages of those participants who were aware and unaware, although no difference was observed based on gender, formal schooling, or occupation. Hypertensive participants, who were aware of their condition, tended to be older (50.76±3.96) than their unaware counterparts (37.95±1.31). The majority (81%) of participants, who were aware of being hypertensive, were on treatment; most of these individuals showed controlled blood pressure.

### 3.3 Risk Factors of Hypertension

Investigation of the risk factors for hypertension in Simanjiro District included computing of the association of different risk factors using correlation and linear regression. Systolic blood pressure was positively ($p<0.0001$) associated with diastolic blood pressure, weight, BMI, WC, and WHR (Table 2). Positive association of hypertension was also observed with FCBG, height, history of raised BG, and physical inactivity. Heart rate, fruit servings per day, and number of vigorous work days were negatively associated with systolic blood pressure.

**Table 1. Socio demographic characteristics of the participants**

| Socio demographic characteristics | Total | | Male | | Female | |
|---|---|---|---|---|---|---|
| | N | % | n | % | N | % |
| **Gender** | | | | | | |
| Men | 175 | 31.2 | - | | - | |
| Women | 386 | 68.8 | - | | - | |
| **Age (years)** | | | | | | |
| 25-34 | 263 | 46.9 | 55 | 31.4 | 208 | 53.8 |
| 35-44 | 150 | 26.7 | 56 | 32 | 94 | 24.4 |
| 45-54 | 63 | 11.2 | 23 | 13.1 | 40 | 10.4 |
| 55-64 | 42 | 7.5 | 18 | 10.3 | 24 | 6.2 |
| 65+ | 43 | 7.7 | 23 | 13.1 | 20 | 5.2 |
| **Education level** | | | | | | |
| No formal schooling | 329 | 58.6 | 91 | 52 | 238 | 61.7 |
| Primary school completed | 151 | 26.9 | 55 | 31.4 | 96 | 24.9 |
| Primary school incomplete | 19 | 3.4 | 7 | 4.0 | 12 | 3.1 |
| Secondary school completed | 33 | 5.9 | 12 | 6.9 | 21 | 5.4 |
| Secondary school incomplete | 24 | 4.3 | 7 | 4.0 | 17 | 3.0 |
| Attended College | 5 | 0.9 | 3 | 1.7 | 2 | 0.4 |
| **Marital status** | | | | | | |
| Currently married | 507 | 90.4 | 155 | 88.6 | 352 | 91.2 |
| Never married | 21 | 3.7 | 16 | 9.1 | 5 | 1.3 |
| Widowed | 29 | 5.2 | 3 | 1.7 | 26 | 6.7 |
| Others[1] | 4 | 0.7 | 1 | 0.6 | 3 | 0.8 |
| **Smoking** | | | | | | |
| Current smoker | 57 | 10.2 | 40 | 22.9 | 17 | 4.4 |
| Past smoker | 15 | 2.7 | 4 | 0.7 | 11 | 2.0 |
| Ever consumed alcohol | 47 | 8.4 | 46 | 26.3 | 1 | 0.3 |
| **Type 2 diabetes** | | | | | | |
| Yes | 5 | 0.9 | 2 | 1.1 | 3 | 0.8 |
| No | 556 | 99.1 | 173 | 98.9 | 383 | 99.2 |
| **Impaired Glucose Tolerance (IGT)** | | | | | | |
| Yes | 14 | 2.5 | 5 | 2.9 | 9 | 2.3 |
| No | 547 | 97.5 | 170 | 97.1 | 377 | 97.7 |

[1]*Others: cohabiting (2), separated (2)*

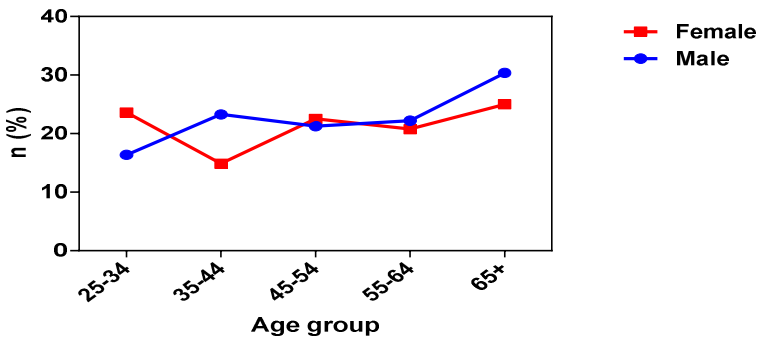


**Fig. 1. Prevalence of hypertension across age groups among Maasai in Simanjiro District**

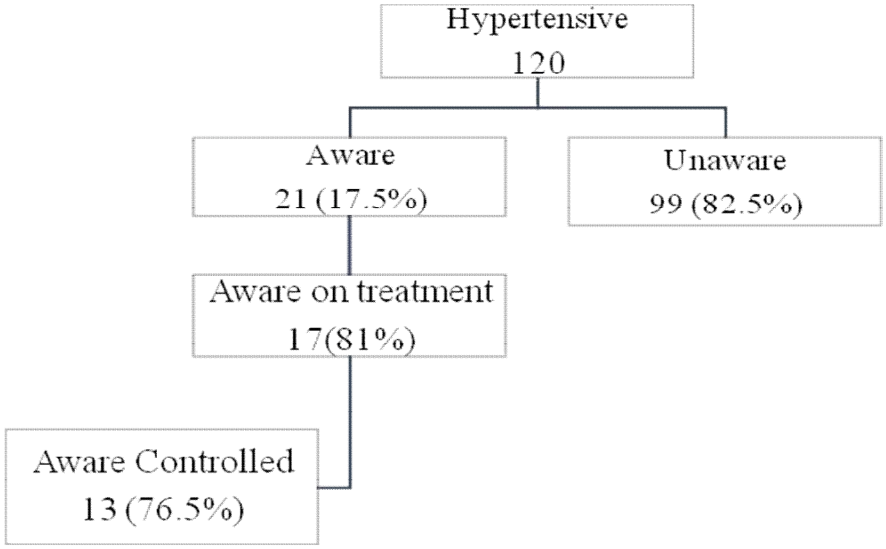


**Fig. 2. Hypertension awareness, treatment and control among the Maasai participants in Simanjiro District**

**Table 2. Pearson's correlation and regression analysis for systolic blood pressure with other risk factors of hypertension**

| Risk factor | Pearson's correlation | | Linear regression | |
|---|---|---|---|---|
| | Correlation coefficient (R) | P | $R^2$ | Linear equation |
| Diastolic blood pressure | 0.8506 | <0.0001**** | 0.7235 | Y= 0.5197*X + 16.91 |
| Heart Rate (bpm) | -0.08593 | 0.0419* | 0.0074 | Y= -0.05848*X + 83.94 |
| BP machine cuff size | -0.09344 | 0.0269* | 0.0087 | Y= -0.001573*X + 2.187 |
| Weight (kg) | 0.2558 | <0.0001**** | 0.0634 | Y= 0.1719*X + 41.45 |
| Height (cm) | 0.1536 | 0.0003*** | 0.0236 | Y=0.066988X + 154.9 |
| BMI ($kg/m^2$) | 0.1902 | <0.0001**** | 0.0362 | Y= 0.04355*X + 18.06 |
| Waist circumference (cm) | 0.2069 | <0.0001**** | 0.0428 | Y = 0.1373*X + 62.55 |
| WHR | 0.2355 | <0.0001**** | 0.0555 | Y = 0.001109*X + 0.7398 |
| FCBG (mmol/L) | 0.1340 | 0.0015** | 0.0180 | Y= 0.003987*X + 3.963 |
| History of raised BG | 0.4679 | 0.0324* | 0.2190 | Y=0.01243*X - 0.3156 |
| Fruit servings per day | -0.09616 | 0.0227* | 0.0092 | Y=-0.005634*X + 1.931 |
| Do vigorous work | -0.1095 | 0.0096** | 0.0119 | Y=-0.003019*X + 1.837 |
| Vigorous work days | -0.1192 | 0.0047** | 0.0142 | Y=-0.01342*X + 3.174 |
| Physically inactive | 0.1607 | 0.0001*** | 0.0269 | Y= 0.001686*X + 0.8335 |
| Main work | 0.09167 | 0.0299* | 0.0084 | Y=0.01187*X + 3.074 |

*BG- blood glucose, BMI- body mass index, WHR – waist to hip ratio, FCBG- fasting capillary blood glucose*

### 3.4 Demographic Patterns of Hypertension risk Factors among Maasai Communities in Simanjiro District

#### 3.4.1 Physical activity

The majority (96.26% [94.3% men and 97.2% women]) of Maasai participants were physically active. Generally, total energy spent on expenditure (METs) decreased with increasing age (p<0.0001). Participants in the 24-34 year age group had higher METs (10563.92±7552) than the 65+ group (4852.09±5835.272) (p< 0.0001). The physical activity levels of hypertensive and non-hypertensive participants were significantly different (p<0.0001) (Fig. 3). Hypertensive participants tended to have lower METs (179.2±107.7) than their non-hypertensive counterparts (297.6±53.1). In addition, METs across the age groups differed (p=0.0001). The most significant difference was among the 65+ group where the non-hypertensive participants had higher METs (207.2±201.2) than the hypertensive participants (35.57±24.02).

Women tended to have higher METs (10348±393) than men (8556±582.2) (p = 0.0111). Women spent more time (minutes) (317.8±11.63) per day carrying out physical activities than men (264.7±17.46, p value 0.0113). In addition, women tended to spend twice as many days doing vigorous work per week as their male counterparts (p = 0.0215).

### 3.4.2 Body Mass Index (BMI)

The majority of participants were within normal weights for both men (57.1%) and women (63.2%) (Fig. 4). Generally, the BMI differed according to the age groupings (p = 0.0454). Participants aged 65+ had the highest BMIs (25.12±5.3) and 25-24 age group reflected the lowest BMIs (23±4.1). The weights of hypertensive and non-hypertensive participants differed significantly (p=0.0231) (Fig. 5). The hypertensive group had a mean weight (in kg) of 66.16±3.18, while the non-hypertensive group's mean weight was 62.59±3.34. In addition, participants who were hypertensive had a higher BMI (24.88±0.93) than the non-hypertensive (23.41±1.169, p=0.0063) (Fig. 6). There was no significant difference by age groups and hypertensive status.

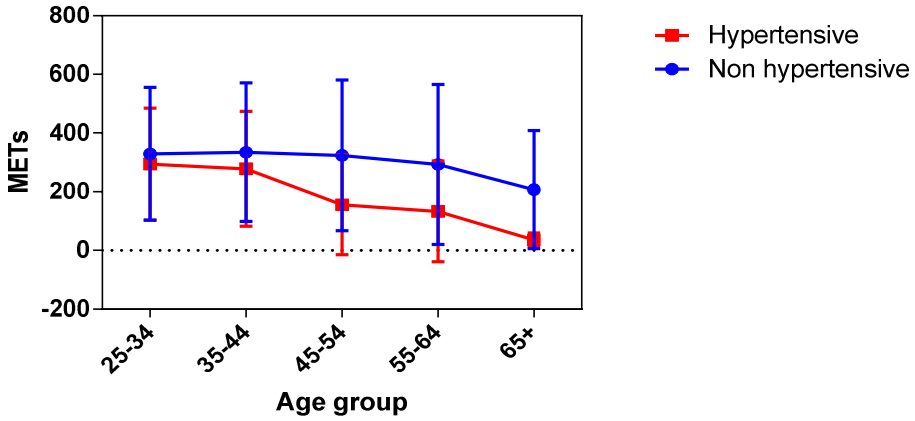


**Fig. 3. Physical activity metabolic equivalents (METs) across age groups**

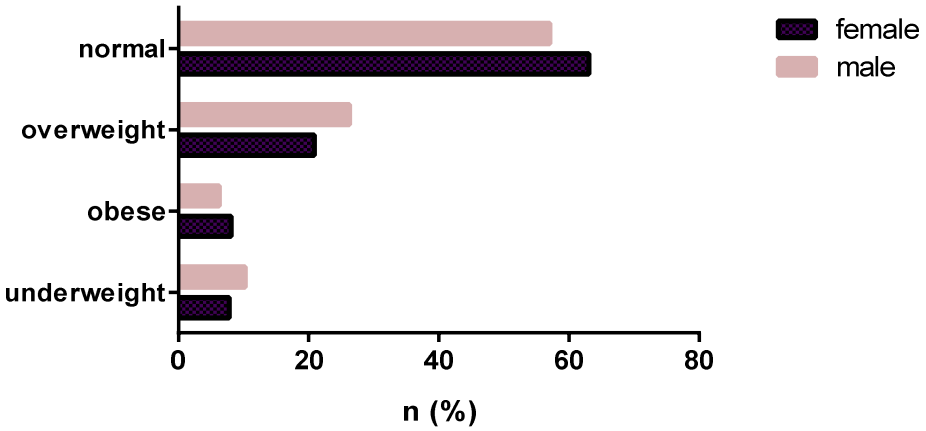


**Fig. 4. Prevalence of weight status of the Maasai in Simanjiro District**

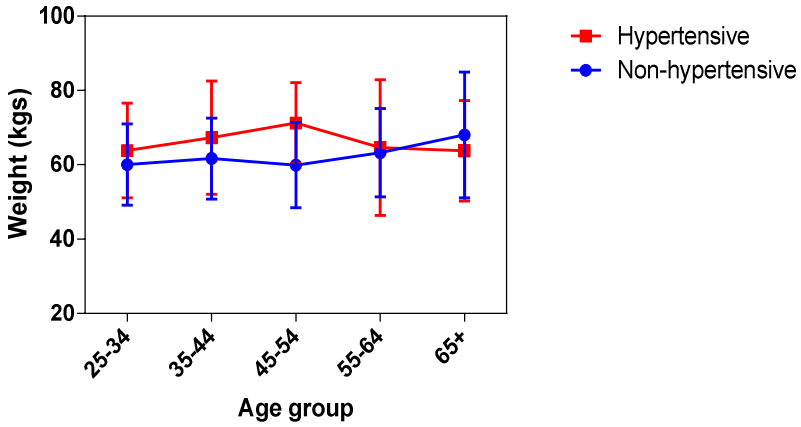


**Fig. 5. Weights of hypertensive and non-hypertensive participants across age groups**

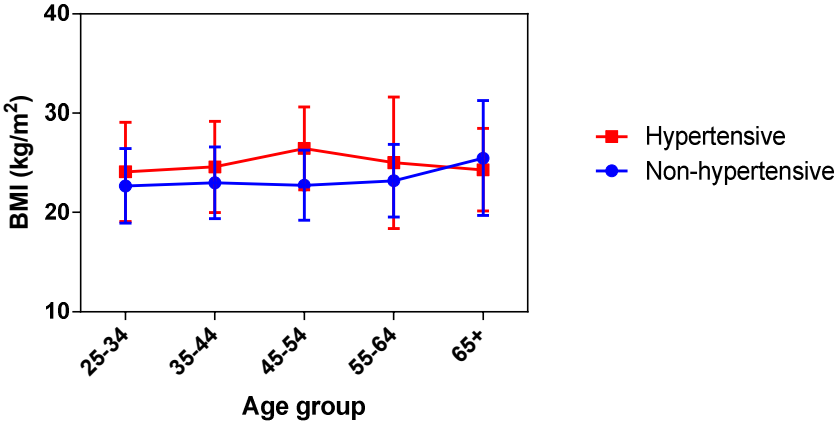


**Fig. 6. BMI of hypertensive and non-hypertensive participants across age groups**

### 3.4.3 Waist to Hip Ratio (WHR)

About half of the participants were at risk of abdominal obesity (48% men; 50.8% women). Participants significantly differed in their WC ($p=0.0014$). Hypertensive participants tended to have higher WC (82.4±1.57) than non-hypertensive individuals (79.11±1.79, $p=0.0362$) (Fig. 7). There was no significant difference in WHR of hypertensive and non-hypertensive participants or by age grouping (Fig. 8).

### 3.4.4 Fasting Capillary Blood Glucose (FCBG)

A small proportion (0.7%) of participants had a history of raised blood glucose. The hypertensive participants had significantly ($p=0.0136$) higher blood glucose levels (4.58±0.11) than the non-hypertensive (4.4±0.04). There was no difference across their age groups (Fig. 9).

### 3.4.5 Dietary pattern

Generally, there was a low intake of fruits and vegetables, with consumption on average of two and four days per week respectively. Women consumed twice as many vegetables per day as men (Table 3). The number of fruit servings per day decreased with increasing age ($p<0.0001$). Consumption of fruits was less within the 65+ age group (0.6±0.9) than in the 25–34 age group (1.2±0.9). Fruits and vegetable intake was similar among hypertensive and non-hypertensive participants; however, there was a significant difference across age groups ($p=0.0085$) (Fig. 10).

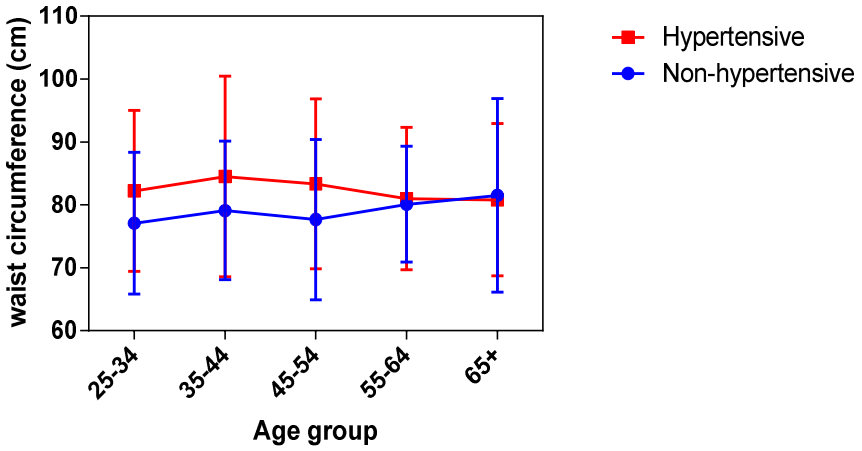


**Fig. 7. Waist circumference of hypertensive and non-hypertensive participants across the age groups**

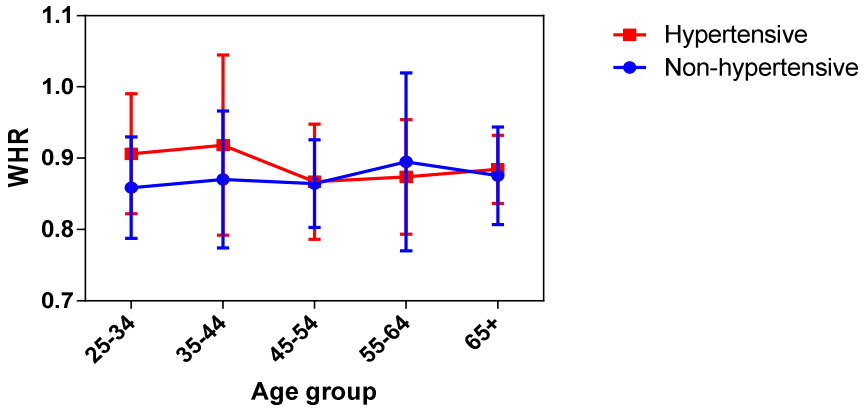


**Fig. 8. Waist to Hip ratio of hypertensive and non-hypertensive participants**

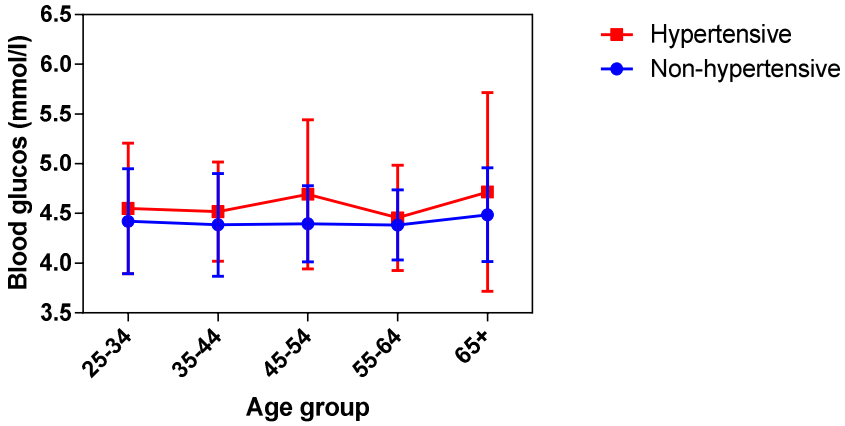


**Fig. 9. Fasting capillary blood glucose of hypertensive and non-hypertensive participants across age groups**

### 3.4.6 Heart rate

There was no significant difference in the heart rates (i.e., pulses) of hypertensive and non-hypertensive participants. Hypertensive participants had a mean heart rate of (75.8±12.5) while the non- hypertensive (77.1±12.28). In addition, there was no significant difference of heart rate across the age groups (Fig. 11).

**Table 3. Dietary patterns of Maasai participants in Simanjiro District**

| Diet | Men | Women | Overall |
|---|---|---|---|
| Fruit days mean, SD | 1.5 (1.57) | 2 (1.63) | 2 (1.63) |
| Fruit servings per day, mean, SD | 1.1 (1.14) | 1.3(1.31) | 1 (1.06) |
| Vegetable days, mean, SD | 2.7 (2.32) | 3.9 (2.1) | 4 (2.26) |
| Vegetable servings per day, mean SD | 1.3 (1.0) | 1.7(1.04) | 2 (1.04) |
| **Vegetable/ fat used** | | | |
| Vegetable oil n. % | 75 (42.9%) | 190 (49.2%) | 265 (42.9%) |
| Animal fat, n, % | 97 (55.4%) | 190 (49.2%) | 287 (49.2%) |
| None, n, % | 3 (0.3%) | 1 (0.3%) | 4 (0.7%) |
| Non in particular, n,% | 0 (0.0%) | 5 (1.3%) | 5 (0.9%) |
| Meals out, mean, SD | 2 (1.84) | 1 (1.44) | 2 (1.6) |

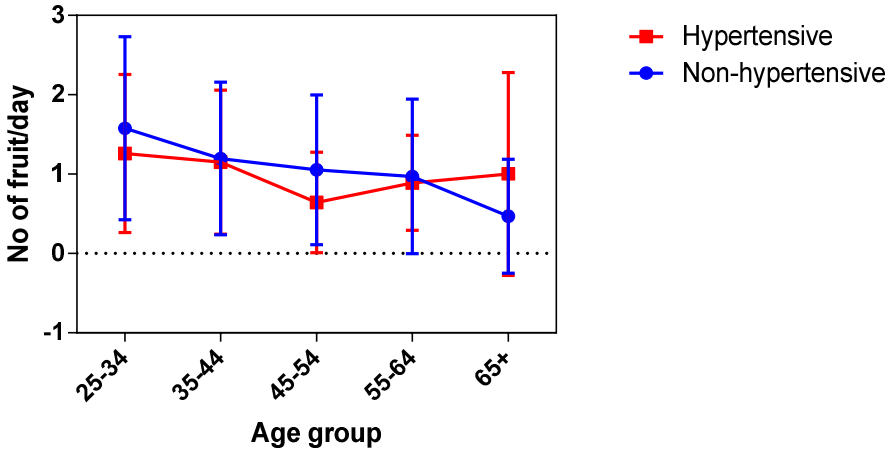


**Fig. 10. Quantity of Fruit serving per day of hypertensive and non-hypertensive participants across age groups**

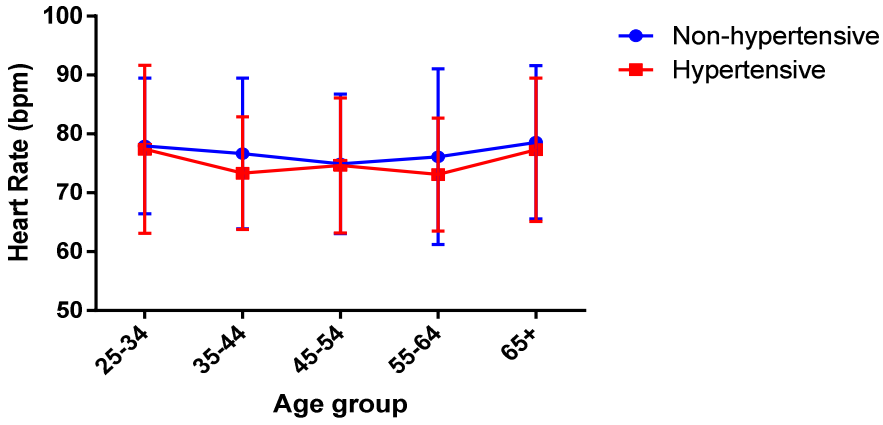


**Fig. 11. Heart rates of hypertensive and non-hypertensive Maasai participants**

## 4. DISCUSSION

The Maasai are a pastoralist tribe with unique culture and lifestyles, which encompass increasing their cattle herds and a consumption pattern focusing mainly of meat and milk. The recent increase in NCDs in developing countries including Tanzania, primarily due to adoption of a western lifestyle, has stimulated interest in the trends of these diseases across the population and within sub-populations [18]. A recent study compared prevalence of hypertension in rural and urban Maasai from Ngorongoro Conservation Area (NCA) and found marked differences between the two groups [9]. However, it can be argued that due to the restrictive regulations on rural Maasai in NCA, which has a bearing on their nutritional status, hypertension prevalence, and risk factors observed may not be representative of rural Maasai living elsewhere. This study therefore focused on pastoral Maasai ethnic communities in Simanjiro District in Tanzania; an area which is outside NCA.

The mean prevalence of hypertension for rural Maasai in Simanjiro District was 21.4%. The prevalence increased across the age groups with the 65+ having the highest prevalence (30.4% men and 25% women). Hypertension was positively associated with systolic blood pressure, diastolic blood pressure, obesity indicators (weight, height, BMI, WC, WHR), history of raised BG, and physical inactivity; where as it was negatively associated with heart rate, fruit servings per day, and number of vigorous work days.

The prevalence of hypertension observed in the current study for rural Maasai living in Simanjiro District (21.4%) is two times higher than what was reported for rural Maasai living in NCA (10%) [9]. Possible reasons for these differences may be the unique environment of the Maasai living in NCA, which makes them less prone to hypertension as previously explained [9]. Compared to the prevalence in other Tanzania rural settings, the prevalence in Simanjiro is considerably lower to that reported for residents of rural Shari in Kilimanjaro area (32.2% in men and 31.5% for women) which was attributed to urban lifestyle practiced by residents of Shari area [19]. The hypertension prevalence in Simanjiro's Maasai is lower compared to that reported for urban Maasai living in Arusha town (27.7%) [9] as well as in mixed urban ethnic communities in Tanzanian (range 27.1-30%) [20].

Consistent with findings of other studies was the positive association of SBP, DBP, obesity, history of raised BG, and physical inactivity with hypertension [21,22,9,23]. Negative association was observed for fruit servings per day, and number of vigorous work days. Although fruits are not a traditional Maasai food, as evidenced by the low frequency of fruit consumption in Simanjiro District, current results suggest that increased consumption of fruits may have a protective influence against hypertension. Based on self-reported fruit consumption, fruits consumed included mainly oranges and wild fruits available on a seasonal basis. Data obtained showed that fruit consumption decreased with age, with consumption being largely by the young who spend more time away from home herding cattle as opposed to the elderly who stay home. It is possible that the youth consume free wild fruits available in the field rather than purchase them.

It is well established that low to moderate exercise reduces blood pressure [22], which is consistent with our results. The level of physical activity decreased with increasing age in alignment with Maasai's cultural work distribution whereby the young will walk long distances daily to herd cows while the elderly will stay home and perform light duties [9]. The negative association between BP and heart rate is a surprising finding. Normally, an increase in heart rate yields an increase in blood pressure, but the increase is countered by negative feedback mechanisms which dilate the blood vessels and normalize the blood pressure [24]. Although the difference was not significant, hypertensive participants had lower heart rates compared to their non-hypertensive counterparts, which may indicate some compensatory mechanisms to lower blood pressure particularly if the elasticity of blood vessels is compromised. Further studies on these results are needed. This finding resembles those of Gui-Ling et al. [25] but differs from others [24,26]. It is suggested that this pattern may be due to dysregulation of the autonomic nervous system that plays a role in the pathogenesis of hypertension [27].

Few studies have reported hypertension awareness, treatment, and control in Tanzania. A majority (82.5%) of the Maasai participants with hypertension were unaware of their condition. This low awareness rate (17.5%) is similar to

other studies [19] in Tanzania. Essentially, younger participants tended to be less likely to be aware of their condition.

## 5. CONCLUSION

Results from this study showed that the prevalence of hypertension among the rural Maasai communities in Simanjiro District was high, while awareness rate was low. This finding indicates that interventions to control hypertension should be focused on advocating for healthy lifestyle programs and regular massive screening for early detection and treatment of hypertension. In addition, the results differed from a number of other recent studies and leads to the potential for a broader population health study on hypertension amongst this unique pastoralist people.

## ACKNOWLEDGEMENT

We acknowledge the African Capacity Building Foundation for funding this research.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. World Health Organization. A global brief on hypertension: Silent killer, global public health crisis; 2013.
Available:http://www.thehealthwell.info/node/466541 (September 28, 2015).
2. Alwan A, Armstrong T, Cowan M, Riley L. Non communicable Diseases Country Profiles 2011. World Health Organization. 2011;1–207.
Available:http://doi.org/10.2471/BLT.07.045138
3. World Bank. The growing danger of non-communicable diseases: Acting now to reverse course; 2011.
Available:http://documents.worldbank.org/curated/en/2011/09/15512807/growing-danger-non-communicable-diseases-acting-now-reverse-course (September, 24 pages).
4. Kagaruki GB, Mayige MT, Ngadaya ES, Kimaro GD, Kalinga AK, Kilale AM, Kahwa AM, Materu GS, Mfinanga SG. Magnitude and risk factors of non-communicable diseases among people living with HIV in Tanzania: A cross sectional study from Mbeya and Dar es Salaam regions. BMC Public Health. 2014;14(1):904.
Available:http://doi.org/10.1186/1471-2458-14-904
5. Dalal S, Beunza JJ, Volmink J, Adebamowo C, Bajunirwe F, Njelekela M, Mozaffarian D, Fawzi W, Willett W, Adami HO, Holmes MD. Non-communicable diseases in sub-Saharan Africa: What we know now. Int J Epidemiol. 2011;40(4): 885–901.
Available:http://doi.org/10.1093/ije/dyr050
6. Sutton JEG. The peopling of Tanzania. In Kimambo I, AJ Temu (eds). A History of Tanzania, Chicago: Northwestern University Press; 1969.
7. Brady R, Suksiri S. Tan S. Dodds J. Aine D. Current health and environmental status of the Maasai people in Sub-Saharan Africa. California Polytechnic Honors Undergraduate Research Journal. 2008; 1(1):17–32.
Available:http://digitalcommons.calpoly.edu/honors/vol1/iss1/6
8. Salter A. Impact of consumption of animal products on cardiovascular disease, diabetes, and cancer in developed countries. Animal Frontiers. 2013;3(1): 20-7.
Available:http://doi.org/10.2527/af.2013-0004
9. Ngoye A, Petrucka P, Buza J. Differences in hypertension risk factors between rural maasai in ngorongoro and urban maasai in arusha municipal: A descriptive study. International Journal of Life Sciences. 2014;1(1):17–31.
DOI: 10.9734/JALSI/2014/11947
10. Kish L. A procedure for objective respondent selection within the household. Journal of the American Statistical Association. 1949;44(247):380-387.
Available:http://amstat.tandfonline.com/doi/abs/10.1080/01621459.1949.10483314
11. Kasiulevičius V, Šapoka V, Filipavičiūtė R. Sample size calculation in epidemiological studies. Gerontologija. 2006;7(4):225–231.
12. Rogoza AN, Pavlova TS, Sergeeva MV. Validation of A&D UA-767 device for the self-measurement of blood pressure. Blood Pressure Monitoring. 2000;5(4):227-31.
Available:http://journals.lww.com/bpmonitoring/Abstract/2000/08000/Validation_of_A_D_UA_767_device_for_the.6.aspx
13. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, Harrap SB.

Clinical practice guidelines for the management of hypertension in the community: A statement by the American Society of hypertension and the International Society of Hypertension. Journal of Clinical Hypertension. 2014; 16(1):14–26.
Available:http://doi.org/10.1111/jch.12237

14. World Health Organization. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia. 2006;52. ISBN 92 4 159493 4.
15. World Health Organization Expert consultation. Waist Circumference and Waist-Hip Ratio Report of a WHO Expert Consultation. World Health. 2008;8–11.
Available:http://doi.org/10.1038/ejcn.2009.139
16. World Health Organization. WHO STEPS Surveillance Manual. WHO Global Report, Geneva; 2008. ISBN 92 4 159383 0.
Available:http://apps.who.int/iris/bitstream/10665/43376/1/9241593830_eng.pdf
17. World Health Organization. Global Physical Activity Questionnaire (GPAQ) Analysis Guide. Geneva: World Health Organization; 2012.
Available:http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf
18. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, Watt J. Priority actions for the non-communicable disease crisis. The Lancet NCD Action Group. 2011;377(9775):1438–47.
19. Edwards RUN, Mugusi F, Whiting D, Seif RJ, Kissima Aspray TJ, Alberti KGM. Hypertension prevalence and care in an urban and rural area of Tanzania. Journal of Hypertension. 2000;18(2):145–52.
Available:http://journals.lww.com/jhypertension/Abstract/2000/18020/Hypertension_prevalence_and_care_in_an_urban_and.3.aspx
20. Njelekela M, Mpembeni R, Muhihi A, Mligiliche NL, Spiegelman D, Hertzmark E, Mtabaji J. Gender-related differences in the prevalence of cardiovascular disease risk factors and their correlates in urban Tanzania. BMC Cardiovascular Disorders. 2009;9:30.
Available:http://doi.org/10.1186/1471-2261-9-30
21. Epstein M, Sowers JR. Brief review diabetes mellitus and hypertension. Hypertension. 1992;19:403-18.
22. Kokkinos P, Myers J. Exercise and physical activity: Clinical outcomes and applications. Circulation. 2010;122(16): 1637–48.
Available:http://doi.org/10.1161/CIRCULATIONAHA.110.948349
23. Shihab HM, Meoni LA, Chu AY, Wang NY, Ford DE, Liang KY, Klag MJ. Body mass index and risk of incident hypertension over the life course: The Johns Hopkins Precursors Study. Circulation. 2012; 126(25):2983–9.
Available:http://doi.org/10.1161/CIRCULATIONAHA.112.117333
24. Reule S, Drawz PE. Heart rate and blood pressure: Any possible implications for management of hypertension? Current Hypertension Reports. 2012;14(6):478–84.
Available:http://doi.org/10.1007/s11906-012-0306-3
25. Gui-Ling X, Jing-Hua W, Yan Z, Hui X, Jing-Hui S, Si-Rui Y. Association of high blood pressure with heart rate variability in children. Iranian Journal of Pediatrics. 2013;23(1):37–44.
Available:http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3574990&tool=pmcentrez&rendertype=abstract
26. World Health Organization. Hypertension control; A report by WHO Expert Committee; 1996.
27. Singh JP, Larson MG, Evans JC, O'Donnell CJ, Levy D. Reduced heart rate variability and new-onset hypertension: Insights into pathogenesis of hypertension: The Framingham Heart Study. Hypertension. 1998;32(2):293–297.
Available:http://doi.org/10.1161/01.HYP.32.2.293.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://sciencedomain.org/review-history/12048*