Mosha, NR; Mahande, M; Juma, A; Mboya, I; Peck, R; Urassa, M; Michael, D; Todd, J (2017) Prevalence, awareness and factors associated with hypertension in North West Tanzania. Global health action, 10 (1). p. 1321279. ISSN 1654-9716 DOI: https://doi.org/10.1080/16549716.2017.1321279

Downloaded from: http://researchonline.lshtm.ac.uk/3962243/

DOI: 10.1080/16549716.2017.1321279

Usage Guidelines

Please refer to usage guidelines at http://researchonline.lshtm.ac.uk/policies.html or alternatively contact researchonline@lshtm.ac.uk.

Available under license: http://creativecommons.org/licenses/by/2.5/
Prevalence, awareness and factors associated with hypertension in North West Tanzania

Neema R. Mosha, Michael Mahande, Adinan Juma, Innocent Mboya, Rob Peck, Mark Urassa, Denna Michael & Jim Todd

To cite this article: Neema R. Mosha, Michael Mahande, Adinan Juma, Innocent Mboya, Rob Peck, Mark Urassa, Denna Michael & Jim Todd (2017) Prevalence, awareness and factors associated with hypertension in North West Tanzania, Global Health Action, 10:1, 1321279, DOI: 10.1080/16549716.2017.1321279

To link to this article: http://dx.doi.org/10.1080/16549716.2017.1321279

© 2017 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

Published online: 09 Jun 2017.

Article views: 261

View related articles

View Crossmark data
Prevalence, awareness and factors associated with hypertension in North West Tanzania

Neema R. Mosha, Michael Mahande, Adinan Juma, Innocent Mboya, Rob Peck, Mark Urassa, Denna Michael and Jim Todd

Background: Hypertension is a public health problem, and yet few people are aware of it and even fewer access effective treatment. With the ongoing demographic transition in many parts of Sub-Saharan Africa, people are changing from rural, manual work to urban lifestyles, hence the risk of hypertension increases.

Objective: This study aimed at determining the prevalence, awareness and risk factors associated with hypertension in North West Tanzania.

Design: A community-based cross-sectional study was conducted among adults in Magu District in 2013. Information on socio-demographic, economic and lifestyle characteristics, medical conditions, and risk factors for hypertension were collected according to the WHO Steps survey tool. Measurements of blood pressure, blood sugar, pulse rate, and anthropometry were taken. Multivariate logistic regression was used to estimate the odds ratios (OR) and 95% confidence intervals (95% CI) for factors associated with hypertension (Blood pressure ≥140/90mm/Hg). Frequencies and percentages were used to determine the awareness, and treatment among hypertensive participants.

Results: Among 9678 participants, the prevalence of hypertension was 8.0% and pre-hypertension 36.2%. There was a higher prevalence of hypertension at older ages, among females (8.2%) compared to males (7.7%), and among urban dwellers (10.1%) compared to rural residents (6.8%). Overweight, obese, and diabetic individuals had a higher risk of hypertension while HIV positive participants had a lower risk of hypertension (OR = 0.56; 95% CI 0.39 – 0.79). Among participants with hypertension, awareness was less than 10%. Conclusion: By integrating blood pressure screening into our long-standing community HIV screening program, we were able to identify many previously undiagnosed cases of hypertension and pre-hypertension. Age, residence, overweight and obesity were the major associated factors for hypertension. Awareness and treatment rates are very low indicating the need for programs to improve awareness, and treatment of hypertension.

Background

Hypertension is a major risk factor for cardiovascular disease (CVD) [1] and is of increasing public health importance in low- and middle-income countries [2]. Worldwide, there are almost one billion people living with hypertension [3] while different estimates have been found in Sub-Saharan Africa (SSA) [4]. Recent literature shows the problem to be higher among individuals over 40 years of age, Africans, and those with a family history of hypertension or diabetes [5–7]. There are number of modifiable, lifestyle factors associated with hypertension including obesity, overweight, cigarette smoking, alcohol, and low physical activity [8–10]. And there are some reports of an association between hypertension and HIV although this may be due to the use of antiretroviral drugs which may cause increased blood pressure [11].

In countries undergoing the transition from rural, agricultural work to more globalized urban lifestyles the prevalence of hypertension is likely to increase [5,10]. In Tanzania a number of studies have shown a high population prevalence of hypertension ranging from 19% in rural areas to 35% in urban areas, with the highest prevalence of 70% found among individuals aged 70 years and above [12]. A review of the prevalence of hypertension across developing countries showed that the prevalence in the Tanzanian population is higher than in many other countries, and will clearly place a substantial strain on the health services [13].

Despite the increase in hypertension cases in low-income countries, awareness of the problem is low, both among health care workers and in the population at large [14]. Awareness of hypertension is an
important factor for early identification and management, but it is poor in many low-income countries [15,16]. Community-based blood pressure screening may be an important way to raise awareness, and refer those with hypertension to receive health services, and this could be integrated with screening for other diseases and conditions such as HIV. Effective treatment and control of hypertension are important for reducing the risk of stroke, heart attack, and other cardiovascular problems, and ultimately, in reducing mortality [17].

The main objective of this study was to determine the prevalence of hypertension, and the associated factors, after blood pressure screening was integrated into a community-based HIV screening program. This population is transitioning from a rural society, to the suburban environment of Mwanza City, thus these results will provide an important baseline for future studies on the prevalence of hypertension in this cohort.

Materials and methods

Study design and setting

The Magu Health and Demographic Sentinel Surveillance (HDSS) has been under continuous enumeration since 1994 in six villages about 20 km east of Mwanza city in North West Tanzania [13,14]. In 2012, the villages had a total population of 32,000, with 50% of the population aged 15 years or less, and an average household size of 7.2 individuals. From 7 December 2012 to 31 July 2013 an epidemiological health survey and HIV screening program was carried out recruiting all eligible, adult residents aged 15 years or more, from the HDSS [18]. A total of 9676 adult participants were included in the study which represents almost two third of the adult population included in the Demographic Health Survey. The sample size was estimated that we would have around 400 participants for each sex in each of the 10-year age groups. This would enable us to estimate the prevalence of hypertension with a precision of ±3%.

Data collection methods and tools

Questionnaires were developed, piloted and translated into Kiswahili (the national language) and KiSukuma (the local language), to collect socio-demographic, economic, behavioural and health information. In the questionnaire, questions from the WHO Steps Survey tool were used for personal and family history of diabetes and hypertension awareness, whether participants have ever had their blood pressure measured before, and if they had received treatment for hypertension [19]. Weight (in kilograms), height (in centimetres) and waist circumference (in centimetres) were measured. Three blood pressure measurements were taken by six trained research nurses using an aneroid-sphygmomanometer, after five minutes of rest, while the participant was quietly waiting for clinical and laboratory services, and the mean of the two last blood pressure measurement was used for analysis. A finger prick dried blood spot was taken from every participant and later anonymously tested for HIV in a central laboratory in Mwanza according to agreed protocols [20]. From the same finger prick, a blood sugar test was performed to screen for the presence of diabetes. The survey procedures were overseen by two field team leaders who supervised the data collection, the clinical services (including the blood pressure readings by the trained nurses), and the laboratory test procedures. Participants who were informed of their HIV positive test result, or high blood pressure, were referred to the government health centre for further investigation, management, and treatment.

Definition of variables

Hypertension was defined as an average systolic blood pressure (SBP) above or equal to 140 mmHg or diastolic blood pressure (DBP) above or equal to 90 mmHg, and pre-hypertension as SBP between 120–139.9 mmHg or DBP between 80–89.9 mmHg [21]. Awareness of hypertension was taken as a positive response to the question ‘Have you ever been told by a doctor or other health care worker that you have raised blood pressure or hypertension?’; and previous treatment through the positive response to the question ‘Have you ever received any drugs (medications) for high blood pressure prescribed by a doctor or other health care worker?’. Aggregated body mass index (BMI) was calculated from the measured weight and height, and categorized as underweight (BMI <18.5), normal (18.5–24.9), overweight (25–29.9), and obese (BMI≥30). Waist circumference was categorized into tertiles for analysis. Raised blood sugar was defined with readings of ≥200 mg/dL and normal blood sugar readings of ≤199.9 mg/dL [22]. Cigarette smoking was categorized into a binary variable as current smokers, and those who are not current smokers (previous or never). Alcohol consumption was categorized into three as: Never, Occasional (one alcoholic drink per week) and Frequent (more than one drink per week). Physical activity was also categorized into three groups as: None, Moderate/Light (carrying light loads, weeding, laundry, herding animals, or using a bicycle or canoe) and Heavy (carrying heavy loads, digging, hoeing, pounding, or chopping).
Data analysis

Data was cleaned, processed, and transferred from CSPro to STATA Version 12.0 (Stata Corp, USA) for analysis. The proportion of participants with hypertension and pre-hypertension were determined for all demographic and socio-economic characteristics and compared using a chi-squared test. The age standardized proportion with hypertension and pre-hypertension were calculated using the WHO standard population for low- and middle-income countries (LMIC) [23]. The mean anthropometric measurements and blood pressure were compared across participant characteristics using the T-test. Bivariate logistic regression was used to determine the unadjusted odds Ratios (OR) and 95% confidence intervals (CI) for the association between the characteristics and hypertension. Multivariate logistic regression models were fitted to adjust the association between hypertension and risk factors for potential confounders.

Ethical consideration

Written consent was obtained from all participants. Ethical approval for the surveys was obtained from the Tanzanian National Medical Research Coordinating Committee under the National Institute for Medical Research (Reference MR/53/100/22) and from London School of Hygiene and Tropical Medicine (Reference 7191). Kilimanjaro Christian Medical University college ethics committee gave approval for the use of these data for an MSc project by NM, and permission to use the data was obtained from the TAZAMA Project, and Magu District Medical Officer.

Results

Demographic and study characteristics

A total of 9742 individuals were enrolled in the study, 64 (0.6%) of participants were excluded with missing blood pressure data, so 9678 individuals were analyzed. Of these, there were 6277 (65%) females enrolled with a median age of 29 years (interquartile range of 20 to 45 years).

Male participants were significantly taller and heavier than females, however female participants had higher BMI, larger waist circumference, and higher blood sugar result compared with males P-Values < 0.001 (Table 1). There was no statistical significant difference between male and female participants with regard to mean systolic and diastolic blood pressure, or mean pulse rate. Overall in this population, there were 3507 people with pre-hypertension giving a prevalence of 36.2%, and 773 people with hypertension giving a prevalence of 8.0%. The proportion of males with pre-hypertension was higher than females (37.6% vs. 35.4%, P-value 0.029), but the proportion of males with hypertension was lower than that of females (7.7% vs. 8.2%, p-value < 0.05). Between the ages of 15 to 55 years, the proportion with pre-hypertension and the proportion with hypertension increases with the age of the participants (Table 2). After the age of 55 years, the proportion with pre-hypertension decreases although the proportion with hypertension increases to 30.8% in those aged 65 years or more.

Both hypertension and pre-hypertension increased with increasing levels of education. Participants living in rural areas had a higher prevalence of pre-hypertension (38.0%) and a lower prevalence of hypertension (6.8%) than those living in urban areas (33.2%, and 10.1% respectively). The prevalence for both pre-hypertension and hypertension increased with increase in body mass index (BMI), whereby those who were overweight (15.6%) and obese (31.4%) were more likely to have high blood pressure compared to participants with a BMI of 25 or less. A similar trend was observed for waist circumference in the largest tertile compared to those in the lowest tertile (Table 2). Participants who reported consumption of alcohol occasionally or frequently and those who were current cigarette smokers had slightly elevated blood pressure as compared to non-drinkers or non-smokers. The 27 participants with raised blood sugar levels had both higher proportions of pre-hypertension 37.0% and hypertension 48.2% compared with participants with normal blood sugar (36.1% and 8.0%) respectively.

Bivariate and multivariate analysis

A number of demographic and clinical variables were significantly associated with increased odds (risk) of hypertension in bivariate analysis (Table 3). These included age, sex, marital status, area of residence, education level, waist circumference, BMI, alcohol consumption, and diabetes. There was no association between cigarette smoking and physical activities with the risk of hypertension.

In multivariate analysis after adjusting for all significant variables (P-value <0.1) from the bivariate analyses and the priori potential confounders; sex and age, waist circumference, BMI, blood sugar and HIV were found to be associated with hypertension (Table 4). Residence, occupation and alcohol consumption were not independently associated with the risk of being hypertensive.

Females had lower odds of being hypertensive compared to males (OR = 0.69; 95% CI 0.56–0.85), while older people > 65 years had 2.5 higher odds of hypertension compared to middle-aged individuals (aged 45–54 years). Compared to single or never married women, separated or divorced women had 1.68 times the odds of being hypertensive even after
adjusting for age. Cigarette smokers had 37% higher risk of being hypertensive compared to non-smokers.

Individuals living in urban areas were more at risk of being hypertensive (OR = 1.18, 95% CI 0.99–1.41) compared to the ones in rural areas, although this association did not reach a statistical significant with \( P = 0.06 \), overweight and obese individuals had almost two to four times higher odds of being hypertensive compared to the ones with normal weight.

There was a significant association between the 3rd tertile of waist circumference (OR = 1.39, 95% CI 1.11–1.76) and hypertension compared to the 1st tertile.

After adjusting for age-groups, education level had no significant association with hypertension as older people were more hypertensive and less educated. Occupation and alcohol consumption were not significantly associated with the risk of being hypertensive (\( P > 0.05 \)), while people with HIV were found to have a 45% lower risk of raised blood pressure. Detailed results on the bivariate and multivariate analyses are given in Table 3 and Table 4.

Finally we assessed effect modification (interaction) by sex for each of the factors with hypertension, and found no significant interactions. For each sex, similar results were obtained to the combined multivariate analysis.

### Awareness and treatment of hypertension

Figure 1 shows the results for awareness, and treatment of hypertension according to the gender of the 773 hypertensive participants. Of these, overall 72 (9.4%) participants were aware of their hypertension status, with significant differences between women (11.1%) and men (5.3%, \( P < 0.003 \)), and between urban (11.9%) and rural dwellers (7%, \( p < 0.02 \)).

Out of all 773 hypertensive individuals, 59 (7.1%) had been treated with antihypertensive drugs, with a higher frequency (9.2%) in urban areas compared to rural areas (5.3%, \( p < 0.03 \)), and in females (8.5%) compared to males (4.1%, \( p < 0.03 \)).

In all these aspects of hypertension management the elderly group aged 55 years and above were more aware, and more likely to be on treatment for hypertension for both male and female participants, although the differences were not statistically significant (\( p > 0.05 \)).

### Discussion

After integrating blood pressure screening into a long-standing community HIV screening program, we identified 773 cases of hypertension, 8% of the screened population, despite the fact that the screened population was relatively young, with

---

**Table 1. Characteristics of resident’s in Magu HDSS by sex (n = 9678).**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total n (%)</th>
<th>Male n = 3401 (35.1%)</th>
<th>Female n = 6277 (64.9%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) median (IQR)</td>
<td>29 (20–45)</td>
<td>26 (18–44)</td>
<td>31 (21–46)</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>15–24</td>
<td>3763 (38.9%)</td>
<td>1585 (46.7)</td>
<td>2178 (35.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>25–34</td>
<td>2018 (21.2%)</td>
<td>551 (16.2)</td>
<td>1467 (23.7)</td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>1439 (15.0%)</td>
<td>434 (12.8)</td>
<td>1005 (16.2)</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>1043 (10.8%)</td>
<td>345 (10.2)</td>
<td>698 (11.2)</td>
<td></td>
</tr>
<tr>
<td>55+</td>
<td>618 (6.5%)</td>
<td>228 (6.7)</td>
<td>390 (6.3)</td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td>704 (7.3%)</td>
<td>253 (7.4)</td>
<td>451 (7.3)</td>
<td></td>
</tr>
</tbody>
</table>

**Education level**

- None: 2724 (28.2%), 608 (17.9%), 2116 (33.7%) <0.001
- Not completed primary: 658 (6.8%), 304 (8.9%), 354 (5.6%)
- Completed primary: 4798 (49.6%), 1714 (50.5%), 3084 (49.1%)
- Secondary: 1242 (12.8%), 604 (18.0%), 638 (10.2%)
- Tertiary/Other: 249 (2.6%), 166 (4.9%), 83 (1.3%)

**Marital status**

- Single/Never married: 3200 (33.1%), 1691 (49.7%), 1509 (24.1%) <0.001
- Married/Cohabiting: 4991 (51.6%), 1533 (45.1%), 3458 (55.1%)
- Separated/Divorced: 707 (7.3%), 55 (1.6%), 662 (10.4%)
- Widowed: 774 (7.9%), 120 (3.5%), 654 (10.4%)

**Economic activities**

- None: 3484 (36.0%), 1241 (36.5%), 2243 (35.7%) <0.001
- Farming/Livestock keeping: 4675 (48.3%), 1650 (48.5%), 3025 (48.2%)
- Skilled: 1076 (11.1%), 255 (7.5%), 821 (13.1%)
- Unskilled: 443 (4.6%), 255 (7.5%), 188 (3.0%)

**Residence**

- Rural: 6093 (62.9%), 2345 (68.9%), 3748 (59.7%) <0.001
- Urban: 3585 (37.0%), 1056 (31.1%), 2529 (40.3%)

**Ethnicity**

- Sukuma: 8979 (92.8%), 3201 (94.1%), 5778 (92.1%) <0.001
- Other: 698 (7.2%), 200 (5.9%), 498 (7.9%)

**BMI (kg/m²)**

- Mean (SD): 21.2 (3.6), 20.3 (2.8), 21.7 (3.9) <0.001*

**Systolic pressure (mmHg)**

- Mean (SD): 116.2 (15.7), 116.4 (14.5), 116.1 (16.4) 0.69*

**Diastolic pressure (mmHg)**

- Mean (SD): 69.9 (12.4), 69.7 (12.9), 70.0 (12.1) 0.06*

**Blood sugar (mg/dl)**

- Mean (SD): 100.1 (24.1), 99.1 (24.9), 100.6 (23.7) <0.001*
little obesity. The overall prevalence of 8.0% with raised blood pressure obtained from our study in a rural adult population was lower than the studies reviewed by Mfinanga [24] where the prevalence of hypertension was 14.5%, and lower than the study of individuals aged 18 years and above in Mwanza municipality by Kavishe [10] where the prevalence of hypertension was 16.4% (95% CI 11.7%-22.4%). However Mfinanga’s review included studies restricted to elderly individuals aged 70 years and above.

Despite having a lower prevalence of hypertension we had a high prevalence (35%) of pre-hypertension. Similar results have been found in a study in rural Tanzania where more than 45% of individuals aged 18 years and above, had pre-hypertension [4]. These findings highlight the need for urgent public health action to improve knowledge and awareness of hypertension in the population. Our study suggests that existing public health infrastructure such as the community HIV screening program described in this project, might provide valuable platforms for raising knowledge and awareness in the community.

One population-based study in Ethiopia found a prevalence of hypertension of 9.3%, which is similar to the prevalence in our study, although the study was restricted to participants aged 15–64 years. Other studies in Africa which have included individuals aged 15 years and above,

### Table 2. Characteristics of the residents in Magu HDSS by blood pressure status (n = 9678).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total n = 9678</th>
<th>Normal n = 5398 (55.8%)</th>
<th>Pre-Hypertensive n = 3507 (36.2%)</th>
<th>Hypertensive n = 773 (8.0%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3401</td>
<td>1883 (55.4)</td>
<td>1275 (37.5)</td>
<td>243 (7.7)</td>
<td>7.07</td>
</tr>
<tr>
<td>Female</td>
<td>6277</td>
<td>3515 (55.9)</td>
<td>2232 (35.6)</td>
<td>530 (8.5)</td>
<td>(0.029)</td>
</tr>
<tr>
<td><strong>Age (Years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;24</td>
<td>3763</td>
<td>2490 (66.2)</td>
<td>1201 (31.9)</td>
<td>72 (1.9)</td>
<td>0.0011</td>
</tr>
<tr>
<td>25–34</td>
<td>2018</td>
<td>116 (57.6)</td>
<td>771 (38.2)</td>
<td>84 (4.2)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>35–44</td>
<td>1439</td>
<td>772 (53.7)</td>
<td>557 (38.7)</td>
<td>110 (7.6)</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>1043</td>
<td>477 (45.7)</td>
<td>420 (40.3)</td>
<td>146 (14.0)</td>
<td></td>
</tr>
<tr>
<td>55–65</td>
<td>618</td>
<td>225 (36.4)</td>
<td>252 (40.8)</td>
<td>141 (22.8)</td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td>704</td>
<td>224 (31.8)</td>
<td>263 (37.4)</td>
<td>217 (30.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2724</td>
<td>1324 (48.6)</td>
<td>1048 (38.5)</td>
<td>352 (12.9)</td>
<td>251.1</td>
</tr>
<tr>
<td>Not completed primary</td>
<td>658</td>
<td>307 (46.6)</td>
<td>273 (41.5)</td>
<td>78 (11.8)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>Completed primary</td>
<td>4798</td>
<td>2888 (60.2)</td>
<td>1641 (34.2)</td>
<td>269 (5.6)</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>1242</td>
<td>766 (61.7)</td>
<td>432 (34.8)</td>
<td>44 (3.5)</td>
<td></td>
</tr>
<tr>
<td>Tertiary/Other</td>
<td>249</td>
<td>108 (43.4)</td>
<td>112 (45.0)</td>
<td>29 (11.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/Never married</td>
<td>3200</td>
<td>2105 (65.8)</td>
<td>1012 (31.6)</td>
<td>83 (2.6)</td>
<td>613.6</td>
</tr>
<tr>
<td>Married/Cohabiting</td>
<td>4991</td>
<td>2639 (52.9)</td>
<td>1932 (38.7)</td>
<td>420 (8.4)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>707</td>
<td>766 (61.7)</td>
<td>432 (34.8)</td>
<td>44 (3.5)</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>774</td>
<td>401 (51.8)</td>
<td>300 (38.8)</td>
<td>73 (9.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>3484</td>
<td>2143 (61.5)</td>
<td>1088 (31.2)</td>
<td>253 (7.3)</td>
<td>78.5</td>
</tr>
<tr>
<td>Farming/Livestock keeping</td>
<td>4675</td>
<td>2456 (52.5)</td>
<td>1825 (39.1)</td>
<td>394 (8.4)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>Skilled</td>
<td>1076</td>
<td>550 (51.1)</td>
<td>428 (39.8)</td>
<td>98 (9.1)</td>
<td></td>
</tr>
<tr>
<td>Unskilled</td>
<td>443</td>
<td>249 (56.2)</td>
<td>166 (37.5)</td>
<td>28 (6.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>6093</td>
<td>3361 (55.2)</td>
<td>2318 (38.1)</td>
<td>414 (6.8)</td>
<td>45.2</td>
</tr>
<tr>
<td>Urban</td>
<td>3585</td>
<td>2037 (56.8)</td>
<td>1189 (33.2)</td>
<td>359 (10.1)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (18.5)</td>
<td>1915</td>
<td>1281 (66.9)</td>
<td>555 (28.9)</td>
<td>79 (4.1)</td>
<td>407.6</td>
</tr>
<tr>
<td>Normal (18.5–24.9)</td>
<td>6752</td>
<td>3734 (55.3)</td>
<td>2519 (37.3)</td>
<td>499 (7.4)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>Overweight (25–29.9)</td>
<td>758</td>
<td>318 (41.9)</td>
<td>322 (42.5)</td>
<td>118 (15.6)</td>
<td></td>
</tr>
<tr>
<td>Obese (≥30)</td>
<td>239</td>
<td>249 (56.2)</td>
<td>166 (37.5)</td>
<td>74 (16.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Waist circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Tertile</td>
<td>3529</td>
<td>2128 (60.3)</td>
<td>1247 (35.3)</td>
<td>154 (4.4)</td>
<td>243.6</td>
</tr>
<tr>
<td>2nd Tertile</td>
<td>2986</td>
<td>1717 (57.5)</td>
<td>1082 (36.2)</td>
<td>187 (6.3)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td>3rd Tertile</td>
<td>3153</td>
<td>1547 (49.1)</td>
<td>1177 (37.3)</td>
<td>429 (13.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Alcohol consumption</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>8817</td>
<td>4989 (56.6)</td>
<td>3163 (35.9)</td>
<td>666 (7.6)</td>
<td>38.0</td>
</tr>
<tr>
<td>Occasionally &amp; Frequently</td>
<td>495</td>
<td>240 (48.5)</td>
<td>194 (39.2)</td>
<td>61 (12.3)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td><strong>Cigarette smoking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not currently</td>
<td>9035</td>
<td>5092 (56.3)</td>
<td>3243 (35.9)</td>
<td>700 (7.7)</td>
<td>22.7</td>
</tr>
<tr>
<td>Current</td>
<td>642</td>
<td>305 (47.5)</td>
<td>264 (41.1)</td>
<td>73 (11.4)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td><strong>Physical activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>3794</td>
<td>2282 (60.2)</td>
<td>1231 (32.5)</td>
<td>281 (7.4)</td>
<td>48.9</td>
</tr>
<tr>
<td>Moderate /Heavy</td>
<td>5884</td>
<td>3116 (52.9)</td>
<td>2276 (38.7)</td>
<td>492 (8.4)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td><strong>Raised blood sugar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No (199.9 mg/dl)</td>
<td>9487</td>
<td>5306 (55.9)</td>
<td>3425 (36.1)</td>
<td>756 (8.0)</td>
<td>61.9</td>
</tr>
<tr>
<td>Yes (≥200 mg/dl)</td>
<td>27</td>
<td>4 (14.8)</td>
<td>10 (37.0)</td>
<td>13 (48.2)</td>
<td>(&lt;0.001)</td>
</tr>
<tr>
<td><strong>HIV status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>8940</td>
<td>4978 (55.7)</td>
<td>3228 (36.1)</td>
<td>734 (8.2)</td>
<td>8.0</td>
</tr>
<tr>
<td>Positive</td>
<td>738</td>
<td>420 (57.8)</td>
<td>279 (37.9)</td>
<td>39 (5.3)</td>
<td>(0.018)</td>
</tr>
</tbody>
</table>
have shown similar increases in the prevalence of hypertension across the age groups [6,25]. Our results show that age is associated with hypertension, with the prevalence rising to 30% in those aged 65 years or more, which agrees with other studies [2,26,27]. A few studies in Africa have explored hypertension by gender with one showing no difference after adjusting for age [28]. In our study we found a difference in the prevalence of hypertension between males and females after controlling for age and other risk factors. The study found that the effect of alcohol consumption, smoking, and physical activity were not independently associated with the risk of hypertension. These results differ from other studies in Africa where there was strong evidence of an association between these lifestyle factors and hypertension [15]. However, our study had similar results to those obtained by Dzudie [25] in Cameroon, where after adjusting for other socio-demographic factors no association was seen between hypertension and these lifestyle factors. The lack of association in our study might be due to the categorization of alcohol and smoking usage, but is also affected by the small numbers engaging in these risk behaviors in this predominately rural population.

In conclusion, the study found that hypertension is highly prevalent in our study population and that age is a significant risk factor. Other factors that are associated with hypertension include obesity, raised blood pressure, diabetes, and smoking. These findings are important for the prevention and management of hypertension in our study population. However, more studies are needed to fully understand the factors associated with hypertension in this population and to develop effective strategies for its prevention and management.
There was a negative association between HIV-positive infected participants and the risk of hypertension, which agrees with findings by Peck in patients that are antiretroviral therapy (ART) naïve [30]. The association between HIV and hypertension has caused many public health experts to argue for the integration of HIV and hypertension services in Africa. Integration of these services could have the benefits of extending the life span of HIV-infected adults and of increasing ART adherence. Possible risks, though include the financial costs of providing hypertension care in an HIV clinic as well as the human resource issues if health care providers in these clinics are asked to do more work.

Despite hypertension emerging as a public health problem in Sub-Saharan Africa, and being a common cause for cardiovascular disease, the rates of hypertension treatment are still very low. Even in developed countries, studies have shown that the awareness and management of hypertension are low, especially in men [27,31]. Our study shows similar findings with <10% of participants with hypertension reporting awareness of their status and only 7% reporting previously receiving treatment. These rates of awareness are even lower than other studies from Africa which showed awareness rates of 29% [32] and 18% [2]. A study in Ghana found similar results to our study with 7.4% of those with hypertension aware of their condition, 4.0% on treatment, and 3.5% having controlled blood pressure [33]. The low rates of treatment are likely related to problems with cost and availability of hypertension drugs. In our study

Table 4. Multivariate logistic regression to determine the factors associated with hypertension in Magu HDSS.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Participants (n = 9678)</th>
<th>Adjusted OR (95% C.I)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.00 (Referent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.64 (0.52 – 0.79)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Age(Years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–24</td>
<td>0.13 (0.09 – 0.20)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>0.27 (0.20 – 0.37)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>0.52 (0.39 – 0.68)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>1.00 (Referent)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>55–65</td>
<td>1.71 (1.30 – 2.26)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td>2.54 (1.90 – 3.39)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st tertile</td>
<td>1.00 (Referent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd tertile</td>
<td>1.07 (0.85 – 1.36)</td>
<td>0.551</td>
<td></td>
</tr>
<tr>
<td>3rd tertile</td>
<td>1.36 (1.08 – 1.72)</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>BMI(kg/)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (18.5)</td>
<td>0.51 (0.39 – 0.67)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Normal (18.5–24.9)</td>
<td>1.00 (Referent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight (25–29.9)</td>
<td>1.74 (1.35 – 2.25)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Obese (30)</td>
<td>3.45 (2.44 – 4.86)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Raised blood sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No (&lt;199.9 mg/dl)</td>
<td>1.00 (Referent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (&gt; 200 mg/dl)</td>
<td>4.86 (2.06 – 11.48)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>HIV Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>1.00 (Referent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>0.56 (0.39 – 0.79)</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Education level, marital status, residence, alcohol consumption and cigarette smoking were insignificant after adjustment.

Figure 1. Awareness and treatment of hypertension by gender and residence among residents of Magu HDSS by sex (n = 773).
setting, for example, hypertension drugs are often not available in public clinics. Although hypertension drugs are available in private clinics and pharmacies, the monthly cost of these drugs often is greater than the average monthly income of many families.

These results show that there is an urgent need for interventions to raise awareness of hypertension, and to help modify lifestyle behaviors in reducing the risk of raised blood pressure. This can include information on the use of alcohol and smoking as well as encouragement to maintain a good diet, as this population is mostly rural, with farming being the main occupation, and located just 20 km from the second largest city in Tanzania. Management of the demographic transition in this population must include advice about lifestyle and dietary choices to reduce the risk of hypertension and to control their blood pressure.

Conclusion

The findings from our study show that hypertension is high even in rural Tanzania, especially in older people. The pre-hypertension prevalence of 36.2% means that more individuals are at risk of developing hypertension, which is a major concern to health planners. Modification of lifestyle through knowledge provision and dietary intake will be an effective strategy in hypertension management, but this requires a strong, national public health messages. Through the integration of the screening for hypertension into routine clinics for HIV, diabetes, and other chronic diseases, many undiagnosed cases can be identified. If this is combined with proper treatment of hypertension then the consequences, such as cardiovascular disease and stroke, can be avoided, but this requires improvements of the clinical services in health facilities.

Acknowledgments

We thank the regional and district health authorities for permission to carry out the study. We acknowledge the hard work of the study teams in collecting and managing the data for the study. We acknowledge the inputs from the TAZAMA project, and the National Institute for Medical Research in Mwanza to organize the study. We thank the study participants for their time and patience in attending the survey and providing the responses for these data.

This analysis was carried out as part of the MSc studies of NM, who would like to thank all those who helped to make the study possible. Dr. Peck is supported by a grant from the National Institute of Health (K01 TWO10281).

Author contributions

NM, MU and JT designed the study. NM, JT, IM, JA and MM conducted or contributed to the data analysis. NM, JT, IM, JA, RP and MM interpreted the data. NM, JT and MM prepared the original manuscript. All co-authors contributed to subsequent revisions and approved the final version. NM is the guarantor of the manuscript. All authors read and approved the final manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics and consent

Ethics approval was obtained from Ethics Advisory Group, The Union, Paris, France and Ethics Review Committee at Department of Medical Research, Yangon. Permission to conduct the study was taken from NAP Myanmar. As this study involved analysis of secondary programmatic data, waiver of informed consent was sought and obtained from the ethics committees.

Funding information

The Magu HDSS Round 7 was funded by Wellcome Trust, the UK’s Department for International Development (DfID), the Bill and Melinda Gates Foundation (through the ALPHA network) and the US NIH (through the IcDEA consortium).

The analysis and work for this paper was supported through the DELTAS Africa Initiative grant # DEL-15-011 to THRIVE-2. The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)’s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa’s Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust grant # 107742/Z/15/Z and the UK government. The views expressed in this publication are those of the author(s) and not necessarily those of AAS, NEPAD Agency, Wellcome Trust or the UK government.

Paper context

Hypertension is a public health problem; and as Tanzania is now facing nutrition transition the risk of non-communicable diseases increases. Hence, appropriate measures should be taken by identifying and managing these patients. Determining the magnitude, awareness, and the contributing factors of hypertension in this HIV-surveillance community will be an added advantage. Findings from this study will have an important role in provision of preliminary information on the magnitude and severity of the problem and will also help in identifying proper management strategies as now we are faced with a double burden of diseases.

References


