Uncovering the high burden of hypertension and its predictors among adult population in Hosanna town, southern Ethiopia: a community-based cross-sectional study

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ABSTRACT

Objective Hypertension is a global public health problem, with its burden increasing particularly in developing countries. However, it has not yet received due attention in Ethiopia. The aim of this study was to determine the prevalence and associated factors of hypertension among adult population in Hosanna town, southern Ethiopia.

Design Community-based cross-sectional study.

Setting Hosanna town, southern Ethiopia.

Participants Adult population aged ≥18 years (n=634) were recruited by a multistage stratified sampling technique.

Outcome measures A face-to-face interview using structured questionnaire was carried out by trained nurses. Anthropometry and blood pressure were measured following standard procedures. Hypertension status was defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg in two separate measurements or reported use of prescribed antihypertensive drugs for raised blood pressure.

Factors associated with hypertension were identified by multivariable binary logistic regression analysis.

Results The overall prevalence of hypertension was found to be 17.2% (19.3% and 14.2% among men and women, respectively). About 40% were unaware that they were hypertensive prior to the study. Older age ≥35 years (adjusted OR=3.9, 95% CI: 1.4 to 10.8), alcohol use (adjusted OR=3.4, 95% CI: 1.4 to 8.3), consumption of saturated oil (adjusted OR=6.5, 95% CI: 1.5 to 17.5) and unspecified different types of oil (adjusted OR=8.2, 95% CI: 1.9 to 25.1) and overweight/obesity (adjusted OR=2.9, 95% CI: 1.9 to 4.6) were found to be independently associated with hypertension.

Conclusions The prevalence of both diagnosed and undiagnosed hypertension is alarmingly high in the town. These findings underscore the need to design health information provision systems on the risk factors of hypertension and promote good health practices. Blood pressure screening programmes at community levels to identify and treat undiagnosed hypertension should be considered.

INTRODUCTION

Hypertension is a state of high blood pressure and a leading risk factor for cardiovascular diseases (CVDs), globally. Non-communicable diseases (NCDs) accounted for 72.3% of global deaths in 2016, of which more than 50% were attributed to cardiovascular problems. There is a declining trend in CVDs in developed countries due to effective interventions, but the burden of CVDs is on the rise in developing countries such as Ethiopia.

In Ethiopia, according to the finding from the WHO STEPS survey of 2015, the prevalence of hypertension was found to be 15.8%. There are also few studies that reported the prevalence of hypertension ranging from 8% to 35%. Moreover, the prevalence of undiagnosed hypertension (those who are neither aware of the raised blood pressure nor are taking any antihypertensive medication) is high in Ethiopia. Undiagnosed hypertension may pose a serious problem, as it is asymptomatic. Although little is known about the study area, reasons reported for the high burden of hypertension disorder in Ethiopia are lifestyle change and effect of urbanisation and globalisation.
Our study area (Hosanna town) is known for its rapid urbanisation and population growth due to in-migration of the surrounding rural people. The lifestyle of these rural people gets altered when they start living in the town, which may pose them at risk of hypertension. However, to our knowledge, there is only one study in the town conducted in 2014 by recruiting adults aged 25–64 years. However, the study was not representative and was limited in assessing several risk factors of hypertension. Although the prevalence of hypertension is known to be varying from place to place and time to time, previous studies conducted in Ethiopia have reported inconsistent and inconclusive findings regarding the risk factors. Moreover, prior studies were limited in assessing dietary risk factors, overweight/obesity, physical activity and behavioural risk factors. Evidence of the burden of hypertension is inadequate to direct the decision-making abilities of the health system policymakers, programmes and actors, which in turn has an implication on budget allocation and resource distribution. There have been many investments to prevent and control communicable diseases in the town, but appropriate attention has not yet been given for the control of NCDs, including hypertension. Therefore, this study aimed to determine the prevalence of hypertension and its associated factors among adult population (≥18 years) using a community-based study design and WHO STEPS approach for surveillance of chronic NCDs. The findings of this study can be used to guide hypertension prevention and control activities in Ethiopia and in similar low-income countries.

MATERIALS AND METHODS

Study setting and population

Data for this study were obtained from the community-based cross-sectional study conducted from 15 May to 20 May 2017 among selected adult population (≥18 years) in Hosanna town, southern Ethiopia.

Sample size and sampling procedures

The sample size (n=634) was estimated using a single population proportion formula by considering 95% confidence level, 5% margin of error, 41% prevalence of undiagnosed hypertension in sub-Saharan Africa and design effect of 1.5% and 10% non-response rate. The sample size determined was for the prevalence study, and the correlations are secondary analysis.

Multistage stratified sampling technique was used to recruit the samples included in the study. In the first stage, of the total three subcities of the town, three kebeles (lowest administrative unit in Ethiopia) from each were selected randomly by lottery method (a total of nine kebeles). The number of households to be included from each kebele was allocated proportionally to the population. Then, households to be included in the study were selected by simple random sampling technique (computer-based random number generator) using the health extension workers’ family folder and registry as a sampling frame. In Ethiopian health system, the lowest health facility located near a community is called health post. In this facility, the health extension workers provide basic services such as immunisation, family planning, ante-natal care, health education, nutritional supplements and some level of treatment for different disease conditions. To facilitate these, the health extension workers have a family folder for each household (family) in their catchment. Each of the family folders contains information such as the address of the household, list of individuals in that family and their age groups, and different household characteristics (eg, type of latrine they have). The health extension workers follow all the population in their catchment based on the family folder and update any vital events such as birth and death. Moreover, the health extension workers have the overall list (registry) of the population in their catchment area. The research team used this list of individuals as a sampling frame to select participants for the study. All the eligible individuals in the selected households were included in the study. The individuals who were critically ill and unable to respond to the interview were excluded from the study.

Patient and public involvement

Neither patients nor the public were involved in the development of this study.

Data collection procedures

A structured questionnaire which is adapted from the WHO STEPS instrument was used to collect data (see online supplemental file 1). The WHO STEPS questionnaire is a standard instrument for surveillance of NCDs and their risk factors. Information on sociodemographic characteristics, behavioural and medical-related questions, and physical and blood pressure measurements was collected. The data collectors were eight trained clinical nurses who were working in the study area and able to speak local language.

Face-to-face interview was conducted at home level after the interviewers explained the purpose of the study and obtained the participant’s informed consent to participate in the study. Eligible participants were declared unavailable if they were not found on three separate visits. After completion of the face-to-face interview, all participants were given appointment for physical and blood pressure measurements to be taken at the nearest outreach sites (health centres). All study instruments were translated into local language (Amharic) by native speakers and then back-translated to English by another person who understood the language, for consistency. Instruments used for measuring physical dimensions such as weight scale and height measuring board were calibrated in a daily basis and checked after each measurement. Daily supervision was made in the field during data collection by the investigators.

Two separate blood pressure measurements were taken using digital blood pressure measuring apparatus (Beurer BM 47 Upper Arm Blood Pressure Monitor). The
right arm was used for this measurement. The displayed reading of the systolic and diastolic blood pressure was recorded. Participants took rest for 10 min between each reading. The average of two blood pressure measurements was taken. Height was measured by a sliding metre and read in centimetres to the nearest 0.1 cm and recorded. Weight was measured using a digital weighing scale (UNICEF seca) and recorded in kilograms to the nearest 0.1 kg.7–10

Physical activity was measured using the WHO physical activity questionnaire.19 The questionnaire assesses work-related activity, walking, sport and recreational activity, and time spent on sitting per day. Work-related activities were categorised as work involving vigorous-intensity and moderate-intensity activities. Work involving vigorous-intensity activity was measured by asking the question, ‘Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate (carrying or lifting heavy loads, digging or construction work) for at least 10 min continuously?’ and work involving moderate-intensity activity was measured by asking the question, ‘Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking (or carrying light loads) for at least 10 min continuously?’ Based on this, an adult person should do at least 150 min of moderate-intensity work (aerobic physical activity) or 75 min of vigorous-intensity work (aerobic physical activity) or 60 min of combination of vigorous-intensity and moderate-intensity work (aerobic physical activity) per week. If the self-reported physical activity did not fit with the WHO recommendation, participants were categorised as physically inactive.19

Operational definitions and measurement of variables
Hypertension status of participants was defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg in two separate measurements or reported use of prescribed antihypertensive drugs for raised blood pressure. Undiagnostic hypertension was defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg, but the participants being unaware of it prior to the study.7–10

Current smoking and current alcohol use was defined as using tobacco products and alcohol within the preceding month prior to the survey, respectively.7–19 Age of the study participants was dichotomised during the analysis as below and above the median age of the study participants (35 years) based on the data of the study (post hoc). The educational status of the study participants was categorised as illiterate, if they were unable to write and read, and literate, if they were able to write and read.

Weight divided by height squared (kg/m²) was used to compute the body mass index (BMI). Then, BMI was categorised as normal, if it was <25 kg/m²; overweight, if it was from 25 kg/m² to 29.9 kg/m²; and obese, if it was ≥30 kg/m². However, for the analysis, we categorised weight into two groups as normal and abnormal BMI (merging the overweight and obese group).7–10

Data management and analysis
Data were checked, cleaned and entered into Epi data V.3.1 software and then imported to SPSS V.20.0 software for analysis. Incomplete and inconsistent data were excluded from the analysis. Descriptive statistics were used to summarise the data by frequency, percentage, mean and SD. The prevalence of hypertension was described using the proportion and 95% CI. Associations between independent variables and hypertension were analysed first using bivariate analysis (χ² test and binary logistic regression) to identify factors eligible for multivariable analysis. Those variables with a value of p<0.25 in the bivariate analysis were included in the multivariable logistic regression analysis. The magnitude of the association between independent and dependent variables was measured using OR and 95% CI, and a value of p<0.05 was considered statistically significant. Multicollinearity between variables was assessed using the multicollinearity diagnostics (variance inflation factor and tolerance test). The final multivariable binary logistic regression model was found to be fit based on the finding of the Hosmer-Lemeshow goodness-of-fit test.

RESULTS
Sociodemographic characteristics of the participants
A total of 627 participants’ data were analysed (response rate of 98.9%). The majority of participants (58.5%) were men, and the mean age of the participants was 36 (±11.6) years. The age of the study participants ranged from 20 to 80 years. About two-thirds of the participants were married (65.6%) and one-third was self-employed (31.6%). Of all the participants approached, 95% indicated that they had formal education and were able to read and write (table 1).

Prevalence of hypertension
The mean systolic and diastolic blood pressure was 123.4 (±14.3) mm Hg and 75.3 (±9.3) mm Hg, respectively. The overall prevalence of hypertension was found to be 17.2% (95% CI: 14.5% to 19.9%), which was higher in men (19.3%) than in women (14.2%). The majority of hypertensive participants were found (29.6%) to be in the age group of 45–54 years. Among all the hypertensive people identified (n=108), a significant proportion (39.8%) were not aware that they had raised blood pressure prior to the study; thus, they were newly diagnosed. The majority of participants who were aware that they were hypertensive were taking dietary modifications (90.8%). Nearly half of the participants (45.9%) were ever screened for raised blood pressure; of them, 22.6% were informed that they have raised blood pressure (table 2).

Factors associated with hypertension
In the bivariate analysis, older age ≥35 years, current tobacco use, alcohol use, abnormal BMI and type of oil
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Commonly used were found to be significantly associated with hypertension (table 3).

Overall, 4.6% of the participants indicated that they were current smokers of tobacco products. Among the current smokers, 38% were found to be hypertensive.

The proportion of current alcohol drinkers was 15.9%, with majority of them being in the age category of 35–44 years. Among the current alcohol drinkers, 34% were found to be hypertensive. One week prior to the survey, about 20% and 9% of participants did not consume fruits and vegetables, respectively. A quarter (25.9%) and 13% of those who did not consume fruits and vegetables were hypertensive, respectively.

A high proportion (87.5%) and more than one-third (37%) of the participants commonly used saturated fats (oils) and unspecified different types of fats (oils) for meal preparation, respectively. Thirty percent of the participants had more than two times meal outside of their home. Nearly half (51.9%) of those who commonly used saturated fats and unspecified different types of fats for meal preparation were found to be hypertensive.

Regarding the participants’ physical activity, more than three-fourths (83%) of the participants’ physical activity did not meet the WHO recommendations. In addition, 9.4% of the participants spent more than 8 hours per day sitting.

The mean height and weight of the participants were 169 (±4.2) cm and 66.98 (±8.2) kg, respectively. The mean BMI of the participants was 23.63 (±3.4) kg/m², which is 23.46 kg/m² among men and 23.87 kg/m² among women. About a quarter of the participants (24.4%) were with abnormal BMI (either overweight or obese). Nearly half of those with abnormal BMI were hypertensive.

In further multivariable analysis after adjusting for confounding variables (sex, age, smoking status and alcohol drinking), hypertension was significantly associated with age ≥35 years, current alcohol drinking, commonly using saturated and unspecified types of oils, and abnormal BMI. However, other variables such as sex, smoking status, fruit and vegetable consumption, and time spent on sitting were not significantly associated with hypertension (table 4).

The odds of hypertension among participants aged ≥35 years were four times higher compared with those of younger ones (adjusted OR=3.97, 95% CI: 1.45 to 10.83).

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**Table 1** Sociodemographic characteristics of study participants in Hosanna town, southern Ethiopia, 2017 (n=627)

| Variable          | Category     | Frequency (%) |
|-------------------|--------------|---------------|
| Sex               | Male         | 367 (58.5)    |
|                   | Female       | 260 (41.5)    |
| Age               | <25 years    | 112 (17.9)    |
|                   | 25–34 years  | 203 (32.4)    |
|                   | 35–44 years  | 155 (24.7)    |
|                   | 45–54 years  | 105 (16.7)    |
|                   | 55–64 years  | 40 (6.4)      |
|                   | ≥65 years    | 12 (1.9)      |
| Marital status    | Single       | 216 (34.4)    |
|                   | Married      | 411 (65.6)    |
| Educational status| Illiterate   | 32 (5.1)      |
|                   | Literate     | 595 (94.9)    |
| Occupation        | Government employed | 181 (28.9) |
|                   | NGO employed | 38 (6.1)      |
|                   | Self-employed| 198 (31.6)    |
|                   | Student      | 59 (9.5)      |
|                   | Housewife    | 87 (13.9)     |
|                   | Retired      | 21 (3.3)      |
|                   | Unemployed   | 43 (5.8)      |

NGO, non-governmental organisation.

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**Table 2** Prevalence of hypertension among adult population in Hosanna town, southern Ethiopia, 2017

| Variables                                      | Frequency (%) | 95% CI       |
|------------------------------------------------|---------------|--------------|
| Overall hypertensive (n=627)                   |               |              |
| Yes                                            | 108 (17.2)    | 14.5 to 19.9 |
| No                                             | 519 (82.8)    | 80.1 to 85.5 |
| Hypertension in the age groups                  |               |              |
| <25 years (n=112)                              | 7 (6.3)       | 2.2 to 11.2  |
| 25–34 years (n=203)                            | 18 (8.9)      | 4.9 to 13.0  |
| 35–44 years (n=155)                            | 28 (18.1)     | 12.0 to 24.1 |
| 45–54 years (n=105)                            | 32 (30.5)     | 21.7 to 39.8 |
| 55–64 years (n=40)                             | 15 (37.5)     | 22.0 to 52.8 |
| ≥65 years (n=12)                               | 8 (66.7)      | 62.9 to 82.6 |
| Ever screened for raised blood pressure by a healthcare provider (n=627) |               |              |
| Yes                                            | 288 (45.9)    | 42.1 to 49.9 |
| No                                             | 339 (54.1)    | 50.1 to 57.9 |
| Told that they had raised blood pressure (n=228) |               |              |
| Yes                                            | 65 (22.6)     | 17.8 to 28.9 |
| No                                             | 223 (77.4)    | 71.2 to 80.3 |
| Measures taken to control their raised blood pressure (n=65) |           |              |
| Taking antihypertensive drugs                   | 30 (46.2)     | 32.8 to 57.8 |
| Dietary modifications                          | 59 (90.8)     | 83.1 to 96.9 |
| Weight loss measures                           | 47 (72.3)     | 60.0 to 83.1 |
| Doing regular exercise                         | 21 (32.3)     | 20.3 to 42.2 |
| Taking traditional medication                  | 16 (24.6)     | 13.8 to 35.4 |
Similarly, the odds of hypertension among current alcohol drinkers were three times higher compared with those of non-drinkers (adjusted OR=2.9, 95% CI: 1.1 to 7.6). Moreover, the odds of hypertension among participants who commonly used saturated oil (adjusted OR=6.5, 95% CI: 1.5 to 17.5) and unspecified different types of oils (adjusted OR=8.2, 95% CI: 1.9 to 25.1) for cooking meals were higher compared with those who commonly used vegetable oils for cooking meals. Furthermore, the odds of hypertension among overweight/obese individuals were three times higher compared with those with normal weight (adjusted OR=2.7, 95% CI: 1.7 to 4.3).

**DISCUSSION**

The burden of hypertension and its associated cardiovascular problems are increasing in developing countries like Ethiopia.\(^1\)\(^2\)\(^3\)\(^4\) This study found out the overall prevalence of hypertension to be 17.2% in Hosanna town. Nearly one in every five adults in Hosanna town had hypertension. About 4 (40%) out of 10 people in the town were not aware of that they were hypertensive prior to the study. This finding of our study has a public health implication and it should be considered as a major public health problem of the community. Hypertension is asymptomatic until complications arise and may cause serious health problems which include sudden death due to cardiac problems, if left unrecognised and untreated. The high proportion of undiagnosed (unaware) hypertension calls for different public health interventions like providing hypertension screening programmes at the community level.\(^20\)\(^-\)\(^23\)

| Table 3 | Bivariate analysis showing factors associated with hypertension in Hosanna town, southern Ethiopia, 2017 |
|----------|-------------------------------------------------|
| Variables | Hypertension | | | | |
| | Yes | No | COR (95% CI) | P value | |
| Sex | | | | | |
| Male | 71 (19.3%) | 296 (79.7%) | 1.5 (0.9 to 2.2) | 0.18 | |
| Female | 37 (14.2%) | 223 (75.8%) | 1.0 | | |
| Age | | | | | |
| <35 years | 25 (7.6%) | 306 (92.4%) | 1.0 | | |
| ≥35 years | 83 (28.0%) | 213 (72.0%) | 4.8 (2.9 to 7.7) | 0.007* | |
| Current smoker | | | | | |
| No | 97 (16.2%) | 501 (83.8%) | 1.0 | | |
| Yes | 11 (37.9%) | 18 (62.1%) | 3.2 (1.5 to 6.9) | 0.71 | |
| Current alcohol drinker | | | | | |
| No | 11 (20.4%) | 43 (79.6%) | 1.0 | | |
| Yes | 21 (46.7%) | 24 (53.3%) | 3.4 (1.4 to 8.3) | 0.03* | |
| Did not consume fruit and/or vegetables in the last week | | | | | |
| No | 87 (16.1%) | 454 (83.9%) | 1.0 | | |
| Yes | 21 (24.4%) | 65 (75.6%) | 1.7 (0.9 to 2.9) | 0.2 | |
| Type of oil used | | | | | |
| Vegetable oils | 3 (3.8%) | 75 (96.2%) | 1.0 | | |
| Saturated fat | 56 (17.7%) | 261 (72.3%) | 5.3 (1.6 to 17.6) | 0.01* | |
| Different types | 49 (21.1%) | 183 (78.9%) | 6.7 (2.0 to 22.1) | 0.004* | |
| Physical activity | | | | | |
| Did not meet WHO recommendation | 92 (17.7%) | 428 (72.3%) | 1.2 (0.7 to 2.2) | 0.49 | |
| Met WHO recommendation | 16 (14.9%) | 91 (85.1%) | 1.0 | | |
| Time spent on sitting | | | | | |
| <8 hours | 90 (15.9%) | 477 (84.1%) | 1.0 | | |
| ≥8 hours | 18 (30.0%) | 42 (70.0%) | 2.3 (1.3 to 4.2) | 0.1 | |
| BMI category | | | | | |
| Abnormal | 49 (29.9%) | 115 (70.1%) | 2.9 (1.9 to 4.6) | 0.0001* | |
| Normal | 58 (12.5%) | 405 (87.5%) | 1.0 | | 

*Significantly associated in the bivariate binary logistic regression analysis and \(\chi^2\) test.

COR, crude OR.
The prevalence of hypertension in this study is comparable with the findings from other towns of Ethiopia such as Hawassa (19.7%), Mekelle (19.1%) and the Ethiopian national prevalence (15.8%). However, the prevalence of hypertension in this study is higher than that reported from the studies conducted in other towns of Ethiopia such as Jimma (13.2%) and Sidama zone (9.9%). Moreover, the prevalence of hypertension in this study is higher than that reported from the study in North West Tanzania (8.0%) and lower than that reported from the studies conducted in an urban slum in Nairobi, Kenya (29.4%) and rural Limpopo province of South Africa (41.4%). The discrepancy in the prevalence of hypertension is due to the difference in urban–rural settings of the studies, the age group of the study participants and difference in the lifestyles of the population in the study areas. Our study is based on urban adult population aged ≥18 years, whereas the study conducted in the urban slum in Nairobi, Kenya, included individuals aged 35–64 years. The higher prevalence in the rural Limpopo province of South Africa might be attributed to their higher tobacco smoking and alcohol use.

This study revealed that hypertension is associated with older age, alcohol drinking, utilisation of saturated fats/oils or unspecified different types of fats/oils and abnormal BMI. Similar to other studies, we found that the prevalence of hypertension increased with age, which might be due to changes that occur in the walls of blood vessels as age increases. Consumption of excessive saturated fat/oil is also associated with hypertension. This is because the body will convert saturated fats into cholesterol, which in turn will narrow the arteries and raise resistance in the blood vessels, resulting in high blood pressure. Studies also identified that abnormal BMI (obesity) is associated with hypertension.

This study used a community-based design, which allows generalisation to the population of the town. Moreover, the study included participants’ interview and physical measurements using standard procedures, which allowed

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**Table 4** Multivariable logistic regression analysis showing factors associated with hypertension in Hosanna town, southern Ethiopia, 2017 (n=627)

| Variables                                      | Hypertension | Se     | COR (95% CI) | AOR (95% CI) | P value |
|------------------------------------------------|--------------|--------|--------------|--------------|---------|
| Sex                                            |              |        |              |              |         |
| Male                                           | 71           | 296    | 1.5 (0.9 to 2.2) | 0.5 (0.2 to 1.4) | 0.18    |
| Female                                         | 37           | 223    | 1.0          | 1.0          |         |
| Age                                            |              |        |              |              |         |
| <35 years                                      | 25           | 306    | 1.0          | 1.0          |         |
| ≥35 years                                      | 83           | 213    | 4.8 (2.9 to 7.7) | 3.8 (1.4 to 10.8) | 0.007*  |
| Current smoker                                 |              |        |              |              |         |
| No                                             | 97           | 501    | 1.0          | 1.0          |         |
| Yes                                            | 11           | 18     | 3.2 (1.5 to 6.9) | 0.8 (0.2 to 2.7) | 0.71    |
| Current alcohol drinker                        |              |        |              |              |         |
| No                                             | 11           | 43     | 1.0          | 1.0          |         |
| Yes                                            | 21           | 24     | 3.4 (1.4 to 8.3) | 2.9 (1.1 to 7.6) | 0.03*   |
| Did not consume fruit and/or vegetables in the last week | |        |              |              |         |
| No                                             | 87           | 454    | 1.0          | 1.0          |         |
| Yes                                            | 21           | 65     | 1.7 (0.9 to 2.9) | 1.5 (0.8 to 2.6) | 0.2     |
| Type of oil used                               |              |        |              |              |         |
| Vegetable oils                                 | 3            | 75     | 1.0          | 1.0          |         |
| Saturated fat                                  | 56           | 261    | 5.4 (1.6 to 17.6) | 6.5 (1.5 to 17.5) | 0.01*   |
| Different types                                 | 49           | 183    | 6.7 (2.0 to 22.1) | 8.2 (1.9 to 25.1) | 0.004*  |
| Time spent on sitting                          |              |        |              |              |         |
| <8 hours                                       | 90           | 477    | 1.0          | 1.0          |         |
| ≥8 hours                                       | 18           | 42     | 2.3 (1.3 to 4.2) | 1.7 (0.9 to 3.2) | 0.1     |
| BMI categories                                 |              |        |              |              |         |
| Abnormal                                       | 49           | 115    | 2.9 (1.9 to 4.6) | 2.7 (1.7 to 4.3) | 0.0001* |
| Normal                                         | 58           | 405    | 1.0          | 1.0          |         |

*Significantly associated in the multivariable binary logistic regression model.

AOR, adjusted OR; BMI, body mass index; COR, crude OR.
us to triangulate the study findings from different sources. However, this study has limitations since it has used cross-sectional study design and some of the variables were taken for the study period only. For instance, nutrition-related questions were assessed for 1 week preceding the survey and might not represent the usual pattern of lifestyles and are prone to recall bias.

CONCLUSIONS
In sum, the prevalence of hypertension in the town is exceedingly high. Significant proportions (40%) of adults were unaware that they had hypertension prior to the study. This is also related to modifiable risk factors such as alcohol drinking, saturated fat/oil consumption, overweight/obesity and physical inactivity. Therefore, due consideration should be given for prevention and control of hypertension by designing health information provision systems on the risk factors of hypertension and promotion of good health practices. Particular attention should be given on the type of oil that people should commonly consume. Moreover, the health departments should facilitate blood pressure screening programmes at community levels to identify and treat undiagnosed hypertension.

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REFERENCES
1 Global burden of diseases collaborators. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the global burden of disease study 2016. The Lancet 2017;390:1151–210.
2 Cooper RS, Kaufman JS, Bovet P. Global burden of disease attributable to Hypertension Global burden of disease attributable to Hypertension Letters. Jama 2017;317:2017–8.
3 Forouzanfar MH, Liu P, Roth GA, et al. Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990–2015. JAMA 2017;317:165–82.
4 Bromfield S, Muntner P. High blood pressure: the leading global burden of disease risk factor and the need for worldwide prevention programs. Curr Hypertens Rep 2013;15:134–6.
5 Gebremariam LW, Chiang C, Yatsuya H, et al. Non-communicable disease risk factor profile among public employees in a regional city in northern Ethiopia. Sci Rep 2018;8:9298.
6 Tefera YG, Abegaz TM, Abebe TB, et al. The changing trend of cardiovascular disease and its clinical characteristics in Ethiopia: hospital-based observational study. Vasc Health Risk Manag 2017;13:143–5.
7 Gebreyes YF, Gosho DY, Gelelew TK, et al. Prevalence of high blood pressure, hyperglycemia, dyslipidemia, metabolic syndrome and their determinants in Ethiopia: evidences from the National NCDS steps survey, 2015. PLoS One 2018;13:e0194819.
8 Esayas A, Tesfamariam T, Kassa D. Prevalence of hypertension and associate risk factors among workers at Hawassa University, Ethiopia: an institution based case cross sectional study. Vasc Med Surg 2018;06:1.
9 Giday A, Tadesse B. Prevalence and determinants of hypertension in rural and urban areas of southern Ethiopia. Ethiop Med J 2011;49:138–47.
10 Asresaghen H, Tadesse F, Beyene E. Prevalence and associated factors of hypertension among adults in Ethiopia: a community based cross-sectional study. BMC Res Notes 2017;10:629.
11 Gudina EK, Michael Y, Assegid S. Prevalence of hypertension and its risk factors in Southwest Ethiopia: a hospital-based cross-sectional survey. Integ Blood Press Control 2013;6:111–7.
12 Helelo TP, Gelaw YA, Adane AA. Prevalence and associated factors of hypertension among adults in Durame town, southern Ethiopia. PLoS One 2014;9:e112790.
13 Abegaz TM, Abdelaa OA, Bhagavathula AS, et al. Magnitude and determinants of uncontrollable blood pressure among hypertensive patients in Ethiopia: hospital-based observational study. Pharm Pract 2018;16:1173.
14 Kobaalew EB, Tbras T, Roman N, et al. Magnitude and associated factors of hypertension in Addis Ababa public health facilities, Ethiopia. MOJ Public Health 2018;7:280–6.
15 Senbeta GA, Yeweyenhareq F, Miftah A. Prevalence of hypertension and pre-hypertension in Addis Ababa, Ethiopia: a survey done in recognition of World hypertension day. Ethiop J Health Dev 2015;29:1–70.
16 Kibret KT, Mesfin YM. Prevalence of hypertension in Ethiopia: a systematic meta-analysis. Public Health Rev 2015;36:14.
17 Bonsa F, Gudina EK, Hajiitko KW. Prevalence of hypertension and associated factors in Bedele town, Southwest Ethiopia. Ethiop J Health Sci 2014;24:21.
18 Assfaw LS, Ayanto SY, Gurmamo FL. Hypertension and its associated factors in Hosanna town, southern Ethiopia: community based cross-sectional study. BMC Res Notes 2018;11:306.
19 WHO. WHO/STEP wise approach to surveillance (STEPS), 2016. Available: https://www.who.int/ncds/surveillance/steps/instrument/en/.
20 Feven A, Sebhat E, Stephen K, et al. Burden of undiagnosed hypertension in sub-Saharan Africa. Hypertension 2014;65:291–8.
21 Hillary KW, Judy AH, Janet SW. Patients with undiagnosed hypertension. JAMA 2014;312:1973–4.
22 Undavalli VK, M, P H N, Praveen M, Narin H. Prevalence of undiagnosed hypertension: a public health challenge. Int J Community Med Public Health 2018;5:1366.
23 Anteneh ZA, Yaliew WA, Abibet DB. Prevalence and correlation of hypertension among adult population in Bahir Dar City, Northwest Ethiopia: a community based cross-sectional study. Int J Gen Med 2015;8:175–85.
24 Moshia NR, Mahande M, Juma A, et al. Prevalence,awareness and factors associated with hypertension in North West Tanzania. Glob Health Action 2017;10:132179.
25 Olack B, Wabwire-Mangen F, Smeeth L, et al. Risk factors of hypertension among adults aged 35–64 years living in an urban slum Nairobi, Kenya. BMC Public Health 2014;15:1251.
26 Nhu ST, Maimela E, Alberts M, et al. Prevalence and associated risk factors of hypertension amongst adults in a rural community of
Limpopo Province, South Africa. *Afr J Prim Health Care Fam Med* 2015;7:847.

27 Wamala JF, Karyabakabo Z, Ndungutse D, et al. Prevalence factors associated with hypertension in Rukungiri district, Uganda—a community-based study. *Afr Health Sci* 2009;9:153–60.

28 Wang L, Manson JE, Forman JP, et al. Dietary fatty acids and the risk of hypertension in middle-aged and older women. *Hypertension* 2010;56:598–604.

29 Peltzer K, Phaswana-Mafuya N, Karl P. Hypertension and associated factors in older adults in South Africa. *Cardiovasc J Afr* 2013;24:67–71.
## QUESTIONNAIRE

### Socio-demographic characteristics

| No. | Questions                                                                 | response | Remark |
|-----|---------------------------------------------------------------------------|----------|--------|
| 101 | Sex (Record Male/Female as observed)                                      | 1. Male  |        |
|     |                                                                           | 2. Female |        |
| 102 | How old are you?                                                         | _______ Years |     |
| 103 | What is your ethnic background?                                          | 1. Hadiya |        |
|     |                                                                           | 2. Kembata |       |
|     |                                                                           | 3. Silte |         |
|     |                                                                           | 4. Gurage |         |
|     |                                                                           | 5. Amhara |         |
|     |                                                                           | 6. Others | _____________ |
| 104 | What is your marital status?                                              | 1. Single |        |
|     |                                                                           | 2. Married |        |
|     |                                                                           | 3. Widow/Widower |     |
|     |                                                                           | 4. Separated / Divorced |   |
| 105 | What is the highest level of education you have completed?                | 1. Unable to read and write |         |
|     |                                                                           | 2. Primary school incomplete |    |
|     |                                                                           | 3. Primary school completed |     |
|     |                                                                           | 4. Secondary school completed |   |
|     |                                                                           | 5. High school completed |        |
|     |                                                                           | 6. College/university completed | |
| 106 | Which of the following best describes your main work status over the last 12 months? | 1. Government employee |        |
|     |                                                                           | 2. Non-government employee |       |
|     |                                                                           | 3. Self-employed |         |
|     |                                                                           | 4. Non paid |         |
|     |                                                                           | 5. Student |         |
|     |                                                                           | 6. Home maker |        |
|     |                                                                           | 7. Retired |         |
|     |                                                                           | 8. Unemployed (able to work) |    |
|     |                                                                           | 9. Unemployed (unable to work) |    |
| 107 | How many people older than 18 years, including yourself, live in your household? | Number of people | __________ |
| 108 | Taking the past year, can you tell me what the average earnings of the household have been? | Per month | __________ |
|     |                                                                           | Per year | __________ |
| 109 | If you don’t know the amount, can you give an estimate of the annual household income if I read some options to you? | 1. ≤ 12,000 |       |
|     |                                                                           | 2. More than 12, 000 ≤ 18,000 |      |
|     |                                                                           | 3. More than 18,000 ≤ 24,000 |      |
|     |                                                                           | 4. More than 24,000 ≤ 30,000 |      |
|     |                                                                           | 5. More than 30,000 |        |
|     |                                                                           | 6. Do not know |    |

### Step 1  Behavioral measurements

**CORE: Tobacco use**
Now I am going to ask you some questions about various health behaviors. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity. Let's start with tobacco.

| Question                                                                 | Response Options | Follow-up |
|-------------------------------------------------------------------------|------------------|-----------|
| **201** Do you currently smoke any tobacco products, such as cigarettes, cigars or pipes? | 1. Yes          | If No, go to |
|                                                                         | 2. No            |           |
| **202** If Yes, Do you currently smoke tobacco products daily?           | 1. Yes          | If No, go to |
|                                                                         | 2. No            |           |
| **203** How old were you when you first started smoking daily?           | Age (years)      |           |
| **204** On average, how many of the following do you smoke each day?    | 1. Manufactured cigarettes  
2. Hand-rolled cigarettes  
3. Pipes full of tobacco  
4. Don’t remember 777 | |
| **205** In the past, did you ever smoke daily?                          | 1. Yes          | If No, go to |
|                                                                         | 2. No            |           |
| **206** If Yes, How old were you when stopped smoking daily?             | Age (years)      | If known, go to |
|                                                                         | Don’t remember 777 |         |
| **207** How long ago did you stop smoking daily?                         | Years ago  
Or Months ago  
Or Weeks before | If known, go to |
|                                                                         |                 |           |
| **208** Do you currently use any smokeless tobacco such as [snuff, chewing tobacco, betel]? | 1. Yes          | If known, go to |
|                                                                         | 2. No            |           |
| **209** If Yes, Do you currently use smokeless tobacco products daily?   | 1. Yes          | If known, go to |
|                                                                         | 2. No            |           |
| **210** On average, how many times a day do you use...                  | Snuff, by mouth  
Snuff, by nose  
Chewing tobacco  
Don’t know 777  
Other |   |
| **211** In the past, did you ever use smokeless tobacco such as [snuff, chewing tobacco, or betel] daily? | 1. Yes          |   |
|                                                                         | 2. No            |   |
| **212** In the last 7 days, how many days did someone in the house smoke when you were present? | 1. 0 day  
2. 1 - 2 days  
3. 3 - 4 days  
4. 5 - 6 days  
5. 7 days |   |
| **213** During the last 7 days, how many days did someone smoke in closed areas in your workplace (in the | 1. 0 day  
2. 1 - 2 days  
3. 3 - 4 days  
4. 5 - 6 days |   |
| Question                                                                 | Answer Options                                                                 | Instructions                                      |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------|
| building, in a work area or a specific office when you were present?   | 5. 7 days
6. You do not work in a closed area                                         |                                                   |
| **CORE: Alcohol consumption**                                           |                                                                                  |                                                   |
| The next questions ask about the consumption of alcohol.                |                                                                                  |                                                   |
| 301 Have you consumed alcohol (such as beer, wine, spirits, fermented tella or tej within the past 12 months?) | 1. Yes
2. No                                                                    | If No go to                                       |
| 302 In the past 12 months, how frequently have you had at least one drink? | 1. Daily
2. 5-6 days per week
3. 1-4 days per week
4. 1-3 days per month
5. Less than once a month                                                  |                                                   |
| 303 When you drink alcohol, on average, how many drinks do you have during one day? | Number ________                                                              |                                                   |
| 304 Have you consumed alcohol (such as beer, wine, spirits, fermented cider or [add other local examples] within the past 30 days?) | 1. Yes
2. No                                                                    | If no go to                                       |
| 305 During each of the past 7 days, how many standard drinks of any alcoholic drink did you have each day? | Don’t know 77
Monday________
Tuesday________
Wednesday________
Thursday________
Friday________
Saturday________
Sunday________    |                                                   |
| 306 In the past 12 months, what was the largest number of drinks you had on a single occasion, counting all types of standard drinks together? | Largest Number ________                                                      |                                                   |
| 307 For men only: In the past 12 months, on how many days did you have five or more standard drinks in a single day? | Number of Days ________                                                      |                                                   |
| 308 For women only: In the past 12 months, on how many days did you have four or more standard drinks in a single day? | Number of Days ________                                                      |                                                   |
| 309 In the last 30 days, how many days on an average                     | Days________
Don’t remember/Not sure 77
Don’t want to respond 99                                                  |                                                   |
| Question                                                                 | Response Options                                                                 |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| did you consume alcoholic beverages?                                    |                                                                                  |
| **CORE: Diet**                                                          |                                                                                  |
| The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions please think of a typical week in the last year. |                                                                                  |
| 401 In a typical week, on how many days do you eat fruit?               | Number of days _______ If none go to Do not know 77                              |
| 402 How many servings of fruit do you eat on one of those days?          | Number of servings _______ Do not know 77                                        |
| 403 In a typical week, on how many days do you eat vegetables?          | Number of days _______ Do not know 77                                             |
| 404 How many servings of vegetables do you eat on one of those days?     | Number of servings _______ Do not know 77                                        |
| 405 What type of oil or fat is most often used for meal preparation in your household? (SELECT ONLY ONE) | 1. Vegetable oil  2. Lard or suet  3. Butter  4. Margarine  5. Other  6. Other  7. None in particular  8. None used  9. Do not know 77 |
| 406 In a typical week how many meals do you eat outside the house?      | Number _______ do not know 77                                                     |
| **CORE: Physical Activity**                                            |                                                                                  |
| Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. |                                                                                  |
| Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate. |                                                                                  |
| **Activity in work**                                                    |                                                                                  |
| 501 Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at | 1. Yes  2. No |
| Question                                                                 | Response |
|------------------------------------------------------------------------|----------|
| **502** In a typical week, on how many days do you do vigorous intensity activities as part of your work? | Number of days _______ |
| **503** How much time do you spend doing vigorous-intensity activities at work on a typical day? | Hours : minutes _____:______ |
| **504** Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously? | 1. Yes  
2. No |
| **505** In a typical week, on how many days do you do moderate intensity activities as part of your work? | Number of days _______ |
| **506** How much time do you spend doing moderate-intensity activities at work on a typical day? | Hours : minutes _____:______ |

**Travel to and from places**
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship.

| Question                                                                 | Response |
|------------------------------------------------------------------------|----------|
| **507** Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places? | 1. Yes  
2. No |
| **508** In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places? | Number of days _______ |
| **509** How much time do you spend walking or bicycling for travel on a typical day? | Hours : minutes _____:______ |

**Recreational activities**
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness, and recreational activities (leisure).

| Question                                                                 | Response |
|------------------------------------------------------------------------|----------|
| **510** Do you do any vigorous-intensity sports, fitness or recreational (leisure) | 1. Yes  
2. No |
| Question                                                                 | Answer |
|-------------------------------------------------------------------------|--------|
| Do activities that cause large increases in breathing or heart rate like [running or football] for at least 10 minutes continuously? |        |
| Number of days __________ |        |
| In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (leisure) activities? | Number of days __________ |
| How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day? | Hours : minutes _____: _____ |
| Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking,(cycling, swimming, volleyball) for at least 10 minutes continuously? | 1. Yes  
2. No |
| In a typical week, on how many days do you do moderate-intensity sports, fitness, or recreational (leisure) activities? | Number of days __________ |
| How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day? | Hours : minutes _____: _____ |

**Sedentary behavior**

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

| Question                                                                 | Answer |
|-------------------------------------------------------------------------|--------|
| How much time do you usually spend sitting or reclining on a typical day? | Hours : minutes _____: _____ |

**History of raised Blood Pressure**

| Question                                                                 | Answer |
|-------------------------------------------------------------------------|--------|
| Have you ever had your blood pressure measured by a health professional? | 1. Yes  
2. No |
| Have you been told by a doctor or other health worker that you have | 1. Yes  
2. No |
| Question                                                                 | Options                                                                 |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| raised blood pressure or hypertension?                                  | 1. Yes                                                                   |
|                                                                          | 2. No                                                                   |
| 603 If yes were you told in the last 12 months?                          |                                                                        |
| 604 Are you currently receiving any of the following treatments/advice for high blood pressure prescribed by a doctor or other health worker? | Drugs (medication) that you have taken in the last 2 weeks 1. Yes 2. No |
|                                                                          | Special prescribed diet 1. Yes 2. No                                     |
|                                                                          | Advice or treatment to lose weight 1. Yes 2. No                         |
|                                                                          | Advice or treatment to stop smoking 1. Yes 2. No                        |
|                                                                          | Advice to start or do more exercise 1. Yes 2. No                       |
| 605 During the past 12 months have you seen a traditional healer for raised blood pressure or hypertension? | 1. Yes                                                                  |
|                                                                          | 2. No                                                                   |
| 606 Are you currently taking any herbal or traditional remedy for your raised blood pressure? | 1. Yes                                                                  |
|                                                                          | 2. No                                                                   |
| History of Diabetes                                                     |                                                                        |
| 607 Have you ever had your blood sugar measured by a health professional? | 1. Yes                                                                  |
|                                                                          | 2. No If No, go to                                                      |
| 608 Have you ever been told by a doctor or other health worker that you have diabetes? | 1. Yes                                                                  |
|                                                                          | 2. No If No, go to                                                      |
| 609 If yes Were you told in the last 12 months?                          | 1. Yes                                                                  |
|                                                                          | 2. No                                                                   |
| 610 Are you currently receiving any of the following treatments/advice for diabetes prescribed by a doctor or other health worker? | Insulin 1. Yes 2. No                                                    |
|                                                                          | Oral drug (medication) that you have taken in the last 2 weeks s 1. Yes 2. No |
|                                                                          | Special prescribed diet Yes 1 No 2                                      |
|                                                                          | Advice or treatment to lose weight Yes 1 No 2                           |
|                                                                          | Advice or treatment to stop smoking Yes 1 No 2                         |
|                                                                          | Advice to start or do more exercise Yes 1 No 2                         |
| 611 During the past 12 months have you seen a traditional healer for diabetes? | 1. Yes                                                                  |
|                                                                          | 2. No                                                                   |
| 612 Are you currently taking any herbal or traditional remedy for your diabetes? | 1. Yes                                                                  |
|                                                                          | 2. No                                                                   |
| History of raised total cholesterol                                     |                                                                        |
| Question                                                                 | Option 1 | Option 2 |
|-------------------------------------------------------------------------|----------|----------|
| Have you ever had your cholesterol measured by a health professional?  | 1. Yes   | 2. No    |
| Have you ever been told by a doctor or other health worker that you have raised cholesterol? | 1. Yes | 2. No |
| If yes were you told in the last 12 months?                             | 1. Yes   | 2. No    |
| Are you currently receiving any of the following treatments/advice for raised cholesterol prescribed by a doctor or other health worker? | Oral treatment (medication) taken in the last 2 weeks 1. Yes 2. No Special prescribed diet 1. Yes 2. No Advice or treatment to lose weight 1. Yes 2. No Advice or treatment to stop smoking 1. Yes 2. No Advice to start or do more exercise 1. Yes 2. No |
| During the past 12 months have you seen a traditional healer for raised cholesterol? | 1. Yes | 2. No |
| Are you currently taking any herbal or traditional remedy for your raised cholesterol? | 1. Yes | 2. No |

**Family history**

| Question                                                                 | Option 1 | Option 2 |
|-------------------------------------------------------------------------|----------|----------|
| Have some of your family members been diagnosed with the following diseases? | Raised Blood pressure 1. Yes 2. No Diabetes or blood sugar 1. Yes 2. No Stroke Yes 1 No 2 Cancer or malignant tumor 1.Yes 2. No Raised Cholesterol Yes 1 No 2 Early Myocardial Infarction Yes 1 No 2 |

**Step 2 Physical Measurements**

| Step 2  | Physical Measurements                                                                 |
|---------|---------------------------------------------------------------------------------------|
| 801     | Height In Centimeters (cm)                                                            |
| 802     | Weight In Kilograms (kg)                                                              |
| 803     | (For women) Are you pregnant?                                                        |
| 804     | Waist circumference In centimeters                                                    |
| 805     | Systolic (mmHg)                                                                       |
| 806     | Diastolic (mmHg)                                                                       |
| 807     | During the past two weeks, have you been                                              |

If Yes, go to...
| treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker? |
|----------------------------------------------------------------------------------------------------------------------------------|
| Hip circumference and Heart rate                                                                                               |
| 808 Hip circumference in centimeters (cm)                                                                                      |
| 809 Heart Rate (Record if automatic blood pressure device is used)                                                           |
| Step 3 Biochemical measurements                                                                                               |
| CORE: Blood glucose                                                                                                            |
| 901 During the last 12 hours have you had anything to eat or drink, other than water                                           |
| 902 Time of day blood specimen taken (24 hour clock)                                                                          |
| 903 Fasting Blood glucose mmol/l                                                                                                |
| CORE: Blood lipids                                                                                                             |
| 904 Total cholesterol mmol/l                                                                                                |