High Burden of Hypertension Among Adult Population in Rural Districts of Northwest Ethiopia: a Call for Community Based Intervention

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Abstract

Background: Estimating prevalence and identifying risk factors of hypertension are paramount important to develop strategies to prevent hypertensive disease. Although, hypertension is a major public health problem in Ethiopia, there is scarcity of evidence in rural areas of the country. Hence, this study is aimed to assess the prevalence and risk factors of hypertension among adult population in rural districts of northwest Ethiopia.

Methods: Community based cross sectional study was conducted from June to October, 2020. Multistage cluster sampling technique was used to select 1177 study participants. A face to face interview was conducted using an adapted version of the WHO STEPwise approach questionnaire. The blood pressure was measured three times using aneroid sphygmomanometer and the mean of the last two readings were used for the analysis. Data were entered using Epidata and analyzed using STAT-14. Multivariable logistic regression was used to identify risk factors associated with hypertension.

Results: Of the total participants, 218(18.5%) were found to be hypertensive. The prevalence of hypertension consistently increased with age. Hypertension was positively and significantly associated with female sex ((adjusted odd ratio (AOR)=2.30, 95% CI: 1.53, 3.45)), age group 45-54 years (AOR=4.63, 95% CI: 1.01, 21.37), 55-64 years (AOR=14.40, 95% CI: 3.07, 67.63), ≥65 years (AOR=19.37, 95% CI: 4.03, 93.09), having history of alcohol consumption (AOR=3.25, 95% CI: 1.17, 9.02), used much amount of salt (AOR=2.37, 95% CI: 1.53, 3.60), used too much amount of salt (AOR=3.78, 95% CI: 1.85, 7.72), sleeping for a short duration (AOR=2.05, 95%CI: 1.30, 3.24), and having Family history of hypertension (AOR=2.12, 95% CI; 1.32, 3.39).

Conclusions: Hypertension was significantly high among the rural population we studied and is emerging as a public health problem in rural areas. Female sex, older age, ever used alcohol, used much and too much amount of salt, inadequate sleep, and family history of hypertension were factors positively and significantly associated with hypertension. We recommend local health authorities integrate promotion of hypertension health education, lifestyle modification intervention on salt and alcohol reduction, and hypertension detection particularly for female and elderly population at health post level to avert the problem.

Background

Hypertension also known as high blood pressure (HBP), is a chronic medical condition in which the blood pressure (BP) in the arteries is persistently high(1). It is an important public health problem all over the world (2). An estimated 1.13 billion adult population worldwide have hypertension in 2016 with two thirds living in low and middle income countries (3). The WHO African region has the highest prevalence of hypertension (27%)(4). In some settings of Africa it reaches as high as 40% and 46% among adults aged ≥18years (5, 6) and >25 years(7), respectively.

Hypertension is the most important modifiable risk factor for coronary heart disease, stroke and other cardiovascular diseases (CVDs) responsible for half of the CVDs morbidity and mortality in the world(8). The higher the BP, the higher the likelihood of harmful consequences in major organs (9–11). It is thought to account for about 45% of deaths due to heart disease, 51% of deaths due to stroke (12–14), and 18% of global deaths each year(15). Complications of hypertension also leads to costly interventions such as cardiac bypass surgery, carotid artery surgery, and dialysis which drains individual and government budgets (13, 16).

Ethiopia experiences double burden of disease attributed to communicable and noncommunicable diseases (NCDs)(17). The World Health Organization 2017 progress report showed that 39% of the deaths in Ethiopia were attributable to NCDs(18). The 2018 Ethiopian noncommunicable disease and injuries commission summary report also showed that NCDs including CVDs are responsible for about 37.5% of disease burden and 43.5% of the deaths in the country(19). These days, hypertension is a public health problem in Ethiopia responsible for 62.3% of CVDs (20), 36.3–69.3% stroke cases(21–25), and 3.5% of all the deaths(26). Studies at Tikur Anbessa Specialized Hospital and Jimma University Specialized Hospital, Ethiopia also showed heart disease is the second most common diagnosis of hypertension (27, 28).

Hypertension affects over 20% of adult population in Ethiopia (29). Several community based studies have been conducted in urban settings of Ethiopia and showed high prevalence of hypertension. For instance, the prevalence of hypertension ranged between 25.1% and 31.9% in Amhara region, northwest Ethiopia (30–34), 19.7–35.2% in Southern Ethiopia (35–38), and 25–32.3% in Addis Ababa (39–42). However, there is limited evidence on the prevalence and risk factors of hypertension in the rural areas of Ethiopia where majority (96.2%) of the population consumes too much amount of salt ($\geq 5\text{gm/day}$)(19), a known modifiable risk factor for hypertension (43–45). Hence, this study aimed to determine the prevalence and risk factors of hypertension among adults aged ≥ 18 years. We used the data from the research project “improving hypertension management through task sharing with the Health Extension workers (HEWs) in rural districts of northwest Ethiopia”. Generating such evidence is paramount importance to develop effective strategies for the prevention and control of hypertension.

Methods And Materials

Study design and setting

A community based cross sectional study design was conducted in rural districts (Dabat and Gondar Zuria) of northwest Ethiopia from June to October, 2020. Dabat is one of the districts in North Gondar Zone of the Amhara regional state of Ethiopia located about 727 km northwest of Addis Ababa and 75km from Gondar city, historical place in Ethiopia. Gondar Zuria is one of the districts in Central Gondar Zone of the Amhara Regional state of Ethiopia. Based on the Ethiopian Central Statistical Agency (CSA) 2014-2017 population projection the estimated total population of Dabat and Gondar Zuria districts were 177,294 and 231, 830, respectively(46). Each district is divided into kebeles (the lowest administrative

areas in Ethiopia). The districts have both urban and rural kebeles. Each rural health center has 5 health posts working in a referral system with a primary hospital forming together a Primary Health Care Unit (PHCU). Each health center with health posts serves 15,000 to 25,000 people(47).

Study population and sampling

Single population proportion formula was used to determine sample size of 1177 using 14.7% estimated prevalence of hypertension in rural areas (48), 95% confidence interval, 3% margin of error, design effect of 2, and a 10% non-response rate. Multi-stage cluster sampling technique was used to select study participants. First, 20 kebeles (10 from each district) were selected using simple random sampling. Then, 3-4 villages from each kebele were selected using the simple random sampling technique. Lastly, one adult per household was selected using lottery method. All adult population aged ≥ 18 years who lived in the study area for at least 6 months were eligible for the study while pregnant women were excluded from the study as this may overestimate the true prevalence because of pregnancy induced hypertension.

Data collection tools, procedures and measurements

A structured questionnaire adapted from WHO STEP wise approach to surveillance of noncommunicable diseases including socio-demographic characteristics, behavioral and lifestyle factors, psychosocial stress levels, family and personal history of hypertension, and comorbidities was used to collect the data (49). The questionnaire was first prepared in English language and then translated into the local language (Amharic) by two bilingual translators. The translated Amharic version was also re-translated back to the source language by other two independent bilingual translators to see its consistency with the original version of the questionnaire.

This study was part of the research project entitled “improving hypertension management through task sharing with the Health Extension workers in rural districts of northwest Ethiopia”. A three day of theoretical and practical training was provided to HEWs, data collectors (health professionals having MSc in Nursing and Public Health officers) and supervisors. The theoretical session focused on hypertensive disease definition, symptoms, main risk factors, and complications, prevention methods, and measuring BP. The practical session included precautions to be taken before BP measurements, proper body positioning during measurement, and conducting BP measurement.

The HEWs with trained data collectors visited residents' home and provided health information on hypertensive disease and importance of hypertension screening for the study participants. They asked participants whether they drank caffeinated beverages such as coffee or tea and have been working within 30 minutes or not. The study participants were allowed to sit quietly for 5 minutes before their BP was measured. The study participants were asked to sit with their back straight, feet flat on the floor and legs uncrossed, and arm supported on knee with the upper arm at heart level.

The HEWs palpated the participants' brachial artery and placed the bell of the stethoscope over it. They inflated the BP cuff while they listened to the pulse sounds until no sounds heard through the stethoscope. They deflated the BP cuff slowly 2 mmHg per second and listened for the systolic and for

the diastolic reading. The HEWs took the first BP reading in the sitting position at the left arm to the nearest 2mmHg using aneroid sphygmomanometer with appropriate size brachial pressure cuff and stethoscope to do a reliability test with the trained data collectors. Five trained data collectors collected the data using the interviewer administered questionnaire. The data collectors also independently took two BP reading for the same participant 30 minutes apart, one before the interview and the other at the end. The average of the last two measurements was taken to confirm the diagnosis of hypertension. Hypertension at the time of screening is defined as systolic blood pressure of ≥ 140 mmHg or a diastolic blood pressure of ≥ 90 mmHg or on antihypertensive treatment(50).

Weight of the individuals was measured using a calibrated weight measuring scale. Participants were asked to wear light clothes and weight was recorded to the nearest 0.1 kg using a digital scale. Height of the participants was measured with a tape to the nearest 0.1 cm. Participants were asked to stand upright without shoes, heels together and eyes directed forward. Body mass index (BMI) was computed using the formula of weight in Kg/height in m^2 and categorized as underweight (<18.5), normal weight ($18.5-24.9$), overweight ($25-29.9$) and obese (≥ 30)(51). Wealth of the families was calculated through household assets for the rural community such as type of flooring, roof and walls; number of rooms in the house; land ownership for agriculture and total amount of agricultural products; ownership of livestock, bank account and solar light source(52). These were combined into a single wealth index and then divided into three groups of equal size (poor, medium and reach), based on their relative standing on the household wealth index.

The dial sphygmomanometers were calibrated against the standard mercury sphygmomanometer on a routine basis to ensure consistency and accuracy of the readings. Information exchange by telephone and close supervision by the principal investigator and supervisor were made on a daily basis. Coding and data cleaning have done.

Operational definitions

Alcohol consumption was assessed by asking participants if they ever consumed alcohol and classified as alcohol user if they are regularly or sometimes used alcohols. Any combinations of walking, moderate, or vigorous intensity activity with an average metabolic equivalents-minutes per week of <600 , $600-2999$ and ≥ 3000 were used to classify the physical activity of the study participants as low, moderate and high level, respectively(53). Sleep duration was assessed using the question, "How many hours do you sleep a day?" (54). Short sleep duration was defined as sleep duration of <6 hours per 24 hour(55). Much and too much amount of salt consumption was defined as self-report of much or too much consumption of actual salt in processed foods, adding salt when cooking and/or to cooked food.

Data processing and analysis

Data were entered using Epidata version 4.6 and exported to STATA version 14 for further analysis. The data were checked for missing values, cleaned for completeness, recoded and computed for calculable variables. Frequency, percentages, means with its standard deviations, and median with interquartile range (IQR) were used to report findings. Tables and figures also used to present the data. Both bivariable

and multivariable binary logistic regression analysis were performed. Variables which have significant associations with hypertension during multivariable analysis were identified on the basis of adjusted odds ratio with 95% CI and p-values <0.05. Model fitness of good test was also computed and reported.

Results

Sociodemographic characteristics of participants

A total of 1177 adult population participated in the study making a response rate of 100%. The median age of the participant was 41 (IQR=30-55) years. Of the total participants, 640(54.4%) were female, 1167 (99.2%) followed orthodox Christianity, 955 (81.1%) were currently married, 808 (68.7%) were unable to read and write, 1110 (94.3%) were farmers, and 393 (33.4%) classified economically as poor (Table 1).

Life style and behavioral characteristics of participants

Of the total participants, only 4 (0.3%) and 10 (0.6%) ever smoked and chewed chat, respectively. One thousand one hundred twelve (94.5%) of the participants have had history of alcohol consumption, of whom, 1073 (96.5%) drank alcohol during the last 12 months. Of the participants who drank alcohol during the last 12 months, 360 (33.5%) and 340(31.7%) drank 1-2 days per week and 1-3 days per month, respectively. All the study participants used grain products for their food consumption. However, 989 (84.0%), 748 (63.5%), and 661 (56.2%) of the study participants never consumed fruits, vegetables and fat free food during the last 6 months prior to data collection, respectively. All the participants added salt during cooking food, of whom, 211 (17.9%) used much and too much amount of salt. Among the total participants, 740 (62.9%) were classified as having highly physically active, whereas 146 (12.4%) were classified as low, 1034 (87.9%) have had adequate sleep during the night time.

Co-morbidities and family history of hypertension related characteristics of participants

Of the participants, 128 (10.9%) have had family history of hypertension (FHH). Moreover, 44 (3.7%), 22 (1.9%), 14 (1.2%), and 4 (0.3%) of the study participants have had self-reported CVDs, chronic respiratory diseases, chronic kidney diseases, and diabetes mellitus, respectively. Thirty two of the participants have been measured for blood cholesterol, of whom, 5 ever been told as having high blood cholesterol (Table 2).

Blood pressure measurements

The mean systolic blood pressure of the study participants was 117.15 mmHg (SD=±17.60), ranging from 80 mmHg to 190 mmHg. The mean diastolic blood pressure of the respondents was also 72.07 mmHg (SD±11.18) ranging from 40 mmHg to 110 mmHg.

Prevalence of hypertension

Of the total participants, 218 (18.5%; 95% CI: 16.3, 20.7%) were found to have hypertension. The prevalence of hypertension consistently increased from 3.6% among the age group of 18-24 years to 41.6% in the age group of ≥ 65 years (Fig. 1). Of those individuals with hypertension, 133 (61.0%) were females, 166 (76.1%) were married, 164 (75.2%) were unable to read and write/illiterates. Besides, 213 (97.7%) of patients with hypertension ever consumed alcoholic drinks, 52(23.9%) have had low level of physical activity, 40(18.3%) had FHH, and 43 (19.7%) slept for <6 hour a day.

Factors associated with hypertension

The bivariate logistic regression analysis showed that being female, age ≥ 45 years, married, widowed, unable to read and write, ever used alcohol, used much and too much amount of salt, having inadequate sleep, FHH, having low level of physical activity, and overweight were positively and significantly associated with hypertension. After adjusting for the possible confounding variables, being female, age 45-54, 55-64 and ≥ 65 years, ever used alcohol, used much and too much amount of salt, inadequate sleep, and having FHH remained positively and significantly associated with hypertension.

In this study, females were 2 times (AOR=2.30, 95% CI: 1.53, 3.45) more likely to have hypertension as compared to males. Compared with younger adults (age 18-40 years), the likelihood of hypertension was 5 times more likely among participants aged 45-54 years (AOR=4.63, 95% CI: 1.01, 21.37), 14 times more likely among those aged 55-64 years (AOR=14.40, 95% CI: 3.07, 67.63) and 19 times more likely among aged ≥ 65 years (AOR=19.37, 95% CI: 4.03, 93.09). Participants who ever used alcohol were 3 times (AOR=3.25, 95% CI: 1.17, 9.02) more likely to have hypertension as compared to those who never used alcohol. Participants who used much and too much amount of salt were 2 times (AOR=2.37, 95% CI: 1.53, 3.60) and 4 times (AOR=3.78, 95% CI: 1.85, 7.72) more likely to have hypertension as compared to those who used the right amount of salt. Participants who have had a short duration of sleep were 2 times (AOR=2.05, 95%CI: 1.30, 3.24) more likely to have hypertension as compared to those who had adequate sleep. Participants who had FHH were 2 times (AOR=2.12, 95%CI; 1.32, 3.39) more likely to have hypertension as compared to their counterparts (Table 3).

Discussion

In this study, hypertension was significantly high among the rural population we studied and is emerging as a public health problem in rural areas. Female sex, older age, ever used alcohol, used much and too much amount of salt, inadequate sleep, and FHH were factors positively and significantly associated with hypertension.

Hypertension in Ethiopia is highly prevalent and accounted for more than half of CVD deaths(20). This study revealed that the overall prevalence of hypertension was 18.5% (95% CI: 16.3, 20.7%). This finding was in agreement with the systematic review and meta-analysis conducted in Ethiopia (18.45%)(29) and a study conducted in Arba Minch Health and Demographic Surveillance Site (17.5%)(56). It's also similar

with findings from other countries: Ombe, Cameroon (19.8%)(57), Davanagere, India (18.3%)(58), South India (18.3%)(59), Southern Rajasthan, India (18.67%)(60), and coastal Karnataka, India (18%)(61). The possible reason for the similarities might be the use of similar age category of the study participants.

On the other hand, our finding was higher than those studies conducted in Amhara regional state, Ethiopia(10%)(62), Humera and Mekelle (15.2%)(63), Southern Ethiopia (9.7%)(64), Gilgel Gibie (7.7%)(65), Nigeria (12.9%)(66), and Rural Uganda (14% and 14.6%)(67, 68). The possible reason for the higher prevalence of hypertension in this study might be the variation in time period between the current study and previous studies which were conducted between 2008 and 2015. This indicates that hypertension is increasing at alarming rate overtime among the rural adult population in the country.

However, our finding was much lower than those of studies conducted among rural residents of Dabat district, Northwest Ethiopia (25.3%)(32), Mali (21.1%)(69), Nigeria (26.8%)(70), Cameroon (23.9% and 31.1%)(71, 72), and India (32.3%)(73). One possible reason might be the age difference in the study population where the median age of the study participants in those studies conducted in Dabat district, northwest Ethiopia (47 years) and Cameroon (53 years) were higher than this study (40 years). This may overestimate the prevalence of hypertension as evidenced by the older age groups showing higher prevalence(74, 75). The site of BP measurement (inter-arm difference) might also be the possible reason for the higher prevalence of hypertension in those of studies conducted in Mali(69) and Cameroon(72) where the BP were taken on the right arm of the study participants which might result in a difference in BP reading from the left arm as high as 10 mmHg. This is supported by some studies which showed a bias towards higher readings from the right arm than the left arm (76–78).

In this study, a significant association was observed between sex of the participant and hypertension. Females were two times more likely to have hypertension as compared to males. The possible reason might be due to the effect of hormone during menopause which makes the BP more sensitive to salt, which, in turn, lead to higher BP (79). This result was in line with the study conducted in Southern Rajasthan(60). However, studies conducted in urban setting of Ethiopia such as Gondar city(34), Mekelle town(80), Addis Ababa(41, 42, 81), Durame town (38), Hosanna town(36), and Jigjiga city(82) showed males were at risk for hypertension.

Age is a known modifiable risk factor for hypertension where the risk of developing HBP tends to increase as people age increases (83). This study showed that participants' age was significantly associated with the risk of hypertension. Individuals aged 45-54 years, 55-64 years, and ≥ 65 years were 4.63, 14.40, and 19.37 times more likely to have hypertension as compared to the age group of 18-24 years, respectively. This was consistent with those studies conducted in Amhara regional state, Ethiopia(62), Dabat HDSS(84), Dabat district and Gondar city(32), Gondar City(33, 34), Northern Ethiopia(63), Addis Ababa(40, 42, 81), Tigray(80), Durame town(38), Wolega(85), Sidama Zone(64, 86), Hawassa University (35), Jimma town (87), Bedele town(88), Dire Dawa city(89), Arba Minch Health and Demographic Surveillance Site(56). Studies conducted in Uganda(68), Cameroon(57, 72), Southern Rajasthan(60), South India(59), India(73), China(90), and urban Varanasi(91) also showed that older age was associated

with hypertension. This might be due to the fact that with increasing age, the vascular system becomes less elastic causing the blood vessels to become stiff and less compliant which in turn increases the BP(83).

Moderate to heavy alcohol drinking significantly increases the risk of developing hypertension (92). In this study, the likelihood of hypertension among participants who ever used alcohol was 3.25 times more likely as compared to those who never used alcohol. This was in agreement with those of studies conducted in Dabat HDSS(84), Dabat district and Gondar town(32), Gondar city(34), Addis Ababa(41), Jimma town(87), Wolega(85), Sidama Zone (64, 86), Bale Zone(93), and systematic review and meta-analysis conducted in Ethiopia(29). This finding was also in agreement with those of studies conducted in rural districts of Cameroon(57), Uganda(68), South India(59), and urban Varanasi(91) where individuals who used alcohol were found to be more hypertensive than who never used alcohol. One possible reason might be due to alcohol contains calories which may contribute to unwanted weight gain, a known risk factor for hypertension (94). Secondly, alcohol intake might increase BP by either inhibiting the endothelial nitric oxide syntheses or causing inflammatory injury to the endothelium which in turn decreases the vasodilators in the vascular endothelium(95). The third possible explanations for the association of excess alcohol intake with HBP include stimulation of the renin-angiotensin-aldosterone system, enhanced sympathetic activity, vasoconstriction, and elevated oxidative stress (95–97).

Excessive dietary salt intake is associated with an increased risk for hypertension which in turn a major risk factor for stroke and CVDs, and kidney diseases(44). This study revealed that those participants who used much and too much amount of salt were 2.37 and 3.78 times more likely to have hypertension as compared to those who used the right amount of salt. Studies conducted in Durame town(38), South India(59), Korea(98), and a systematic review(99) supported this finding where those individuals who used much amount of salt were at risk for hypertension than their counterparts. The reason is explained by the pathophysiological effect of salt/sodium on blood volume; where increased salt consumption provokes water retention, increased blood volume; which in turn leads to a condition of high flow in arterial blood vessels. The other possible reason might be high intake of sodium might damage the endothelial function, changes in the structure and function of large elastic arteries, and modifies the sympathetic activity resulting peripheral vascular resistance and increases in BP(100).

A number of studies have reported that sleep duration might have an important role in the development of hypertension (101, 102). In this study, participants who slept <6 hours per 24 hour (with short sleep duration) were 2 times more likely to develop hypertension as compared to those who slept 6 or more hours over night. This was consistent with the Sleep Heart Health Study (SHHS)(55), study conducted in northeast China among adults aged 18-44 years(103), and meta-analysis(104–108). This might be due to the reason that short sleep durations or sleep deprivation might induce an over activity of the sympathetic nervous system which leads to HBP(109).

Family history of hypertension was found to be a significant factor associated with hypertension. In this study participants with FHH were 2.12 times more likely to have hypertension as compared to their

counter parts. This finding was supported by studies conducted in Amhara regional state, Ethiopia(62), Gondar city (33), Dabat district and Gondar town(32), Addis Ababa(40), Sidama Zone(64), Jimma University Specialized Hospital, Southwest Ethiopia(110), Durame town (38), Assosa town(111), Jigjiga city(82), Cameroon(71), Uganda(68), South India(59), and Sri Lankan adults(112). One possible reason might be blood relatives tend to have many of the same genes that can predispose a person to hypertension, heart disease and stroke(113, 114).

This study assessed the magnitude of hypertension and its associated risk factors in rural districts of Northwest Ethiopia where there is limited data and the findings will be eye opening for health authorities, health workers, and researchers. It has used also a standardized tool developed by WHO. However, it was also limited by the tools applied such as assessment of behavioral risk factors using an interview technique which might be liable to recall bias. Furthermore, the study didn't address the biochemical measurements such as blood lipid and blood glucose level, which are main risk factors for hypertension.

Conclusion

The finding of this study showed that hypertension is high among adult population in rural districts of northwest Ethiopia. Hypertension is more common among females, age group of ≥ 55 years, ever used alcohol, used much and too much amount of salt, short sleep duration, and FHH. Hence, we recommend local health authorities integrate measures such as hypertension health education, lifestyle modification including salt and alcohol reduction, and early detection of hypertension particularly among females and elderly population in communities residing in rural areas.

List Of Abbreviations

AOR Adjusted Odds Ratio

BP Blood Pressure

CVD Cardiovascular Diseases

HBP High Blood Pressure

HEWs Health Extension Workers

IQR Interquartile Range

NCDs Non Communicable Diseases

WHO World Health Organization

Declarations

Ethics approval and consent to participate

This study has been approved by the Institutional review board (IRB) of the University of Gondar (Ref. No: V/P/RCS/05/1580/2020). Verbal informed consent was obtained from the study participants after delivering information regarding the purposes of the study. Participant involvement in the study was based on a voluntary basis. The chance to ask anything about the study as well as freedom to refuse or stop the interview at any moment was given. Confidentiality of data was guaranteed by using identification numbers rather than names and limiting access to the data.

Consent for publication

Not applicable

Availability of data and material

Data will be available from the corresponding author upon request

Competing Interests

There is no any competing of interests related with this work

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Authors' contributions

DFT is the principal investigator of the study. DFT involved in conception, designing research questions, conduct the study, analysis of the data, and write of the manuscript. SAB, TAA, AA, MS, MGA, GM and KAG participated in selecting appropriate research design and critical review of the manuscript. All authors read and approved the manuscript with revisions.

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114. Family History and High Blood Pressure.

Tables

Table 1 Sociodemographic characteristics of participants in northwest Ethiopia, 2020.

Variables	Frequency	Percent (%)
Sex		
Male	537	45.6
Female	640	54.4
Age, in years		
18-24	56	4.8
25-34	294	25.0
35-44	280	23.8
45-54	237	20.1
55-64	144	12.2
≥65	166	14.1
Religion		
Orthodox	1167	99.2
Muslim	10	0.8
Marital status		
Single	87	7.4
Married	955	81.1
Divorced	46	3.9
Widowed	89	7.6
Educational status		
Unable to read and write	808	68.7
Able to read and write	200	17.0
Primary school	113	9.6
Secondary and high school	42	3.5
College/University completed	14	1.2
Occupational status		
Farmer	1,110	94.3
Merchant	7	0.6
Student	41	0.5

Daily laborer	5	0.4
Others	14	1.2
Wealth index*		
Poor	393	33.4
Medium	392	33.3
Rich	392	33.3

*Income is categorized based on percentiles

Table 2 Co-morbidity and FHH related characteristics of participants in northwest Ethiopia, 2020

Variables	Frequency	Percent (%)
Family history of HTN		
Yes	128	10.9
No	1,049	89.1
Cardiovascular disease		
Yes	44	3.7
No	1133	96.3
Chronic respiratory disease		
Yes	22	1.9
No	1,155	98.1
Chronic kidney disease		
Yes	14	1.2
No	1,163	98.8
Diabetes mellitus		
Yes	4	0.3
No	1,173	99.7
History of Cancer		
Yes	3	0.3
No	1,174	99.7
Ever been measured for blood cholesterol		
Yes	32	2.7
No	1145	97.3
High blood cholesterol(n=32)		
Yes	5	15.6
No	27	84.4

Table 3 Bivariate and multivariable logistic regression analysis of factors associated with hypertension in northwest Ethiopia, 2020

Variable	Hypertension		COR (95% CI)	AOR (95 % CI)
	Yes (%)	No (%)		
Sex				
Male	85 (15.8)	452(84.2)	1	1
Female	133(20.8)	507(79.2)	1.39 (1.03, 1.88)	2.30(1.53,3.45)**
Age				
18-24	2(3.6)	54(96.4)	1	1
25-34	19(6.5)	275(93.5)	1.87(0.42, 8.24)	1.78(0.38, 8.26)
35-44	36(12.9)	244(87.1)	3.98(0.93, 17.05)	3.30(0.72, 15.24)
45-54	42(17.7)	195(82.3)	5.82(1.36, 24.80)	4.63(1.00, 21.37)*
55-64	50(34.8)	94(65.2)	14.36(3.36, 61.37)	14.40(3.07, 67.63)*
≥65	69(41.6)	97(58.4)	19.21(4.53, 81.44)	19.37(4.03, 93.09)**
Marital status				
Single	4(4.6)	83(95.4)	1	1
Married	166(17.4)	789(82.6)	4.37(1.58, 12.07)	1.86(0.62, 5.55)
Divorced	14(30.4)	32(69.6)	9.08(2.78, 29.65)	2.53(0.67, 9.60)
Widowed	34(38.2)	55(67.8)	12.83(4.31, 38.18)	1.90(0.56, 6.52)
Educational status				
Unable to read and write	164(20.3)	644(79.7)	2.14(1.27, 3.59)	0.66(0.36, 1.22)
Able to read and rite	36(18.0)	164(82.0)	1.84(1.01, 3.38)	0.84(0.43, 1.65)
Primary school and above	18(10.7)	151(89.3)	1	1
Wealth index category				
Poor	86(21.9)	307(78.1)	1	1
Medium	65(16.6)	327(83.4)	0.71(0.50, 1.01)	0.96(0.63, 1.46)
Rich	67(17.1)	325(82.9)	0.74(0.52, 1.05)	0.90(0.59, 1.39)
Ever consumed alcohol				
Yes	213 (19.2)	898(80.8)	2.89 (1.15, 7.29)	3.25(1.17, 9.02)*
No	5(7.6%)	61(92.4)	1	1
Amount of salt				
Too much	21(47.7)	23(52.3)	4.98(2.66, 9.30)	3.78(1.85, 7.72)*

Much	51(30.5)	116(69.5)	2.40(1.62, 3.53)	2.37(1.53, 3.68)**
Right amount	111(15.5)	605(84.5)	1	1
Little	31(14.0)	190(86.0)	0.89(0.58, 1.37)	0.78(0.48, 1.25)
Too little	4(13.8)	25(86.2)	0.87(0.30, 2.55)	1.13(0.36, 3.53)
Sleep duration, in hours				
<6	43(30.0)	100(70.0)	2.11(1.43, 3.13)	2.05(1.30, 3.24)*
≥6	175(16.9)	859(83.1)	1	1
Family history of HTN				
Yes	40(31.3)	88(68.7)	2.22(1.48, 3.34)	2.12(1.32, 3.39)*
No	178(17.0)	871(83.0)	1	
Physical activity				
Low	52(35.6)	94(64.4)	3.24(2.18, 4.81)	1.35(0.80, 2.28)
Moderate	58(19.9)	233(80.1)	1.46(1.02, 2.07)	0.88(0.58, 1.34)
High	108(14.6)	632(85.4)	1	1
BMI				
Below normal	62(19.5)	256(80.5)	1.12(0.81, 1.57)	0.76(0.52, 1.11)
Normal	147(17.7)	685(82.3)	1	1
Overweight	9(33.3)	18(66.7)	2.33(1.03, 5.29)	1.89(0.74, 4.80)

*P-value<0.05 **P-value<0.001 Hosmer and Lemeshow Test=0.54

Figures

Figure 1

See image above for figure legend.