

The Determinant Risk Factors of Hypertension in Kebri Beya Woreda Somalia Regional State, Ethiopia

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Abstract

Background: Hypertension has been the major public health challenge worldwide. It is a chronic disease in which the prevalence has been steadily increasing in Ethiopia. **Objectives:** The main purpose of this study was to assess determinants of hypertension. Methods: A total of 352 (176 cases and 176 controls) subjects constituted the sample size for this study. Binary logistic regression was used for data analysis considering hypertension as the response variable **Results:** Always cigarette smoking/chewing, always alcohol consumption, overweight, low physical activity, excess salt use, insufficient use of fruits/vegetables, uneducated and mental stress were modifiable risk factors having higher odds of developing hypertension than non- smokers/chewers, no alcohol consumption, being normal, having high physical activity, no excess salt use, sufficient fruit/vegetable use, diploma/above and no mental stress respectively.**Conclusion:** This study has shown that hypertension was significantly associated with sex, age above 45, BMI above 25 kg/m^2, excess salt utilization, family history of hypertension, alcohol consumption, smoking/chewing, insufficient use of fruit and vegetables, mental stress, low physical activity, residence and low level of educational status.

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Introduction

Hypertension is the leading global metabolic risk factor responsible for 18% of global deaths (Lim et al., 2012). Hypertension accounts for 45% of deaths due to heart disease and 51% of deaths due to stroke (World Health Organization, 2013). Complications of hypertension are responsible for 9.4 million or more than half of all CVDs deaths worldwide (World Health Organization, 2013). This makes hypertension the single most important risk factor for CVDs and a condition of public health importance.

"The heart pumps blood through the blood vessels, the blood pushes against the walls of blood vessels. This creates blood pressure. Hypertension is a state in which blood vessels have constantly elevated pressure. The body needs blood pressure to move the blood throughout the body, so every part of our body can get the oxygen it needs. Healthy arteries (the blood vessels that carry oxygen-rich blood from the heart to the rest of the body) are elastic. They can stretch to allow more blood to push through them. How much they stretch depends on how hard the blood pushes against the artery walls. For arteries to stay healthy, it's important that our blood pressure be within a healthy range" (American Heart Association, 2014).

Normal adult blood pressure is defined as a systolic blood pressure of 120 mm Hg and a diastolic blood pressure of 80 mm Hg whereas, hypertension is defined as systolic blood pressure of equal to or greater than 140 mm Hg or diastolic blood pressure equal to or greater than 90 mmHg (World Health Organization, 2013). Elevated systolic and diastolic blood pressure levels interfere with efficient function of vital organs such as the heart, brain and kidneys and with overall health and wellbeing of individuals (World Health Organization, 2013).

Hypertension is the most common cardiovascular disorder affecting approximately 1 billion people globally and accounts for approximately 7.1 million deaths annually. Some of the known risk factors for primary hypertension like age, heredity, and gender are non-modifiable. However, the majority of the other risk factors like tobacco use, alcohol use, unhealthy diet, physical inactivity, overweight and obesity can be effectively prevented (Brundtland, 2002).The World Heart Federation reports that there are approximately 970 million hypertensive people in the world with more than 60% or 640 million of hypertensive people in LMIC (World Heart Federation, 2016).

The prevalence of raised blood pressure in adults older than 25 years of age was about 40 % in 2008 (WHO, 2013) and contributed to 12.8 % of the total deaths in the world (WHO, 2010 & 2011).The prevalence of hypertension among African adults aged 25 years and above is 46% (World Health Organization, 2013).This presents double burden of disease for LM IC due to an already existing high burden of communicable diseases. Recent studies suggest that while the prevalence of hypertension is decreasing in high income countries, whereas prevalence is increasing in low and middle-income countries, with the largest increase seen in countries in sub-Saharan Africa (Mills et al., 2016; NCD Risk Factor Collaboration, 2016).

Until now, communicable diseases, maternal, and nutritional causes were responsible for the highest burden of morbidity and mortality in Africa (Lopez DA, 2006). Most recently it has been shifting towards non-communicable diseases and developing countries are facing what is known as "double burden of diseases"

(Bygbjerg IC, 2012). Similarly, in the first half of the twentieth century, high blood pressure was almost non-existent in African societies, but currently estimates show that in some settings in Africa more than 40 percent of adults have hypertension (WHO, 2013 & Vijver SVD, 2013).Ethiopia is one of the lower income countries that has affected by double burden diseases.

The result from a systematic review conducted in Ethiopia indicates that there are different associated risk factors for hypertension in Ethiopia. Evidence shows that different associated factors include being overweight, having a family history of hypertension, age, sex, alcohol intake, physical inactivity, eating vegetables three or fewer days per week, stress, salt use, obesity, higher education, and smoking/chewing, vigorous recreational activities were identified as risk factors for hypertension (Mulugeta M, 2015). This study is going to be carried out in kebry beya woreda which is hot area and there was no research done regards to hypertension so it is aimed to determine the determinant risk factors and the probabilities of those factors and their level probabilities in relation to hypertension.

Limitation of the study

Limited availability of resources and time to undertake the study on a wider scale

Many variables are not covered

Data and Methodology

Data

Both primary and secondary data was used in this study. The primary source of data had been collected through questionnaire and measurement; whereas secondary sources of data had been generated through a review of health records department of MLPH

Sample size

Greg and Emily (2015) define sampling as "the selection of a subset of members of a population for inclusion in the study". Sampling from a defined population allows statistical inferences made from the selected sample to be generalized to the target population (Miquel et al., 2008).

A sample is defined as "a selected subset of a population" (Miquel et al., 2008), it includes the total number of participants who will be selected and enrolled in the study from the population. Sample size is the number of targeted study participants about which the researcher wishes to enroll in the study and obtain information from (Brink, 2012). Based on an estimated population of people in ESMW (AMHARA Demography and Health, 2018), a sample size of 352 participants (176 cases and 176 controls) was calculated for an unmatched case-control study as given below. The parameters used to calculate this sample size are presented in Table 3.2. The 63.2 % and 46.9% percentages of exposed cases and exposed controls respectively was chosen based on findings from the research (Negussie S. Muluneh S. 2017) on the percentage of Mettu Karl Hospital, Southwest Ethiopian adults with BMI ≥25.

Parameter	Specification
Confidence level	95%
Power	80%
Ratio of control to case	1 (1:1)
Percentage of exposed controls	46.9
Percentage of exposed cases	63.2

Sample Size formula for an Un-matched Case-Control Study as described (Kelsey et. al.) above is:

$$\boldsymbol{n_1} = \frac{\left(\boldsymbol{z_{\frac{\alpha}{2}}} + \boldsymbol{z_{1-\beta}}\right)^{2} \overline{\boldsymbol{p}}\, \overline{\boldsymbol{q}}\, (\boldsymbol{r}+\boldsymbol{1})}{\boldsymbol{r}(\boldsymbol{p_1}-\boldsymbol{p_2})^{2}}$$

and $\boldsymbol{n_2}=r\boldsymbol{n_1}$

Where

n_1 = number of cases

n_2 = number of controls

$\boldsymbol{z_{\frac{\alpha}{2}}}$ = standard normal deviate for one-tailed test based on beta level (relates to the power level)

r = ratio of controls to cases

p_1 = proportion of cases with exposure and $q_1 = 1-p_1$

p_2 = proportion of controls with exposure and $q_2 = 1-p_2$

$$\overline{\boldsymbol{p}} = \frac{\boldsymbol{p_1}+\boldsymbol{r}\boldsymbol{p_2}}{\boldsymbol{r}+\boldsymbol{1}},\ \ \boldsymbol{and}\ \overline{\boldsymbol{q}} = \boldsymbol{1}-\overline{\boldsymbol{p}}$$

$\boldsymbol{z_{\frac{\alpha}{2}}}$=1.96 $\boldsymbol{z_{1-\beta}}$ =0.84

$\overline{p} = \frac{63.2+1(46.9)}{1+1}$= 55.05, $\overline{q}$ =54.05

$n_1 = \frac{(1.96+0.84)^2\ (55.05)(54,05)\ (1+1)}{1(63.2-46.9)^2} \approx 176$ and n_2=rn_1=176

Methodology

In this study, the variable of interest hypertension is dichotomized as 1 if the patient is hypertensive and as 0 if the patient is not hypertensive. When the response variable is a dichotomous it is appropriate to use Binary logistic regression to describe the relationship between the outcome variable and a set of predictor variables.

Binary Logistic regression model

Binary logistic regression model is a standard frame work for the analysis of dichotomous response variable. Logistic regression analysis extends the techniques of multiple regression analysis to research situations in which the dependent variable is categorical. Binary logistic regression is a type of logistic regression that is used when the dependent variable is dichotomous and the predictor variables are of any type. It estimates the probability that a certain characteristic is present (in our case, the probability that hypertension) given the values of explanatory variables.

Logistic regression uses the logit transformation linearize to the non-linear relationship between X and the likelihood of Y. It does by using odds and logarithms. The logit, a nonlinear function, describing the s-shaped curve. Generalized linear models' refer to a class of models that uses a relation function to make estimation. The logit link function is used for binary logistic regression.

Suppose X_i=(X_{1i} , X_{2i} ,…, X_{ki})$'$ denotes the vector of k predictor variables for the i^{th} individual, i=(1,2,…,176). The probability that the i^{th} hypertension) given his background characteristics X_i is given by:

$$p_i = \text{prob}\ (y_i = 1/\ X_i) = \frac{e x_i' \beta}{1+e x_{i\beta}'} = \frac{e^{\beta_0+\ x_{1i}\beta_1 + x_{2i}\beta_2 +,\dots,+x_{ki}\beta_k}}{1+e^{\beta_0+\ x_{1i}\beta_1 + x_{2i}\beta_2 +,\dots,+x_{ki}\beta_k}} \quad \dots\dots\dots (1)$$

Where, $\beta = (\beta_0, \beta_1, \beta_2, \dots \beta_k)'$ is a vector of unknown parameters.

$$Y_i = \begin{cases} 1 & \text{, patient is hypertensive} \\ 0 & \text{, patient is not hypertensive} \end{cases}$$

The logit transformation of p_i is a linear function of the explanatory variables:

$$\text{logit}\ (p_i) = \ln[\frac{p_i}{1-p_i}] = X_i'\beta = \beta_0 + \ x_{1i}\beta_1 + x_{2i}\beta_2 +,\dots,+x_{ki}\beta_k \quad \dots\dots\dots\dots\dots\dots\dots(2)$$

In fitting the above model maximum likelihood estimation method is used to estimate the parameters.

Over all model fit tests

The likelihood ratio chi-square ***(*G2*)*** statistic is the test statistic commonly used for assessing the overall fit of the logistic regression model. This log likelihood ratio test uses the ratio of the maximized value of the likelihood function for the intercept only model $L0$ over the maximized value of the likelihood function for the full model $L1$. The statistic of likelihood ratio test for is given by the following equation:

$$G^2 = -2\text{Log}(\frac{L0}{l1}) = -2[\text{Log (Lo)-Log (L1)}] = -2[\text{LL0-(-LL1)}] \quad \dots\dots\dots\dots\dots\dots\dots (3)$$

This statistic has a Chi-squared distribution with 1 degrees of freedom and LL is log-likelihood. If the statistic is greater than the critical value then, at least one of the predictors is significantly related to the response variable. (Hosmer and Lemeshow, 2000).

Results and discussion

Descriptive statistics results

Hypertension family history is another factor, the highest rate of hypertension (77.1%) was observed for those having family history of hypertension and 43.3% for those who were not having the highest prevalence rate of hypertension for marital status, religion and monthly income the rate of developing hypertension than the other category.

The chi-square test of association revealed that sex, age, BMI, physical activity status frequency of drinking alcohol ,frequency of smoking cigarette, residence, mental stress, education status, additional salt intake, hypertension family, friute intake have statistically significant association with hypertension at 0.05 level of significance

Inferential statistics result

Goodness of fit test

The insignificant p value in the Hosmer and Lemeshow test result revealed that the fitted logistic regression model is good in fit of the data.

Table 1 :Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	8.313	8	.404

Table 2: Results of the binary logistic regression model

			B	S.E.	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
							Lower	Upper
Step 1[a]	Sex	sex(1)	1.496	.432	.001*	4.464	1.915	10.406
	Age							
		age(1)	1.821	.949	.055	6.176	.962	39.635
		age(2)	2.089	.979	.033*	8.081	1.186	55.075
		age(3)	1.158	.977	.236	3.184	.470	21.590
		age(4)	-.138	.934	.883	.871	.140	5.437
	BMI							
		BMI(1)	1.665	.568	.003*	5.284	1.735	16.093
		BMI(2)	1.821	.499	.000*	6.180	2.325	16.423
		BMI(3)	.378	.604	.532	1.459	.447	4.762
	Physical							
		physical(1)	1.904	.536	.000*	6.709	2.345	19.200
		physical(2)	1.509	.529	.004*	4.522	1.602	12.762
	Education							
		education(1)	1.472	.580	.011*	4.358	1.398	13.584
		education(2)	-1.134	.578	.050*	.322	.104	1.000
		education(3)	.354	.583	.544	1.424	.454	4.468
	Drink alcohol	drinkalcoho(1)	2.638	.737	.000*	13.980	3.298	59.258
		drinkalcoho(2)	2.257	.727	.002*	9.556	2.300	39.692
	Chat chewing							
		smokingchew(1)	2.583	.724	.000*	13.242	3.206	54.688
		smokingchew(2)	.687	.414	.097	1.988	.882	4.479
	Residence	residenc(1)	1.073	.395	.007*	2.925	1.348	6.347
	Mentalstress	mentalstre(1)	1.691	.409	.000*	5.426	2.433	12.101
	Addtion salt	addsalt(1)	1.698	.418	.000*	5.461	2.409	12.378
	Family history	familyhist(1)	1.515	.486	.002*	4.548	1.755	11.784
	Friut in take	fruitveg(1)	1.790	.422	.000*	5.989	2.618	13.698
		Constant	-10.325	1.599	.000*	.000		

Prevalence of hypertension increases with increasing age group for cases compared to controls and the odds of being hypertensive increases with increasing age group relative to the reference category (<=24). That is the odds of respondents being hypertensive has increased by a factor 6.176 for the age group >=55 compared to the reference controlling for other variables in the model. Similarly, the odds of respondents being hypertensive has increased by a factor of 8.081 for the age group >=45, <=54 compared to the reference controlling for other variables in the model. For the third category of age, the respondents being hypertensive has increased by a factor of 3.184 for the age group >=35, <=44 compared to the reference controlling for other variables in the model and for the last category, being hypertensive has decreased by a factor of 0.871 for the age group >=25, <=34 compared to the reference controlling for other variables in the model. The results of this study are consistent with the study conducted in different parts of Ethiopia (Melkamu.MM, 2019, S.M.Abebe, 2015, Anteneh ZA, 2015, Awoke A, 2012). This is mainly due to arterial stiffness as one gets older.

For, sex the category male was prevalent (55.3%) than female (40.95) regards to hypertension status. The odds of developing hypertension among males were four times more likely than when compared with those who were females. This was different from the study conducted in Debremarkos (Kiber.M, 2019) this could be attributed due to the study area, but this study was consistent with the study conducted on Gondar university students (Tadesse and Henok, 2014).

For, BMI body mass index above 25 kg/m^2 was associated with hypertension. The rate of developing hypertension for those who were obese and overweight were the same (70.8% and 70.0% respectively) for cases compared to controls. Being overweight or obese increased the odds of hypertension by six and five times respectively compared to having normal BMI. This finding was in line with the studies conducted in Southern Ethiopia (Bonsa F 2014, Helelo TP 2014, Asresahagn H 2017) even though the order was reversed.

Respondents those having low physical activity were seven times more likely to be hypertensive compared to those who have high physical activity. However, there was reduced risk of being hypertensive among participants who were engaged in moderate physical activity as compared to those who did engaged in high physical activities. It was similar with the studies conducted in different parts of Ethiopia (Awoke et.al 2012, Helelo TP, 2014). Respondents who were uneducated are four times more likely to be hypertensive compared to having diploma and above. This was in line with the study conducted in Ethiopia (Asresahegn H, 2017). However this was different from the study conducted in Dire Dawa (Melkamu.MM, 2019). This difference could be attributed due to the study population and study area.

The odds of developing hypertension among those who were drinking alcohol always and sometimes was thirteen and nine times respectively prone to hypertension than their counter parts. This finding was supported by other research findings in Ethiopia (S.M.Abebe, 2015, Kiber.M, 2019). Similarly khat chewing was also associated with the development of hypertension. This result was consistent with a study conducted in different parts of Ethiopia (Negussie S, 2017, Workineh TG, Melkamu.MM, 2019).

Our study has shown urban residents were more likely prone to develop HP compared to rural residents. This was in line with the study conducted in Mettu Karl Hospital (Negussie S, 2017). The reason for the higher prevalence of hypertension among urban residents might be sedentary life style, easily access and expose to some risk factors. Like alcohol consumption on regular base. Mental stress was also associated with developing HP. Respondents who were stressed were five times more likely to be hypertensive than the reference category. This was consistent with the research conducted in Saúde Pública (Gasperin et.al, 2009)

The odds of developing hypertension among those who consumed excessive salt was five times more likely when compared to counterparts. This was in line with the study conducted in southern Ethiopia and northwest Ethiopia (Anteneh ZA, 2015, Helelo TP, 2014, Tadesse, 2014, Kiber.M, 2019). The odds of developing hypertension among those who had a family history of hypertension were five times more likely when compared with counterparts. This was supported by the study conducted in different parts of Ethiopia (Kiber.M, 2019, Esayas, 2013, Helelo et.al, 2014, Asresahegn H, 2017). Finally, the odds of developing hypertension among those who use fruit and vegetables sufficiently was six times more likely when compared to counter parts. This was consistent with the study conducted in Durame town, southern Ethiopia (Helelo et.al, 2014). Marital status, monthly income and religion were not associated with HP in this study.

Conclusion

This study has shown that hypertension was significantly associated with sex, age, BMI above 25 kg/m^2, excess salt utilization, family history of hypertension, alcohol consumption, smoking/chewing, insufficient use of fruit and vegetables, mental stress, low physical activity residence and low level of educational status are some of the interventions that increases the risk of hypertension in kebry beya woreda.

This study, therefore recommends reducing these risky behavior and the government and NGOs working on non-communicable areas should have to give due emphasis on promoting healthy life style like avoiding excessive salt use and have regular physical exercise.

Conflict of Interests

The authors declared no potential conflicts of interest with respect to the research.

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