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Cardiovascular disease risk among hypertensive patients and associated determinants in Addis Ababa, Ethiopia: an institutional-based cross-sectional study

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ABSTRACT

Objective The aim of this study was to assess the level of cardiovascular disease (CVD) risk and associated factors among hypertensive patients having follow-up at selected hospitals in Addis Ababa, Ethiopia, in 2022.

Setting A hospital-based cross-sectional study was conducted in public and tertiary hospitals in Addis Ababa, Ethiopia, from 15 January 2022 to 30 July 2022.

Participants A total of 326 adult hypertensive patients who visited the chronic diseases clinic for follow-up were included in the study.

Primary and secondary outcome measures A high predicted 10-year CVD risk level was assessed using an interviewer-administered questionnaire and physical measurement (primary data) and reviews of medical data records (secondary data) by using a non-laboratory WHO risk prediction chart. Logistic regression with an adjusted OR (AOR) using a 95% CI was calculated for independent variables associated with 10-year CVD risk.

Results The prevalence of a high predicted 10-year CVD risk level was 28.2% (95% CI 10.34% to 33.2%) among the study participants. A higher CVD risk level was found to be associated with age (AOR 4.2 for age 64–74, 95% CI 1.67 to 10.66), being male (AOR 2.1, 95% CI 1.18, 3.67), unemployment (AOR 3.2, 95% CI 1.06 to 6.25) and stage 2 systolic blood pressure (AOR 11.32; 95% CI 3.43 to 37.46).

Conclusion The study showed that the respondent's age, gender, occupation and high systolic blood pressure were determinant factors for CVD risks. Therefore, routine screening for the presence of CVD risk factors and assessment of CVD risk are recommended for hypertensive patients for CVD risk reduction.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study had a maximum response rate (100%).
⇒ The study used a cross-sectional study design, which does not establish a causal relationship between the outcome variable and independent factors.
⇒ The fact that the study was done in a facility restricts the generalisability of the conclusion to the entire community.
⇒ The findings may not apply to the larger Ethiopian population since the majority of study participants were urban employees who were often well educated.
⇒ Additionally, the study excluded biochemical measurements in favour of only behavioural and physical measurements.

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading causes of death worldwide.[1] CVD incidence nearly doubled from 271 million in 1990 to 523 million in 2019, and CVD deaths increased steadily from 12.1 million in 1990 to 18.6 million in 2019, accounting for 32% of all global deaths.[2] In sub-Saharan Africa, CVDs are the most frequent causes of non-communicable disease (NCD) deaths, which account for approximately 13% of all deaths and 37% of all non-communicable disease deaths.[3 4]

Ethiopia is one of the countries in sub-Saharan Africa where people suffer from CVD. Despite significant reductions in the risks to maternal, neonatal, child health and major communicable diseases, there are still obvious difficulties in tackling the burden of CVDs as a top priority for public health in Ethiopia.[5] Based on a systematic review and meta-analysis of institutional and community-based studies in Ethiopia, the prevalence of CVD ranges from 1% to 20%.[6]

CVDs are a group of disorders of the heart and blood vessels.[7] They are generally classified as atherosclerotic CVDs (related to atherosclerosis of arteries that supply organs (coronary heart disease, cerebrovascular disease and peripheral arterial diseases)[8] and non-atherosclerotic CVDs that include

rheumatic heart disease, congenital heart disease, cardiomyopathies and others.[9]

Most CVDs are preceded by many years of cardiovascular risk factors. Early detection and treatment of modifiable risk factors can lower an individual's risk of developing CVD.[2 9] Modifiable risk factors are those conditions for which interventions exist to reduce their levels and decrease the occurrence of CVDs. In terms of attributable deaths, hypertension is the leading risk factor responsible for 19% of global deaths, followed by overweight, obesity and raised blood glucose.[10]

Modifiable risk factors can be identified early and treated to reduce the chance of having CVD in an individual. Cessation of tobacco use, reduction of salt in the diet, eating more fruit and vegetables, regular physical activity, and avoiding harmful use of alcohol have been shown to reduce the risk of CVD.[9] In addition, drug treatment of hypertension, diabetes and high blood lipids is necessary to reduce cardiovascular risk and prevent heart attacks and strokes among people with these conditions.[2]

Several CVD risk scores exist to estimate the 10-year risk of developing CVDs ('baseline cardiovascular risk').[11] Our country recently adopted the WHO 2020 cardiovascular risk score charts to be used for primary prevention of CVDs since the score is more applicable for resource-poor countries like Ethiopia.[8] In Ethiopia, the laboratory tests for serum cholesterol and blood glucose are not widely available, and a non-laboratory WHO cardiovascular risk prediction chart can be used in areas where these tests are not available or unaffordable.

The WHO risk score was adopted nationally for use by health workers very recently; there is no published work on the risk assessment of CVD among hypertensive patients using the WHO risk prediction chart. Therefore, the aim of this study was to determine the level of CVD among hypertensive patients using a non-laboratory-based WHO cardiovascular risk chart and to identify determinant factors at selected hospitals in Addis Ababa, Ethiopia, in 2022.

METHODS

Study area and period

The study was conducted at selected public hospitals in Addis Ababa, Ethiopia. There were 13 public hospitals that were providing hypertension treatment and follow-up services in Addis Ababa. These hospitals are responsible for inpatient and outpatient care of different health conditions, including hypertension. These hospitals provide tertiary and specialised services with different levels of healthcare workers. The study was conducted from 15 January 2022 to 30 July 2022, using a facility-based cross-sectional study design.

Source population

All hypertensive patients having treatment and follow-up in Addis Ababa public hospitals were our reference population.

Study population

All adult hypertensive patients having follow-up at selected hospitals in Addis Ababa.

Eligibility criteria

All adult hypertensive patients on follow-up for at least 6 months and aged between 40 and 74 years (the WHO risk scoring applies to this age group only) were included in the study. However, pregnant women and patients with any history of CVD (ischaemic heart disease, stroke or peripheral artery disease) during their follow-up were excluded.

Sample size determination and sampling technique

The minimum required sample size was estimated using Cochran's formula (1977) with the following assumptions: a standard normal distribution with a 95% CI, a tolerable margin of error of 5%, and an anticipated proportion of high cardiovascular risk among hypertensive patients of 0.26.[12] Adding a 10% non-response rate, the final sample size was 326.

$$n = \frac{\left(Z\frac{\alpha}{2}\right)^2 P(1-P)}{d^2}$$

Out of the 13 public hospitals that provide hypertension services, three were chosen for this study using a simple random selection procedure. The total sample size was divided proportionally for male and female participants at the selected hospitals. Based on the registry of follow-up hypertensive patients, 4000 at Yekatit, 2500 at Ras Desta and 2500 at Menelik II hospitals were expected to come for follow-up during the study period. The total sample size was divided based on this proportion, resulting in final sample sizes of 148 from Yekatit, 96 from Ras Desta, and 82 from Menelik II hospitals. A sampling frame was prepared using their card number, and simple random sampling was used to select each participant.

Study variables and definition

Hypertensive patients predicted 10-year CVD risk level was considered an outcome variable, and age, sex, educational status, marital status, smoking history, body mass index (BMI), waist circumference, systolic blood pressure (SBP), diastolic blood pressure (DBP), type of antihypertensive treatment, duration of antihypertensive treatment, physical exercise, history of diabetes, history of CKD (chronic kidney disease), history of high cholesterol and physical activity were all selected as explanatory variables.

Hypertensive patient

Patients diagnosed with hypertension by a health professional with a sustained office BP level of systolic greater than or equal to 140 and/or diastolic BP of 90 mm Hg, or any patient taking antihypertensive medication.

Waist circumference

The measurement of abdominal circumference in centimetres is halfway between the anterior superior iliac spine and the lower rib cage.

Cardiovascular diseases

CVDs are a group of disorders that affect the heart and the blood vessels that supply the heart (coronary heart disease, rheumatic heart disease and congenital heart disease), the brain (cerebrovascular disease) and the arms and legs (peripheral artery disease, deep vein thrombosis and pulmonary embolism).[13]

Ten-year CVD risk level

The chance of developing CVD in the next 10 years is computed based on the current background status of cardiovascular risk factors.

Nutritional status

Nutritional status refers to an individual's health status as influenced by nutrient intake and utilisation. It was estimated using the BMI for the presence of malnutrition in both sexes, defined as BMI 18.5 kg/m^2 and overweight, defined as BMI>25.0 kg/m^2.[14]

Data collection tools and procedures

The data were gathered using a data collection checklist designed to extract relevant information. The checklist was adapted from different literature with modifications. A questionnaire was developed to collect relevant data based on the eligibility criteria.

This study used primary and secondary data derived from patient interviews with an interviewer-administered questionnaire and physical measurement (primary data) and reviews of medical records (secondary data) by using a data extraction checklist. Both the questions and the checklist were prepared in English and then translated to the local working (Amharic) language.

Three data collectors with at least a diploma in nursing were used to collect the data. Two supervisors with BScs in public health were employed. The responsibility of the supervisors was to check whether the checklist was correctly filled out during the data collection period and hand over the completed tools to the principal investigator on the day of data collection. The principal investigator checked for the final completeness of the checklist.

Data quality assurance and analysis

To ensure quality of the data, the checklist was examined by senior experts in the area of study for content validity, and a pretest was done on 5% of the total population at Zewditu hospital in Addis Ababa. Any errors found during the expert evaluation and pretest were corrected. One day of training was given to data collectors and supervisors before the actual data collection period. Data quality was controlled by designing the proper data collection tools and through continuous supervision. All completed data collection forms were examined for completeness and consistency during data management, storage, cleaning and analysis. The data were entered and cleaned by the principal investigator before analysis.

The collected data were entered into Epi Data and exported to SPSS V.25 for further analysis.[15] Frequency tables, percentages and graphs were used to summarise the descriptive data. The risk of CVD among hypertensive patients was predicted based on the parameters of the non-laboratory-based WHO CVD risk chart, that is, age, sex, BMI, SBP and smoking status. Descriptive statistics were used to determine the prevalence of CVD risk factors among hypertensive patients.

Bivariate and multivariable logistic regression were used to assess the association between cardiovascular risk level and selected explanatory factors. Variables with a p<0.25 in binary logistic regression were considered for multivariable analysis. Then those variables with a p<0.05 were considered to have a significant association.

Patient and public involvement

Throughout the data collection period, the study participants received free support and advice for the researchers related to ethical issues and advice on how to share our findings with a wide audience in a way the public can understand.

RESULTS

Sociodemographic data

In total, 326 hypertensive patients (150 men and 176 women) from 3 public hospitals voluntarily participated in the study, giving a response rate of 100%. Close to half (45.7%) of the participants were between 48 and 55 years of age, with a mean age of 51.5 ranging from 40 to 74 years. Two hundred and sixty (66.3%) of the participants were married. Seventy-one participants (21.8%) have no formal education, while 144 (44.2%), 54 (16.6%) and 57 (17.5%) have attended primary, secondary school and higher diploma education, respectively (table 1).

Clinical characteristics of respondents

More than half (50.3%) of the patients had a duration of hypertension greater than 5 years, and only 33 (10.1%) patients had a duration of hypertension less than 1 year. Entirely (100%) of the hypertensive patients are on medications plus lifestyle modifications, with the most commonly used class of medication being ACE inhibitors, followed by calcium channel blockers (31%) and diuretics (12%). Half of the respondents were diagnosed with having comorbidities, and diabetes was the leading comorbidity, contributing to 78% of the comorbidities. Renal disease was found in nine (5.4%) of the study participants. The mean SBP measurements were 141.5 mm Hg (95% CI 120 to 146) and the mean DBP measurement was 81.9 mm Hg (95% CI 70 to 85). 232 (71.2%) of the study participants had an SBP of 140 mm Hg, and 132 (40.5%) of the study participants had a DBP greater than 90 mm Hg (table 2).

Physical measures and behavioural risk factors

Three hundred and six (96.9%) of the participants had never smoked a cigarette, while 10 (3.1%) of them were current smokers. Only 30 (9.2%) of the participants drink alcohol, and 23 (76.6%) of them drink alcohol on special

Table 1 Sociodemographic characteristics of study participants in Addis Ababa, 2022

Variable	Category	Frequency (n)	%
Gender of respondent	Male	150	46.0
	Female	176	54.0
Age of respondent	40–47 years	98	30.1
	48–55 years	90	27.6
	56–63 years	90	30.4
	64–74 years	39	12.0
Marital status	Single	16	4.90
	Married	216	66.3
	Divorced	41	12.6
	Separated	18	5.50
	Widowed	35	10.7
Educational status	Illiterate	71	2.18
	Primary school	144	44.2
	Secondary school	54	16.6
	Higher diploma	57	17.5
Current occupation	Unemployed	214	65.6
	Employed	112	34.4

occasions. One hundred and twenty-four (38%) of the participants reported regular daily walking for at least 30 min for lifestyle purposes and as part of their work. The mean BMI of the study participants was 26.8 kg/m^2 (table 3).

Prevalence of CVD risk

The WHO CVD risk (non-laboratory-based) charts were used to predict the total CVD risk level. Based on non-laboratory-based WHO risk chart patients, a 10-year risk of >10% was used to define a high CVD risk level. As a result, the risk of CVD was high in this study population for 92 patients (28% of the participants) (figure 1).

Table 2 Clinical characteristics of respondents in Addis Ababa in 2022

Characteristics	Frequency (n)	%
Duration of hypertensions		
Less than 1 year	33	10.1
1–5 Years	129	39.6
More than 5 years	164	50.3
Diagnosis for other disease		
Yes	166	50.9
No	160	49.1
Types of comorbidities (n=166)		
Diabetic Mellitus	131	78.9
Renal disease	16	9.6
HIV	9	5.4
Connective tissue diseases	10	6.0

Table 3 Physical and behavioural risk factors of the study participants in Addis Ababa, 2022

Variables	Frequency (n)	%
Current cigarette smoking		
Yes	10	3.1
No	316	96.9
Duration of smoking (n=10)		
Less than 5 years	3	30
5–10 years	7	70
Currently consume alcohol		
Yes	30	9.20
No	296	90.8
Frequency of consumption of alcohol (n=30)		
Every day	1	3.30
1–2 times per week	3	10.0
3–4 times per week	3	10.0
On special occasion	23	76.7
Regular walk		
Life style	102	31.3
As work	100	30.7
Both	124	38.0
Frequency of taking fruit for health		
Daily	34	10.4
Once per week	115	35.3
Once per month	154	47.2
Never	23	7.10

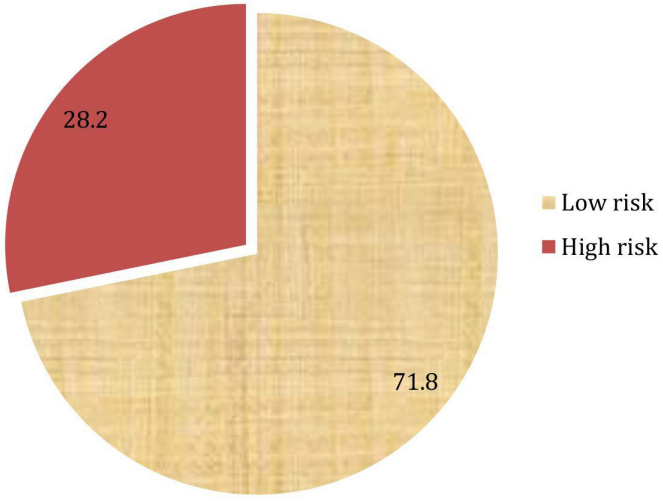

Figure 1 The prevalence of high cardiovascular disease risk in Addis Ababa, Ethiopia, 2022.

Table 4 Factors associated with cardiovascular disease risk

Variable	CVD risk level				AOR (95% CI)
	High		Low		
Age					
40–47 years (Ref)	27	8.2	71	21.8	1
Age 48–55 years	24	7.3	66	20.2	1.02 (0.49 to 2.14)
Age 56–63 years	23	7.1	76	23.3	0.56 (0.27 to 1.18)
Age 64–74 years	18	5.5	21	6.4	4.21 (1.67 to 10.66)*
Gender					
Female (ref)	36	11.0	140	42.9	1
Male	56	17.2	94	28.8	2.08 (1.18 to 3.66)*
Occupation					
Employed (ref)	22	6.7	90	27.6	1
Unemployed	70	21.4	144	44.2	3.24 (1.06 to 6.25)*
Systolic blood pressure					
SBP<120 (ref)	4	1.2	38	11.6	1
SBP 120–139	10	3.1	42	12.9	1.79 (0.45 to 7.09)
Stage 1140–159	7	2.1	54	16.6	2.23 (0.59 to 8.47)
Stage >160	71	21.8	100	30.1	11.33 (3.43 to 37.46)†
Smoking history					
Smoker	6	12.3	4	37.7	1.79 (0.35 to 9.28)
Non-smoker	86	12.9	230	29.8	1
Presence of comorbidity					
Comorbidity	57	17.5	109	33.4	1.805 (0.92 to 3.170)
No comorbidity (ref)	35	10.7	125	38.3	1

*p-value<0.05
†p<0.01
AOR, adjusted OR; COR, crude OR; CVD, cardiovascular disease; SBP, systolic blood pressure.

Factors associated with CVD

The strength of the association between the independent variables and CVD was assessed using bivariate and multivariate logistic regression (table 4). Based on the p<0.25 of the bivariable analysis, different variables were identified as candidates for the multivariable analysis. These are sex, age, occupation, cigarette smoking, current SBP and comorbidity. The result of multivariable analysis, however, identified gender, age, occupational status and current SBP as risk factors associated with CVD at p<0.05.

Consequently, males had a twofold higher CVD risk level as compared with female hypertensive patients. (AOR (adjusted OR) 2.08, 95% CI 1.18 to 3.66). The odds of having a higher CVD risk level were 4.21 times higher among those aged 64–74 years as compared with those aged 40–47 years (AOR 4.21, 95% CI 1.67 to 10.66). The odds of having a higher CVD risk level were 3.24 times higher among the unemployed than the employed (AOR 3.24, 95% CI 1.06 to 6.25). Participants with SBP greater than 140 mm Hg had more than 11 times the odds of having a high CVD risk level than those with SBP less than 140 mm Hg (AOR 11.33, 95% CI 3.43 to 37.46) (table 4).

DISCUSSION

High 10-year CVD risk (CVD risk greater than 10%) was detected in 28.2% (95% CI 10.34% to 33.2%) of hypertensive patients in selected hospitals in Addis Ababa. It was consistent with a study finding from Malaysia of 20.5%.[16] However, the current results showed a higher prevalence of high CVD risk levels among hypertensive patients compared with results from a study conducted in Sri Lanka,[17] which found a prevalence of 8.2%. In contrast, the proportion of people in this study who were found to be at low risk of a CVD over 10 years (10% risk) was 71.8%, which is lower than the proportions found in rural Nepal (86.4%),[18] rural South India (83%)[19] and rural Bangladesh (81.3%).[20] This difference might be due to the difference in sociodemographic, methodological variation and sociocultural characteristics of the study participants. For instance, the study of Nepal used the WHO/ISH (World Health Organization/International Society of hypertension prediction charts) risk prediction charts, which indicate a 10-year risk of a fatal or non-fatal major cardiovascular event (myocardial infarction or stroke) and have different applications among different epidemiological subregions.

The study identified several factors that are significantly associated with the CVD risk level in hypertensive patients. The 10-year CVD risk was more prominent in males as compared with females. This finding is in line with the review made by Kessler *et al* on sex-specific influence on cardiac structural remodelling and therapy in CVD, where women during premenopause have a lower prevalence of CVD than men.[21] Another study conducted in England also showed that the proportions of hypertensive women were less likely to develop CVD risk than men.[22] Conversely, other studies done in India indicated that women were more likely to have CVD than men.[23] This is also in line with the study in China, Mexico, Gahanna and South Africa that found females died from CVD at a higher rate than males. Despite the fact that women develop CVD 10 years later than men, they are more likely to suffer from a heart attack than man.[24] The difference might be due to the difference in population and risk prediction methods.

Age was identified as one of the strongest predictors of a high CVD risk level. This finding is not surprising since most cardiovascular risk factors increase with age, resulting in high predicted cardiovascular risk levels. Several studies conducted in various countries found an association between various behavioural, sociodemographic and clinical factors and CVD risk among hypertensive patients as they aged. Oxidative stress, mitochondrial dysfunction, impaired resistance to molecular stressors and chronic low-grade inflammation with advanced ageing are among the factors listed for an increased prevalence of CVDs in older individuals.[25 26]

The study also identified that employment status was significantly associated with a high cardiovascular risk level. Subsequently, the odds of having a higher CVD risk level were more than three times higher among the unemployed than the employed. This finding is consistent with other studies done in China and Korea, where those who were unemployed had a higher risk of CVD than those employed.[27] Low levels of employment were related to the high rate of death from CVD[28] and self-reported chronic conditions.[29] This might be due to the fact that employed persons have better health awareness and adherence to treatment, and hence they might have lower levels of cardiovascular risks.

In this study, high SBP was also found to be associated with high CVD risk. In this study, participants who had SBP>160 mm Hg had more than 11 times the odds of having a high level of CVD risk compared with participants with SBP 120 mm Hg. It was supported by previous prospective cohort studies that examined the relationship between BP and the risk of CVD and were mainly conducted in western populations.[30] Other studies also identified a similar pattern and association of high SBP with a high cardiovascular risk level.[31] Therefore, lowering BP in the entire population should be an important component of any preventive plan to reduce the societal burden of CVD in the general population.

Previous research found that hypertensive renal vascular damage exacerbated by albuminuria was a risk factor for hypertension, CVD and mortality.[32–35] The reason for this was that, while the key mechanisms differed depending on the stage of CKD (eg, shared risk factors at milder stages and uraemic toxins at more severe stages), several mechanisms were involved, including shared risk factors for CKD and CVD, volume overload, bone-mineral metabolism disorder, uraemic toxins, anaemia, inflammation and oxidative stress.

Limitations of the study

Most of the study participants were urban employees who were often well educated. Hence, the results might not be applicable to the larger Ethiopian population. The study used a cross-sectional study design, which does not establish a causal relationship between the outcome variable and independent factors. The fact that the study was done in a facility restricts the generalisability of the conclusion to the entire community. Additionally, the study excluded biochemical measurements in favour of only behavioural and physical measurements.

CONCLUSION

The study showed that older age, being male, unemployment and high SBP were factors identified for a high CVD risk level. Moreover, research involving more patients from different parts of the country and using different risk scoring tools is needed to understand the reasons for the high prevalence of high CVD risk levels among hypertensive patients in Ethiopia. Finally, proper interventions, such as statins and ASA (aspirin), should be provided to hypertensive patients at high risk to prevent the development of CVDs.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval Ethical approval was obtained from Yanet College's research and ethical board with reference number YEC/019/22. Permission letters were obtained from each selected public hospital's higher officials. Written informed consent was secured from each study participant before the interview. Confidentiality was maintained at each level of the response. The Declaration of Helsinki's ethical principles, which state that 'it is the researcher's responsibility to promote and protect the health, well-being and rights of study participants, including those who participate in medical research,' serve as the framework for all research activities. Moreover, all the study participants were informed that their participation was voluntary and that they had the possibility of withdrawing from the interview at any time.

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Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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