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Prevalence and predictors of dyslipidemia among hypertensive patients in Lumame Primary Hospital, Amhara, Ethiopia: A cross-sectional study

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ABSTRACT

Background: Serum lipid profile abnormalities are major predictors for coronary artery diseases. The relationship between demographic factors and dyslipidemia in Ethiopia is not completely explored. Thus, this study aimed to assess the prevalence and predictors of dyslipidemia among hypertensive patients in Lumame Primary Hospital.
Methods: A cross-sectional study was conducted from June to August 30, 2020, on the hypertensive patients in Lumame Primary Hospital. All adult hypertensive patients who visited the adult hypertensive care services during the study period were included. Interview-guided self-administered questionnaire and a chart review were used for data collection. Statistical Package for the Social Sciences (SPSS) software version 24.0 was used for data analysis.
Results: Out of 372 hypertensive patients, 190(51.1%) were females and the mean age of the study participants was 43.56 years (SD ± 4.31). The overall prevalence of dyslipidemia in this study was 48.4%. Besides the overall prevalence, the prevalence of TC, TG, LDL-c, and HDL-c was 73(19.6%), 91(24.5%), 60(16.1%), and 115(30.9%), respectively. Females were at higher risk for having high levels of TC (AOR = 2.31, 95% CI = 1.54–3.13), TG (AOR = 1.70, 95% CI = 1.34–3.79), LDL-c (AOR = 2.15, 95% CI = 1.56–2.86), and HDL-c (AOR = 2.67, 95% CI = 1.44–5.67) than males. Respondents who were from urban were at higher risk for having high levels of TC (AOR = 1.98, 95% CI = 1.04–6.83), TG (AOR = 1.78, 95% CI = 1.09–2.86), LDL-c (AOR = 3.01, 95% CI = 1.45–7.43), and HDL-c (AOR = 2.01, 95% CI = 1.94–4.55) than respondents who were from rural. Similarly, obese respondents were at higher risk for having high levels of TC (AOR = 2.03, 95% CI = 1.64–2.00), TG (AOR = 3.78, 95% CI = 1.06–6.42), LDL-c (AOR = 1.92, 95% CI = 1.66–2.12), and HDL-c (AOR = 4.23, 95% CI = 2.84–4.32) than to respondents who were underweight.
Conclusion: The prevalence of dyslipidemia among hypertensive patients was high. Independent variables such as age, gender, residence, family history of HTN, smoking, alcohol drinking, fruit diet habits, physical activity, DM, and BMI were significant determinants of dyslipidemia.

1. Background

Dyslipidemia is an increment of plasma triglycerides, cholesterol, or both, or a high low-density lipoprotein or low high-density lipoprotein levels that contributes to the development of atherosclerosis [1]. It is the most important risk factor for many chronic non-communicable diseases resulting in morbidity, and mortality, and medical costs globally [2–4]. With the development of the economy and improvement of living standards, more and more people suffer from atherosclerotic cardiovascular diseases which constitute the leading cause of death [5]. Elevated blood cholesterol levels are related to an increased risk of cardiovascular events like coronary heart disease, thereby serving as contributors to this process. The cholesterol abnormalities on coronary heart disease risk are raised if other risk factors such as obesity are concurrently occurred [3,6].

Increased serum lipid level was found to be a predictor for the first coronary event and predictive of recurrent events [7–9]. Therefore, the prevention and control of dyslipidemia particularly in adult populations have a significant role in reducing coronary events. Although the benefits of lipid-lowering therapy have been demonstrated most

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conclusively in persons with cardiovascular disease, lipid-lowering therapy is effective even in persons without the clinically apparent cardiovascular disease [10]. The NCEP ATP reports have been developed to provide healthcare professionals with recommendations pertinent to detecting and managing dyslipidemia [11]. The overall prevalence of dyslipidemia was 25.5% in African general adult population. The individual prevalence of TC, TG, HDL-c, and LDL-c was 25.5%, 17.0%, 19.5%, and 21.4%, respectively [12]. A study conducted in Eastern Ethiopia revealed that drinking coffee, vegetable intake, increased age, and elevated FBG were the independent predictors of dyslipidemia [13].

Patients with increased serum lipide levels have a higher-than-expected incidence of HTN, and those with HTN have a higher-than-expected incidence of raised serum lipide levels [14–16]. The number of cardiovascular disease cases has quickly increased worldwide. This is supposed due to various factors such as lifestyle changes, ageing, urbanization, and rapid socio-economic development [17–19]. The prevalence of cardiovascular disease in Saudi Arabia was found to be 5% [18]. Although cardiovascular disease risks such as dyslipidemia have been investigated in many countries, studies regarding the prevalence and risk factors of dyslipidemia in Ethiopia are still limited. For instance, even though cardiovascular disease is a common problem, there are inadequate understanding of the associated factors for dyslipidemia and cardiovascular disease risks [17,20–23]. Thus, this study aimed to estimate the prevalence and predictors of dyslipidemia among hypertensive patients in Lumame Primary Hospital.

2. Methods

2.1. Study setting, design, and period

A cross-sectional study was conducted from June to August 30, 2020, in the hypertensive care service of Lumame Primary Hospital, located in East Gojjam zone, Ethiopia, 302 km far from Addis Ababa Lumame Primary Hospital serves more than 151,065 people of the East Gojjam zone and the people around the neighboring zones. In the referral hospital, there are different care services among which the hypertensive care services is the one serving for follow up and treatment of patients with HTN.

2.2. Study participants and sample size determination

All adult hypertensive patients (age ≥18 years) who visited the hypertension care services of Lumame Primary Hospital through the study period were included. Single population proportion formula was used with the assumption of 95% CI, 5% margin of error, the prevalence (p) of dyslipidemia among African adults (25.5%), and 10% for possible non-response to determine a final adjusted sample size of 321. However, to increase the power of the study, the sample size was extended to 372. Simple random sampling technique was used to select study participants by using adult hypertensive care services of Lumame Primary Hospital appointment list as a sampling frame.

2.3. Inclusion and exclusion criteria

Inclusion criteria were the following: adult hypertensive patients (age ≥18 years) who visited the hypertension care services of Lumame Primary Hospital through the study period, no changes in drug therapy in the previous 3 months, a full lipid profile [total cholesterol (TC), high-density lipoprotein cholesterol (HDLc), low-density lipoprotein (LDLc), and triglycerides (TG)] both performed within the previous month, and valid ambulatory BP monitoring were included in the study. However, changes in drug therapy in the previous 3 months, pregnant women, incomplete lipid profile, and participants with mental problems were excluded from the study.

2.4. Data collection quality control

For quality assurance, the principal investigator was continuously supervising the data collectors for completeness and consistency and the records were cross-checked. The training was given for data collectors and supervisors. The data collection was supervised daily and it was pretested on 10% of the sample size. Based on the findings of the pre-test, some questions were modified and some others were added. The data extracted for the pre-test was not included in the main analysis.

2.5. Data collection and measurement

The data collectors were appropriately skilled in the data collection tool before data collection. Several published articles were reviewed to prepare the data collection tool [24–26]. An interview-directed self--administered questionnaire and a chart review were used for data collection. Hypertensive patients who were unable to write and read were interviewed. The questionnaire includes socio-demographic characteristics and the clinical status of the patients. Lipid abnormalities were calculated according to NCEP ATP III [27], as TC > 200, TG > 150, LDL >130 mg/dL, and HDL<40. During data gathering, trained health professionals were recruited and supervised by the principal investigator. Finally, the completeness and fulfillment of all questions were checked by the principal investigator and data collectors.

2.6. Data analysis

Statistical Package for the Social Sciences (SPSS) software version 24.0 was used for data analysis. Descriptive statistics like, frequency, percentage, mean, standard deviation, and median were used for data presentation. Univariate and multivariate logistic regression was computed to identify associated factors with a 95% confidence interval using a p-value <0.05 as a cutoff point.

3. Results

3.1. Prevalence of dyslipidemia according to respondent's demographics

A total of 372 respondents participated in the survey. The mean age of the participants was 43.56 years (SD ± 4.31). Half 190(51.1%) of the respondents were female and 190(51.1%) of them were married. The majority of the respondents 259(69.6%), were Orthodox Christian followers and the majority of the participants were permanent residents of urban areas 208(55.9%). Concerning parents' educational level, 120 (32.3%) were Illiterate and 158(42.5%) of them were self-employed. The prevalence of dyslipidemia among hypertensive patients in the socio-demographic characteristics was reported in Table 1. The overall prevalence of all types of dyslipidemia was ranged from about 16.1% to 30.9%. Prevalence of dyslipidemia according to age, gender, marital status, residence, religion, occupation, educational level, and monthly income was found to be 73(19.6%), 91(24.5%), 60(16.1%), and 115 (30.9%), respectively for TC, TG, LDL-c, and HDL-c Table 1.

Prevalence of dyslipidemia according to comorbidity with hypertension, diabetes, and medical profiles of patients.

Table 2 shows the prevalence of dyslipidemia by type of hypertension, duration of hypertension, diabetes mellitus, BMI, and family history of dyslipidemia. Among respondents with DM, the prevalence of TC, TG, LDL-c, and HDL-c was 44.8%, 47.1%, 33.3%, and 48.3%), respectively. Nevertheless, the prevalence of dyslipidemia among non-diabetic respondents was 11.9%, 17.5%, 10.9%, and 25.6%, respectively. Prevalence of TC, TG, LDL-c, and HDL-c was 5.6%, 11.1%, 5.6%, and 13.9%), respectively among respondents who were underweight. However, the prevalence of TC, TG, LDL-c, and HDL-c was 38.7%, 45.2%, 32.3%, and 56.9%), respectively among respondents who were obese. Prevalence of TC, TG, LDL-c, and HDL-c was 29.4%, 53.9%, 37.3%, and 50.9%), respectively for participants who had a family

Table 1
Prevalence of dyslipidemia by participant's demographics (n = 372).

Variable		Frequency (%)	TC ≥ 240 mg/dL (6.21 mmol/)	TG ≥ 200 mg/dL (2.26 mmol/)	LDL-C ≥ 160 mg/dL (4.14 mmol/)	HDL-C < 40 mg/dL (1.03 mmol/L)
Age	<30	41(11.0)	10(24.4)	9(21.9)	4(9.8)	16(39.0)
	31–45	128(34.4)	19(14.8)	26(20.3)	18(14.1)	33(25.8)
	>45	203(54.6)	44(21.7)	56(27.6)	38(18.7)	66(32.5)
	Total	372(100)	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Sex	Male	182(48.9)	22(12.1)	25(13.7)	19(10.4)	43(23.6)
	Female	190(51.1)	51(26.8)	66(34.7)	41(21.6)	72(37.9)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Religion	Orthodox	259(69.6)	51(19.7)	75(28.9)	41(15.8)	99(38.2)
	Muslim	81(21.8)	16(19.8)	12(14.8)	14(17.3)	10(12.3)
	Protestant	32(8.6)	6(18.8)	4(12.5)	5(15.6)	6(18.8)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Marital status	Single	116(31.2)	20(17.2)	22(18.9)	14(12.1)	33(28.4)
	Married	202(54.3)	46(22.8)	56(27.7)	32(15.8)	69(34.2)
	Divorced	32(8.6)	5(15.6)	8(25)	11(34.4)	6(18.8)
	Widowed	22(5.9)	2(9.1)	5(22.7)	3(13.6)	7(31.8)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Residence	Urban	208(55.9)	52(25)	61(29.3)	50(24)	75(36.1)
	Rural	164(44.1)	21(12.8)	30(18.3)	10(6.1)	40(24.4)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Occupations	Government	85(22.8)	22(25.9)	26(30.6)	20(23.5)	30(35.3)
	Nongovernment	44(11.8)	12(27.3)	17(38.6)	7(15.9)	20(45.5)
	Self employed	158(42.5)	23(14.6)	34(21.5)	23(14.6)	43(27.2)
	Farmer	73(19.6)	15(20.5)	12(16.4)	9(12.3)	19(26.0)
	Student	12(3.2)	1(8.3)	2(16.7)	1(8.3)	3(25)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Educational level	Illiterate	120(32.3)	26(21.7)	31(25.8)	17(14.2)	48(40)
	Elementary school	76(20.4)	17(22.4)	23(30.3)	12(15.8)	26(34.2)
	Secondary school	72(19.4)	18(25)	20(27.8)	16(22.2)	21(29.2)
	High school diploma	65(17.5)	9(13.8)	15(23.1)	11(16.9)	17(26.2)
	Higher education	39(10.5)	3(7.7)	2(5.1)	4(10.3)	3(7.7)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Monthly income	<1000 ETB	174(46.8)	31(17.8)	41(23.6)	25(14.4)	46(26.4)
	1000-2000 ETB	88(23.7)	20(22.7)	26(29.5)	10(11.4)	35(39.8)
	2001-3000 ETB	62(16.7)	15(24.2)	19(30.6)	18(29.0)	28(45.2)
	>3000 ETB	48(12.9)	7(14.6)	5(10.4)	7(14.6)	6(12.5)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)

Table 2
Dyslipidemia by comorbidity with hypertension, diabetes, and medical profiles of patients (n = 372).

Variable		Frequency (%)	TC ≥ 240 mg/dL (6.21 mmol/)	TG ≥ 200 mg/dL (2.26 mmol/)	LDL-C ≥ 160 mg/dL (4.14 mmol/)	HDL-C < 40 mg/dL (1.03 mmol/L)
Classifications of Hypertensive patients	Normal	69(18.5)	4(5.8)	3(4.3)	2(2.9)	5(7.2)
	Stage 1	77(20.7)	9(11,7)	18(23.4)	7(9.1)	25(32.5)
	Stage 2	127(34.1)	35(27.6)	41(32.3)	25(19.7)	49(38.6)
	Stage 3	99(26.6)	25(25.3)	29(29.3)	26(26.3)	36(36.4)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Duration of hypertension	<5	84(22.6)	10(11.9)	16(19.0)	8(9.5)	21(25)
	5–9	73(19.6)	11(15.1)	15(20.5)	11(15.1)	18(24.7)
	10–14	56(15.1)	6(10.7)	12(21.4)	6(10.7)	17(30.4)
	15–20	68(18.3)	16(23.5)	18(26.5)	20(29.4)	29(42.6)
	>20	91(24.5)	30(32.9)	30(32.9)	15(27.5)	30(32.9)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Diabetes mellitus	Yes	87(23.4)	39(44.8)	41(47.1)	29(33.3)	42(48.3)
	No	285(76.6)	34(11.9)	50(17.5)	31(10.9)	73(25.6)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
BMI	Underweight	36(9.7)	2(5.6)	4(11.1)	2(5.6)	5(13.9)
	Normal	122(32.8)	8(6.6)	11(9.0)	6(4.9)	18(14.8)
	Overweight	121(32.5)	27(22.3)	34(28.1)	22(18.2)	39(32.2)
	Obesity	93(25.0)	36(38.7)	42(45.2)	30(32.3)	53(56.9)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Family history of lipid	Yes	102(27.4)	30(29.4)	55(53.9)	38(37.3)	52(50.9)
	No	270(72.6)	43(15.9)	36(13.3)	22(8.1)	63(23.3)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Overall prevalence of Dyslipidemia	**Yes**	180(48.4)				
	No	192(51.6)				

history of HTN. But, the Prevalence of TC, TG, LDL-c, and HDL-c was 15.9%, 13.3%, 8.1%, and 23.3%), respectively for respondents with a family history of HTN (Table 2).

3.2. Prevalence of dyslipidemia according to lifestyle practices of participants

The prevalence of dyslipidemia in participants with sedentary physical activity was 31.0%, 37.2%, 25.5%, and 47.6%, respectively for TC, TG, LDL-c, and HDL-c. However, the prevalence of dyslipidemia in participants with vigorous physical activity was 6.9%, 9.2%, 5.7%, and 9.2%, respectively for TC, TG, LDL-c, and HDL-c. Prevalence of TC, TG, LDL-c, and HDL-c was 7.3%, 9.4%, 7.3%, and 12.5%), respectively among respondents who had a habit of fruit in their diet. But, the prevalence of TC, TG, LDL-c, and HDL-c was 23.9%, 29.7%, 19.2%, and 37.3%), respectively for respondents who hadn't habit of fruit in their diet. Likewise, the prevalence of TC, TG, LDL-c, and HDL-c was 30.7%, 35.4%, 22.0%, and 47.2%), respectively for those who were alcohol drinkers. Nevertheless, the prevalence of TC, TG, LDL-c, and HDL-c was 13.9%, 18.8%, 13.1%, and 22.4%), respectively for those who weren't alcohol drinkers Table 3.

3.3. Determinants of dyslipidemia among participants

Respondents whose age >45 were at higher risk for having high levels of TC (AOR = 1.36, 95% CI = 1.13–3.97), and low level of HDL-c (AOR = 1.54, 95% CI = 1.25–3.18) than respondents who were below 30 years of age. Females were at higher risk for having high levels of TC (AOR = 2.31, 95% CI = 1.54–3.13), TG (AOR = 1.70, 95% CI = 1.34–3.79), LDL-c (AOR = 2.15, 95% CI = 1.56–2.86), and HDL-c (AOR = 2.67, 95% CI = 1.44–5.67) than males. Respondents who were from urban were at higher risk for having high levels of TC (AOR = 1.98, 95% CI = 1.04–6.83), TG (AOR = 1.78, 95% CI = 1.09–2.86), LDL-c (AOR = 3.01, 95% CI = 1.45–7.43), and HDL-c (AOR = 2.01, 95% CI = 1.94–4.55) than respondents who were from rural. Participants who had a family history of HTN were at higher risk for having high levels of TC (AOR = 1.66, 95% CI = 1.04–2.33), TG (AOR = 1.92, 95% CI = 1.21–4.32), LDL-c (AOR = 1.54, 95% CI = 1.02–3.32), and HDL-c (AOR = 1.49, 95% CI = 1.04–3.13) than respondents who had not HTN. Participants who had sedentary physical activity were at higher risk for having high levels of TC (AOR = 2.33, 95% CI = 1.13–3.97), TG (AOR = 1.76, 95% CI = 1.23–1.98), LDL-c (AOR = 1.83, 95% CI = 1.36–2.48), and HDL-c (AOR = 1.53, 95% CI = 1.25–2.18) than participants who had vigorous physical activity. Similarly, obese respondents were at higher risk for having high levels of TC (AOR = 2.03, 95% CI = 1.64–2.00), TG (AOR = 3.78, 95% CI = 1.06–6.42), LDL-c (AOR = 1.92, 95% CI = 1.66–2.12), and HDL-c (AOR = 4.23, 95% CI = 2.84–4.32) than to respondents who were underweight Table 4.

4. Discussion

In the present study, a high prevalence of dyslipidemia (48.39%) was found among hypertensive patients in Lumame Primary Hospital. The high prevalence of dyslipidemia in this study could be due to sedentary physical activity, better socioeconomic status, alteration in the intensity of work, speedy urbanization, and alteration in dietary habits. This finding is in agreement with previous studies conducted in India (50.7%) [24]. However, this finding is lower than the previous similar studies conducted in Poland (77.2%) [28], Lithuania (89.7%) [29], Palestine (66.4%) [30], South Africa (67.3%) [31], India (78.4%) [32], Uganda (63.3%) [33], South Africa (85.0%) [34]. In contrast, the current finding is higher than previous studies done in China (32.2%) [35], Ethiopia (34.8%) [13], and Iran (30.0%) [36]. This difference could be because of differences in the study period, lifestyles of respondents, stage of urbanization, cutoffs, and socioeconomic status. In the previous studies, the prevalence of dyslipidemia ranges from 2.7% to 51.9% [37–42].

In this study, the prevalence of dyslipidemia (individual serum lipide level) among hypertensive patients ranges from 16.1% to 30.9%. Prevalence of dyslipidemia according to age, gender, marital status, residence, religion, occupation, educational level, and monthly income was found to be 73(19.6%), 91(24.5%), 60(16.1%), and 115(30.9%), respectively for TC, TG, LDL-c, and HDL-c, which is in agreement with previously published similar studies [43–46]. Low HDL-c was the most prevalent (30.9%) component of dyslipidemia followed by high TG (24.5%), which is in agreement with previous studies [43–46]. This might be due to high saturated fat intake, and high carbohydrates intake related to speedy urbanization. The prevalence of high TG was (24.5%), which lower than previous studies conducted in Uganda (42.1%) [47], Jordan (41.9%) [48], (56.1%) [49], South Africa (59.3%) [49], Senegal (7.1%) [50], Malawi (28.7%) [51], Thailand (49.9%) [6], and Brazil (65.3%) [52]. However, this finding is higher than previous studies done in Nigeria (9.9%) [53]. and Ethiopia (21.0%) [54]. The prevalence of high TC was (19.6%), which is lower than previous findings conducted in Ethiopia (33.7%) [13]. Iran (29.6%) [36], and Ethiopia (30.8%) [55]. The prevalence of high LDL-c was (16.1%), which is lower than previous similar studies conducted in Thailand (56.5%) [6]. Jordan (75.9%) [48]. Ghana (61.0%) [56]. India (47.8%) [32], Senegal (66.3%) [57], Iran (50.0%) [58], and Uganda (60.9%) [47]. However, the current finding is higher than previous similar studies done in Ethiopia (14.1%) [54]. The difference in the prevalence of dyslipidemia may be due to differences in study populations, methodologies, genetic races, and socioeconomic status.

Females were at higher risk for having high levels of TC (AOR = 2.31, 95% CI = 1.54–3.13), TG (AOR = 1.70, 95% CI = 1.34–3.79), LDL-c (AOR = 2.15, 95% CI = 1.56–2.86), and HDL-c (AOR = 2.67, 95% CI = 1.44–5.67) than males. This finding is similar to a study conducted in Thailand [6]. In contrast, studies showed that the prevalence of dyslipidemia was high among male respondents [59,60]. Older age was also risk factors of dyslipidemia, respondents whose age >45 were at higher risk for having high levels of TC (AOR = 1.36, 95% CI = 1.13–3.97), and low level of HDL-c (AOR = 1.54, 95% CI = 1.25–3.18) than respondents

Table 3
Prevalence of dyslipidemia by life style practices (n = 372).

Variable		Frequency (%)	TC ≥ 240 mg/dL (6.21 mmol/)	TG ≥ 200 mg/dL (2.26 mmol/)	LDL-C ≥ 160 mg/dL (4.14 mmol/)	HDL-C < 40 mg/dL (1.03 mmol/L)
Physical activity	Sedentary	145(39.0)	45(31.0)	54(37.2)	37(25.5)	69(47.6)
	Moderate	140(37.6)	22(15.7)	29(20.7)	18(12.9)	38(27.1)
	Vigorous	87(23.4)	6(6.9)	8(9.2)	5(5.7)	8(9.2)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Fruits/vegetables consumption	Yes	96(25.8)	7(7.3)	9(9.4)	7(7.3)	12(12.5)
	No	276(74.2)	66(23.9)	82(29.7)	53(19.2)	103(37.3)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Smoking	Yes	49(13.2)	25(51.0)	29(59.2)	20(40.8)	32(65.3)
	No	323(86.8)	48(14.9)	62(19.2)	40(12.4)	83(25.7)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)
Alcohol	Yes	127(34.1)	39(30.7)	45(35.4)	28(22.0)	60(47.2)
	No	245(65.9)	34(13.9)	46(18.8)	32(13.1)	55(22.4)
	Total	372	73(19.6)	91(24.5)	60(16.1)	115(30.9)

Table 4
Association of different factors with dyslipidemia (n = 372).

Variable		TC ≥ 240 mg/dL (6.21 mmol/L) AOR (95% CI)	TG ≥ 200 mg/dL (2.26 mmol/L) AOR (95% CI)	LDL-C ≥ 160 mg/dL (4.14 mmol/L) AOR (95% CI)	HDL-C < 40 mg/dL (1.03 mmol/L) AOR (95% CI)
Age	<30	1	1	1	1
	31–45	0.57(0.20–1.60)	0.62(0.26–1.48)	0.83(0.33–2.12)	0.97(0.16–0.82)
	>45	1.36(1.13–3.97)	1.53(0.23–5.20)	0.86(0.36–2.08)	1.54(1.25–3.18)
Sex	Male	1	1	1	1
	Female	2.31(1.54–3.13)	1.70(1.34–3.79)	2.15(1.56–2.86)	2.67(1.44–5.67)
Residence	Urban	1.98(0.84–6.83)	1.78(1.09–2.86)	3.01(1.45–7.43)	2.01(1.94–4.55)
	Rural	1	1	1	1
Family history of HTN	Yes	1.66(1.04–2.33)	1.92(1.21–4.32)	1.54(1.02–3.32)	1.49(1.04–3.13)
	No	1	1	1	1
Smoking	Yes	1.77(1.19–2.98)	1.89(2.56–3.55)	1.66(1.36–2.89)	1.53(1.34–4.32)
	No	1	1	1	
Alcohol	Yes	0.76(0.23–4.87)	1.45(0.45–5.43)	0.77(0.15–7.45)	1.93(1.45–3.78)
	No	1	1	1	1
Physical activity	Sedentary	2.33(1.13–3.97)	1.76(1.23–1.98)	1.83(1.36–2.48)	1.53(1.25–2.18)
	Moderate	1.26(0.13–1.97)	0.53(0.43–1.27)	0.96(0.74–2.01)	1.34(1.03–2.91)
	Vigorous	1	1	1	1
BMI	Underweight	1	1	1	1
	Normal	1.43(0.74–1.31)	0.72(0.03–2.32)	1.54(1.03–1.92)	0.72(0.01–2.13)
	Overweight	1.87(1.13–1.89)	2.12(1.21–4.93)	1.51(1.66–2.34)	2.34(1.73–3.91)
	Obesity	2.03(1.64–2.00)	3.78(1.06–6.42)	1.92(1.66–2.12)	4.23(2.84–7.32)
Fruits	Yes	1	1	1	1
	No	2.21(1.23–2.66)	2.01(2.65–3.45)	1.87(1.03–3.79)	2.34(1.02–4.87)
DM	Yes	1.71(1.21–2.91)	1.34(1.03–2.62)	1.01(1.00–1.83)	1.51(1.03–2.71)
	No	1	1	1	1
Duration of HTN	<5	1	1	1	1
	5–9	1.32(0.23–1.62)	1.67(0.34–2.11)	0.82(0.65–1.45)	1.69(0.51–2.01)
	10–14	1.51(0.65–1.32)	0.91(0.77–1.94)	1.58(0.81–2.36)	0.74(0.52–3.76)
	15–20	0.73(0.23–1.63)	1.33(0.80–2.18)	0.81(0.62–1.55)	1.71(0.29–2.90)
	>20	1.49(0.61–2.10)	0.92(0.34–1.64)	1.57(0.90–2.04)	1.52(0.59–1.84)

who were below 30 years of age. This finding is consistent with previous studies [61,62].

Physical exercise influences the lipid profile by increasing the level of HDL-c on account of increased HDL2 subfractions trailer and reduce the level of masculine triglyceride. Several studies have verified that physical exercise (walking about 5 miles a week without strain) accompanied by music helps increase energy, and optimizing body [63,64]. In the present study, intensive physical activity was associated with favorable lipid profiles. Likewise, a previous intervention studies have demonstrated improvements in lipid profile with increases in exercise [65–67], as physical activity mainly results in a reduction in triglyceride levels and an increase in HDL-c [68]. In the present study, participants who had sedentary physical activity were at higher risk for having high levels of TC (AOR = 2.33, 95% CI = 1.13–3.97), TG (AOR = 1.76, 95% CI = 1.23–1.98), LDL-c (AOR = 1.83, 95% CI = 1.36–2.48), and HDL-c (AOR = 1.53, 95% CI = 1.25–2.18) than participants who had vigorous physical activity. Physical activity helps to reduce the risk of dyslipidemia and had been recommended as lifestyle therapy for dyslipidemia [69].

In this study, there is a significant association between smoking status and TC, TG, LDL-c, and HDL-c. This finding is consistent with a study conducted in Tunisia, it revealed that a significant association between smoking status and hypercholesterolemia, hyperlipoproteinemia, hypertriglyceridemia, low c-HDL, and hyper-LDL concentration, before and after adjustment for potential confounder's factors; this result confirm the association of smoking with the risk of dyslipidemia [70]. Although the mechanisms by which cigarette smoking changes lipoprotein and serum lipid levels are not fully understood, possible explanations have been proposed. The nicotine stimulates the secretion of catecholamines as well as other hormones such as growth hormones and cortisol, leading to an increased serum concentration of free fatty acids which stimulates hepatic secretion of triglycerides and very low density lipoprotein [71]. Consistent with the previous study, current smoking and drinking increase the risk of dyslipidemia in hypertensive population [61]. In contrast, a previous study revealed that current drinking might protect hypertensives from low HDL-c (alcohol drinkers had a higher HDL-cholesterol level than non-drinkers) [72].

As the previous study had confirmed diabetes and overweight/obesity increased the risk of dyslipidemia [73,74]. In this study, dyslipidemia was significantly associated with obesity and diabetes. Hypertensive patients with diabetes mellitus were at higher risk for having high levels of TC (AOR = 1.71, 95% CI = 1.21–2.91), TG (AOR = 1.34, 95% CI = 1.03–2.62), LDL-c (AOR = 1.01, 95% CI = 1.00–1.83), and HDL-c (AOR = 1.51, 95% CI = 1.03–2.71) when compared to patients who had not diabetes mellitus. Similarly, participants who had a family history of HTN were at higher risk for having high levels of TC (AOR = 1.66, 95% CI = 1.04–2.33), TG (AOR = 1.92, 95% CI = 1.21–4.32), LDL-c (AOR = 1.54, 95% CI = 1.02–3.32), and HDL-c (AOR = 1.49, 95% CI = 1.04–3.13) than respondents who had not HTN. Likewise, obese respondents were at higher risk for having high levels of TC (AOR = 2.03, 95% CI = 1.64–2.00), TG (AOR = 3.78, 95% CI = 1.06–6.42), LDL-c (AOR = 1.92, 95% CI = 1.66–2.12), and HDL-c (AOR = 4.23, 95% CI = 2.84–4.32) than to respondents who were underweight. This could be attributed to the high tendency of increasing the concentration of serum lipide levels as increased weight. The current finding is consistent with previous studies that obesity was significantly associated with dyslipidemia [40,43,45,46,66,68,75,76]. As a limitation, minor imprecisions may occur since a single laboratory measurement was applied to assess the prevalence of dyslipidemia. As cross-sectional study designs, confines causal relationships between dyslipidemia and its independent predictors.

5. Conclusion

In summary, the different forms of dyslipidemia were prevalent among hypertensive patients, with hypo-HDL-c as the most common among the participants. This study revealed that age, gender, residence, family history of HTN, smoking, alcohol drinking, fruit diet habits, physical activity, diabetes mellites, and BMI were significant determinants of dyslipidemia. Thus, education, communication, and information programs based on lifestyle modifications like healthy diet

habits, weight reduction, physical activity, smoking, and cessation should be given.

CRediT authorship contribution statement

Zemene Demelash Kifle: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Agumas Alemu Alehegn:** Conceptualization, Data curation. **Meaza Adugna:** Formal analysis, Funding acquisition, Investigation. **Biruk Bayleyegn:** Methodology, Project administration, Resources.

Declaration of competing interest

The author declares that they have no competing interests.

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Abbreviations

TC	total cholesterol
TG	triglycerides
VLDL	very-low-density lipoprotein
HDL	high-density lipoprotein
LDL	low-density lipoprotein
HTN	hypertension
SPSS	statistical package for the social sciences
AOR	adjusted odds ratio
WHO	world health organization

Ethics approval and consent to participate

This study was approved by the ethical committee of Lumame Primary Hospital with a reference number of LPH/274/2020. Informed verbal, as well as written consent, was obtained from study participants before data collection, and the purpose of the study was explained to the respondents in advance. The information collected from respondents was kept confidential.

Availability of data and materials

Most of the data is included in the manuscript. Additional can be found from the corresponding author based on reasonable request.

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