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Evaluation and Correlation Analysis of Serum High Sensitivity C - reactive protein and Lipid Profile among Hypertensive Patients: a Cross-Sectional Study

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ABSTRACT

Hypertension and dyslipidemia are the two most significant healthanxieties and major risk factors for cardiovascular diseases. It has been reported that chronic inflammatory disorder is the root causes of hypertension and elevated levels ofserum high-sensitivity C-reactive protein (hsCRP).A laboratory based comparative cross-sectional case-study was conducted from November 2017 to April 2018. A total of 100 participants, 57 hypertensive patients, and 43 normal controls were recruited. Data were collected on socio-demographic factors, anthropometric measurements, blood pressure, hsCRP, and lipid profiles.The elevated levels of serum hsCRP($p<0.001$), triglycerides, and total cholesterol were observed in both sexes of hypertensive patients ($p<0.05$). However, the serum levels of high-density lipoprotein and low-density lipoprotein showed only numerical differences but not statistically. The hsCRP was positively correlated with triglycerides, total cholesterol, and inversely correlated with serum high-density lipoprotein. The significant changes in hsCRP may suggest that inflammation might be associated with hypertensive

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patients. Measurement of hsCRP at regular intervals may be used for a prognosticmarker for disease severity.

Keywords:Anthropometric indicators, Hypertension, hs-CRP, Lipid profiles.

BACKGROUND

High blood pressure (BP) is a ground-breaking hazard factor for both ischemic and hemorrhagic stroke. Hypertension has continuously turned into a noteworthy risk to individuals in sub-Saharan Africa (SSA). The World Health Organization 2018 report demonstrated that 36 % of deaths in Ethiopia were because of NCDs, from which CVD contributes 16 %,and raised blood pressure in adults is one of the rote causes of CVD[1]. Distinctive investigations in Ethiopia exposed that hypertension was related to more seasoned age (> or = 45 years), obesity [2], smoking [3], and chat chewing [4].The pre-hypertensioncharacterized as a systolic pulse of 120-139 mmHg as well as a diastolic of 80-89 mmHg, stage 1:characterized as systolic between 140 and 159 mm Hg or diastolic 90 and 99 mm Hg and stage 2: systolic 160 mm Hg or higher or diastolic 100 mm Hg or higherwas presented as the new rule for the management of blood pressure by the seventh report of the Joint National Committee on prevention, detection, assessment, and treatment of high blood pressure (JNC-7)[5].Many investigations showed that the peoples with hypertension had more elevated amounts of blood glucose, insulin resistance, TC, LDL, and TGL,higher BMI, impaired glucose metabolism, and lower levels of HDL than the normotensive group[6, 7]. There are many established hazard factors for the development of hypertension which emphasizes the significance of an early conclusion ideally at the phase of prehypertension [7]. The recent research proof demonstrates that vascular inflammation might be advancement of hypertension. [8] This is clear from the raised levels of inflammatory markers like Tumor Necrosis Factor-α (TNF-α), Interleukin-6 (IL6) and C - reactive protein (CRP) in individuals with hypertension [9].

In normal people, CRP is present in blood in a very small amount yet the amount increases 100-fold because of cell damage, microbial infections, or inflammations. CRP is named so for its capacity to precipitate the somatic C-polysaccharides of *Streptococcus pneumonia* and is the first acute phaseprotein to be described [10, 11]. CRP is essentially produced by the liver because of IL-6 and IL-1ß signaling. As a decent natural marker, it is steady, the half-life of 19 hours, and little variety in the amount between fresh and frozen forms [12, 13].The hsCRP, a marker of low-grade systemic inflammation may promoteatherosclerosis, plaque destabilization, endothelial damage, alteration of macrophages, smooth muscle cell proliferation, more serious hazard and seriousness of aggregate and ischemic stroke in populations, and especially among adults with high BP [14].The significance of high levels of inflammatory markers in foreseeing cardiovascular hazard is increasing expanding acknowledgment also,

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in that regard, hsCRP has been the most seriously examined in clinical examinations. Hence the present investigation is an endeavor to assess the connection between serum hsCRP levels and blood pressure, lipid profile.

METHODS

Study Area, Design, and Period

The study was carried out at Karamara general hospital, Jijiga Ethiopia. Jigjiga is the capital city of the Somali regional state of Ethiopia, located 628km to the East of Addis Ababa.A hospital-based cross-sectional study was conducted to estimate serum high sensitivity C- reactive proteins and serum lipid profiles among hypertensive patients fromNovember 2017 to February 2018.

Population

This investigation incorporated all qualified hypertensive patients attendingKaramara general Hospital, an outpatient clinic in the time of the study.The patients age less than 18 and more than 70 years, those who suffered by diabetes,liver disease,pre-eclampsia/eclampsia, renal, thyroid disease, and inflammatory diseasewere rejected from this study.

Sample Size Determination and Sampling Method

The sample size measure was resolved given the prevalence of hypertension (19.6%) in Ethiopia as announced by deliberate meta-examination, using a single population proportion formula with a confidence interval (CI) of 95%. After sample size adjustment, 100 patients were enlisted in this investigation for the blood test accumulation and related information gathering. While the purposive sampling technique was executed to choose the healthcare facility, a simple random sampling technique was utilized to get the examination members in the investigation time frame.

Variables

Lipid profiles of hypertensive patients and also serum hsCRP were considered as dependentvariables.Then again age, sex, socio-demographic factors, clinical distinctiveness,and anthropometric indicators were also taken as autonomous variables.

Blood Sample and Data Collection Procedures

After a short clarification, the participant members had been requested for their agreement. A total of 100 blood samples (57 hypertensive patients and 43 normal control participants) with a volume of 3-5ml of

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blood were collected using a serum separator tube and serum was speared and stored in -80^{o}c deep freezer until the analysis. The serum was used to determine the levels of serum hsCRP, TC, HDL-cholesterol, TGLandLDL-cholesterol was estimated using standard laboratory procedure and HR and BP (two consecutive readings) were also assessed. Likewise, the questionnaire was filled by interview.

Data Quality Control and Management

All standard operating procedures (SOPS) were applied during the collection of a sample from the study participants. There was a well-prepared data collection questionnaire to assess participant's demographic information.All the laboratory procedures were taken care of by proficient lab technologists. Every one of the tests was standardized and automated.

Data Processing and Analysis

All the information was checked for fulfillment and cleaning, preparing and examination of the information acquired from laboratory analysis of the blood tests. Questionnaires were performed by coding and entering the information into Epi-Data measurable software (version 3.5.1, 2008). Afterward sent out the entered information to SPSS programming (form 22.0, 2013, America) for statistical analysis. Descriptive analysis, Spearman correlation, and linear regression, independent sample T-test were used to compare categorical variables. All the data were expressed in mean ± SD and $P < 0.05$ at 95% confidential level was considered as statistically significant in all the analytes.

Ethical Consideration

The ethical clearance was obtained from the Medical Biochemistry Department, School of Medicine College of Health Sciences Addis Ababa University with protocol number 09/17 and meeting number DRERC 02/17.

RESULTS

Socio-demographic Characteristics

The present examination enrolled 100 members. Among the 100, 57 were hypertensive (37 were male and 20 were females) and 43 normal volunteers (20 guys and 23 females). The dominant part of hypertensive patients (61.4%) were found within the age group of 40-59 years Among the 57 hypertensive patients, 27 (47.4%) of the guys and 18 (41.9%) of the females were living in urban regions, though the rest of the patients were living in provincial zones. The greater part of the hypertensive guys and females were hitched, and half were uneducated. Among the 37 hypertensive male patients, 15 had a past filled with cigarette smoking and 5 of them were liquor clients, and 28 of them were *khat* chewers (Table 1).

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Table 1: Socio-demographic characteristics of male and female study participants.

Variables		Males (N=57)		Females (N=43)	
		Normal (n=20) N%	Hypertensive (n=37) N%	Normal (N=23) N%	Hypertensive (n=20) N%
Age (years)		49.55±11.29	48.78±10.9	54.51±9.06	47.05±12.26
Marital status	Married	18 (31.6)	35 (61.5)	20 (46.5)	15 (34.9)
	Single	2 (3.5)	2 (3.5)	3 (7)	5 (11.6)
EducationalLevel	Illiterate	18 (31.6)	28 (49.1)	15 (34.9)	13 (30.2)
	Up to 12	2 (3.5)	9 (15.8)	8 (18.6)	7 (16.3)
Residence	Urban	17 (29.8)	27 (47.4)	20 (46.5)	18 (41.9)
	Rural	3 (5.3)	10 (17.4)	3 (7)	2 (4.6)
Physical exercise	Yes	5 (8.8)	12 (21)	4 (9.3)	5 (11.6)
	No	15 (26.3)	25 (43.9)	19 (33)	15 (34.9)
Cigarette smoking	Yes	8 (14)	15 (26.3)	nil	nil
	No	12 (21)	22 (38.6)	23 (53.5)	20 (46.5)
Khatchewing	yes	12 (21)	28 (29.1)	nil	Nil
	No	8 (14)	9 (15.8)	23 (40.3)	20 (46.5)
Family history of HTN	yes	nil	26 (45.6)	nil	12 (27.9)
	No	20(35)	11 (19.3)	23(53.5)	8 (18.6)
Income(Birr)	< 2000	12(21)	19 (43.8)	11 (58.1)	17 (39.5)
	>2000	8 (14)	18 (31.6)	12 (27.9)	8(7)
Alcohol use	Yes	1 (1.75)	5 (8.8)	nil	nil
	No	19 (33)	32 (56.1)	23 (53.5)	20 (46.5)

Abbreviation: HTN = hypertension

Anthropometric characteristics of the study participants

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The levels of BMI, WHR, SBP, DBP, and duration of Hypertension are demonstrated in table 2. Among the anthropometric pointers, BMI was significantly higherin the male and female hypertensive patients. The hoisted WHR (>0.9 for guys and >0.8 for females), the SBP was high (140 mmHg or above), and diastolic BP was high (90 mmHg or above) in hypertensive patients.

Table 2: Anthropometric indicators of male and female study participants

Characteristics		Males (N=57)		Females (N=43)	
		Normal (N=20) N%	Hypertensive (N= 37) N%	Normal (N=23)N%	Hypertensive (N=20) N%
BMI (kg/m2)		23.57±2.376	25.05±2.728	23.95±3.187	25.50±3.306
	<25	12 (21)	21(36.8)	17 (39.5)	nil
	25-30	8 (14)	14(28)	6 (13.9)	15 (34.9)
	>30	nil	nil	nil	5 (11.6)
WHR (cm)		0.775±0.0639	0.922±0.712	0.770±0.0765	0.905±0.153
	<cut-off	15 (26.3)	12(31.6)	19 (44.2)	2 (4.6)
	>cut-off	5 (8.8)	25 (33)	4 (9.3)	18 (41.9)
BP mmHg	SBP	104.50±12.8	148.92±11.73	105.50±8.87	149.13±9.960
	DBP	73.00±8.645	89.73±11.17	71.00.±6.959	90.50±12.106
Duration of HTN	<1 years	nil	12 (21)	nil	12 (27.9)
	1-5 years	nil	20 (35)	nil	11 (25.6)
	>5 years	nil	2 (3.5)	nil	3 (7)

Abbreviations: HTN**=** hypertension**;**BP= blood pressure;BMI= Body mass index; WHR= Waist-to hip ratio; SBP= Systolic blood pressure; DBP=Diastolic blood pressure.

Levels of serum lipid profiles and serum high sensitivity C-reactive proteins in the studyparticipants

The serum levels of TG, LDL-C, HDL-C, TC,andhsCRP was indicated in table 3. Among these lipid profiles, the levels of TG ($p<0.001$) and TC ($p<0.009$ in male and $P<0.007$ in females) were elevated in the hypertensive patients. However, LDL-C and HDL-C did not show a significant difference in both sexes' patients and also thehsCRP was recorded high in both sexes ($p<0.001$).

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Table 3: Levels of serum lipid profiles and SerumhsCRP in the study participants.

Variables	Males (N=57)			Females (N=43)		
	Normal (N=20)	Hypertensive (N=37)	P-value	Normal (N=23)	Hypertensive (N=20)	P-value
TG	91.30±31.593	195.92±109.915	0.001	94.09±31.969	190.75±99.59	0.001
LDL-C	77.51±23.298	80.80±33.780	0.700	78.86±32.892	108±42.575	0.520
HDL-C	47.95±12.614	46.78±13.701	0.526	49.40±9.566	47.95±12.24	0.556
TC	140.60±38.32	189.08±39.525	0.009	147.05±38.45	197.52±51.90	0.007
HSCRP	1.80±0.696	2.97±1.040	0.001	1.70±0.571	3.45±0.912	0.001

Abbreviations: TG= triglycerides**;** LDL-C= low density lipoprotein cholesterol; HDL-C= high density lipoprotein cholesterol; TC=total cholesterol; HSCRP=high-sensitivity C-reactive proteins.

Table 4 below shows the comparison between stage 1 and stage 2 hypertensive patients (both male and female) serum lipid profile levels and serum hsCRP. Among the parameters, the elevated levels of TG, TC and hsCRP were observed in male and female stage 2 hypertensive patients. However, LDL-Cholesterol and HDL-cholesterol did not bringing any significant changes in stage 1 and stage 2 hypertensive patients.

Table 4: Levels of lipid profiles and high sensitivity C-reactive protein for stage 1 and stage 2 hypertensive patients.

Variable	Males(N=37)			Females (N=20)		
	Stage 1 HTN (N=21)	Stage 2 HTN (N=16)	P-value	Stage1 HTN (N=12)	Stage 2 HTN (N=8)	P-value
TG	149.56±217.13	198.57±117.2	0.035*	119.75±40.27	217.13±135.7	0.017*
LDL-C	78.30±30.625	83.31±33.556	0.639	101.35±48.67	119.48±40.55	0.396
HDL-C	48.33±11.280	44.56±11.581	0.765	49.63±7.050	47.00±13.725	0.271
TC	126.2±39.447	187±199.25	0.030*	170.92±58.58	199.25±49.2	0.030*
HSCRP	2.86±0.910	3.56±0.964	0.001*	3.45±0.688	3.75±0.707	0.001*

*P<0.05 is statistically significant

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Among the 57 hypertensive patients in the male hypertensive patients, 23 of them had elevated level of TG (above 200 mg/dL); 29 of them had elevated level of TC (above 200 mg/dL); 20 of them had a high level of LDL-C (above 100 mg/dL); 27 of them had elevated hsCRP (above 3mg/L) and 6 of them decreased level of HDL-C were observed in the present study (below 40 mg/dL). Among the female hypertensive patients, 16 had elevated levels of TG (above 200mg/dL); and 12 of them had high levels of TC (above 200mg/dL); 17 of them had elevated levels of LDL-C (above 100mg/dL) (Figure 1).

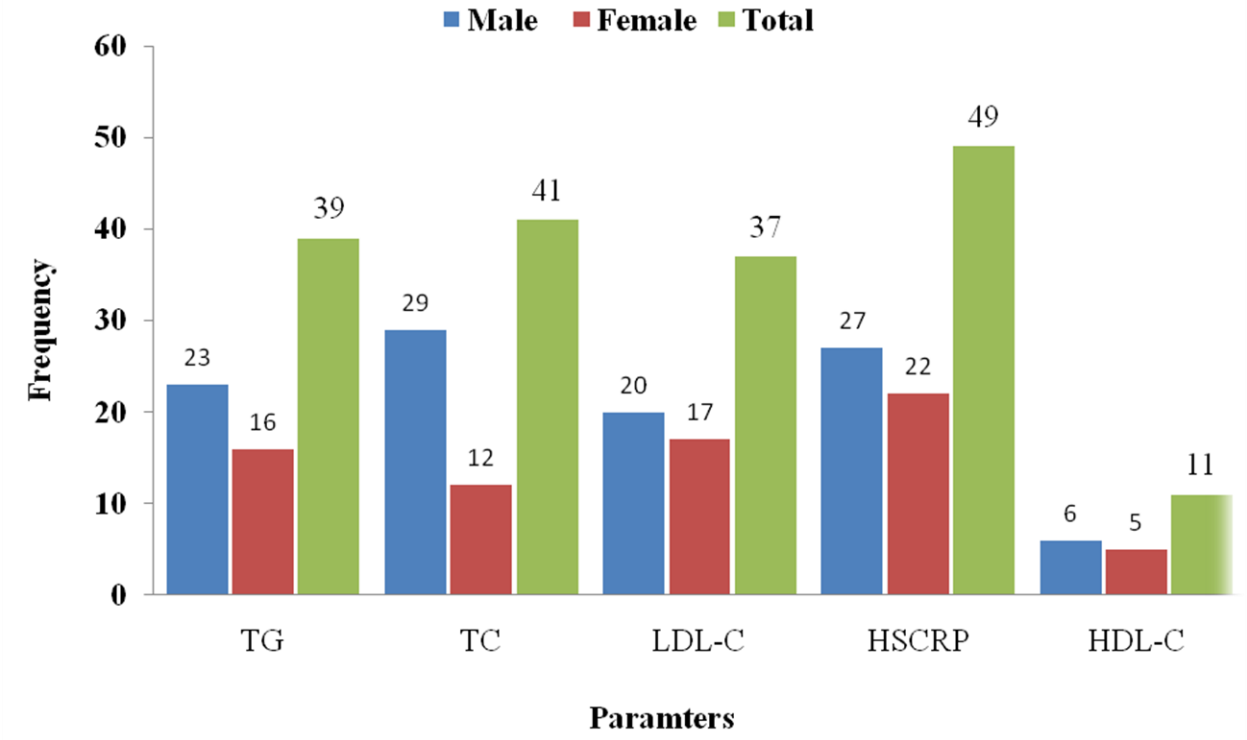

Figure 1: Hypertensive patients with abnormal levels of lipid profiles and high sensitivity C-reactive proteins stratified by sex.

Correlation between Socio-demographic profiles, anthropometric parameters with lipid profiles in hypertensive patients

Bivariate Pearson correlation showed that among the socio-demographic profiles, age was positively correlated with hypertension, TC, LDL-cholesterol, and inversely correlated with TG and HDL-C. Cigarette smoking was positively correlated with TC and LDL-C. The SBP was positively correlated with TG and TC and inversely correlated with LDL-C and HDL-C. The DBP was positively correlated with TG and LDL-C. Body mass index (BMI) was positively correlated with TG, TC, and LDL-cholesterol,

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and inversely correlated with HDL-cholesterol. Waist to hip ratio (WHR) was positively correlated with TG and TC and inversely correlated with LDL-cholesterol and HDL-cholesterol (Table 5 and 6).

Correlation between serum high sensitivity C-reactive proteins with serum lipid profiles and anthropometric indicators in the hypertensive patients

High-sensitivity C-reactive protein was positively associated with age, BMI, SBP, WHR, TG, TC, LDL-cholesterol, and inversely correlated with HDL-cholesterol in hypertensive male and female hypertensive patients (Figure 2).

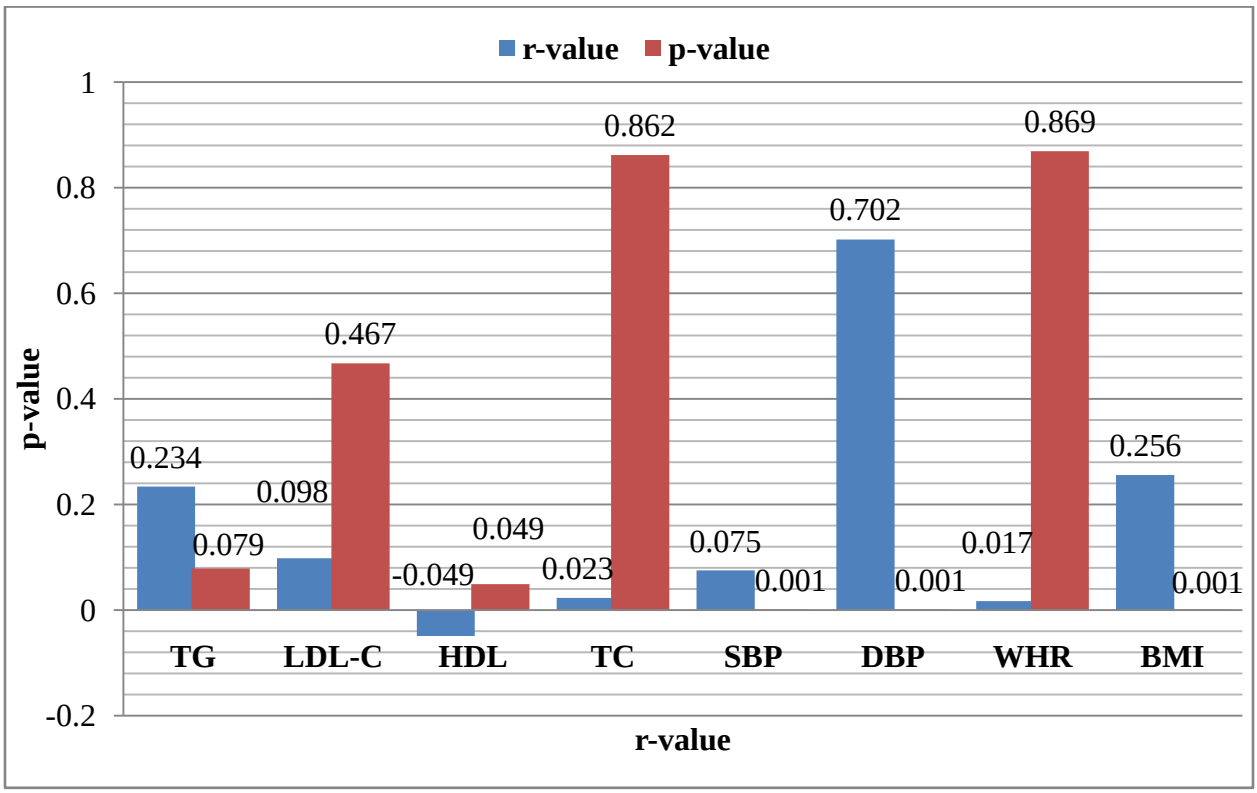

Figure 2: Correlation between high sensitivity C-reactive protein with lipid profilesand anthropometric indicatorsin the hypertensive patients.

When compare stage 1 hypertensive patients' hsCRP with stage 2 patients. The results show a positive correlation with SBP, DBP, BMI, WHR, TG, TC, and LDL-C, with hsCRP, however, inversely correlated with and HDL-C (Table 7).

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Table 5: Correlation between socio-demographic characteristics, anthropometric indicator with Triglycerides, and High-density lipoproteins in the study participants.

Variables	TG				HDL-C			
	HTN		N		HTN		N	
	r- value	p-value	r-value	p-value	r-value	P-value	r-value	p-value
Age	-0.017	0.023	0.080	0.649	-0.090	0.508	0.071	0.649
Smoking	-0.060	0.658	0.483	0.110	-0.041	0.763	0.812	0.037
SBP	0.143	0.288	0.245	0.113	-0.051	0.705	0.366	0.016
DBP	0.026	0.023	0.117	0.453	-0.217	0.024	0.221	0.145
BMI	0.131	0.064	-0.199	0.200	-0.034	0.012	-0.051	0.747
WHR	0.228	0.289	0.289	0.089	-0.112	0.406	0.055	0.406

Abbreviation: H= hypertension; N=normal

Table 6: Correlation between socio-demographic characteristics, anthropometric parameters with Total cholesterol, and Low-density lipoproteins in the study participants.

Variables	TC				LDL-C			
	HTN		N		HTN		N	
	R-value	P-value	R-value	P-value	R-value	P-value	R-value	P-value
Age	0.385	0.067	0.108	0.490	0.205	0.467	0.154	0.323
Smoking	0.146	0.736	0.612	-0.080	0.647	-0.041	-0.064	0.069
SBP	0.227	0.006	-0.475	0.187	0.092	0.498	0.461	0.498
DBP	0.002	0.042	0.205	0.187	0.061	0.145	0.111	0.032
BMI	0.476	0.425	-0.085	0.587	0.120	0.145	0.047	0.765
WHR	0.144	0.286	0.185	0.478	-0.043	0.282	0.162	0.752

P. value of <0.05 is statistically significant

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Table 7: Correlation of hsCRP with anthropometric and lipid profiles in stage 1 and 2 hypertensive male and female patients.

Variables	Male stage 1 and 2 HTN		Female stage 1 and 2 HTN	
	r-value	p-value	r-value	p-value
AGE	0.031	0.854	0.027	0.423
SBP	0.194	0.057	0.111	0.051
DBP	0.709	0.001	0.526	0.001
BMI	0.235	0.161	0.538	0.027
WHR	0.127	0.405	0.276	0.746
TG	0.163	0.035	0.356	0.017
HDL-C	-0.049	0.065	-0.132	0.021
TC	0.163	0.774	0.374	0.114
LDL-C	0.049	0.631	0.149	0.396

DISCUSSION

The results of the present' study revealed the average levels of triglycerides and total cholesterol in hypertensive patients were higher than the normal controls. However, LDL-C and HDL-C not showing any significant difference. The result of the present finding is lined with the previous study only TG and TCbut they report that high level of LDL-C [15–19]. But our finding did not show any changes in LDL-Clevels. In our investigation, serum TC levels are significantly higher in hypertensive patients. A recent study has identified that inflammatory cytokines, mainly TNFα, IL 6, and IL1β can disturbance of serum lipid levels, particularly cholesterol reverse transport, which is connected to atherosclerosis. Criteria incorporateincreased waist circumference, increased triglyceride. In our study line with this explanation. Elevated triglyceride, elevated blood pressure, and WHR (both sexes) were observed in this study. Moreover,Xiaoetal., reported that the impacts of BMI, waist circumference and waist-hip ratio on the pervasiveness of hypertension were noteworthy, however, the impact of waist circumference on hypertension was more prominent than the waist-hip ratio. Keeping lower body weight may be one of the effective ways to prevent hypertension [20].

The high levels of LDL-C are hazard factor for hypertension, dyslipidemia, and thedevelopment of atherosclerosis. But our study shows that there was no significant difference in LDL-C levels. However, the recent studies demonstrated that normal levels of LDL-C subjects may create hypertension, and CHD.

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Soevaluation of LDL-C may not by any means mirror its atherogenic potential. Because circulating LDL particles differ in size, density, composition, and atherogenic potentials. LDL comprises several subclasses of various molecule sizes. The sizes of the LDL particles are inversely associated with their atherogenicity. A few lines demonstrated that a smallLDL (sdLDL) molecule is a hazard factor for CHD. Patients with more sdLDL particles are considered to have a more atherogenic profile than those with large particles. The smaller subtype is denser, less cholesterol, and more apolipoprotein B100 (apoB100) containing yet more atherogenic than large LDL-C particles which are generally cholesterol-rich and fewer apoB100[21- 23]. So, this study brings new insight into the importance of the evaluation of the sdLDL-C levels in hypertensive patients in Ethiopia.

The current finding of the HDL-C levels was no significant differenceamong the groups. The epidemiological investigation has shown that high HDL-C levels are protecting the heart from CVD. Thus, HDL has for quite some time been known as the "anti-atherosclerotic factor" or "cardiovascular security factor."On account of its anti-atherosclerotic impact, such as, reverse cholesterol transport (RCT), against oxidation, stabilizing already formed plaques, repressing the framed plaque burst,HDL had broadly contemplated [24,29]. However, in clinical work even though the HDL levels are normal or even high, the significant vascular residual risk still exists [25].As per the particle size, HDL can be classified into 10 subtypes (HDL1-HDL10). Among them 1-3 types were large particle types (HDL), 4-7 types were intermediate particle types (HDLM), and 8-10 types were small particle types (HDLS)[26].Gao et al. reported that the simple use of HDL levels to predict the risk of Coronary Heart Disease (CHD) was unfair. The HDLL in the CHD patientsserum was significantly loweredand had maturation disorders. CHD decrease was closely related to the risk increase of heart diseases and HDLL may be a protective factor for it. TheapoAIcintentmay have impact on the cardiovascular protection function of HDLL [27].

Hypertensivepatients had higher levels ofhsCRP than healthy controls. This shows that inflammation might be associated with hypertension; this finding agreed with different studies of,Tolmay*et al.*,Suthahar*etal.*,thatfound a positive relationship between increasing levels of hs-CRP and risk of developing hypertension[28,29].As the current study revealed,hsCRPwas positively correlated with BMI and WHR. This relationship among'shsCRP and BMI is predictable with the new investigations that revealed a chronic inflammatory state is related with insulin resistance and dysfunction of the endothelial, further leading to CVD.In our study an increasing SBP is associatedwithhsCRP**;** this independent risk factor may suggest that hsCRP as a valuable marker to predict future cardiovascular diseases in hypertension. This finding agreed with different studies of Kamath *et al.*,Vukovic–Dejanovic*et al.*, and Cortez and Muxfeldt.[30,31,32].

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Correspondingly, SBP, and DBP were higher in stage 2 hypertensive peoples than stage 1 hypertensive peoples. This result was lined with previously reported by Nayak et al. [33].This showed that high blood pressure is relationship with the risk of cardiovascular events. In our present finding hsCRPwas higher in stage 2 hypertensive peoples. This finding was linked with studies done by, Aslam et al., which showed that higher hsCRP in stage 2 hypertension compared to stage 1 hypertension. The results of this research showed that there isa positively correlated between hsCRP and TG, TC, and LDL-C in stage 1 and 2hypertensive patients [34]While, HDL-C was inversely correlated.

The discoveries of our investigation in this manner may estimation of hs-CRP levels as a fundamental for early identification of individuals at risk for CVD. The elevated levels of hsCRP and hypertension are independent determinants of CVD risk; the finding of this investigation may give reason to the pharmacotherapy, in majority of people with hypertension. Since individuals with hypertension might be in a more prominent CV danger than recently appreciated because of raising hsCRP levels, subsequently designs focused to bring down hsCRP levels may conceivably provide increased clinical benefits.

Our current finding indicates that the elevated levels of TC and TG but numerical differences only found in LDL-C and HDL-C in hypertensive peoples.The simple use of LDL and HDL levels to predict the risk of cardiovascular diseases was unfair because they differ in size, density, composition, and atherogenic potentials. The effect of the significant changes in high sensitivity C-reactive protein may suggest that inflammation might be associated with hypertensive patients. Therefore, measurement of high-sensitivity C-reactive protein at regular intervals may be used for a prognostic marker for butter prevention and management of cardiovascular diseases and stroke.

Conclusion

The results of this research indicated thatthere are significantly higher mean levels of TC and TG but numerical differences only found in LDL-C and HDL-C in hypertensive patients.In Ethiopia use LDL-C and HDL-C levels to predict the risk of cardiovascular diseases was unfair because they differ in size, density, composition, and atherogenic potentials. The effect of the significant changes in high sensitivity C-reactive protein may suggest that inflammation might be associated with hypertensive patients.Therefore, high-sensitivity C-reactive protein measurementat regular intervals may be used asa prognostic marker for butter prevention and cardiovascular diseases and strokemanagement.

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Declaration of conflicting interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Ethical consideration

The Ethical clearance was obtained from theBiochemistry Department College of Health Sciences Addis Ababa University with protocol number 09/17 and meeting number DRERC 02/17. Furthermore, a collaboration letter for data collection was also obtained from Karamara General Hospital.

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Informed consent

Samples and data were collected after written informed consent hadbeen obtained from study participants. Confidentiality, anonymity,neutrality, accountability, and academic honesty were maintainedthroughout the study

ABBREVIATIONS

BP- High blood pressure

SBP-Systolic blood pressure

CVD-Cardiovascular Disease

NCDs-Non-communicable disease

TNF-α- Tumor Necrosis Factor-α

IL6-Interleukin-6

IL-1ß-Interleukin-1ß

hsCRP- High-sensitivity C-responsive protein

TG- Triglycerides

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LDL-C= Low-density lipoprotein cholesterol

HDL-C= High-density lipoprotein cholesterol

TC=Total Cholesterol

WHR-Waist-to-Hip Ratio

BMI -Body Mass Index

sdLDL-Small dense low-density lipoprotein

HDLL-large particle types HDL

HDLM-intermediate particle types HDL

HDLS-types were small particle types HDL

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