International International Journal of Health Science & Biomedicine (IJHSB)

EPICGLOBE PUBLISHER

RESEARCH ARTICLE OPEN ACCESS

Relationship between Serum Lipid Levels and Hypertension among Hypertensive Patients attending Health Centers in ElObeid City North Kordofan State West of Sudan

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Citation: Hamed S, Abbas W (2025) Relationship between Serum Lipid Levels and Hypertension among Hypertensive Patients attending Health Centers in ElObeid City North Kordofan State West of Sudan. Int. J. Health Sci. Biomed. 2(5):1-6.

Received Date: 2025-09-01, **Accepted Date:** 2025-09-20, **Published Date:** 2025-09-30

Keywords: Hypertension; Lipid profile; Dyslipidemia; Sudan

Abstract

Background: Hypertension and Dyslipidemia (abnormalities of serum lipid levels) are commonly coexisting, causing what is known as dyslipidemia hypertension (DH). Both represent the most important pathogenic cause for atherosclerosis, the major risk factors for cardiovascular disease (CVD), and account for more than 80% of deaths and disability in low- and middle-income countries.

Objectives: The objective of this study was to assess the serum lipid levels in Sudanese hypertensive patients inElObeid City, North Kordofan State, and West of Sudan.

Methodology: This was cross-sectional hospital-based study, carried out between October (2019) and December (2020) at three health centers in ElObeid city.Data were collected on blood pressure measurements and serum lipid profile (Total Cholesterol, Triglycerides, High Density Lipoprotein and Low Density Lipoprotein).The data were analyzed by the Statistical Package of Social Science (SPSS) software version 23.0. Independent sample t test, Chi-square ($\chi 2$) test and Pearson's correlation coefficient were used.p value of ≤ 0.05 was taken as measure of statistical significance.

Results: Total one hundred hypertensive individuals (19 males and 81 females) with mean age of 53.05 (±8.28) were recruited. The mean value of SBP was 138.20 (±14.591), DBP was 85.50 (±9.252) and the mean values for TC, TGs, LDL-C, HDL-C and VLDL were 208.17(±28.776), 179.95(±43.717), 125.74(±26.248), 46.32(±13.410) and 35.99(± 8.743) respectively. High levels of TC, TGs, LDL-c, VLDL and low HDL-c were found in 57%, 78%, 48%, 78% and 57% of all subjects respectively.

Conclusion: Hypertensive patients had a high prevalence of lipid profile abnormalities. The mean serum levels were significantly higher in the hypertensive patients than their respective cut-off values.Measuring of serum lipid levels at regular intervals for hypertensive patients is recommended.

Introduction

Hypertension is well-definedas (SBP) equal or above 140 mm Hg and (DBP) equal or above 90 mm Hg (≥ 140/90 mm Hg), or under antihypertensive medication [1–5]. It's often entitled "the silent killer" [2], [6-8], because it has no specific symptoms and thus can be undetected for many years [7]. It is one of a complex multifaceted metabolic disorders, including other abnormalities as central obesity, dyslipidemia, hyperinsulinemia and glucose intolerance [3], [9, 10].

Abnormality of serum lipid levels (Dyslipidemia) is defined as abnormal levels of Total Cholesterol TC, Triglycerides TGs, Low Density Lipoproteins (LDL-c) and High Density

Lipoproteins (HDL-c) [11]. Many studies have shown that lipid profile tend to be more commonly abnormal among hypertensive patients than in the general population [12, 13]. Dyslipidemia is more common in untreated hypertensive patients than normotensives, and lipid levels increase as BP increases [12]. Dyslipidemia or hyperlipidemia causes endothelial damage, which results in the loss of physiological vasomotor activity (endothelial dysfunction). Endothelial dysfunction of the vascular system, leads to the formation of atherosclerotic plaque and decreases the lumen diameter, with increases in arterial wall resistance, leads to risein blood pressure (BP) and contributing to hypertension [13, 14].

Hypertension and dyslipidemia are commonly coexisting, causing what is known as dyslipidemia hypertension (DH) [15]. The coexistence of hypertension and dyslipidemia has multidimensional clinical consequences [12], [16-18]. Both represent the most important pathogenic cause for atherosclerosis [19]. Additionally they are the major risk factors for (CVD) [14], [16], [20-22] and account for more than 80% of deaths and disability in low- and middle-income countries [16]. Therefore, this study was conducted on hypertensive patients to assess their lipid profile and to study this type of relationship in ElObeid city. The benefits are to help raise the general awareness and knowledge of the risks of these disorders particularly when they are coexisting and to guide future health planning.

Material and Methods

This was observational descriptive cross-sectional hospital-based study, carried out between October (2019) to December (2020). It was conducted at three health centers including Wad Alias, Kordofan University and Algala'a Health Centers in ElObeid City, North Kordofan State, and West of Sudan.

The inclusion criteria: patients previously diagnosed with essential hypertensionwith their blood pressure greater than orequal140/90 or under antihypertensive medication,both gender, and between 30-65 years of age who voluntary agree to participate in the study.

The exclusion criteria: patients with secondary hypertension, chronickidneydisease, heartdiseases, diabetesmellitus and hyperthyroidism. Additionally, pregnantwomen,lactating mothers, smokers and alcoholic were also excluded.

After officials of Wad Alias, Kordofan University and Algala'a health centers committee were consulted and their agreement was taken, an informed written consent was obtained from the willing participantsto be interviewed and to give a blood sample.The data was collected on socio-demographic characteristics, blood pressure measurements and lipid profile by a questionnaire via a face-to-face interview.

BP was measured using a calibrated portable mercury sphygmomanometer, with fittingcuff size [3], [7], [22-25].The average of the two readings was recorded [16] in millimeters of mercury (mmHg) as systolic over diastolic blood pressures [7],[22-26].

For lipid profile, five (5 ml) of venous blood was withdrawn from the study participants after an overnight fasting. The collected blood was allowed to stand at room temperature until clotting [18], [26], then centrifuged for 10 to15 min at 3000-4000 r/min to extract serum [18]. Serum samples then were subjected to enzymatic colorimetric methods using Biosystems kits and spectrophotometer to determine levels of TC, TGs and HDL-c [16], [22], [26]. LDL-cwas calculated using Friedewald formula [LDL-c = TC – (HDL + TG/5) [17, 18], [28]. Serum TC, LDL-C, HDL- C and TG levels were classified on the basis of the Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III) [12] [16, 17]. Those who had TC ≥200 mg/dl or TG ≥150 mg/dl or LDL-C≥130 mg/dl or HDL-C <40 mg/dl were considered as dyslipidemia [12], [27].

Statistical analyses

The data analysis was performed using the IBM statistical package for social science (SPSS) version 23. Data were presented as mean ± SD and comparison between groups was done using independent sample t test, while other categorical variables were expressed in frequencies and percentages. Chi-square ($\chi 2$) tests and Pearson's correlation coefficient were used. p value of ≤ 0.05 was taken as measure of statistical significance.

The results

A total of 100 adult hypertensive patients, 81 females and 19males were enrolled in this study. The mean age of hypertensive patients was 53.05 (±8.28), for males it was 56.47(±7.121) and for females it was 52.25(±8.373). The mean (± SD) for SBP was 138.20 (± 14.591), there was no significant differences between males and females (p-value = 0.333). The mean (± SD) of DBP was 85.50 (± 9.252), there was significant differences between males and females (p-value = 0.018).

More than half of hypertensive patients (55%) had poorly controlled blood pressure, despite (96%) of them were using antihypertensive medications?Poorly controlled blood pressure is when it is not well controlled despite using antihypertensive drugs, when BP ≥ 140/90 mm Hg, while controlled blood pressure is when BP less than 140/90 mm Hg [18].

Lipid Profile

The mean (± SD) for TC was found to be 208.17(±28.776), in females = 208.37(±29.112) vs 207.36 (±28.052) in males. As for TG, the mean (± SD) was 179.95(±43.717), 178.67(±46.942) for males, 180.25±43.229 for females. LDL-c mean (±SD) was found to be 125.74(±26.248), in males = 127.04(±25.498) while in females=125.44(±26.567). For HDL-c, the mean (± SD) was 46.32(±13.410), in males = 43.71(±11.825)and 46.93(±13.750) in females. VLDL mean (± SD) was 35.99 (± 8.743), in males =35.73(± 9.388), in females= 36.05(±8.646). There were no significantly differences between the two sexes in all lipid parameters [Table 1].

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Sex of participant		TC	TG	LDL-c	HDL-c	VLDL
		mg/dl	mg/dl	mg/dl	mg/dl	mg/dl
Male						
	Mean	207.36	178.67	127.04	43.71	35.73
	Std. Deviation	28.052	46.942	25.498	11.825	9.388
	% of Total N	19.00%	19.00%	19.00%	19.00%	19.00%
Female						
	Mean	208.37	180.25	125.44	46.93	36.05
	Std. Deviation	29.112	43.229	26.567	13.75	8.646
	% of Total N	81.00%	81.00%	81.00%	81.00%	81.00%
Total						
	Mean	208.17	179.95	125.74	46.32	35.99
	Std. Deviation	28.776	43.717	26.248	13.41	8.743
	% of Total N	100.00%	100.00%	100.00%	100.00%	100.00%
	p-value	0.891	0.888	0.813	0.348	0.888

Table 1: Lipid Profile of Sudanese Hypertensive Patients according to Sex

Fifty-eight percent (58%) of the total participants had high serum levels of TC (≥200 mg/dl), while the rest (42%) haddesirable levels which is below 200 mg/dl, the cut-off level. In the sample hypertensive patients, (78%) had high levels of TG (≥150 mg/dl), but the remaining patients (22%) had normal levels (<150 mg/dl). High levels of LDL-c (≥130mg/dl) found in 48% of whole participants, while (52%) had desirable levels. Fifty-seven (57%) of all participants had low serum levels of HDL-c (<40 mg/dl). Highlevels of TC, TG, LDL-c, VLDL and low levels of HDL-c were observedin 11(57.9%), 12(63.2%), 10(52.6%), 12 (63.2%)and 9 (47.4%)of all male participants respectively.While it represented 47(58.0%), 66(81.5%), 38 (46.9%), 66 (81.5%)and 48 (59.3%) of female participants respectively[Table 2, Figure 1].

Variables		Total	Male	Female
	TC classification			
	Desirable levels (<200	42	8 (42.1)	34 (42.0)
	High levels (≥200	48	11 (57.9)	47 (58.0)
	TG classification			
	Normallevels (<150mg/	22	7 (36.8)	15 (18.5)
	Highlevels (≥150 mg/dl)	78	12 (63.2)	66 (81.5)
	LDL-c classification			
	Normallevels (<130 mg/dl)	52	9 (47.3)	43 (53.1)
	Highlevels (≥130 mg/dl)	48	10 (52.7)	38 (46.9)
	HDL-c classification			
	Lowlevels (<40mg/dl)	57	9 (47.4)	48 (59.3)
	Desirable levels (≥40mgld	43	10 (52.6)	33 (40.8)

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	VLDL classification			
	Desirablelevels (<30mg/d)	22	7 (36.8)	15 (18.5)
	Highlevels (≥30mg/d)	78	12 (63.2)	66 (81.5)
	Total	100	19 (100%)	81 (100%)

Table 2: Lipid profile classification among the participants

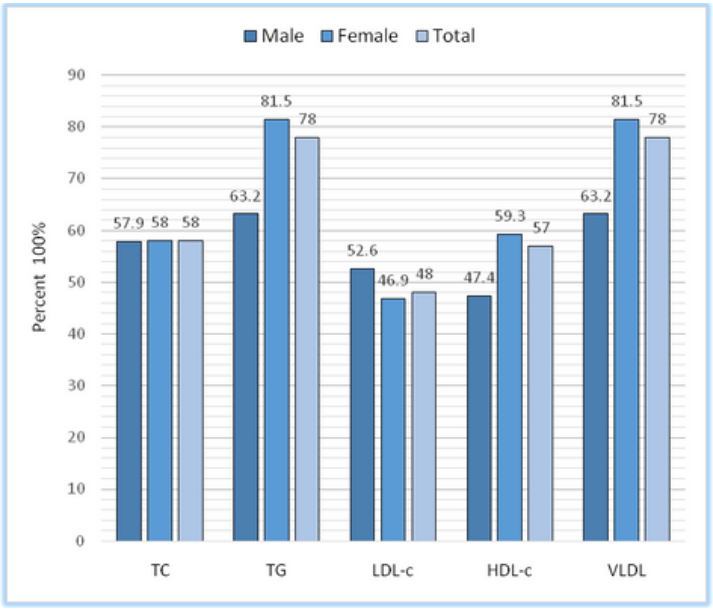

Figure 1: Abnormal lipid profile in total hypertensive subjects & in each sex

There was no statistically significant correlation between SBP, DBP and any of the lipid indices.

Discussion

In the present study, 100 patients with essential hypertension, (81%) females and (19%) males, ages between 30 to 65 years were evaluated to assess the serum lipid levels and to investigate the relationship between hypertension and lipid profile. Significantly larger proportions of patients were found to have elevated BP and elevated levels ofserum lipid.

This study showed that about (96%) of the hypertensive patients were using at least one antihypertensive drug prescribed yet (55%) had poorly controlled blood pressure. Mean SBP and DBP showed a greater value in males than in females. Male subjects have statistically significant higher DBP than female subjects but no statistically significant variation between sexes regarding SBP. These results were in contrast with Gebrie et al study in Ethiopia [18] who observed that females had significantly higher SBP and DBP than males. There was no statistical significance between SBP and DBP in male and female patients in Akintunde et al study in Nigeria [3]. In Dua, et al. study in India (2014), reported that both SBP and DBP were found to be significantly higher among men as compared with women [29].

The mean value (mean ± SD) of serum TC and TG are significantly higher in hypertensive patientsthan their respective cut-off values. This finding in agreement with previous studies by Faiq I. Gorial et al in Baghdad (2012) [21], Gebrie et al. in Ethiopia (2018) [18], Kalam Singh Butola et al. in India, 2016 [30],Sarwar MS et al in Bangladesh, 2014 [28], Choudhury et al in Bangladesh (2014) [16]. Levels of serum HDL-c and LDL-c were found to be within the normal ranges which did not agree with previous studies. As for VLDL mean ± SD it is considerably high which was agree with previous reports done by Sarwar MS et al [28] and by Parsuram Nayak et al in India(2016) [31] as well as in Pyadala et al study, India, 2016 [11].

In this study, the mean ± SD of TC was 208.17±28.776 (208.37±29.112 for femalesand 207.36 ±28.052 for males), TG was 179.95±43.717 (178.67±46.942 for males, 180.25±43.229 for females), LDL was 125.74±26.248 (males = 127.04±25.498, females = 125.44±26.567), HDL was 46.32±13.410 (43.71±11.825 in males and 46.93±13.750 in females) and VLDL was 35.99 ± 8.743 (in males =35.73 ± 9.388, in females = 36.05±8.646). Mean value of TC, LDL-C and HDL-C were higher, while TG is lower in this study when compared with a study done by Kalam Singh Butola et al. which reported that serum levels of TC, TG, HDL-C and LDL-C in hypertensive subjects were 190.50±32.84, 225.94±86.72, and 40.10±4.23 and 43.05±9.50 mg/dl respectively. Serum levels of TC, TG, HDL-C and LDL-C in hypertensive male subject were 190.10 ± 31.78, 231.92 ± 91.37, 39.75 ± 4.18 and 43.94± 9.60 mg/dl respectively while in female hypertensives the results were 191.45 ± 35.64, 211.55 ± 73.31, 40.95 ± 4.25 and 40.91 ± 9.07 mg/dl respectively [30].

The present study showed that there was no significantly different between sexes in all lipid parameters, but females had slightly higher level of TC, TG and HDL while males had slightly higher level of LDL-C. In Kalam Singh Butola et al study showed that female hypertensives had slightly higher level of TC and LDL-C while males had higher levels of TG and HDL-c, which does not agree with the study.Faiq I. Gorial [21] reported that, male hypertensive patients have significant higher level of TC, TG and no significant difference in HDL level than female hypertensive which does not agree with this study.

High (abnormal) levels of TC, TG, LDL-c and VLDL-C were found in 57%, 78%, 48% and 78% of all subjects respectively. Low (abnormal) levels of HDL-c values were found in 57%of subjects. Females are affected more frequency than male with high levels of TC, TG and HDL-c. These findings are comparable with a study done in India 2018 by Kumar PR, Sasikala S, who reported that about 43.92% of hypertensives have high TC; high TG is found in 84.11%, high LDL is found in 28.03%. The low HDL is seen in 53.27% of hypertensive subjects [27].

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In the present study, abnormally high serum level of TG and VLDL-C were the most frequently occurring serum lipid profile abnormalities among hypertensive patients.Females are affected more frequently than males. Followed by high levels of TC and HDL-c. Females also affected more frequently than males.

However, high LDL-C was found to be the most infrequent lipid abnormality in hypertensive patients. Males are affected more frequently than females. These findings are comparable with a study done in Ethiopia (2018) by Gebrie et al. who reported that abnormally high LDL-C was the most frequently occurring serum lipid profile abnormalities, followed by high levels of TC and TG. However, low HDL-C was found to be the most infrequent lipid abnormality in hypertensive patientsin their study [18], which does not agree with our findings.

In the present study, elevated TG is the most frequent lipid abnormality and high LDL-C is the most infrequent lipid abnormality in hypertensive patients. A study done by Charles U. Osuji et al. reported that elevated TC was the most frequently occurring abnormality among the hypertensive subjects (35.6%), followed by elevated LDL-C (28.4%) [12], which does not agree with our findings. A study done by Kumar PR, Sasikala S agreeswith our findings (2018) [27].

Abnormalities in serum lipid profiles play a central role in endothelial functional abnormality which is important in the pathogenesis of atherosclerosis, thrombosis, insulin resistance, and hypertension. Lipoproteins rich in TG and LDL-C have been recognized to be toxic to endothelium, while HDL-C may have protective role. Abnormally high serum TC levels are considered to be risk factors for developing macrovascular complications such as coronary heart disease (CHD), stroke, and hypertension [18].

Hypertension is already recognized as one of the major risk factors in the development of coronary atherosclerosis, it frequently coexists with other risk factors, especially dyslipidemia, which may act synergistically in the pathogenesis of atherosclerosis disease [10]. The present study revealed a significant relationship between lipid abnormalities (dyslipidemia) and hypertension which is in trajectory with the previous studies [16], [18], [21], [27], [28], [30].

There was no statistically significant correlation between SBP, DBP and any of the lipid indices.

Conclusion

Hypertensive patients had a high prevalence of lipid profile abnormalities. The mean serum levels were significantly higher than their respective cut-off values in the hypertensive patients mainly TC, TG and VLDL.

Limitations of the study

This study has several limitations. First, the sample size was obtained from a three urban primary health centers related to the National Health Insurance Fund (NHIF) and may not be representative of all hypertensive patients in ElObeid city. Second, the sample size is small; only 100 hypertensive patients were enrolled. The study also targeted only hypertensive patients and did not compare with normotensive subjects.

Recommendations of the study

It is recommended that comprehensive examinations be made, such as measuring of serum lipid levels at regular intervals for patients who regularly visiting health centers and hospitals. Measurement of serum lipid profile should be introduced to the management plan of hypertension. Since a small number of the population was considered for the present study, future studies on higher populations are recommended.

Acknowledgement

The authors thank and wish to acknowledge the efforts of the medical staff of Wad Alias, Kordofan University and Algala'a Health Centers, El-Obeid City, North Kordofan, West Sudan, for their patience and creating an enabling environment for this research work without their help this study cannot come out.

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