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Original Article

Dyslipidemia patterns in Kordofan, Sudan: a clinic-based study

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Abstract: Background: The strong association between dyslipidemia and cardiovascular diseases highlights the importance of early detection and effective management of lipid abnormalities. This study aimed to evaluate the epidemiology of dyslipidemia in Kordofan State, Sudan. Methodology: This study is a prospective descriptive clinic-based study conducted at the Prof. Medical Complex in the Prof. Medical Research Consultancy Centre (Prof. MRCC) in El-Obeid City, North Kordofan State, Sudan. The enrollment period for the relevant data was from January 1, 2025, to April 7, 2026. Results: This cohort included 812 individuals aged 12-95 years, with a mean ± SD = 46.8 ± 16.76. Males were 442 (54.4%), and females were 370 (45.6%). Females had a higher prevalence of high LDL-C than males: 21.4% vs. 15.2%. Male sex was associated with a lower risk of high LDL-C, RR = 0.71, P = 0.022. Low HDL-C was significantly higher in males than females (77.1% vs. 64.9%, RR = 1.19, P < 0.001). HTG affected 318 (39.2%) of individuals, 181 (56.9%) of whom were men. Low HDL-C was the most common lipid anomaly and was much more prevalent in males than females. About 50 (6.1%) of the individuals had mixed dyslipidemias (high LDL-C, low HDL-C, and HTG). Conclusion: High prevalence of low HDL-C was observed in nearly three-quarters of the study population. Low HDL-C was more prevalent among participants with LDL > 160 mg/dl than among those with LDL < 160 mg/dl, but the association was not statistically significant. These findings suggest that low HDL-C was the predominant lipid abnormality and occurred independently of LDL and triglyceride categories in this sample.

Keywords: Dyslipidemia, HDL-C, LDL-C, CVDs, Sudan

Introduction

Lipid abnormalities represent an increasing global health concern, characterized by both regional and global disparities in disease burden. Approximately 20-25% of adults and young children exhibit abnormal lipid profiles worldwide. Dyslipidemia denotes abnormalities in lipid profiles, characterized by elevated plasma total cholesterol, increased low-density lipoprotein cholesterol (LDL-C), hypertriglyceridemia (HTG), and reduced high-density lipoprotein (HDL) levels [1-4].

Lipid abnormalities are mainly associated with poor diet, obesity, inactivity, smoking, diabetes, hypertension, genetic factors, and some chronic diseases. The major risks are cardiovascular diseases, stroke, peripheral vascular disease, and pancreatitis. Prevention is based on a healthy diet, regular physical activity, weight control, smoking cessation, screening, and treatment of underlying diseases [5, 6].

Dyslipidemia is closely associated with cardiovascular diseases (CVD), responsible for over four million deaths annually worldwide. This significant mortality rate is preventable through effective management of dyslipidemia and other CVD risk factors at both regional and global levels. Hypercholesterolemia, particularly elevated LDL-C levels, is highly prevalent, affecting approximately one-third of the global population and contributing to around 4.4 million deaths worldwide in 2019 [1-4].

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The prompt initiation of dyslipidemia treatment is essential for mitigating the risk of early atherosclerosis and premature cardiovascular events, especially in patients with familial hypercholesterolemia, young adults exhibiting LDL-C levels of ≥ 160 mg/dl, and those with a significant family history of premature atherosclerotic cardiovascular disease (ASCVD). In secondary prevention, it is advised to lower LDL-C to below 55 mg/dL and non-HDL-C to below 85 mg/dL for individuals at very high risk of ASCVD events, while LDL-C should be reduced to below 70 mg/dL for those not at very high risk of ASCVD events. In primary prevention, the target LDL levels for heterozygous familial hypercholesterolemia are less than 70 mg/dL. For individuals with LDL-C levels of 190 mg/dL or higher, as well as those classified as moderate to high risk with LDL-C levels ranging from 70 to 189 mg/dL, the LDL goal is set at less than 100 mg/dL [1, 4, 7]. The available data concerning dyslipidemia in Western Sudan is scarce; thus, this study aimed to investigate the epidemiological aspects of dyslipidemia within that region.

Materials and methods

Study design

This study is a prospective, descriptive, clinic-based study conducted at the Prof. Medical Complex within the Prof. Medical Research Consultancy Centre (Prof. MRCC) located in El-Obeid City, Kordofan State. The period of enrollment for the pertinent data spanned from January 1, 2025, to April 7, 2026.

Inclusion and exclusion criteria

Individuals were randomly selected from those who attended the Prof. MRCC medical complex for a routine medical checkup and consented to participate, regardless of any demographic considerations. Individuals exhibiting excessive illness (patients who required hospital admission were transferred immediately to the hospital without investigation in our clinic) or those who opted out of participation were excluded from consideration. The process of data collection was executed utilizing a meticulously designed self-administered questionnaire.

Sample collection and demonstration

Blood samples for lipid profiling were collected by standard venipuncture into serum or plasma tubes after 9-12 hours of overnight fasting and labeled with participant ID and time of collection. Samples were immediately centrifuged, and serum/plasma was separated and transferred into labeled aliquots; specimens were stored at appropriate temperatures (refrigerated short-term or frozen long-term) until analysis to minimize the effects of hemolysis and lipemia. Lipid parameters were measured by routine clinical chemistry, including total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C). For fasting samples with TG < 400 mg/dL, the LDL-C was estimated by the Friedewald equation: LDL-C (mg/dL) = TC - HDL-C - (TG/5). In other cases, LDL-C was calculated by direct measurement according to the method of the analyzer. Internal quality control and calibration procedures were performed in accordance with the laboratory's Standard Operating Procedure. Results are reported in mg/dL.

Measurement

Dyslipidemia is characterized by elevated total cholesterol (TC) levels of 200 mg/dl or higher; high levels of LDL-C at 130 mg/dl or above; low HDL-C levels, defined as 40 mg/dl for men and less than 50 mg/dl for women; and increased triglycerides (TG) at 150 mg/dl or more. A person exhibiting one or more abnormalities in the previously mentioned variables is deemed to have dyslipidemia [7-9]. In this group, an LDL-C level higher than 160 mg/dl was considered high, and an HDL level lower than 40 mg/dl was considered low for both men and women.

Serum was used to assess lipids using a standard spectrophotometer analyzer made by BioSystems in Italy. Triglycerides (TG) were quantified using the Glycerol Phosphate Oxidase method, total cholesterol (TC) using the Cholesterol Oxidase-Peroxidase assay method, and high-density lipoprotein cholesterol (HDL-C) using the Cholesterol Oxidase-aminophenazone method. BioSystems kits provided the corresponding reagents. The Bio System Company provided the reagents for the direct homogeneous (direct) enzymatic test method used

Table 1. Represents the distribution of the study populations based on their age and sex

Age	Males n (%)	Females n (%)	Total n (%)
< 30 years	79 (17.9%)	83 (22.4%)	162 (20.0%)
31-40	92 (20.8%)	77 (20.8%)	169 (20.8%)
41-49	69 (15.6%)	48 (13.0%)	117 (14.4%)
50-60	109 (24.7%)	93 (25.1%)	202 (24.9%)
> 60	93 (21.0%)	69 (18.6%)	162 (20.0%)
Total	442	370	812

to measure low-density lipoprotein cholesterol (LDL-C).

Statistical analysis

After data collection, we entered the data into a data sheet before entering them into the statistical software package for social science (SPSS) version 31 (Chicago, USA). Frequencies (N), Percentages (%) and cross-tabulations were computed. We calculated the relative risk (RR) with a 95% confidence interval (95% CI) and performed a chi-square test; a *P*-value < 0.05 was deemed statistically significant.

Results

Demographics

We enrolled 812 people in this cohort, ranging in age from 12 to 95 years, with a mean ± SD = 46.8 ± 16.76. Males constituted 442 (54.4%) of the total, while females comprised 370 (45.6%). **Table 1** shows that the majority of candidates, 202 (24.87%), were aged 50-60 years, followed by 31-40 years at 169 (20.8%) and > 60 years at equal representation 162 (19.95%).

Lipid profile by sex

Females had a higher prevalence of high LDL-C than males: 21.4% vs. 15.2%. Male sex was associated with a lower risk of high LDL-C, RR = 0.71, P = 0.022. Low HDL-C was significantly higher in males than females (77.1% vs. 64.9%, RR = 1.19, P < 0.001). The number of males with high triglycerides was slightly higher than females (41% vs. 37%); however, the difference was not statistically significant (P = 0.249), as indicated in **Table 2**.

Low HDL-C was the most common lipid anomaly and was much more prevalent in males than females. Elevated LDL-C was substantially more frequent in females, but there was no statistically significant sex difference for hypertriglyceridemia.

Lipid profile by age

In terms of age and LDL level, the majority of candidates with high LDL levels were between the ages of 50 and 60 years, followed by those aged 31 to 40 and over 60, with incidence rates of 51/146 (34.9%), 30 (20.5%), and 28 (19%), respectively. Furthermore, the age group of 50-60 years comprises the majority of individuals with low HDL values (141/581, 24%), followed by those > 60 years at 120 (20.6%) and those 31-40 years old at 117 (20%). Furthermore, the age group 50-60 years accounts for most participants with high TG levels, followed by 31-40 and > 60 years, with 89/318 (27.98%), 69 (21.69%), and 60 (18.8%), respectively, as seen in **Table 3**.

High LDL-C increased significantly with advancing age and was highest in the 50-60-year-old group. All older age groups compared with those under 30 years had a higher risk of elevated LDL-C, particularly those aged 50-60 years. Low HDL-C and hypertriglyceridemia were common in all age groups, but the variation with age was not statistically significant overall; see **Table 4**.

Interrelation of lipid measures

Among participants with LDL < 160 mg/dl, low HDL-C was seen in 343/494 (69.4%); among participants with LDL > 160 mg/dl, low HDL-C was seen in 238/318 (74.8%). The risk of low HDL in participants with LDL > 160 mg/dl is represented by the relative risk (RR) of 1.08 (95% CI: 0.99-1.17), with a *P*-value of 0.093. Participants with LDL > 160 mg/dl had a slightly higher probability of having low HDL-C compared with those with LDL < 160 mg/dl; however, this association was not statistically significant.

Among participants with TG < 150 mg/dl, low HDL-C was present in 476/666 (71.5%), compared with 105/146 (71.9%) among those with TG > 150 mg/dl. Risk for low HDL in TG > 150: this difference was not statistically significant,

Table 2. Shows the relationship between sex and LDL, HDL, and TG levels

Variable	Males n (%)	Females n (%)	Total n (%)	RR (95% CI)	*P*-value
LDL level					
< 160 mg/dl	375 (84.8%)	291 (78.6%)	666 (82%)		
> 160 mg/dl	67 (15.2%)	79 (21.4%)	146 (18%)	0.71 (0.53-0.95)	0.022
HDL level					
< 40 mg/dl	341 (77.1%)	240 (64.9%)	581 (71.6%)	1.19 (1.09-1.3)	< 0.001
> 40 mg/dl	101 (22.9%)	130 (35.1%)	231 (28.4%)		
TG level					
< 150 mg/dl	261 (59%)	233 (63%)	494 (60.8%)		
> 150 mg/dl	181 (41%)	137 (37%)	318 (39.2%)	1.11 (0.94-1.3)	0.249
Total	442	370	812		

Table 3. Distribution of the individuals based on age and LDL, HDL, and TG levels

Variable	< 30 years n (%)	31-40 n (%)	41-49 n (%)	50-60 n (%)	> 60 n (%)	Total n (%)
LDL mg/dL						
< 160	148 (91.4%)	139 (82.2%)	94 (80.3%)	151 (74.8%)	134 (82.7%)	666 (82%)
> 160	14 (8.6%)	30 (17.8%)	23 (19.7%)	51 (25.2%)	28 (17.3%)	146 (18.0%)
HDL mg/dL						
< 40	111 (68.5%)	117 (69.2%)	92 (78.6%)	141 (69.8%)	120 (74.1%)	581 (71.6%)
> 40	51 (31.5%)	52 (30.8%)	25 (21.4%)	61 (30.2%)	42 (25.9%)	231 (28.4%)
TG mg/dL						
< 150	110 (67.9%)	100 (59.2%)	69 (59%)	113 (55.9%)	102 (63%)	494 (60.8%)
> 150	52 (32.1%)	69 (40.8%)	48 (41%)	89 (44.1%)	60 (37%)	318 (39.2%)
Total	162	169	117	202	162	812

Table 4. Relative risk (RR) and 95% confidence interval (CI) of lipid abnormalities in age groups, compared with age < 30 years as the reference

Age group	High LDL-C	Low HDL-C	High TG
	RR (95% CI), *P*-value	RR (95% CI), *P*-value	RR (95% CI), *P*-value
31-40 Years	2.05 (1.13-3.73), < 0.001	1.01 (0.87-1.17), 0.106	1.27 (0.96-1.68), 0.164
41-49	2.28 (1.22-4.27)	1.15 (1.00-1.32)	1.28 (0.94-1.73)
50-60	2.92 (1.67-5.11)	1.02 (0.89-1.17)	1.37 (1.05-1.79)
> 60	2 (1.09-3.65)	1.08 (0.94-1.24)	1.15 (0.86-1.54)

with a relative risk (RR) of 1.12 (95% CI: 0.97-1.3) and a *P*-value of RR (95% CI) = 1.01 (0.90-1.13), *P*-value = 0.929. Thus, the prevalence of low HDL-C was nearly comparable in the TG groups, as indicated in **Table 5**.

The prevalence of low HDL in TG < 150 was 288/422 (68.2%), and the prevalence of low HDL in TG > 150 was 55/72 (76.4%). Among participants with LDL < 160 mg/dl, low HDL-C was more frequent in those with TG > 150 mg/dl; however, the difference was not statistically significant, the RR (95% CI) = 1.12 (0.97-1.3), *P*-value = 0.16, as indicated in **Table 5**.

The association between triglyceride (TG) levels and high-density lipoprotein (HDL) cholesterol was examined among participants with low-density lipoprotein (LDL) levels greater than 160 mg/dl. The prevalence of low HDL in TG < 150 mg/dL was 188/244 (77.0%), and the prevalence of low HDL in TG > 150 mg/dL was 50/74 (67.6%). Among participants with LDL > 160 mg/dl, low HDL-C was slightly less common among those with TG > 150 mg/dl, but the association was not statistically significant; the RR (95% CI) = 0.88 (0.35-1.11), *P*-value = 0.101, as indicated in **Table 5**.

Table 5. Shows the interrelation of the HDL, LDL, and TG levels

Variable	HDL		Total
	< 40 mg/dl	> 40 mg/dl	
LDL < 160 mg/dl			
TG < 150 mg/dl	288	134	422
TG > 150	55	17	72
Total TG	343	151	494
LDL > 160 mg/dl			
TG < 150 mg/dl	188	56	244
TG > 150	50	24	74
Total TG	238	80	318
Total LDL			
TG < 150 mg/dl	476	190	666
TG > 150	105	41	146
Total TG	581	231	812

Discussion

The present study revealed a high prevalence of dyslipidemia among patients attending health care facilities in Kordofan, Sudan. The most prevalent conditions were low HDL-C (71.6%) and hypertriglyceridemia (39.2%), and the least prevalent was high LDL-C (17.98%). These findings suggest a high prevalence of atherogenic lipid profiles in this population and a potentially major contribution to future risk of CVD.

Abnormalities in the lipid profile are caused by dysregulation of lipoprotein metabolism, resulting in an increased burden of atherogenic particles. Insulin resistance or deficiency is the main driver of hypertriglyceridemia, which increases hepatic VLDL synthesis and impairs clearance of TG-rich lipoproteins by reduced lipoprotein lipase activity and altered remnant uptake. Diabetes, hypothyroidism, renal disease, alcohol use, and lipid-altering drugs are secondary factors. Reduced HDL-C is the consequence of impaired HDL biogenesis and enhanced HDL catabolism, often observed when coupled with systemic inflammation, smoking, obesity, and insulin resistance, and it leads to reduced reverse cholesterol transport. Elevated LDL-C (and non-HDL-C) results from increased production and decreased clearance of LDL particles due to reduced LDL receptor-mediated uptake and altered remnant metabolism, as seen in familial and metabolic disorders. Together, these mechanisms promote accumulation of atherogenic remnant and LDL particles, increasing cardiovascular risk even when LDL-C alone is not markedly elevated (notably in mixed dyslipidemia with high TG and low HDL) [10].

The prevalence of high LDL-C in this investigation was 17.98%. This finding is marginally lower than previous reports from Sudan but higher than some reports from Sudan associated with diabetic patients [11]. Nevertheless, the prevalence rate was closer to the previous global reports at 18.9% [1].

There were significant sex differences in lipid abnormalities. The prevalence of low HDL-C was higher in males than in females (341 vs. 240). A high prevalence of LDL-C was observed in females. Hypertriglyceridemia was slightly more prevalent in men. The differences are likely due to variations in lifestyle, eating habits, physical activity, obesity, hormonal factors, and metabolic risk profiles between men and women.

There are major disparities concerning sex predominance between the current study and the previous global values, with higher values reported in males globally [1], in contradiction to the female predominance in the current study. The incidence of elevated LDL-C was greater in females than in males: 21.4% compared to 15.2%. The male gender was linked to a diminished likelihood of elevated LDL-C, RR = 0.71, P = 0.022. The prevalence of low HDL-C was markedly greater in males compared to females (77.1% versus 64.9%, RR = 1.19, P < 0.001). HTG impacted 318 individuals, representing 39.2%, with 181 of these, or 56.9%, being male. Moreover, our findings are lower than those reported in Africa, with a higher prevalence rate of 26% to 29% and higher values of up to 50% in diabetic or hypertensive populations. Some regional and racial disparities in LDL values may be related to food and living conditions as well as genetics, climates, testing methods, and (for example) cut-off values for the definition of high LDL-C. Such disparities can lead to significant differences in health outcomes and treatment approaches in different populations. The prevalence rate in some regions, like West Africa, is as high as 41%, and in Eastern Africa, 39%. The female predominance concerning high LDL-C in this

cohort is very close to the findings in African countries [12, 13].

The growing concern about CVDs is mainly due to the aggregation of modifiable and non-modifiable risk factors. LDL-C is an important modifiable risk factor in the pathogenesis and progression of atherosclerosis. In particular, oxidized LDL can pass through tight junctions of the vascular endothelium. Inflammation of the vascular endothelium and oxidative stress induced by the primary risk factors for CVDs such as type 2 diabetes mellitus (T2DM), hypertension, obesity, cigarette smoking, and hypercholesterolemia critically depend on the formation of oxidized LDL and subsequent foam cells in the subintimal region. This process, and the development of atherosclerotic plaques, is driven by the secretion of various inflammatory mediators. This condition can lead to widespread atherosclerosis affecting vital organs such as the heart, brain, and kidneys. The progression of this process can occur swiftly and engage multiple systems, contingent upon LDL levels and exposure duration; elevated LDL levels and prolonged exposure exacerbate the condition, whereas reduced LDL levels linked to treatment and risk factor modification can enhance or reverse it. Despite the potential of emerging therapeutic agents and biomarkers to prevent atherosclerosis, significant efforts are still needed in optimizing risk factors, as well as addressing the ethnic and geographical patterns of CVDs [14-18].

Low HDL-C was prevalent in 71.6% of this population, with a higher rate in females. This finding exceeds the previously reported global range [1] but aligns with reports from Africa and is marginally higher than those from Sub-Saharan Africa, where some reports show 77%; however, the female association with low HDL aligns closely with the current study [16]. Dyslipidemia is more prevalent in African populations with BMI > 25.0 kg/m^2 and waist circumference > 94 cm, and those with diabetes and hypertension, compared to those without [19].

Low HDL-C is recognized as a significant risk factor in atherogenic dyslipidemia. In addition to its critical function in the reverse transport of LDL-C from tissues to the liver for metabolism, HDL-C also contributes to the maintenance of vascular endothelial integrity and the reduction of chronic inflammation and oxidative stress in both the macro- and microcirculation of vital organs. Another significant emerging risk factor, in addition to low HDL, is non-high-density lipoprotein cholesterol (non-HDL-C). This measure includes all plasma lipoproteins such as LDL, triglyceride-rich lipoproteins (TRL), TRL remnants, and lipoprotein(a) (Lp(a)), excluding HDL. Non-HDL-C is recognized as an independent risk factor for the pathogenesis of atherosclerosis and atheroma formation, especially in patients with new atherosclerotic events, despite achieving target LDL cholesterol levels and being on optimal statin therapy. High non-HDL-C levels are associated with increased mortality in many epidemiological studies and therefore are recommended as a secondary target by many international lipid guidelines [20-23].

This study found a 39.2% prevalence of hypertriglyceridemia (HTG). These data are marginally lower than a prior Sudanese study, but they exceed Sudanese levels in diabetic patients [24, 25]. While our results remain higher than the global average, male predominance is more in line with the global scale [1]. There are some discrepancies in HTG prevalence among reports from Africa. One meta-analysis of 181 studies found a prevalence rate of 17% [26], whereas South Africa reported rates as high as 62% [27]. HTG is a major metabolic disorder that is usually caused by a complicated interaction between a person's genetics and other metabolic abnormalities, including metabolic syndrome, obesity, T2DM, and a sedentary lifestyle. Increased or decreased body utilization and clearance of TG-rich lipoproteins such as very low-density lipoproteins (VLDL) and chylomicrons are central to HTG. Impaired function or activity of the enzyme lipoprotein lipase (LPL) is critical in the pathogenesis of the disease. The activity of LPL is closely tied to insulin, which explains the association between HTG and insulin resistance diseases such as metabolic syndrome. Higher levels of HTG are typically associated with retinal vein thrombosis and pancreatitis, although moderate elevations are independent risk factors for CVDs [28-32].

In this series, 6.1% of the people have mixed dyslipidemia (high LDL-C, low HDL-C, and high TG). The findings are lower than the results of the INTERSPIRE trial, which was undertaken in

13 countries across 6 WHO regions in patients with coronary heart disease (CAD) at 24.6% [33].

Atherogenic dyslipidemia represents a developing notion concerning the interplay between hypertriglyceridemia and HDL cholesterol, in addition to elevated HDL cholesterol levels. This combination is notably common among individuals with metabolic syndrome, T2DM, prediabetes, and obesity, as well as those who are overweight, presenting significant risks associated with increased cardiovascular diseases and mortality. Statins, either alone or in combination with agents such as ezetimibe, PCSK9 inhibitors, and bempedoic acid, are first-line treatment. Contemporary international guidelines advocate early and aggressive combination therapy for those with acute coronary syndrome (ACS) in the setting of an embrace of a healthy Mediterranean diet and vigorous physical activity. Another significant aspect of these guidelines is the examination of cardiovascular risk modifiers such as lipoprotein(a) and CRP/inflammatory disease [34, 35].

In terms of age distribution, lipid abnormalities were present in all age groups, but the changes were more obvious in middle-aged and older participants. The age group with the largest number of people with high LDL-C, low HDL-C, and high triglycerides was 50 to 60 years. The finding is consistent with the established rise in metabolic and cardiovascular risk with increasing age and emphasizes the necessity of lipid screening in adults, particularly after the age of 40.

The combined lipid profile analysis further showed that many participants had more than one lipid abnormality. Low HDL-C prevalence was high in both normal and elevated LDL-C and triglycerides. Low HDL-C with hypertriglyceridemia and high LDL-C may represent a potentially high-risk lipid phenotype, often seen in insulin resistance, obesity, and diabetes mellitus, and is associated with an increased risk of cardiovascular disease.

Overall, the findings indicate that dyslipidemia, especially low HDL-C and hypertriglyceridemia, is highly prevalent in this clinic-based population in Kordofan. The findings emphasize the necessity of routine lipid screening, early identification of high-risk individuals, lifestyle modification programs, dietary counseling, promotion of physical activity, and appropriate medical management to reduce the burden of cardiovascular disease in the region.

Limitations

The study was carried out in a clinic and used a randomized prospective design, which may limit the generalizability of the findings to the whole population of Kordofan. The study setting enables identification of the associations, but not the causality, between risk factors and lipid abnormalities. Important variables such as dietary habits, body mass index, waist circumference, smoking, alcohol intake, physical activity, diabetes, hypertension, thyroid disease, medication use, and family history were not fully assessed, and these limitations may limit the interpretation of the factors contributing to dyslipidemia. The participants were recruited from a single medical facility, which may lead to selection bias.

Future perspectives

Future studies should include larger community-based samples from different areas of Kordofan and Sudan to better estimate the exact prevalence of dyslipidemia. Longitudinal studies are needed to evaluate causal relations and to assess the effect of lipid abnormalities on cardiovascular outcomes. Future studies should investigate other risk factors such as obesity, diabetes, hypertension, diet, physical inactivity, smoking, and socioeconomic status. Public health programs should also include routine screening for lipids, lifestyle modification, nutrition education, weight control, promotion of physical activity, and early treatment of high-risk individuals. Such measures could help reduce the burden of cardiovascular disease in Kordofan and Sudan.

In conclusion, this study demonstrated a high burden of dyslipidemia among clinic attendees in Kordofan, Sudan, with low HDL-C being the most common abnormality, followed by hypertriglyceridemia and elevated LDL-C. Lipid abnormalities varied by sex and age, with low HDL-C and hypertriglyceridemia more frequent among males and elevated LDL-C relatively more common among females. These findings emphasize the necessity of routine lipid screening, lifestyle modification, and early preventive

interventions to reduce future cardiovascular disease risk in the region.

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Written informed consent was obtained from all adult participants.

Disclosure of conflict of interest

None.

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