

The common risk factors associated with cardiovascular diseases at El-Obeid Teaching Hospital

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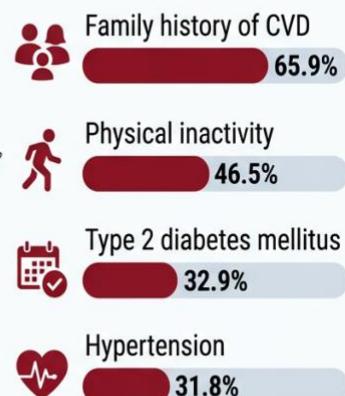
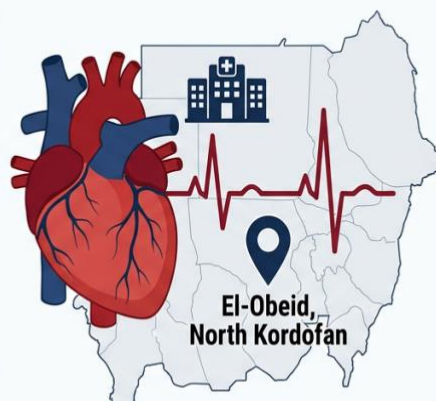
ABSTRACT

Background: Cardiovascular diseases (CVDs) continue to represent the foremost cause of death and disability worldwide. Data regarding CVD risk factors in Western Sudan is limited; therefore, the current study seeks to investigate this problem in Western Sudan. **Methodology:** We conducted a prospective descriptive study, carried out at El-Obeid Teaching Hospital, which is located in North Kordofan State, Sudan, from July 2026 to September 2026. The sample size encompasses all patients admitted to the coronary care unit, besides those reviewed in the cardiology outpatient clinic with a preliminary diagnosis of CVDs in the designated time frame. **Results:** This comprised 119 patients aged 17 to 90 years, including 36.13% males and 63.86% females. Of the 119 participants, CVD was found in 73.9% of patients. The most commonly reported CVD risk factor is a positive family history (65.9%), followed by physical inactivity (46.5%), type 2 diabetes mellitus (T2DM) (32.9%), and hypertension (31.8%). **Conclusion:** The most prevalent CVD risk factors in Western Sudan are a positive family history of CVDs, T2DM, and hypertension. These findings mandate substantial efforts toward adopting protocols for the early screening of at-risk families, as well as timely diagnosis and management of CVD risk factors.

Keywords: Cardiovascular diseases, risk factors, diabetes, hypertension, family history of cardiovascular disease, Sudan

RISK FACTORS ASSOCIATED WITH INCREASED PREVALENCE OF CVD IN SUDAN

Prospective descriptive study; El-Obeid Teaching Hospital; July 2026–September 2026
n=119 suspected CVD patients; age range 17–90 years; female 63.86%, male 36.13%; CVD confirmed 73.9%.



Priority actions: family-based screening, early detection, and timely management of diabetes and hypertension.

Introduction

Cardiovascular diseases (CVDs) continue to represent the foremost cause of death and disability worldwide. The huge burden of CVD risk factors, along with population aging and the increase of populations, has remained crucial for the increased burden of CVDs in most countries since 1990. In the world, ischemic heart disease (IHD), intracerebral hemorrhage, ischemic stroke, and hypertensive heart disease (HHD) are the commonest cardiovascular causes of disability-adjusted life years (DALYs), which increased by 1.4-fold (320 million in 1990 to 437 million in 2023) [1-3]. The burden of CVDs is measured in DALYs. DALYs are the sum of years of life lost and years lived with disability and give a useful estimate of the total loss of productive years. Among the various CVDs, heart attacks and strokes account for the majority of deaths. Risk factors for CVDs are broadly categorized into modifiable and non-modifiable ones. Type 2 diabetes (T2DM), hypertension, dyslipidemia, obesity, tobacco smoking, physical inactivity, unhealthy dietary intake, and air pollution remain the major modifiable CVD risk factors globally [4-7]. In Sudan, CVDs and the related risk factors are prominent, notably in the era of continuous and devastating armed conflict. Major factors contributing to the burden of CVDs in Sudan include the near collapse of the health system, the scarcity of medical supplies, and the relocation of trained medical personnel [8, 9]. The current research aimed to study the limited data on CVD risk factors in Western Sudan.

Materials and methods

We conducted a prospective descriptive study, carried out at El-Obeid Teaching Hospital, which is located in North Kordofan State, Sudan, from July 2026 to September 2026. The hospital represents the fundamental access point for health services provision in El-Obeid city, which is

the capital of North Kordofan State. The sample size encompasses all patients admitted to the coronary care unit, besides those reviewed in the cardiology outpatient clinic with a preliminary diagnosis of CVDs in the designated time frame. In this cohort, CVDs encompass coronary artery disease (CAD), heart failure, and hypertensive heart disease. The relevant data were obtained from the patients and their families through a well-structured self-administered questionnaire. All the information related to CVDs, including the individual's demographic characteristics and the relevant CVD risk factors, was obtained.

Statistical analysis

Data were initially retrieved into a data sheet before being entered into the Statistical Package for Social Sciences (SPSS version 31, IBM, Chicago, USA). SPSS was used for variable analysis, crosstabulations, and Pearson's chi-square test. The 95% confidence level and confidence interval were used, and a P-value of < 0.05 was deemed statistically significant.

Results

This study included 119 participants aged 17 to 90 years. Males represented 43/119 (36.13%), and females 76/119 (63.86%) of the total. The bulk of the individuals lie in the age group range of 36-44 years at 41/119 (34.4%), followed by 45-54 at 27 (22.6%) and 55-64 years at 20 (16.8%).

Most of the study participants, 89/119 (74.7%), were from urban areas, while 30 (25.2%) had rural residence. The majority of the individuals in this cohort were married, followed by single marital status and widowed, represented by 97/119 (81.5%), 15 (12.6%), and 7 (5.8%), respectively. Table 1 and Figure 1 demonstrated that most of the individuals were illiterate, followed by primary and secondary education levels with incidence rates of 44/119 (36.9%), 40 (33.6%), and 18 (15.1%), respectively.

Table 1 describes the demographic characteristics of the study participants.

Variable	Males n = 43	Females n =76	Total n =119
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<i>Age group</i>			
≤ 30 years	8	10	18
31-44	4	9	13
45-54	8	19	27
55-64	3	17	20
≥ 65	20	21	41
Total	43	76	119
<i>Residence</i>			
Urban	34	55	89
Rural	9	21	30
Total	43	76	119
Married	34	63	97
Single	9	6	15
Widowed	0	7	7
Total	43	76	119
<i>Educational level</i>			
None / Illiterate	16	28	44
Primary	11	29	40
Secondary	7	11	18
University	7	8	15
Other	2	0	2
Total	43	76	119

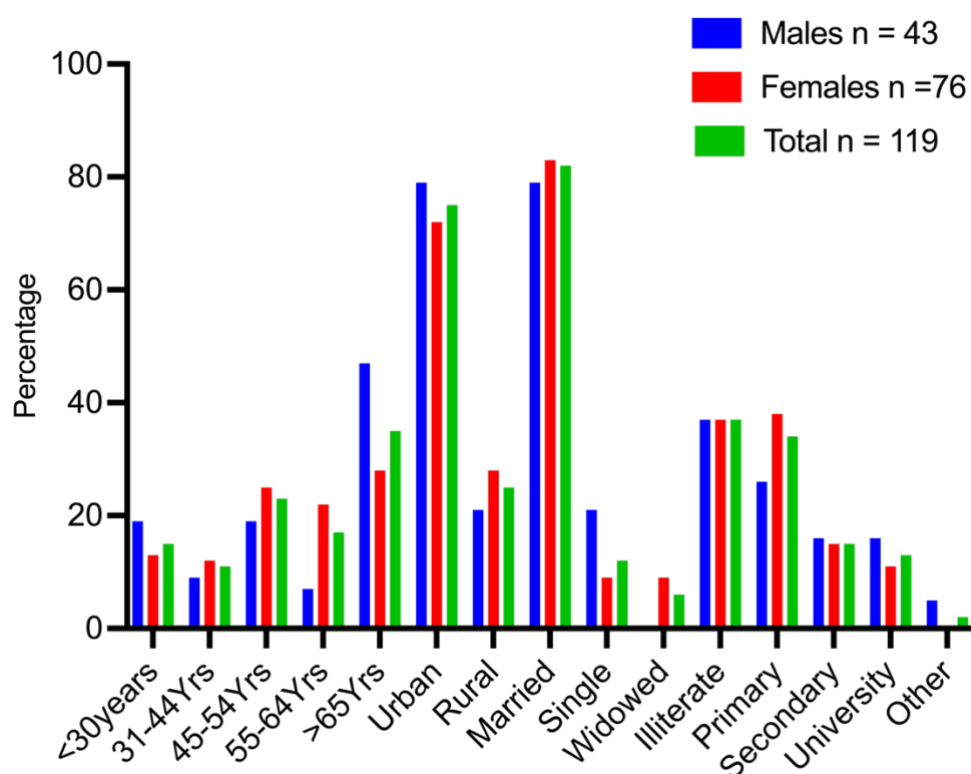


Figure 1 shows the demographic features of the individuals.

In this series, 88/119 (73.9%) of the patients had CVDs, 27/88 (30.6%) of whom were males, and 61/88 (69.3%) were females. T2DM was reported in 33/119 (27.7%); 13/33 (39.3%) of them were males, and 20/33

(60.6%) were females. Hypertension was reported in 31/119 (26%) of the individuals; 12/31 (38.7%) of them were males, while females were 19/33 (57.5%), as explained in Table 2 and Figure 2.

Table 2 describes the relationship between the candidate with CVD, their sex, and CVD risk factors.

Variable	Males n = 43	Females n = 76	Total n = 119
<i>Individuals with CVD</i>			
Yes	27	61	88
No	16	15	31
Total	43	76	119
<i>T2DM</i>			
Yes	13	20	33
No	30	56	86
Total	43	76	119
<i>Hypertension</i>			
Yes	12	19	31
No	31	57	88
Total	43	76	119

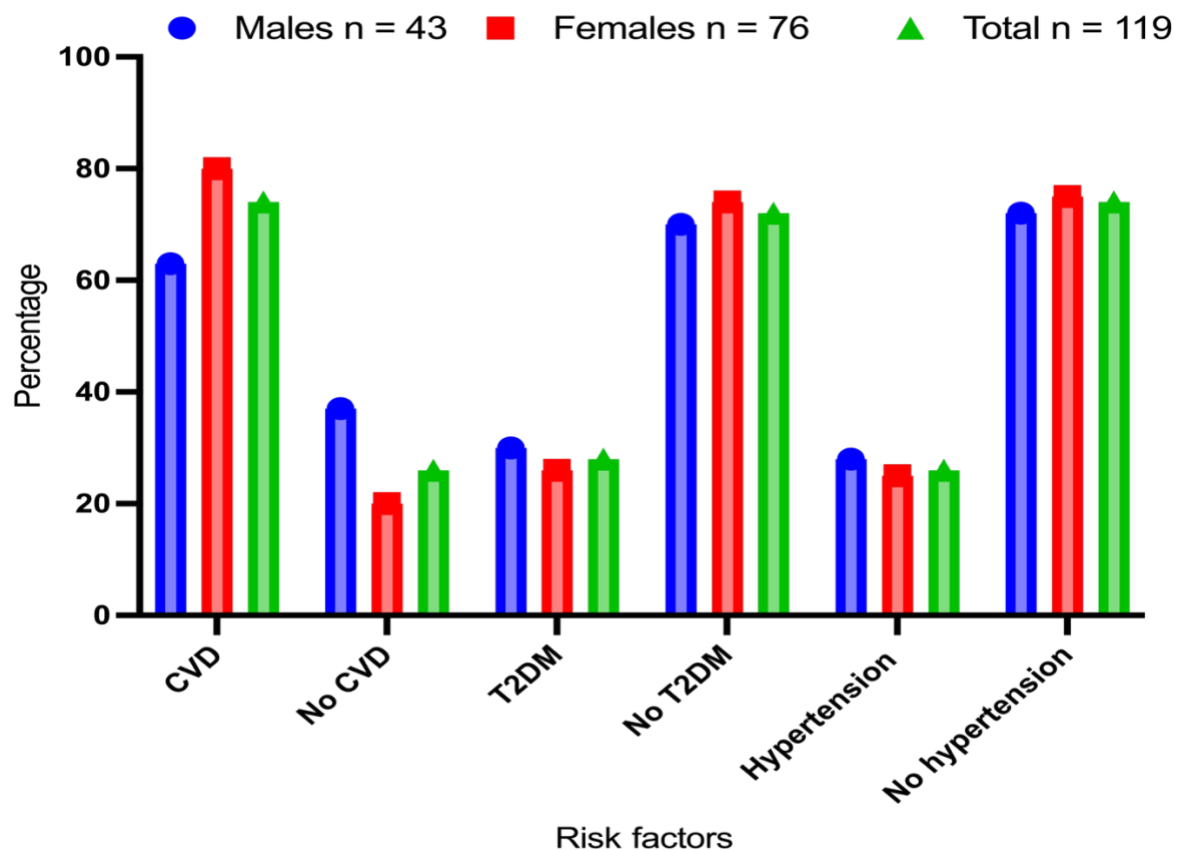


Figure 2 shows the relationship between the individuals with CVD, their sex, and CVD risk factors.

The bulk of the participants in this study had a positive family history of CVD at 70/119 (58.5%), while 49 (41.1%) had no family history of CVD. Table 3 and Fig. 3 illustrated

that tobacco smoking, use of high dietary salt, and regular physical activity constituted 13/119 (10.9%), 4 (3.3%), and 67 (56.3%), respectively.

Table .3 describes the study participants' CVD risk factors and their sex.

Variable	Males n = 43	Females n = 76	Total n = 119
<i>Family history of CVD</i>			
Yes	25	45	70
No	18	31	49

Total	43	76	119
<i>Tobacco smoking</i>			
Yes	4	9	13
No	39	67	106
Total	43	76	119
<i>Use of high salt</i>			
Yes	4	0	4
No	39	76	115
Total	76	43	119
<i>Alcohol consumption</i>			
Yes	4	0	4
No	39	76	115
Total	43	76	119
<i>Regular physical activity</i>			
Yes	26	41	67
No	17	35	52
Total	43	76	119

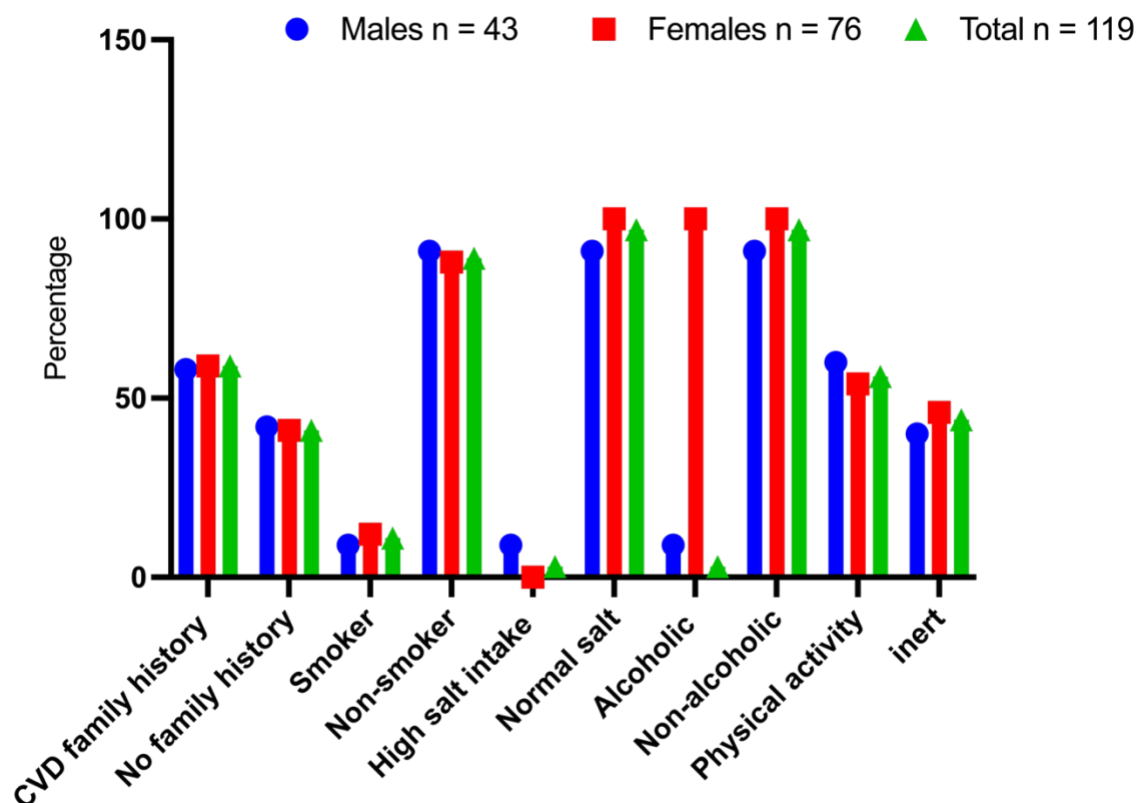


Figure 3. Depiction of the individuals' CVD risk factors and their sex.

Of the 88/119 (73.9%) individuals with CVD, the most commonly reported CVD risk factor is a positive family history of CVD, followed by physical inactivity, T2DM, and hypertension, with incidence rates of 58/88 (65.9%), 41 (46.5%), 29 (32.9%), and 28 (31.8%), respectively. T2DM is associated

with CVD, with an odds ratio (95% CI) of 1.281 (1.058-1.551) and a P-value of 0.024. The association of hypertension and CVD, with an odds ratio (95% CI) of 1.325 (1.103 - 1.591) and a P-value of 0.011. A positive family history of CVD is strongly linked to CVD, with an odds ratio (95% CI) of 1.353

(1.057-1.732) and a P-value of 0.008, as illustrated in Table 4 and Figure 4.

Table. 4 represents the relationship of people with and without CVD and the relevant CVD risk factors.

Variable	Individuals with CVD	Without CVD	Total
T2DM			
Yes	29	4	33
No	59	27	86
Total	88	31	119
Hypertension			
Yes	28	3	31
No	60	28	88
Total	88	31	119
Family history of CVD			
Yes	58	12	70
No	30	19	49
Total	88	31	119
Tobacco smoking			
Yes	13	0	13
No	75	31	106
Total	88	31	119
Regular physical activity			
Yes	47	20	67
No	41	11	52
Total	88	31	119

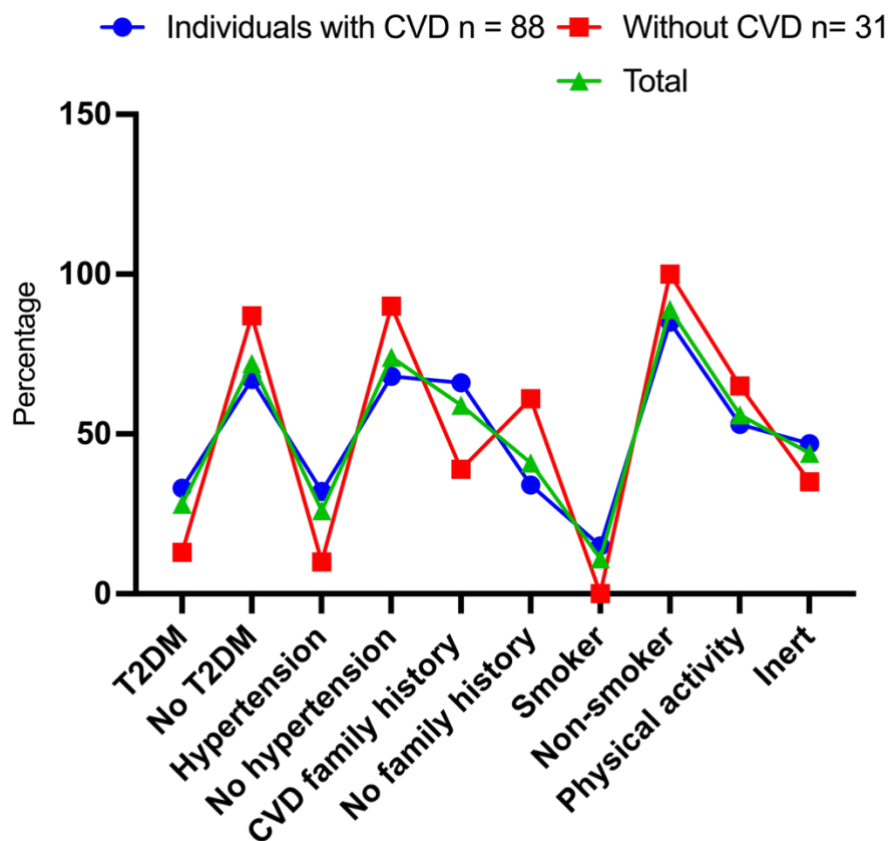


Figure 4 represents the relationship between people with and without CVD risk factors.

Discussion

Health service providers and the people of Sudan continue to face various challenges related to the high costs of treating different forms of CVDs and the associated serious complications. The ongoing 2023 devastating armed conflict, coupled with the rising number of refugees and the fragility of the existing health system, exacerbates the situation. This situation compounds the suffering, particularly in regions still affected by the war, especially in western Sudan. Moreover, efforts targeting the strategic prevention of this serious disease are cost-effective, notably in low-resource regions like Sudan. Therefore, the current research seeks to investigate CVD risk factors in this region of the country. The current study found that 31.8% of individuals with CVDs reported hypertension. Over 10 million deaths related to high blood pressure occur annually worldwide. This high mortality rate

is nearly preventable, with some interracial and geographical variations. Moreover, there are disparities across nations, particularly in low- and middle-income countries. These countries have the worst scenario concerning hypertension control and CVD mortality, which is four times higher in Black Americans than in white individuals. The disease affects both microvascular and macrovascular circulation throughout the body, but more importantly, the brain, heart, kidneys, and limbs. Early diagnosis and control of high blood pressure (BP) to the optimal values mentioned in the guidelines are crucial to preventing damage to these vital organs. In addition to prescribing medications, various lifestyle changes have been reported to help control BP and reduce CVD mortality. These include optimal body mass index (BMI), a healthy diet with more fruits and vegetables,

high dietary fiber besides reduced dietary salt, and maintaining healthy lifestyles (smoking, alcohol consumption, and sedentary behaviour). These measures were reported to reduce the risk of CVD by up to 30% [10-13].

T2DM was seen in 32.9% of the CVD patients in this study. Previous research demonstrated the importance of controlling multiple risk factors, like T2DM and other traditional CVD risk factors, with some studies reporting a reduction of CVD risk events by $\geq 50\%$; however, only $\leq 20\%$ reach the optimal target. T2DM is ranked among the top of these risk factors and sometimes is regarded as a CVD risk equivalent. The disease is quiescent for a time in some individuals, and occasionally the first presentation will be with target organ damage, loss of more than 50% of the B-cells of the pancreas, and consequently established CVD. These findings highlight the importance of early detection of T2DM, obesity, and CVDs, which share overlapping pathophysiological features, particularly low-grade chronic inflammatory processes, oxidative tissue stress, and gastrointestinal microbiota dysbiosis. Galectin-4 (Gal-4), which is one of the B-galactoside-binding lectin family, is highly expressed in the gut and emerges as a marker that is elevated in diabetes, obesity, and CVDs, as it has a role in epithelial integrity, inflammatory signalling, and various metabolic regulations. Although the role of Gal-4 is demonstrated in cancer and inflammatory conditions, its role in cardiometabolic disorders needs to be clarified. Recent research demonstrated the emergence of novel drugs that combined the efficacy of metabolic control with established cardiovascular benefits for individuals with T2DM; these include glucagon-like peptide 1 receptor agonists (GLP-1RAs) and sodium-glucose cotransporter 2 inhibitors (SGLT 2is), which exhibited comparable cardiovascular and cardiometabolic renal benefits [14-16].

In the current research, physical inactivity was observed in 46.5%. The recent European Society of Cardiology 2026 guidelines endorse regular exercise training and

cardiac rehabilitation as essential components of cardiovascular health. Adopting the current physical activity guidelines concerning the suitable exercise dose has been associated with a reduction in the risk of CVDs and mortality. Moreover, the role of regular exercise extends to involve both primary and secondary prevention of CVDs and the related traditional and nontraditional CVD risk factors. The benefits of regular exercise training result directly from physiological adaptations that improve the fitness of the cardiopulmonary system, which occur alongside beneficial changes in the vascular system and skeletal muscles. Research has demonstrated the effect of regular exercise as the dominant strategy in the reduction of the CVD risk linked to increased age. Regular exercise improves vascular endothelial function by reducing reactive oxygen species (ROS) and increasing levels of the vasodilatory molecule nitric oxide, while also enhancing mitochondrial function, homeostasis, and the stress response, all of which are direct consequences of an aging vascular system [17-21].

In this series, 58.8% of participants reported a positive family history of CVDs. Risk assessment tools to assess the various inherited and familial CVDs have been adopted to screen relatives with serious CVDs, notably those with sudden cardiac death presentations. Expert-based family criteria to screen the relatives of people with CVDs at a young age by clinical professionals were established. The criteria include sudden death, any CVD, implantable cardioverter-defibrillator, aortic aneurysm, and inherited CVD in one or more close relatives. Research demonstrated high diagnostic accuracy when applying these criteria, particularly among high-risk people. Assessment of family history is very crucial for the prediction of future CVD and T2DM. It helps in the early identification of risk factors, allowing for the timely adoption of lifestyle modifications before the onset of many chronic diseases [22-24].

Limitations: The limitations are a small sample size and a brief study timeframe, so the findings may not be widely generalizable.

In conclusion, the most prevalent CVD risk factors in Western Sudan are a positive family history of CVDs, T2DM, and hypertension. These findings mandate substantial efforts toward adopting protocols for the early screening of at-risk families, as well as timely diagnosis and management of CVD risk factors.

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Ethical Approval: The Prof. Medical Research Consultancy Center's Human Research Ethics Committee (HREC) has approved the study proposal. Approval #: HREC 0020/MRCC.7/25

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Author contributions:

All authors approved the final version of the publishable manuscript.

Hassan MO: Concept and design, acquisition, analysis, or interpretation of the data, and drafting of the manuscript. **Mohammed AKY:** Critical review of the manuscript for important intellectual content. **Hamid NA:** Drafting of the manuscript. **Salem, GA:** Analysis or interpretation of the data, drafting of the manuscript. **Humida EHM:** Supervision, concept and design, drafting of the manuscript.

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