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Original Article

Blood pressure control, glycemic control, and dyslipidemia among healthy adults in the Cape Coast metropolis, Ghana

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ABSTRACT

Background: The World Health Organization recommends the implementation of interventions focused on the early detection of clinical risk factors for cardiovascular disease (CVD) as effective strategies for the control of CVD in low resource settings. However, due to health system resource constraints, surveillance capacity for the identification of high-risk populations for non-communicable diseases, including CVD have been inadequate. The purpose of this study was to describe the prevalence of CVD clinical risk factors among healthy adults residing in the Cape Coast metropolis of Ghana. The clinical risk factors assessed included glycemic control, insulin sensitivity, lipid control and blood pressure.

Methods: The study participants included 70 healthy adults without a previous diagnosis of CVD from Cape Coast metropolis. Blood samples, blood pressure and anthropometric measurement were obtained for each participant. Serum glycated hemoglobin (HbA1c), insulin, glucose, triglycerides, and cholesterol levels were measured.

Results: Approximately four out of ten participants were either overweight or obese. Almost three-quarters of the sample were considered prehypertensive or hypertensive. About three in ten were clinically prediabetic. About a third of the participants had high non-HDL cholesterol levels. Triglyceride concentration levels were found to be high in almost 10 percent of the study sample. Approximately six percent were identified as having metabolic syndrome.

Conclusion: A significant proportion of the study participants were identified to be at risk for CVD. There is the need for adaptive and less resource-intensive CVD risk-factor screening interventions to allow for the timely detection and management of CVD risk factors in low-resource settings.

1. Introduction

Cardiovascular disease (CVD) is the leading cause of death globally, accounting for more than 15 million deaths annually [1–3]. Nearly eight out of ten deaths due to cardiovascular problems occur in low or middle-income countries [3]. Between 1990 and 2013, Western sub-Saharan Africa remained the only region of the world where age-specific CVD death rates increased, after isolating the effects of aging and growth of the population [2]. In Ghana, a West African country, it is estimated that CVD accounts for one-fifth of all deaths [4].

The clinical risk factors for CVD include hypertension, diabetes, and hyperlipidemia [5–7]. Other highly prevalent diseases in developing countries, such as Chagas heart disease (CHD), malaria and human immunodeficiency virus (HIV) may also increase the risk for CVD [8,9]. Behavioral risk factors for CVD include poor diet (including high salt intake and low intake of fruits and vegetables), tobacco use, alcohol use and physical inactivity [10–14].

The WHO recommends the implementation of population-wide interventions targeted at behavior change and individual-level interventions focused on the early detection of clinical risk factors for CVD as effective strategies for the control of CVD in low resource settings [3]. However, due to health system resource constraints, CVD detection, management and control efforts in sub-Saharan

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African have been limited [15]. In addition, surveillance capacity for the identification of high-risk populations for non-communicable diseases, including CVD has been inadequate [16].

The purpose of this study was to describe the prevalence of CVD clinical risk factors among healthy individuals who have not previously been diagnosed with CVD within the Cape Coast metropolis of Ghana, a western sub-Saharan African nation. The clinical risk factors assessed included glycemic control, insulin sensitivity, lipid control, and blood pressure control.

2. Methods

2.1. Study sample

The study sample included 70 healthy adults selected by a lottery system from 482 individuals who had previously completed a General Health Survey conducted by the research team. The General Health Survey obtained information on demographic conditions as well as health conditions, including diabetes, heart disease, and stroke. Eligibility for this present study was restricted to participants who were not previously diagnosed with CVD. Because researchers were also interested in assessing the prevalence of prediabetes and undiagnosed diabetes, participation in this phase of the study was further restricted to individuals without a history of diabetes. Selected individuals were then contacted for their consent to participate. Where a person declined, another participant was selected from the larger pool of 482 participants and contacted for consent. The participants from the larger sample were drawn from the Cape Coast metropolis in the Central Region of Ghana (including the city of Cape Coast and surrounding villages/townships of Abura, Akotokyir, Amamoma, Amisano, Ankaful Village, Kakumdo, Ola, and Pedu). These participants were recruited from public spaces such as markets, mosques, and churches. The larger study sample has been previously described elsewhere (Masked citation) [17]. The Institutional Review Board (IRB) at Georgia Southern University (GSU) – I16167 and University of Cape Coast (UCC) – UCCIRB/EXT/2016/02 both approved the study.

2.2. Anthropometric and blood pressure measurements

Weight and height were measured to the nearest 0.1 kg (kg) and 0.1 cm (cm) respectively, and in light clothing without footwear. Weight was measured by an electronic scale (Smart Weigh Scale, China) capable of determining the body mass index (BMI) and body composition. Height measurement was done by a wall-mounted stadiometer. BMI was computed as the ratio of weight in kilograms (kg) to the square of height in meters.

Blood pressure and heart rate were measured in triplicates by an automatic digital blood pressure monitor (Model MS-700AMI, Mars Medical Products Company Limited, China) on the right arm of respondents in sitting position and after at least 5 min resting intervals. The average of the three measurements was recorded for each respondent.

2.3. Biochemical measurements of HbA1c, triglycerides, and non-HDL cholesterol

Glycated hemoglobin (HbA1c), insulin, glucose, triglycerides and non-HDL cholesterol were measured in the serum of study volunteers. HbA1c was measured via commercially ELISA (enzyme-linked immunosorbent assay) kits following manufacturer's instructions (Crystal Chem, Inc., USA). (HbA1c Assay Kit#80099; Insulin kit#90095). Briefly, samples were bound to immobilized antibodies on plate wells, followed by the removal of unbound materials through washing steps in accordance with instructions from the manufacturer. The levels of the appropriate biomarkers were determined after addition of a chromogen and subsequent reading on a microplate reader at the appropriate wavelength using the chemwell microplate reader (Chemwell awareness technology Inc., model 2910). Similarly, HDL Cholesterol (#203 M), triglycerides (#TR210 M) and non-HDL cholesterol (#CH200 M), were analyzed on an automated clinical analyzer (Chemwell awareness technology Inc., model 2910) following the kit insert directions provided by Randox Laboratories, County Antrim, UK.

Results from biochemical measurements were used to assess the proportion of participants with high blood pressure, poor glycemic control, insulin sensitivity, dyslipidemia and metabolic syndrome.

2.4. Blood pressure (BP) screening

Normal BP range was defined as a systolic blood pressure below 120 and a diastolic blood pressure below 80. Individuals were classified as prehypertensive if they recorded a systolic blood pressure between 120 and 139 mmHg and/or a diastolic blood pressure of 80–89 mmHg. Individuals were classified as hypertensive if they recorded a systolic blood pressure of 140 mmHg and more and/or a diastolic blood pressure of 90 mmHg and more [18].

2.5. Glycemic control

Glycemic control was evaluated using HbA1c and fasting plasma glucose (FPG) measurements. Prediabetes was defined as impaired fasting glucose (FPG levels of 100–125 mg/dL) and or HbA1c levels of 5.7–6.4%[19]. The combined use of HbA1c and FPG in defining prediabetes results in superior sensitivity, compared to the use of either test alone [19].

2.6. Insulin sensitivity

Insulin sensitivity was evaluated based on the Homeostatic Model Assessment (HOMA), using the HOMA of insulin resistance index (HOMA-IR) and the HOMA of beta-cell function index (HOMA-B), previously described [20]. HOMA-IR and HOMA-B are considered good proxy measures for insulin resistance and beta-cell dysfunction, respectively [20]. Insulin resistance and beta-cell dysfunction have been associated with type 2 diabetes [21].

2.7. Dyslipidemia

High-density lipoprotein (HDL) and low-density-lipoprotein (LDL) are cholesterol transporting proteins, and their levels can be good indicators of risk for CVD. High levels of LDL are associated with higher risk for CVD, while high levels of HDL (good cholesterol) are associated with lower risk for CVD. Thus high levels of non-HDL cholesterol (i.e., total cholesterol – HDL cholesterol) place individuals at a higher risk for CVD. Another dyslipidemia parameter measured was triglycerides. Most measured triglycerides within an individual are dietary-derived. Dyslipidemia was evaluated based on non-HDL cholesterol and triglyceride levels as follows:

- Triglycerides:Normal (<150 mg/dL); Borderline High (150–199 mg/dL) and; High (200 mg/dL and above)
- Non-HDL Cholesterol: Normal (less than 130 mg/dL); High (130 mg/dL and above)

2.8. Metabolic syndrome

Metabolic syndrome is the name applied to a group of risk factors that increases the risk for heart diseases, diabetes and stroke among other maladies [22]. Based on the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria [23], individuals were categorized as having metabolic syndrome if they met at least three out of the following criteria: (1) triglyceride level of 150 mg/dL or higher (2) high-density lipoprotein less than 40 mg/dL (men) or less than 50 mg/dL (women), (3) blood pressure of 130/85 mm Hg or higher and (4) fasting blood sugar of 100 mg/dL or higher [23]. The NCEP ATP III includes a fifth criterion on central obesity – waist circumference: > 40 inches (for males) or > 35 inches (for females). However, waist circumference information was not available for this study.

2.9. Statistical analysis

Data were analyzed using descriptive statistics, including frequencies, means, and standard deviations. Mean comparisons were made using independent *t*-test. All data management and statistical analyses were completed in Stata 14.

3. Results

3.1. Demographic characteristics

Majority of the study participants were male (60.0%), married (64.3%) from rural areas (88.6%), with less than secondary school education (40.0%), employed (91.4%), insured (97.1%), reporting good to excellent health (77.1%) and of normal body weight (54.3%). None of the participants had a known history of diabetes, heart disease, cancer or depression. A few had been previously diagnosed with hypertension (8.6%), chronic lung disease, asthma or chronic bronchitis (4.3%), arthritis or rheumatism (2.9%) and sickle cell disease (2.9%) (Table 1).

3.2. Blood pressure (BP) screening

Tables 2 and 3 summarize results of the biochemical measurements. The average systolic and diastolic blood pressure readings were 126.3 mmHg and 80.3 mmHg, respectively. Blood pressure reading of participants ranged between 101 to 170 mmHg for systolic blood pressure and 55–114 mmHg for diastolic blood pressure. Systolic and diastolic blood pressure were not found to vary by gender or age (Table 2).

Among participants with a known history of hypertension (N = 6), only 33.3% had blood pressure in the controlled range (systolic blood pressure less than 140 mmHg and diastolic blood pressure less than 90 mmHg). Among participants without a known history of hypertension (N = 64), approximately 30% were normotensive, 52% were prehypertensive, and 19% were hypertensive.

3.3. Glycemic control

The average HbA1c and fasting plasma glucose levels were 5.0% and 96.4 mg/dL, respectively. HbA1c values ranged from 3.7 to 6.9%, while glucose levels ranged from 77 to 162 mg/dL. The mean glucose values did not differ based on age or gender. However, HbA1c was found to be higher for women, compared to men (5.2% vs. 4.9%; p = 0.05) (Table 2).

About a third (31.4%) were classified as prediabetic, and 4.3% were clinically diabetic. Approximately two-thirds (64.3%) of participants were non-diabetic (Table 3).

3.4. Insulin sensitivity

The average insulin level, HOMA-IR and HOMA-B values were 15.1 (range = 1.2–40.6), 3.6 (range = 0.3–10.0) and 175.1 (range – 12.7–435.3), respectively. These values did not differ significantly based on gender. However, insulin (20.2 vs. 14.4 ng/ml; p = 0.087) and HOMA-IR (4.9 vs. 3.4; p = 0.091) values were found to be higher for adults 50 years and older, compared to those under 50 years (Table 2).

3.5. Dyslipidemia

The average LDL and HDL values for participants were 103.8 and 72.0 mg/dL, respectively. The LDL of participants ranged between 28.4 and 339.1 mg/dL. HDL levels ranged between 33.2 and 118.4 mg/dL. The total cholesterol and non-HDL cholesterol values were 190.7 (range = 116.9–262.5) and 118.7 (range = 46.5–208.6), respectively. The average LDL and HDL levels did not vary by age or gender. However, total cholesterol (202.2 vs. 183.0; p = 0.02) and non-HDL cholesterol levels (128.3 vs. 112.3; p = 0.077) were found to be higher in women, compared to men (Table 2).

Approximately 45% of participants had LDL levels higher than 100mgdl. Only 2.86% of the study participants had low HDL levels (<40 mg/dL for men and <50 mg/dL for women). Non-HDL cholesterol levels were normal in 63% or participants, while 37% had non-HDL cholesterol levels greater than 130 mg/dL (i.e., dyslipidemia) (Table 3).

The average triglyceride value was 100.0 (range = 15.1–552.5) and was not found to vary by age and gender (Table 2). Triglyceride levels were normal in 90% of the subjects while 10% recorded borderline high to high values (Table 3).

3.6. Metabolic syndrome

Five point seven percent of the study sample were identified as having metabolic syndrome (i.e., met at least 3 of the four evaluated criteria) (Table 3). About a third (37.1%) met none of the four criteria for metabolic syndrome; 44.3% met one criterion, and 12.9% met two of the four criteria.

4. Discussion

The present study examined clinical risk factors for CVD in a sample of healthy adults, in the Cape Coast metropolis of Ghana, who had not been previously diagnosed with the disease. A relatively high proportion of the sample was considered at risk for CVD. Half of the sample without a known history of hypertension were clinically classified as prehypertensive and two out of ten were hypertensive. Three in ten were clinically prediabetic. About a third of the sample had high non-HDL cholesterol levels, and triglyceride concentration levels were found to be high in almost 10 percent of the sample. Further, approximately six percent were identified as having metabolic syndrome.

4.1. Blood pressure control

Hypertension is the most common risk factor for the development of CVD in Ghana [24]. It is a major public health problem in Ghana with an estimated prevalence between 19 – 55%, depending on geographic location [25–28]. In Ghana, only a third of adults with hypertension are aware of their condition [26,27]. In this study, only a quarter of participants with hypertension were aware of their condition. Among those who were aware of their condition, only a third had their blood pressure in the controlled range. The findings from this study revealed an even higher prevalence of

Table 1
Demographic characteristics.

	N	%/Mean (S.D)
Gender		
Male	42	60.0
Female	28	40.0
Age (Mean)	70	38.2 (10.2)
Location of Residence		
City	8	11.4
Other	62	88.6
Education		
Less than Secondary School	28	40.0
Secondary School/Technical/Vocational School	19	27.1
Post-Secondary Education, Other than University	3	4.3
College Graduate or Advanced Degree	20	28.6
Marital Status		
Married	45	64.3
Living Together/Informal/Consensual Union	6	8.6
Widowed	1	1.4
Divorced	4	5.7
Separated	2	2.9
Single	12	17.1
Employment Status		
Employed	64	91.4
Other	6	8.6
Perceived Health Status		
Excellent	5	7.1
Very Good	24	34.3
Good	25	35.7
Fair	12	17.1
Poor	4	5.7
Health Insurance		
Yes	68	97.1
No	2	2.9
Body Mass Index (BMI)		
Underweight (BMI < 18.5)	1	1.4
Normal Weight (18.5 − 24.9)	38	54.3
Overweight (25.0 -29.9)	24	34.3
Obese (BMI > 30)	7	10.0
Diagnosed Chronic Conditions (select all that apply)		
Heart Conditions such as congestive heart failure or heart attack	0	0.0%
Diabetes	0	0.0%
Depression or Anxiety Disorder	0	0.0%
Cancer	0	0.0%
Hypertension	6	8.6%
Chronic Lung Disease, Asthma or Chronic Bronchitis	3	4.3%
Arthritis or Rheumatism	2	2.9%
Sickle Cell Disease	2	2.9%

Note: Percentages may not add up to 100 due to rounding. S.D = Standard Deviation.

prehypertension, with over half of participants without a known history of hypertension being classified as clinically pre-hypertensive. It is noteworthy that while past studies have attempted to evaluate the prevalence of and risk factors for hypertension in Ghana, very few have focused on prehypertension. The lack of such studies represent a missed opportunity for early detection and targeted disease risk minimization interventions.

Within the Ghanaian context, factors found to be associated with hypertension include overweight/obesity, male gender, old age, urban residency and alcohol consumptions [26]. Given the high cost associated with the treatment of hypertension, the recommended strategies for the control of hypertension in low-resource settings include low-cost interventions focused on increasing population awareness on the need for reducing salt intake, increasing physical activity and eating a proper diet [26,27]. However, despite the high and increasing prevalence of hypertension in Ghana, there is a low level of population awareness of the disease, and the impact of control efforts so far have been minimal [25]. The findings of this study and several other studies highlight an urgent need for early detection strategies and effective population-based strategies targeted at reducing the prevalence of hypertension in the country.

4.2. Glycemic control

Research shows that individuals diagnosed with diabetes have an increased risk for CVD (Mannucci et al., 2013) [29]. Hyperglycemia, a condition of abnormally high blood glucose levels is a hallmark of diabetes. Glycemic control, therefore, becomes critical for diabetes management. Of particular interest in this study was the estimation of the proportion of participants with prediabetes. As with pre-hypertension, less is known about the prevalence and determinants of prediabetes in Ghana. The few studies that have examined this have estimated the prevalence of prediabetes to be between 11% and 33%, with studies on rural populations reporting the lowest prevalence [30]. Among this study population without a known history of diabetes, the prevalence of prediabetes was found to be alarmingly high at 31%. Further, almost five percent were considered clinically diabetic. It is estimated that 5–10 percent of individuals with prediabetes develop type 2 diabetes every year and 70% of patients with prediabetes will develop type 2 diabetes in their lifetime [31]. Thus, strategies targeted at identifying and managing individuals at high risk for prediabetes may result in a decrease in the incidence of type 2 diabetes. Additional studies are, therefore, needed to characterize the risk factors for prediabetes comprehensively.

Table 2
Means levels of assessed biomarkers.

Biomarker	TOTAL		GENDER					AGE				
	All Participants (N = 70)		Males (N = 42)		Females (N = 28)			Under 50 years (N = 60)		50 years and older (N = 9)		
	Mean (S.D)	Range	Mean (S.D)	Range	Mean (S.D)	Range	p-value	Mean (S.D)	Range	Mean (S.D)	Range	p-value
Systolic Blood Pressure (mmHg)	126.3 (14.5)	101 170	126.7 (2.3)	101 170	125.7 (2.7)	101 158	N.S (14.4)	126.6 170	101 (15.6)	126.3 159	106	N.S
Diastolic Blood Pressure (mmHg)	80.3 (11.3)	55 114	80.3 (1.7)	62 114	80.4 (2.3)	55 106	N.S (11.0)	80.0 107	55 (14.2)	82.2 114	68	N.S
Glucose (mg/dL)	96.4 (11.6)	77 162	95.2 (1.4)	77 137	98.1 (2.7)	81 162	N.S (12.3)	96.1 162	77 (6.2)	99.0 108	89	N.S
HbA1c %	5.0 (0.7)	3.7 6.9	4.9 (0.1)	3.7 6.0	5.2 (0.1)	3.7 6.9	* (0.6)	5.0 6.1	3.7 (1.0)	5.1 6.9	3.7	N.S
Insulin (ng/mL)	15.1 (9.6)	1.2 40.6	14.0 (1.5)	1.2 40.6	16.8 (1.7)	3.3 33.7	N.S (8.8)	14.4 39.9	1.2 (13.6)	20.2 40.6	4.2	*
HOMA-IR	3.6 (2.4)	0.3 10.0	3.3 (0.4)	0.3 10.0	4.1 (0.4)	0.8 9.9	N.S (2.2)	3.4 9.9	0.3 (3.4)	4.9 10.0	1.1	*
HOMA-B	175.1 (114.8)	12.7 435.3	164.9 (17.8)	12.7 435.3	190.4 (21.7)	33.0 403.2	N.S (111.5)	169.3 435.3	12.7 (141.9)	211.8 396.0	36.0	N.S
Triglycerides (mg/dL)	100.0 (70.9)	15.1 552.5	95.1 (12.8)	15.1 552.5	107.3 (9.0)	27.5 192	N.S (73.9)	101.7 552.5	15.1 (48.6)	96.1 168.5	21.3	N.S
Total Cholesterol	190.7 (33.1)	116.9 262.5	183.0 (4.9)	116.9 256.1	202.2 (6.1)	133 .4 262.5	** (32.8)	189.4 261.8	116.9 (37.8)	196.5 262.5	145.6	N.S
LDL (mg/dL)	103.8 (44.5)	28.4 339.1	101.8 (7.8)	38.4 339.1	106.8 (6.4)	28.4 178.8	N.S (46.3)	103.9 339.1	28.4 (32.4)	99.2 145.5	68.6	N.S
HDL	72.0 (17.9)	33.2 118.4	70.7 (3.0)	33.2 118.4	73.9 (2.9)	33.2 112.3	N.S (18.3)	71.2 118.4	33.2 (15.6)	78.1 94.3	47.7	N.S
Non-HDL Cholesterol (Total Cholesterol − HDL)	118.7 (37.0)	46.5 208.6	112.3 (5.6)	56.6 199.0	128.3 (6.9)	46.5 208.6	* (37.3)	118.2 208.6	46.5 (38.3)	118.5 173.5	77.5	N.S

Notes: Age information was missing for 1 participant. S.D. = Standard Deviation; N.S = Not Significant at the $p < 0.10$ level. *$p < 0.10$; **$p < 0.0$.

Table 3
Results from biochemical measurements.

	(%)	95% Confidence Interval
Glycemic Control (N=70)		
HbA1c and FPG		
Normal (HbA1c: 4.0–5.6% and FPG: less than 100 mg/dL)	64.3	52.2–74.8
Prediabetic[a] (HbA1c: 5.7–6.4% and/or FPG: 100–125 mg/dL)	31.4	21.5–43.5
Diabetic (6.5% and above and/or FPG above 125 mg/dL)	4.3	1.3–12.8
Blood Pressure Control (N=70)		
Among Previously Diagnosed (N = 6)		
Controlled Hypertension (Systolic: below 140 mmHg and Diastolic: below 90 mmHg)	33.3	4.2–85.1
Uncontrolled Hypertension (Systolic: 140 mmHg and above or Diastolic: 90 mmHg and above)	66.7	14.9–95.8
Among Those Without Previous Diagnoses of Hypertension (N = 64)		
Normal (Systolic: below 120 mmHg and Diastolic: below 80 mmHg)	29.7	19.6–42.3
Prehypertensive (Systolic: 120–139 mmHg or Diastolic: 80–89 mmHg)	51.6	36.2–60.9
Hypertensive (Systolic: 140 mmHg and above or Diastolic: 90 mmHg and above)	18.8	10.8–30.5
Dyslipidemia (N=70)		
Triglycerides		
Normal (<150 mg/dL)	90.0	80.2–95.2
Borderline High (150–199 mg/dL)	8.6	3.8–18.1
High (200 mg/dL and above)	1.4	0.2–9.9
Non-HDL Cholesterol Level		
Normal (less than 130 mg/dL)	62.9	50.7–73.6
High (130 mg/dL and above)	37.1	26.4–49.3
Metabolic Syndrome[b] (N=70)		
Yes	5.7	2.1–14.6
No	94.3	8.5–97.9

[a] Prediabetic group does not include individuals classified as diabetic based on either HbA1c or FPG.
[b] Individuals were categorized as having metabolic syndrome if they met three or more of the following criteria: (1) triglyceride level of 150 mg/dL or higher (2) high-density lipoprotein less than 40 mg/dL (men) or less than 50 mg/dL (women), (3) blood pressure of 130/85 mm Hg or higher and (4) fasting blood sugar of 100 mg/dL or higher. **Note**: Percentages may not add up to 100 due to rounding.

4.3. Lipid control and metabolic syndrome

A significant proportion of the study's sample had abnormal lipid (non-HDL cholesterol and triglyceride) levels, and approximately four out of ten (44.3%) were either overweight or obese. In a recent study, Ofori-Asenso et al. [9], estimated the prevalence rate of overweight or obesity in Ghana to be 43%. The high prevalence of dyslipidemia found in this study is consistent with findings from previous studies in other regions of Ghana [32,33]. Further, approximately 6 percent of the study sample were classified as having metabolic syndrome. The incidence of metabolic syndrome has been increasing in Africa and is largely driven by obesity and dyslipidemia, both risk factors for CVD[5]. In a meta-analysis, Ofori-Asenso et al. [9], estimated the prevalence of the metabolic

syndrome among seemingly healthy Ghanaians to be between 6.0 – 21.2% depending on the guidelines adhered to for defining metabolic syndrome. In using the NCEP-ATP guideline, as was used in this study, the authors estimated the prevalence of metabolic syndrome to be 12.4%., higher than estimated in this study. Notably, the lack of waist circumference data in defining metabolic syndrome may have resulted in an underestimation of the prevalence of metabolic syndrome in the study sample.

There are some noteworthy limitations of this study. This was an exploratory, descriptive study of a convenient sample of 70 healthy adults in one metropolitan area in Ghana. Due to the small sample size, the study did not have enough power to detect small differences. Additionally, the study's findings cannot be generalized beyond the study population. Despite these limitations, this study can serve as a foundation for additional population-based studies aimed at identifying high-risk populations for CVD.

5. Conclusion

A high proportion of the study population was found to be at risk for CVD. Notably, a higher proportion of women were classified as having dyslipidemia, an important risk factor for CVD. There is the need for adaptive and less resource-intensive CVD risk-factor screening interventions to allow for the timely detection and management of CVD risk factors in low-resource settings.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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