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The spectrum of computed tomography calcium scoring values of individuals testing for coronary artery disease in Accra: a study from a peripheral private clinic in Southern Ghana

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Abstract

Background: Coronary artery disease is a significant cause of morbidity and mortality globally. Most people with coronary artery disease are asymptomatic, making its early detection with coronary artery calcium scoring using multidetector computed tomography an important aspect of its management.

Objective: Our study aimed to describe the spectrum of computed tomography findings (such as the absolute coronary artery calcium scores and coronary artery risk percentiles) and associated risk factors of 325 patients evaluated for coronary artery disease in Accra.

Methods: The study was a retrospective study involving retrieving electronically stored coronary artery calcium score reports for 325 patients reported by two radiologists. Patient information, including weight, blood pressure, and a history of diabetes mellitus and hypertension, were recorded. Data were analysed using Statistical Package for the Social Sciences version 23.

Results: There were 62.2% (n = 202) males and 37.8% (n = 123) females. Of the total number, 44.6% (n = 145) had a normal coronary artery calcium score of 0, while 55.4% (n = 180) had values ranging from 1 to 2,690 (mean 109.0 ± 325.4). The two most prevalent modifiable risk factors for coronary artery disease recorded for individuals with coronary artery calcium score above 0 were an abnormality of weight (overweight and obesity) and hypertension in decreasing order. A significant relationship was observed between coronary artery calcium scoring and age (p = 0.001).

Conclusion: Our study showed that more than half of the participants had coronary artery calcification; abnormalities of weight followed by hypertension were the two commonest risk factors for CAD in Accra, and CAD occurred in individuals as young as 30 to 39 years old.

Keywords: Coronary artery calcium score, Coronary artery disease, Ghana,

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INTRODUCTION

The course of coronary artery disease (CAD) can be rapid and lead to coronary heart disease (CHD) presenting as acute myocardial infarction (MI), unstable angina and even death. Investigative tests like computed tomography (CT) and coronary artery calcium scoring (CACSn) are requested by clinicians to identify people at a high risk of experiencing a coronary event. The clinician can then advise the high-risk patient to adopt appropriate preventive measures to improve their prognosis [1].

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Ischaemic heart disease was the fifth most common cause of mortality among Ghanaians in 2019 [2]. CHD can present as sudden death in about half of all asymptomatic patients [3]. In developed countries like the USA, 75% of patients with myocardial ischaemia are asymptomatic, forming the commonest presentation for CAD [4]. Two to 4% of asymptomatic, middle-aged men are expected to have significant coronary artery stenosis, with most of the individuals with coronary events exhibiting normal baseline electrocardiography (ECG) findings. In the presence of two or more CAD risk factors, the prevalence of coronary artery stenosis increases to 10% [1,5]. Screening, therefore, seems important for identifying asymptomatic people with CAD. More than three-quarters of deaths due to cardiovascular diseases (CVD) in 2016 occurred in low-and-middle-income countries, where people are often diagnosed late in the course of the disease and die at younger ages [6]. In Ghana, non-communicable diseases (NCD) were estimated to account for 43% of all deaths in 2016 [7]. Of these deaths due to NCD, CVD accounted for 19%. [7]. Generally, CVDs are associated with risk factors such as hypertension, diabetes, hyperlipidemia and weight abnormalities [6]. The primary prevention of CAD is most appropriate for patients with a relatively high risk for coronary artery-related heart disease [8]. Screening for CAD can be done by CACSn, using multidetector computed tomography (MDCT). The score can be interpreted either as an absolute coronary artery calcium score (CACS) value or as a coronary artery calcium risk percentile (CACRP) adjusted for patient ethnicity, age and gender. CACSn focuses on detecting subclinical atherosclerosis rather than severe stenosis. Calcifications in plaques are depicted as hyperdensities greater than 130 Hounsfield units and a size of at least 1mm^2. The calcifications could be colour-coded by the system manufacturers or users [9]. The CACS obtained is usually quantified using the Agatston score, stratified into five groups as follows: no evidence of CAD (0 calcium score), minimal (1 - 10), mild (11 - 100), moderate (101-400), and severe (> 400) [10]. Other quantification methods not so commonly used are systems for determining the volume of calcium [11] and the calcium mass score [12]. Coronary stenosis is unlikely in people with a calcium score from 0 to 100 but highly probable in those with calcium scores above 100 to 400. People with calcium scores greater than 400 have a greater than 90% chance of having at least one significant coronary artery stenosis. Calcified (stable) intimal plaques, which are evaluated during CT calcium scoring tests, usually occur with non-calcified (unstable) plaques. Non-calcified plaques have a propensity to rupture, thereby exposing their lipid core and causing coronary artery thrombosis [13]. CACS is, however, not considered an absolute test in predicting the risk for a life-threatening cardiac event such as a heart attack. This is because it is thought that the calcifications confer stability to the atherosclerotic plaques and, hence, may be associated with a lower risk of life-threatening cardiac events than non-calcified plaques [8]. A single Ghanaian study by Frimpong et al. outlined the calcium score characteristics of 170 individuals in the middle zone of Ghana [14]. Our study in the southern sector of Ghana seeks to add to the limited published studies of CT and CACS findings of Ghanaians in literature. We report retrospectively the findings, pertinent clinical history and recorded risk factors for CAD of 325 people who underwent calcium score assessment with MDCT at a private clinic in Accra.

MATERIALS AND METHODS

Study design and sites

This was a retrospective study which involved retrieving electronically stored radiology reports for 325 patients reported by two of the authors. The patients had been referred for CACSn at the Akai House Clinic in Accra from January 2020 to December 2021. Patient information, including age, sex, clinical history and indication for the exam, was retrieved and entered into a database for later analysis. Each patient's weight, height, and blood pressure were measured, and the CACS and CACSP were recorded for each patient. The CACS was stratified based on work done by Agatston et al. [10] as follows: no evidence of CAD (0 calcium score), mild (1 - 100), moderate (101 - 400), and severe (> 400). Additional information regarding tobacco use and diabetes was obtained before examination and recorded. The CACSn examination was conducted with a 64-slice General Electric (GE) lightspeed series, VCT model, and CT machine (Milwaukee, Wisconsin, USA). The scanning method involved a non-contrast scan with prospective ECG-gated at 0.35 seconds. CT scan images of 2.5 mm thickness were obtained from the aortic root to the inferior cardiac wall (during an inspiratory breath hold) at a 00 gantry angle and 120 kVp. The images are usually acquired in mid/late diastole. Image interpretation was then made with 3 mm axial reconstructions, and CACSs were generated on a GE Advantage Workstation using the GE CardiQ Xpresstm 2.0 program. Calcifications were colour-coded as green by default. Selective colour coding based on coronary arteries involved was as follows: left main artery-blue, left anterior descending artery-purple, left circumflex artery-yellow, right coronary artery-red and posterior descending artery-mauve (Figure 1).

Sampling size and sampling Technique

All adult, non-Caucasian patients with Ghanaian nationality referred for CACSn for any reason were included in the study. Caucasians and non-Ghanaians of African descent were excluded from the study.

Data analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 23. Before the analysis, data were entered into a Microsoft Excel 2016 spreadsheet and later transferred into the SPSS for analysis. Descriptive statistics (means, percentages, and frequencies) were generated. A Shapiro-Wilk test was used to test for the normality of the data. Since the data variables were not normally distributed, an Independent Sample Mann-Whiney U test was used to compare CASC parameters among gender categories and age groupings (≤ 50 years and above 50 years). Moreover, Spearman's correlation coefficient test was conducted to find the relationship between CACS and CACSP and the various patient characteristics such as weight (kg), height (cm), body mass index (BMI) and a systolic component of blood pressure (BP).

RESULTS

A total of 325 data sets were used in this study. About 62.2% (n = 202) were males, while 37.8% (n = 123) were females. The mean age for the study population was 58.4 ± 11.5 years, with a minimum age of 18 years and a maximum of 86 years. The age group with the highest frequency of 34.2% (n = 111) were patients between 50 - 59 years. Of the total number of patients, 44.6% (n =145) had a normal CACS value of 0, while 55.4% (n = 180) had CACS values ranging from 1 - 2690 (mean 109.0 ± 325.4). Patients with CACS values > 1 were 180, 125 patients had values ranging from 1 - 100 (mild), 33 patients had CACS values > 100 - 400 (moderate), and 22 patients had CACS values > 400 (severe). In this study, five females and 17 males, representing 4.1% and 8.4% of female and male participants, had CACS values greater than 400. The highest score of 2690, which was the only CACS value > 2000, occurred in a female. The CACS values obtained from our study in the people with (mean 115.0 ± 342.1) or without (mean 100.8 ± 315.1) diabetes did not differ significantly (p = 0.163). The CACS categories observed in the study and their distribution between genders and age groups are presented in Tables 1 and 2. Table 1 shows the calcium scoring values recorded in males and females. The calcium scoring values were stratified as described by Agatston et al. [10] into the following groups: 0, 1 - 100, 101 - 400, 401 - 1000, 1001 - 2000, > 2000. Table 2 shows the calcium score values seen in the different age groups. The table shows that the 50 – 59-year-olds were the group that underwent the most CACS procedures (34%, n = 111). Of this number, 52 had calcified coronary arteries.

Table 1: Gender distribution of Coronary artery calcium scoring (CACS) groups

CACS category	Sex		Total
	Male n (%)	Female n (%)	(Both gender) N (%)
0	85 (26.2)	60 (18.5)	145(44.6)
1-100	77(23.7)	48 (14.8)	125(38.5)
101-400	23(7.1)	10 (3.1)	33(10.2)
> 400-1000	8(2.5)	2 (0.6)	10(3.1)
1001-2000	9(2.8)	2 (0.6)	11(3.4)
> 2000	0(0)	1 (0.3)	1(0.3)

N = number, % = percentage

Table 2: Distribution of CACS with age groups

Age Range	CACS						Total
	0	1-100	101- 400	> 400 - 1000	1001 - 2000	> 2000	
<20	1	0	0	0	0	0	1
20-29	3	0	0	0	0	0	3
30-39	11	1	0	0	0	0	12
40-49	25	21	0	0	1	0	47
50-59	59	40	7	3	2	0	111
60-69	34	42	14	4	4	0	98
70-79	9	19	9	1	3	1	42
80-89	3	2	3	2	1	0	11
Total	145	125	33	10	11	1	325

CACS: coronary artery calcium score

Table 3: Descriptive statistics of data variables.

	Minimum	Maximum	Mean	Std. Deviation
Age	18	86	58.4	11.5
CACS	0.0	2690.0	109.0	325.4
BMI	17.3	59.0	29.6	5.8
Weight (kg)	47.0	170.0	85.5	17.4
Height (cm)	135.0	197.0	169.0	9.6
CACSP (%)	10.0	90.0	47.8	23.6

CACSP - Coronary artery calcium score percentile; CACS: coronary artery calcium score; BMI: Body mass index

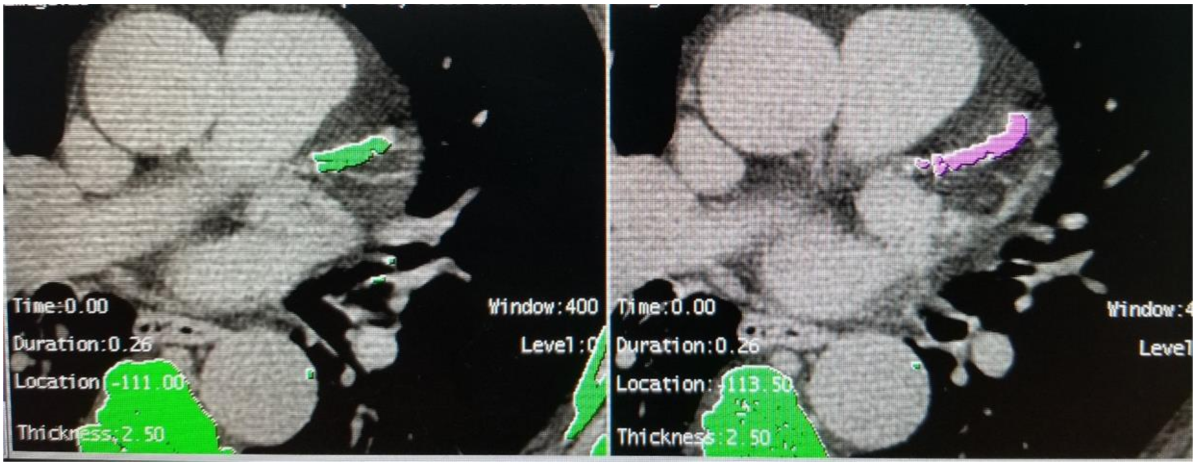

Figure 1. Colour coding of coronary artery calcification during calcium score evaluation. Two images of the same patient showing the left anterior descending artery are initially green in colour (image on the left), but appear purple in colour after coding (image on the right).

Table 4: Relationship between coronary artery calcium scoring (CACS) and patients' anthropometrics and systolic blood pressure

Variable	(CACS)	
	Rho	P value
Age	0.370	0.001*
CACSP (%)	0.267	0.001*
Weight (kg)	0.080	0.150
Height (cm)	- 0.011	0.843
BMI	0.091	0.103
BP	0.105	0.059

*Statistically significant; CACSP Coronary artery calcium score percentile; CACS: coronary artery calcium score; BMI: Body mass index; Rho: Spearman's rank correlation coefficient

Table 5: Relationship between CACSP and patients' anthropometrics and systolic blood pressure

Variable	CACSP	
	Rho	P value
Age	-0.368	0.001*
Weight (kg)	-0.055	0.320
Height (cm)	-0.151	0.006*
BMI	0.028	0.620
BP	-0.120	0.030*

*Statistically significant; CACSP: Coronary artery calcium score percentile; CACS: coronary artery calcium score; BMI: Body mass index; Rho: Spearman's rank correlation coefficient

Table 6: Comparative analyses of CACS among patient groupings.

Patient Groupings	Categories	Mean	P-value
Gender	Male	125.53	0.091
	Female	81.78	
Diabetes	Absent	109.58	0.163
	Present	85.30	
BP	Hypotension (<90/60)		0.264
	Normal (90/60 < 120/80)		
	Pre-HPT (120/80 – 139/89)	-	
	Stage 1 (140/90 – 159/99)		
	Stage 2 (160 /100 or more)		
BMI groups	Underweight (BMI < 18.5)		0.574
	Normal (BMI = 18.5 - 24.5)	-	
	Overweight (BMI = 25-29.9)		
	Obese (BMI = 30-35)		
	Severely Obese (BMI = 35-40)		
	Morbidly obese (40 and over)		

BMI: Body mass index; HPT: hypertension; BP: blood pressure; CACS: coronary artery calcium score; std= standard deviation

The 60 - 69 age group was the next with the largest number of participants and had the highest number (n = 64) of participants with calcified coronary arteries. Participants below the age of 30 years did not exhibit coronary artery calcifications. From the 30 - 39 to 70 - 79 age groups, the percentage of participants in each age group exhibiting coronary artery calcifications increased steadily as follows (30 – 39, 8.3%), (40 – 49, 44.7%), (50 – 59, 46.8%), (60 - 6 9, 65.3%), (70 – 79, 78.6%). A minimal decrease in the percentage to 72.7% was noted in the 80 - 89 age group. Table 3 shows the descriptive statistics regarding variables recorded in the study. The CACS ranged from 0 to 2690. The body mass index (BMI), coronary artery calcium score percentile, weight and height of participants were also recorded. Table 4 presents the relationship between CACS and patients' characteristics. Significant associations were observed between the coronary artery calcium score, participant age (p = 0.001) and coronary artery calcium score percentile (p = 0.001). One hundred and thirty-five patients were hypertensive, 31.1% (n = 42) of them with stage 2 hypertension. Of the hypertensive patients, 51.9% (n = 70) had CACS values between 1 and 400, 8.1% (n = 11) had CACS scores > 400, and 3.7% (n = 5) had scores > 1000. No significant statistical relationship existed between hypertension and CACS (p = 0.059). Weight, BMI and height also showed no statistically significant relationship. Table 5 shows how patients' characteristics relate to CACSP. Age, height and the systolic component of BP had statistically significant negative relationships with CACSP. BMI and weight had no statistically significant relationship with CACSP. Table 6 shows the comparative analysis of CASC between male and female participants, participants with and without diabetes, participants with different stages of hypertension, and participants falling in different BMI categories. No statistically significant relation was noted between CACS values and the different classes of hypertensives (p = 0.264) or among any of the remaining different groups shown in the table. The mean CACS for participants with and without diabetes was 85.30 and 109.58 (p = 0.163). There were 1.5% (n = 5) smokers; hence, the influence of tobacco use as a risk factor could not be included in the analysis on account of their small number. There were 13.8% (n = 45) of patients with diabetes. Ten of 45 diabetic patients (22.2%) and 2 of 5 smokers (40.0%) had CACS values > 100. One diabetic and one smoker each had CACS values > 1000. A little over a third (35.6%, n = 16) of the 45 diabetics had normal CACS values of 0, whereas only 1 (20.0%) of the five tobacco

Table 7: Comparative analyses of CACSP among patients' characteristics groupings.

Patients' Characteristics	Mean/std	P-value
Gender		
Male	43.02	0.001*
Female	55.65	
Diabetes		
Absent	48.59	0.153
Present	41.93	
BP		
Hypotension (<90/60)		0.194
Normal (90/60 < 120/80)		
Pre-HPT (120/80 – 139/89)	-	
Stage 1 (140/90 – 159/99)		
Stage 2 (160 /100 or more)		
BMI groups		
Underweight (BMI < 18.5)		0.802
Normal (BMI = 18.5 - 24.5)		
Overweight (BMI = 25 - 29.9)		
Obese (BMI = 30 - 35)	-	
Severely Obese (BMI = 35 - 40)		
Morbidly obese (40 and over)		

CACSP: Coronary artery calcium score percentile; BMI: Body mass index; HPT: hypertension; BP: blood pressure; std - standard deviation

Table 8: Frequency (n) of clinical history presented on patients' request forms and the corresponding observed CACS values.

History	CACS						Total
	0	1-100	101-400	>401-1000	1001-2000	>2000	
Screening	59	66	15	4	3	0	147
IHDX	18	19	9	2	5	1	54
HPT	5	5	4	0	0	0	14
Dyslipidemias	10	7	2	0	0	0	19
Chest pain	33	18	2	1	3	0	57
Paroxysmal atrial fibrillation	2	1	0	0	0	0	3
DM	3	1	0	0	0	0	4
HPT+DM	1	2	0	1	0	0	4
Asthmatic	1	0	0	0	0	0	1
HF	5	3	0	1	0	0	9
Palpitation	3	1	0	0	0	0	4
PE	2	0	1	0	0	0	3
HPT+Dyslipidemia+angina	1	1	0	0	0	0	2
HPT+dyslipidemia	2	1	0	1	0	0	4
Total	145	125	33	10	11	1	325

IHDX: ischaemic heart disease; HPT: hypertension; DM: diabetes mellitus; HF: heart failure; PE: pulmonary embolism.

users had a normal CACS value. Table 7 shows the comparative analysis of CACSP between male and female participants, participants with and without diabetes, participants with blood pressures presented at the different stages of hypertension, and participants falling in different BMI categories. There was a statistically significant difference between male and female participants (p = 0.001); no statistically significant differences were noted among any of the demographic groups displayed in the table. Table 8 lists the clinical histories recorded from the request forms of all study participants and their calcium scores (stratified according to the work of Agatston et al.). One hundred and forty-seven participants, accounting for 45.2% of the study population, were asymptomatic. Of this asymptomatic subset, 59.8% (n = 88) of participants had abnormal calcium score values, accounting for 27.1% of the total study population with abnormal calcium score values. Participants with a history of ischaemic heart disease (IHDX) and chest pain formed 11.1% and 7.4% of the study population with calcified coronary arteries. Patients with other histories represented less than 5% of the study population. Symptomatic patients formed the majority of the study participants (n = 178), 92 of whom had CACS values > 0. The inferential analysis further showed that those presenting with clinical symptoms or diagnoses (such as IHDX, hypertension (HTN), dyslipidemia, chest pain, and paroxysmal atrial fibrillation) had significantly higher coronary artery score percentiles than asymptomatic patients who presented for screening (p = 0.021). However, there was no statistically significant difference between the asymptomatic and symptomatic groups in terms of CACSP.

DISCUSSION

Our study was conducted in Accra, located in southern Ghana. We demonstrated that more than half of the patients examined with MDCT for coronary artery disease had abnormal values and that findings such as the modifiable risk factors for CAD, age and gender distribution of people found to have coronary artery calcifications, differed from existing data recorded from Kumasi located in the central part of Ghana [14]. Considering our findings, it may be useful to conduct a combined analysis of data from Accra and Kumasi to ascertain if there are similar CAD characteristics in patients in both regions. Even though the Framingham risk function was the first CVD risk prediction model developed from the Framingham Heart Study in the 1970s, the CACS is currently also recognised as an independent predictor of coronary heart disease events [15]. The relative risks associated with increasing CACS have been found to be comparable to those associated with established CHD risk factors. People with low CACS (1 - 100) have about twice the risk of CHD events (relative risk, 2.1) than people who have no evidence of coronary artery calcification. Individuals with very high CACS (> 400) are associated with very high relative risks (4.3 - 17.0) [8]. The presence of diabetes mellitus, tobacco use, extreme values of low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, or hypertension, on the other hand, confers a relative risk of approximately 1.5 to 3.4 [8]. The most common age group that presented for CACS in our study was the 50 – 59-year group, which differs by about 5 to 10 years more than the most common group presented in the study by Frimpong et al. [14]. This suggests that future screening programs to detect CAD in Accra would have to target a slightly older age group than similar screening programs conducted by Kumasi. Descriptive statistics of the data variables such as age, CACS, BMI, weight (kg), height (cm) and relative age and sex-specific strata (distribution percentiles in the general population) are presented in Tables 2 and 3. These show that a minority of individuals (44.6%, n = 145) in the study had CACS value of 0, while the majority of 55.4% (n = 180) had CACS values ranging from 1 to 2690 (mean 109.0 ± 325.4). The CACS obtained in this study support a review of data published by Greenland et al. [16] but contrast with data recorded by Frimpong et al. [14], which showed that 78.8% of patients had CACS of 0. In patients with a score > 0, 125 (38.5%), 33 (10.2%) and 22 (6.7%) had CACS values ranging from 1-100 (mild), > 100 - 400 (moderate) and > 400 (severe), respectively. The decreasing number of patients with increased CACSs follows the trend presented in available data. Data recorded by Frimpong et al. [14] showed that CACS values greater than 400 were recorded only in 3 males, with the highest calcium score of 692. No females in the Frimpong et al. study had calcium score values greater than 400, whereas five females in our study had CACS values greater than 400 [14].

Recent evidence has included a family history of premature CAD as an independent risk factor for future major cardiac events for a male first-degree relative less than 55 years old or a female first-degree relative less than 65 years old [9]. Risk factors assessed in our study were age, sex, weight, height, BMI, hypertension, diabetes and tobacco use. The most prevalent modifiable risk factor for CAD recorded in our study for individuals with CACS values above 0 was an abnormality of weight (overweight and obesity), followed by hypertension. This is in contrast to the study by Frimpong et al., where hypertension was the most prevalent risk factor, followed by overweight [14]. Our study showed no statistically significant relationship between CACS and BMI, weight, height and hypertension (BP) (Table 4). A significant relationship was noted with age, with most of the CACS values above 1000 being found in people aged 50 years or older (Table 2). Whereas CACS values above 100 were more common in patients aged between 60 - 70 years in our study, the study in the middle section of Ghana showed a slightly lower age range of 55 - 64 years. [14]. Our finding of coronary artery calcifications being more common in adults aged 40 years or more supports the findings of existing data worldwide [8,9,16]. In preventing CHD, therefore, it seems necessary to maintain a healthy weight and prevent or reduce the incidence of raised blood pressure by reducing risk factors associated with lifestyle activities, such as physical inactivity, high salt intake and harmful alcohol use [16,17]. Akosah et al. reported cholesterol management as an important risk factor considered in the United States of America (USA) as the cornerstone of primary prevention in CHD management [17]. A total-risk approach must be adopted, including early detection and cost-effective management of hypertension to prevent heart attacks, strokes and other complications [14]. A limitation of our study was that only 1.5% (n = 5) of study participants were smokers, hence the influence of tobacco use as a risk factor could not be included in the analysis due to the small number. Participants with diabetes were 13.8% (n = 45). Less than half of diabetics (22.2%) and smokers (40.0%) had CACS values > 100. A review of eight studies by Kramer et al. showed that diabetics with a CACS greater than 10 had an increased risk of cardiovascular events and mortality [18]. The CACS values obtained from our study participants with or without diabetes did not differ significantly (p = 0.163). This finding is in contrast with a review by Neves et al., which stated that the presence of any degree of CACS value in diabetics confers a higher risk of future coronary events than in non-diabetics [9].

The World Health Organization (WHO) encourages behavioural modification as one way of reducing CHDs, with the aim of achieving a 25% reduction in premature deaths attributable to non-communicable diseases (NCDs). WHO has therefore proposed an action plan that provides a road map policy options for all member states and other stakeholders to take coordinated and coherent actions at all levels to attain the nine voluntary global targets. The sixth target in the Global NCD action plan (Global Action Plan for Prevention and Control of NCDs 2013 - 2020) calls for a 25% reduction in the global prevalence of raised blood pressure (defined as systolic and diastolic blood pressure more than or equal to 140/90 mmHg), which is the leading risk factor for cardiovascular disease globally [19]. In contrast to the above, our study showed no significant statistical relationship between hypertension and CACS (p = 0.059), as shown in Table 4. No statistically significant relation was noted between CACS values and the different classes of hypertensives (p = 0.264) shown in Table 6. Within gender groups, our study showed a slightly higher percentage of CACS values > 0 in males (57.9%) compared to females (51.2%) than was recorded by Frimpong et al. [14]. This finding, however, is in support of Grech et al. [20], which state that the male gender is known to be associated with a higher risk of CAD. Our comparative analysis, however, exhibited no statistically significant gender difference in CACS values (p = 0.091), as shown in Table 6. Our study's findings exhibited significant relationships between the CACSP and age (p = 0.001), height (p = 0.006) and hypertension (p = 0.030) in Table 5. All three risk factors had negative Rho values, implying an inverse relationship with the percentile rank obtained. It is, however, unclear why patients within the same age group and of the same gender, increased blood pressure is associated with a decreasing percentile rank, as hypertension is known to be an important risk factor for coronary heart disease. A prior study by Detrano et al. [21] showed no significant differences in the CACS prediction scores between ethnic groups. To account for baseline ethnic group differences, they suggested that ethnic-specific calibration of CACS measures might be required [21]. Residents of different neighbourhoods in the USA who were Hispanic, Black, White, and Chinese-American were involved in the Multi-Ethnic Study of Atherosclerosis (MESA). It showed that CACS values varied by ethnicity, with Black men and Hispanic women having the lowest levels [22]. Our study included only non-caucasian participants and did not take note of the different ethnicity of participants. Another study may, therefore, be useful in determining if there are ethnic differences in the relationship between CACS and risk factors such as hypertension, obesity, diabetes and tobacco use [14]. Analyses of clinical histories on request forms presented to the radiology units showed that 45.2% of the study population was asymptomatic. Of this asymptomatic subset, more than half of the participants had abnormal calcium score values, accounting for 27.1% of the total study population. With more than 25% of the total participants being asymptomatic but having evidence of CAD, there may be a need for screening programs to detect these individuals for timely management. Timely treatment may, in turn, help to reduce the possibility of future heart attacks in some patients.

There is a scarcity of radiology facilities in resource-poor communities like Ghana. A recent study reported that there were only 35 authorised CT scanners in Ghana in 2007, of which only 28 were functional at the time of this study [23]. With recent additions, Ghana's 16 regions now have a total of 60 authorised CT scanners, serving a population of 31 million [24], with just three screening facilities for CACS evaluation. Because there are so few screening facilities and so few radiologists in Ghana (0.181 per 100,000 persons), coronary artery calcium screening has not yet had the expected impact in identifying those who are at risk for developing coronary artery disease (CAD) [25,26]. CACS is the gold standard when screening for coronary artery calcification, despite the fact that the cardiothoracic ratio calculated from plain chest radiographs is effective in the early diagnosis of cardiomegaly as a symptom of heart disease while allowing for gender and age discrimination [27,28]. However, a recent review of available data recommends that coronary artery testing for CAD should not be used as a universal screening tool, especially in people with low and high predicted risk for atherosclerotic cardiovascular disease (ASCVD). Coronary artery calcium screening is currently thought to be most effective when utilised in patients with intermediate or borderline risk for ASCVD [29]. Abdominal aortic calcification outperformed the Framingham risk score, according to a study by O'Connor SD et al. Hence, non-enhanced abdomen CT scanning used for illnesses unrelated to cardiovascular disease may soon be a helpful addition to CACS in predicting future cardiovascular events [30].

Conclusion

Our study reported the findings, pertinent clinical history and recorded risk factors for CAD of 325 people who underwent calcium score assessment with MDCT at a medical imaging facility in the southern Ghanaian city of Accra. Our study demonstrated three main findings: more than half of participants in Accra had coronary artery calcification, abnormalities of weight followed by hypertension were the two commonest risk factors for CAD in Accra, and CAD occurred in individuals as young as 30 to 39 years old. Awareness of these findings may impact the planning of future health preventive programs for addressing the public health issue posed by coronary heart disease in Ghana.

DECLARATIONS

Ethical considerations

Ethical approval was obtained from the Ethical Review Committee of Cape Coast Teaching Hospital (Approval ID No. CCTHERC/EC/2022/059), and clearance to conduct the study was also obtained from the various hospitals involved in the study.

Consent to publish

All authors agreed to the content of the final paper.

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Competing Interest

No conflict of interest was reported by the authors.

Author contributions

EKB, BOB, and BDS participated in the initial procedure design and acquisition of data. EKB, JA, EKME, PNG, and KDT participated in the procedure, data acquisition, analysis, and manuscript writing. All the authors read and approved the final draft of the manuscript.

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Availability of data

The data used for this article is available upon request to the corresponding author.

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