Cardiovascular Topics

Contemporary risk factors associated with ischaemic heart disease in central South Africa: a single-centre study

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Abstract

Background: Deaths from non-communicable diseases have increased in sub-Saharan Africa over the years, with limited data on coronary artery disease (CAD) and the risk factors thereof. The objective of this study was to investigate modifiable and non-modifiable risk factors in central South Africa in patients with CAD.

Methods: Patients with angiographically confirmed CAD who were evaluated in the catheterisation laboratory for the first time over a two-year period (2016–2017) were included. Data were extracted from the patients' medical records.

Results: Four hundred and eighty-two patients met the inclusion criteria, presenting at a mean age of 58.4 ± 10.8 years, and were predominantly male (66%). Females were significantly older than the males (60.3 ± 9.6 vs 57.4 ± 11.1 years; $p < 0.05$). The mean age at presentation was comparable between ethnic groups, except Asian patients who presented at a significantly younger age compared to Caucasians (49.8 ± 10.5 vs 59.1 ± 10.8 years; $p < 0.05$). Hypertension (91%) was the most common risk factor, followed by smoking (67%) and obesity (41%). Black Africans demonstrated a higher incidence of hypertension when compared to Caucasians (96 vs 87%; $p < 0.05$). Smoking was more prevalent in Caucasians than black Africans (68 vs 55%; $p < 0.05$) and occurred more commonly in males than females (73 vs 55%; $p < 0.05$). Most patients presented with acute coronary syndrome (ACS) (72%), mainly with ST-elevation myocardial infarction (STEMI) (36%). The majority of patients presenting with ACS were in the age group 51–60 years. The ACS risk-factor profile was similar to that of the total study group.

Conclusion: CAD was present in all ethnic groups, and modifiable and non-modifiable risk factors were similar to the classical risk factors described worldwide. Minor interracial differences were observed and hypertension was the most prevalent risk factor recorded in central South Africa. Most patients with CAD presented with ACS, particularly STEMI. Recognition of the risk factors associated with CAD would contribute to improved planning of healthcare systems and increased awareness of CAD.

Keywords: coronary artery disease, acute coronary syndrome, risk factors, modifiable risk factors, non-modifiable risk factors

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In 2010, middle- to low-income countries accounted for 80% of the global cardiovascular disease (CVD) burden.[1] In sub-Saharan Africa, CVD is responsible for 13% of all deaths and accounts for up to 37% of all non-communicable disease deaths, making CVD the leading cause of non-communicable disease deaths in sub-Saharan Africa.[2] Sub-Saharan Africa is home to the most significant proportion of the world's poorest individuals. Several countries in sub-Saharan Africa have reported an increase in the prevalence of CVD.[3]

Urbanisation of low- to middle-income countries, such as South Africa, as well as the transition to a more westernised lifestyle and diet, causes an increase in CVD prevalence, as well as an increase in the risk factors responsible for CVD.[4,5-8] This presents significant challenges to healthcare, as low- to medium-income countries are already overburdened by expenditure on nutrition and communicable diseases.

Established risk factors associated with CVD include non-modifiable [age, gender, ethnicity and family history of coronary artery disease (CAD)] and modifiable risk factors [hypertension, diabetes mellitus (DM), obesity and elevated low-density lipoprotein cholesterol (LDL-C) levels].[9] Modifiable risk factors, especially hypertension, are considered global epidemics and are of particular concern in sub-Saharan Africa, where they are still under-detected and under-diagnosed due to poverty and ignorance of disease.[10]

The INTERHEART Africa study indicated in 2005 that known risk factors are present in 90% of patients presenting with myocardial infarctions (MI) in sub-Saharan Africa.[11] However, recent data describing the prevalence of non-modifiable and modifiable risk factors causing CVD are unavailable for central South Africa. Published South African studies focus on acute myocardial infarctions (AMI) rather than CAD.[12-14] This study aimed to determine the current non-modifiable and modifiable risk factors in patients with established coronary artery atherosclerosis in central South Africa to highlight the need for preventative strategies.

Methods

A retrospective, descriptive, single-centre study was conducted describing the modifiable and non-modifiable risk factors for public sector patients. The study was conducted at the Universitas Academic Hospital in Bloemfontein, the only tertiary referral hospital in the central South African region, with a population of approximately 6.3 million. Patients are referred from the Free State and Northern Cape provinces and Lesotho.

Only patients with proven atherosclerotic CAD, confirmed by coronary angiography and presenting for the first time to the catheterisation laboratory between January 2016 and December 2017, were included in this study. Clinical symptoms and atherosclerosis leading to narrowing of the lumen in one or more of the major coronary arteries, reported by a qualified cardiologist, confirmed the presence of CAD. Patients with evidence of primary myocardial, muscular, valvular and congenital heart diseases were excluded. Ethnicity was self-identified and cross-referenced using the hospital identification system.

Patient data were captured from the patients' medical records and catheterisation laboratory reports and included demographic (age, gender, ethnicity and hospital classification), anthropometric [height, weight and body mass index (BMI)] and clinical data (clinical diagnosis and cardiac risk factors). BMI was calculated using the weight/height^2 formula.[4] Non-modifiable (age, gender, ethnicity and family history of CAD) and modifiable (hypertension, diabetes mellitus, smoking, obesity and hypercholesterolaemia) risk factors were recorded for each patient.

Hospital classification (H0–H4) was done according to the Western Cape Government-subsidised patients' 2019 website.[15] Hypertension was defined as systolic blood pressure > 140 mmHg and/or diastolic blood pressure > 90 mmHg.[16] Patients on antihypertensive treatment were also included.

Smoking refers to the use of any tobacco product as an inhalant, and both current and previous/ex-smokers were included. Patients were classified as obese if they had a BMI of ≥ 30 kg/m^2.[17] Type 1 and 2 diabetes mellitus was determined as specified in the patient's medical file and/or reference to diabetic medication in treatment.

For acute coronary syndrome (ACS), standard definitions were applied.[18] History of heart disease referred to any history of ischaemic heart disease in a first-degree relative.

Ethical approval was obtained from the Health Sciences Research Ethics Committee (HSREC) of the University of the Free State (UFS-HSD2019/1351/011001) and the Free State Department of Health.

Statistical analysis

Statistical analysis was done in collaboration with a biostatistician. Raw data were captured on an Excel spreadsheet and the *t*-test was used to compare normally distributed data. Non-parametric data were compared using the Mann–Whitney *U*-test. Where required, the chi-squared or Fisher's exact test was utilised for comparisons. Analysis was done using standard statistical analysis software. Statistical significance was noted if $p < 0.05$.

Results

Seven hundred and twenty-five patients met the inclusion criteria for this study. However, 243 patients had to be excluded due to incomplete records. The study group consisted of 482 patients who had complete clinical records.

Most patients were from the Free State (59%) and Northern Cape (37%) provinces, with only 4% from other provinces and Lesotho. More than half (57%) of the patients from the Free State were from rural areas outside the Mangaung metropolitan area. Ninety per cent ($n = 435$) of patients included in the study were from low-income groups (H0–H2).

Demographic data can be viewed in Table 1. The study population ($n = 482$) demonstrated a male preponderance (66%) and males were also significantly younger than females (57.4 ± 11.1 vs 60.3 ± 9.6 years; $p < 0.05$). Notably, atherosclerosis was observed in all ethnic groups, with Caucasians making up almost half (46%) of the total group, followed by 23% in mixed-race individuals and 24% in black Africans.

Compared to the rest of the group, Asian patients presented

Table 1. Non-modifiable cardiac risk factors of the study population

	First-time presenters with atherosclerotic disease (n = *482*)		
Parameters	*Number (%)*	*Age (years) mean ± SD*	p-*value (age)*
Gender			
Male	317 (65.8)	57.4 ± 11.1	0.01*
Female	162 (33.6)	60.3 ± 9.6	
Ethnicity			
Caucasian	223 (46.3)	59.1 ± 10.8	–
Black African	112 (23.2)	59.4 ± 9.5	0.80
Asian	30 (6.2)	49.8 ± 10.5	< 0.01*
Mixed race	117 (24.3)	58.1 ± 11	0.42
Positive family history per ethnicity			
Caucasian ($n = 223$)	82 (36.8)	58.4 ± 10.6	0.77
Black African ($n = 112$)	13 (11.6)	57.5 ± 9.5	
p-value	< 0.01*		< 0.01*
Asian ($n = 30$)	16 (53.3)	49.2 ± 9.7	
p-value	0.08		0.68
Mixed race ($n = 117$)	30 (25.6)	57.5 ± 9.3	
p-value	0.04*		

All *p*-values in comparison to Caucasians. *Significant difference ($p < 0.05$).

Table 2. Clinical presentation for the study population per gender and ethnicity

	First-time presenters with atherosclerotic disease (n = 482)						
	ACS (n = 348)						
Parameters	*STEMI* n *(%)*	*NSTEMI* n *(%)*	*UA* n *(%)*	*Non-specific chest pain* n *(%)*	*Ischaemic CMO* n *(%)*	*Positive stress/ MIBI* n *(%)*	*Incidental atherosclerosis finding* n *(%)*
Clinical presentation	171 (35.5)	112 (23.2)	65 (13.5)	57 (11.8)	36 (7.5)	10 (2.1)	31 (6.4)
Gender							
Male (*n* = 317)	119 (37.5)	71 (22.4)	40 (12.6)	36 (11.4)	27 (8.5)	6 (1.9)	18 (5.7)
Female (*n* = 162)	50 (30.9)	40 (24.7)	25 (15.4)	21 (13)	9 (5.6)	4 (2.5)	13 (8)
Unknown (*n* = 3)							
Ethnicity							
Caucasian (*n* = 223)	66 (29.6)	54 (24.2)	35 (15.7)	29 (13)	14 (6.3)	8 (3.6)	17 (7.6)
Black African (*n* = 112)	39 (34.8)	22 (19.6)	10 (8.9)	20 (17.9)	13 (11.6)	0	8 (7.1)
Asian (*n* = 30)	16 (53.3)	4 (13.3)	4 (13.3)	1 (3.3)	3 (10)	2 (6.7)	0
Mixed race (*n* = 117)	50 (42.7)	32 (27.4)	16 (13.7)	7 (6)	6 (5.1)	0	6 (5.1)

STEMI: ST-elevation myocardial infarction; NSTEMI: non-ST-elevation myocardial infarction; UA: unstable angina; CMO: cardiomyopathy.

at a significantly younger age than Caucasians (49.8 ± 10.5 vs 59.1 ± 10.8 years; $p < 0.05$). The ages of black Africans and mixed-race individuals were similar to that of Caucasians ($p > 0.05$). Family history was unknown or not recorded in a third of the patients (n = 165; 34%). A positive family history of CAD was recorded in significantly more Caucasians than black Africans ($p < 0.05$) and mixed-race ethnicities ($p < 0.05$).

The majority of patients (72%) presented clinically with ACS, 12% with non-specific chest pain and the remaining 16% with other clinical conditions such as ischaemic cardiomyopathy, positive stress tests, or incidental findings during routine cardiac catheterisation (Table 2).

Fig. 1 illustrates the modifiable cardiac risk factors for the study population. Most patients (63%, n = 304) presented with three or more risk factors, 27% (n = 128) had two risk factors, and 10% (n = 46) presented with only one risk factor for CAD.

Hypertension was the most frequently documented risk factor in all ethnic groups (≥ 87%) as well as in both male (91%) and female (91%) patients. Hypertension was significantly more common in black African patients than in Caucasians (96 vs 87%; $p < 0.05$).

Smoking was the second most common risk factor and occurred in two-thirds of the patients, but significantly more in Caucasians than black Africans (68 vs 55%; $p < 0.05$). Smoking was substantially more prevalent in males than females (73 vs 55%; $p < 0.05$). Caucasian patients presented with significantly more chronic obstructive pulmonary disease than black Africans (10 vs 2%; $p < 0.05$).

The mean BMI for the study population was 30 ± 6.1 kg/m^2. Notably, 70% of patients were classified as overweight, while 41% of those were obese (BMI ≥ 30 kg/m^2). Asians were significantly less obese compared to Caucasians (23 vs 45%; $p < 0.05$). No significant gender differences were observed for obesity (Table 3).

Diabetes mellitus was present in 34% of the study group, of which most presented with type 2 diabetes (n = 128; 78%). No gender differences were observed, but diabetes was present in significantly more black African (37%; $p < 0.05$), Asian (50%; $p < 0.05$) and mixed-race patients (45%; $p < 0.05$) than Caucasians (25%). Elevated LDL-C levels (≥ 3.4 mmol/l) were noted in more female patients than males (25 vs 16%; $p < 0.05$), but there were no significant differences between ethnicities (Table 3).

Three hundred and forty-eight patients had a confirmed diagnosis of ACS. Almost half of them presented with ST-elevation myocardial infarction (STEMI) (49%), followed by non-ST-elevation myocardial infarction (NSTEMI) (32%) and unstable angina (UA) (19%) (Table 4).

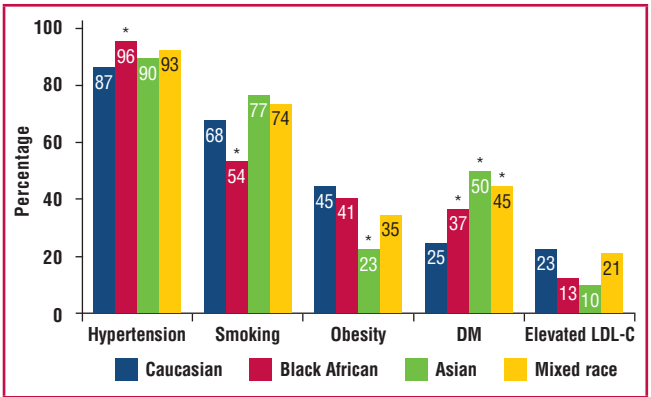

Fig 1. Modifiable risk factors per racial group (%). DM, diabetes mellitus; LDL-C, low-density lipoprotein cholesterol.

Table 3. Modifiable cardiac risk factors for the study population per gender and ethnicity

Parameters	*HTN,* n *(%)*	*Smoking,* n *(%)*	*Obesity,* n *(%)*	*DM,* n *(%)*	*LDL-C,* n *(%)*
All patients (*n* = 482)	438 (90.9)	323 (67)	195 (40.5)	164 (34)	94 (19.5)
Gender					
Male (*n* = 317)	288 (90.9)	232 (73.2)	125 (39.4)	103 (32.5)	52 (16.4)
Female (*n* = 162)	148 (91.4)	89 (54.9)	70 (43.2)	61 (37.7)	41 (25.3)
Unknown (*n* = 3)	2	2	0	0	1
p-value (Fishers exact)	1.0	< 0.01*	0.43	0.27	0.03*
Ethnicity					
Caucasian (*n* = 223)	194 (87)	152 (68.2)	101 (45.3)	55 (24.7)	51 (22.9)
Black African (*n* = 112)	108 (96.4)	61 (54.5)	46 (41.1)	41 (36.6)	15 (13.4)
p-value (Yates)	0.01*	0.02*	0.54	0.03*	0.06
Asian (*n* = 30)	27 (90)	23 (76.7)	7 (23.3)	15 (50)	3 (10)
p-value (Yates)	0.86	0.46	0.04*	< 0.01*	0.12
Mixed race (*n* = 117)	109 (93.2)	87 (74.4)	41 (35)	53 (45.3)	25 (21.4)
p-value (Yates)	0.12	0.29	0.09	< 0.01*	0.86

HTN: hypertension; DM: diabetes mellitus; LDL-C: low-density lipoprotein cholesterol; COPD: chronic obstructive pulmonary disease.
Smoking includes both current and ex-smokers; LDL-C ≥ 3.4 mmol/l; obesity = BMI ≥ 30 kg/m^2.
All *p*-values in comparison to Caucasians. *Significant difference ($p < 0.05$).

Table 4. Non-modifiable cardiac risk factors for ACS group per clinical diagnosis, age, gender and ethnicity

	ACS patients (n = 348)					
	STEMI (n = 171)		*NSTEMI* (n = 112)		*UA* (n = 65)	
Parameters	n *(%)*	*Age (years) mean ± SD*	n *(%)*	*Age (years) mean ± SD*	n *(%)*	*Age (years) mean ± SD*
Total group (*n* =348)	171 (49.1)	56.6 ± 10.4	112 (32.2)	59.2 ± 11.3	65 (18.7)	59.1 ± 9
Gender						
Male (*n* = 230)	119 (51.7)	56.2 ± 10.1	71 (30.9)	58.2 ± 11.9	40 (17.4)	57.6 ± 9.4
Female (*n* = 115)	50 (43.5)	57.9 ± 10.4	40 (34.8)	60.9 ± 10.3	25 (21.7)	61.5 ± 7.8
Unknown (*n* = 3)						
p-value	0.18	0.32	0.54	0.23	0.41	0.09
Ethnicity						
Caucasian (*n* = 155)	66 (42.6)	57.1 ± 10.2	54 (34.8)	60.3 ± 11.7	35 (22.6)	60.0 ± 8.1
Black African (*n* = 71)	39 (54.9)	57.7 ± 9.4	22 (31)	60.0 ± 10.6	10 (14.1)	58.4 ± 4.5
p-value	0.11	0.77	0.68	0.92	0.19	0.55
Asian (*n* = 24)	16 (66.7)	48.3 ± 9.2	4 (16.7%)	51.3 ± 9.7	4 (16.7%)	45.8 ± 5.9
p-value	< 0.05*	< 0.01*	0.11	0.14	0.61	< 0.01*
Mixed race (*n* = 98)	50 (51)	57.7 ± 10.5	32 (32.7)	57.7 ± 10.9	16 (16.3)	60.8 ± 10.8
p-value	0.24	0.76	0.85	0.31	0.30	0.77

All *p*-values in comparison to Caucasians. *Significant difference ($p < 0.05$).

The ACS group of patients had a male preponderance (66%) and were predominantly Caucasian (*n* = 155; 45%). Of note, females with ACS presented at an older age than males (59.7 ± 10 vs 57 ± 10.6 years; $p < 0.05$). Similar to the findings observed for the total study group with atherosclerosis, Asian patients presented at a younger age than their Caucasian counterparts in the ACS group (48.3 ± 9.2 vs 58.9 ± 10.5 years; $p < 0.05$). A positive family history was significantly more common in Asians than Caucasians presenting with STEMI ($p < 0.05$).

For the ACS group, regardless of gender and ethnicity, most patients presented in the age group 51–60 years (36%). Most Caucasian patients presented in the 61–70 age group (*n* = 57; 37%), while most black African and mixed-race patients presented in the 51–60 years age group (*n* = 35; 49% and *n* = 36; 37%). The majority of Asian patients presented in the age group of 41–50 years (*n* = 10; 42%) (Table 5).

As expected, the modifiable risk factors in the ACS group showed similar patterns to that of the total study population.

Table 5. Age intervals per ACS diagnosis for each ethnic group

		ACS patients (n = 348)					
	Age interval	*STEMI* (n = 171)		*NSTEMI* (n = 117)		*UA* (n = 65)	
Parameters	*(years)*	n *(%)*	p-*value*	n *(%)*	p-*value*	n *(%)*	p-*value*
Caucasian (*n* = 155)	41–50	16 (10.3)	–	9 (5.8)	–	5 (3.2)	–
	51–60	20 (12.9)	–	15 (9.7)	–	11 (7.1)	–
	61–70	23 (14.8)	–	18 (11.6)	–	16 (10.3)	–
	71–80	3 (1.9)	–	7 (4.5)	–	3 (1.9)	–
Black African (*n* = 71)	41–50	5 (7)	*NC*	4 (5.6)	*NC*	0	–
	51–60	19 (26.8)	0.02*	9 (12.7)	0.66	7 (9.9)	0.65
	61–70	7 (9.9)	0.42	5 (7)	*NC*	3 (4.2)	*NC*
	71–80	5 (7)	*NC*	3 (4.2)	*NC*	0	-
Asian (*n* = 24)	41–50	7 (29.2)	0.03*	1 (4.2)	*NC*	2 (8.3)	*NC*
	51–60	5 (20.8)	*NC*	1 (4.2)	*NC*	1 (4.2)	*NC*
	61–70	1 (4.2)	*NC*	1 (4.2)	*NC*	0	–
	71–80	0	–	0	–	0	–
Mixed race (*n* = 98)	41–50	10 (10.2)	0.98	7 (7.1)	0.87	1 (1)	*NC*
	51–60	18 (18.4)	0.32	11 (11.2)	0.89	7 (7.1)	0.99
	61–70	11 (11.2)	0.53	9 (9.2)	0.69	5 (5.1)	*NC*
	71–80	8 (8.2)	0.04*	3 (3.1)	0.80	1 (1)	*NC*

ACS: acute coronary syndrome; NC: not calculated due to small sample size.
All *p*-values in comparison to Caucasians. *Significant difference ($p < 0.05$).

Most ACS patients presented with three or more vessel disease (STEMI = 53%; NSTEMI = 49%; UA = 43%). There were no racial differences in patients having three-vessel disease presenting with STEMI. One hundred and sixty patients (46%) from the ACS group had percutaneous coronary intervention, 75 (22%) were referred for coronary artery bypass graft surgery, 82 (24%) received only medical therapy, and in 31 patients (9%) the treatment was not recorded.

Discussion

Non-communicable disease is the second most common cause of death in sub-Saharan Africa, with CVD documented as the leading cause of death.[2] This is the only recent study in central South Africa that describes current cardiac risk factors for patients with angiographically confirmed CAD.

The main findings of this study showed that cardiovascular risk factors occurred in all population groups and concurred with risk factors documented worldwide. The majority of the patients included in this study (90%) were from low socio-economic status groups (H0–H2). The study demonstrated that coronary artery atherosclerosis was present in all the ethnic groups studied in central South Africa. CAD occurred most frequently in males, who presented 2.9 years younger than females.

Our results concur with the INTERHEART study results of 2005[11] and a study conducted by Masina *et al.* in 2017,[14] which also demonstrated a male preponderance (75 and 85%, respectively) with males presenting three years earlier compared to female patients. Compared to the other ethnic groups in our study, Asian patients presented significantly younger. Similar findings were reported by Patil *et al.* in a study conducted in 2020 in rural India, where 41.8% of patients with premature CAD were under the age of 35 years.[19]

Classic modifiable cardiac risk factors were observed in all ethnic groups in central South Africa. Numerous risk factors were present, with most patients having three or more risk factors (63%). Hypertension was the most prevalent modifiable risk factor in the total study population and occurred in ≥ 87% of all patients, and significantly more in black African patients. Smoking or a history of smoking was reported in 67% of

patients, followed by obesity (41%), diabetes mellitus (34%) and elevated LDL-C levels (20%).

The high prevalence of modifiable cardiac risk factors, especially hypertension, in our central South African group is cause for concern. Despite the differences in methodology, hypertension was markedly higher than that reported in the INTERHEART study in 2005[11] and that by Masina *et al*. in 2017[14] (21.9 and 46%, respectively). Cognisance should be taken that the INTERHEART study[11] included patients from nine countries in sub-Saharan Africa (of which 1 107 were from South Africa) and Masina *et al.* studied 94 black patients with AMI.[14]

Interestingly, hypertension occurred in 50% of black patients in the INTERHEART study, which was higher compared to the 34% of the European or other African cases.[11] This supports our observation that hypertension appears to be a significant risk factor in black patients with coronary artery atherosclerosis. Our results agree with those of Loock *et al*., demonstrating an 88.8% hypertension prevalence in 89 cases of coronary heart disease in rural black South Africans attending the Kalafong Hospital between 1982 and 1986.[20] Hypertension showed no significant differences between the genders, as supported by Bosu *et al*. evaluating hypertension in older adults in Africa.[21]

Geographical differences may also exist. In a study on risk factors in central South Africa conducted in 1990, the authors showed that a blood pressure of > 140/90 mmHg was present in more than 70% of males and females over the age of 55 years.[5]

Smoking was frequently observed in our study and was the second most common modifiable risk factor in the patient population (67%). This resembles the findings of Patil *et al*., where a prevalence of 60.4% smoking history was observed.[19] Similar results were also reported by the INTERHEART study, where smoking/ex-smoking was present in 65% of cases in the overall group and 72% of patients from Africa.[11] Our results showed that males smoked significantly more than females, which has also been observed in several other studies.[5,22-24]

Asian populations were significantly less obese than the other ethnic groups. However, no statistical differences were observed between the genders in all groups. Notably, 70% of all patients with coronary artery atherosclerosis in our study were overweight, of which 41% were obese (BMI of ≥ 30 kg/m^2). The presence of overweight and obesity in our study is remarkably similar to the Heart of Soweto study findings, where 70% of their adult population was also overweight.[25] However, their study showed that more females than males were overweight, and is supported by several other studies.[5,20,22] The African cohort in the INTERHEART study had an average BMI of 27.59 kg/m^2 (overweight),[11] higher than that of the overall group, emphasising the high prevalence of this modifiable problem in sub-Saharan Africa.

Diabetes was a noteworthy risk factor in our study population. Similar to Kabongo *et al*. in 2018, who observed a South African population with NSTEMI, a prevalence of 39.3% of diabetes was observed,[26] while 34% of our patients had diabetes. Diabetes was significantly more common in black African, Asian and mixed-race patients, and comparable with the reported results of Masina *et al*.[14] More females than males had elevated LDL-C levels, which concurred with other studies.[5,24,27]

Although this study did not focus on the metabolic syndrome, the high prevalence and combination of hypertension, obesity, diabetes and hypercholesterolaemia in our population is cause for concern. Masina *et al*. recorded the metabolic syndrome in 45% of their patients studied.[14]

This study shows that 72% of patients with coronary artery atherosclerosis presented with ACS. STEMI was the most common clinical presentation and accounted for nearly half of the ACS patients (49%). Our results are lower than the 83% ACS cases observed by Masina *et al*.,[14] but higher than that of Shavadia *et al.*, who described 111 patients with ACS in an urban hospital in sub-Saharan Africa,[28] and Sookan *et al*. (63%), who studied 117 patients with AMI at a hospital in KwaZulu-Natal.[13]

The ACS group mainly consisted of male patients, similar to studies by Sookan *et al*.,[13] Shavadia *et al*.,[28] Maharaj *et al*.[29] and Meel and Gonçalves,[30] who also demonstrated a high male prevalence. Overall, Asians presented significantly younger in the STEMI and UA groups than other ethnicities. The Worldwide INTERHEART study reported a mean age of 58 years, while the African INTERHEART study population had a mean age of 54 years for MI, therefore patients in Africa appear to be younger.[11] Not unexpectedly, the sub-analysis results of modifiable and non-modifiable risk factors in the ACS group were virtually indistinguishable from the results of all patients with radiologically confirmed coronary artery atherosclerosis.

Based on our patients' non-modifiable and modifiable risk profiles, the authors postulated that central South Africa may be in the process of an epidemiological transition, with subtle differences among the various ethnicities, similar to conclusions from the INTERHEART study.[11] Our study shows that CAD occurred in all ethnic groups and that STEMI was the dominant clinical presentation. Therefore, this diagnosis should be considered in any patient presenting with chest pain and should not be ignored in patients of any ethnicity.

The results of this study emphasise the importance of epidemiological studies such as these, especially if certain risk factors may be region specific. Such data are essential for healthcare providers for planning and organising service delivery. It highlights preventable areas that regional and primary healthcare services should target. Primary healthcare services in central South Africa should prioritise education and screening for hypertension.

Limitations

Limitations of this study relate to its retrospective nature and the fact that it was a relatively small study population. Results for smaller subgroups need to be interpreted cautiously as 34% of records were not used due to incomplete data, which may have influenced the results. However, the African group in the INTERHEART study, conducted in 2005, included 1 363 patients.[15] Masina *et al*. studied 94 patients,[18] compared to our 482 total study population and 348 ACS patients.

In neither of these studies were coronary angiograms performed, while all patients in our study had coronary angiograms. Although only patients with angiographically significant atherosclerosis were included, the degree of obstruction was not quantified. This would have added value to the study. However, all patients had clinical symptoms requiring cardiac catheterisation. This study did not investigate the prevalence of human immunodeficiency virus and its contribution to premature CAD in ethnic groups.

Conclusion

This study demonstrated that CAD in South Africa was present in all the ethnic groups studied, and modifiable and non-modifiable risk factors observed in this study were similar to the classical risk factors described for CAD in the rest of the world. Hypertension is a significant risk factor in central South Africa and warrants further investigation. Most patients with proven coronary artery atherosclerosis presented with ACS, particularly STEMI. The average age of patients with ACS was younger than those documented in the rest of the world but similar to recorded data for sub-Saharan Africa. Regional epidemiological studies similar to this are essential for planning health services and increasing awareness of CAD.

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