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Masters in Medicine

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Title:

THE CHANGING SPECTRUM OF CORONARY ARTERY DISEASE IN BLACK AFRICAN PATIENTS AT A TERTIARY INSTITUTION: A ONE YEAR EXPERIENCE

Supervised by: Professor D. P. Naidoo

Institute: University of Kwa-Zulu Natal

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Contents

Declaration

I, Dr Sapna Shivani Dela, do hereby declare that this work is original, under the supervision of Professor D. P. Naidoo.

Declaration

I, Sapna Shivani Dela, declare that:

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Presentation

This research has been presented at a 2014 MMed Workshop on 16 October 2014 at the Nelson R. Mandela Medical School.

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To J, for the love and support.

List of Tables and Figures

Abbreviations and Acronyms

ACS	Acute Coronary Syndrome
DVD	Double vessel disease
HDL-C	High-density lipoprotein cholesterol
LDL-C	Low-density lipoprotein cholesterol
MI	Myocardial Infarction
MS	Metabolic Syndrome
NCEP	National Cholesterol Education Program
NSTEMI	Non ST segment (non-Q wave) myocardial infarction
REACH	Reduction of Atherothrombosis for Continued Health
STEMI	ST segment (Q wave) myocardial infarction
SVD	Single vessel disease

TC	Total cholesterol
TG	Triglycerides
TVD	Three vessel disease
UA	Unstable Angina

Abstract

The spectrum of coronary artery disease among Black African patients in South Africa is not completely known. Previous reports have described acute coronary syndrome (ACS) in Blacks as uncommon. Studies have shown that Blacks have milder coronary artery disease compared to other population groups. More recently, reports are showing a rising number of cardiovascular risk factors and myocardial infarction in this population group. There is currently a paucity of local data looking at the growing burden of this disease and the spectrum of presentation in Black African populations.

The aim of this study was to describe the spectrum of coronary artery disease in Blacks and determine if there were significant differences in severity and outcome as compared to more usually affected population groups with coronary artery disease.

A retrospective chart review of Black African patients with acute coronary syndrome was conducted at Grey's Hospital, with data obtained over a twenty month period at our tertiary referral centre. Blacks were compared with an equivalent number of Indian and Caucasian subjects presenting with acute coronary syndrome during the same period. The clinical presentation, biochemistry and angiographic findings were examined.

The prevalence of acute coronary syndrome in Blacks was similar to Caucasians (17% v. 19%) but lower than Indians (64%). Except for family

history (5%), traditional risk factors occurred as frequently in Blacks as in Indians and Caucasians. The prevalence of diabetes mellitus in Blacks (46.8%) was almost identical to Indians (50%). Hypertension (67%) was similar to Indians and Caucasians, but dyslipidaemia (56%) and smoking (41%) was lower among Blacks. Metabolic syndrome occurred as frequently in Blacks as in Indians. Black African patients had comparable coronary vessel involvement to Caucasians (single and double vessel disease), but less three vessel disease (18%). They were more likely to present, ab initio, at a younger age compared to Caucasians, with less preceding angina and with anterior ST segment elevation myocardial infarction.

In conclusion, the study shows that Black African patients have become a high risk group with coronary artery disease than previously thought. It shows that coronary artery disease in Blacks is no longer an uncommon problem and that they should be considered a high risk group of patients with a cardiovascular risk that is comparable to Indians and Caucasians. Aggressive screening and treatment of cardiovascular risk factors should be undertaken with the same seriousness as in other usually affected population groups.

392 words

Chapter 1: Background and Literature

Coronary artery disease (CAD) remains the leading cause of cardiovascular-related mortality worldwide [1]. An extensive review of world literature in 2003 by Okrainec et al, looked at the burden of coronary artery disease in terms of both coronary artery disease mortality and prevalence of risk factors for coronary artery disease in developing countries. Significant risk factors for coronary artery disease included diabetes, hypertension, Western-type diets and smoking. They found that there was a notable paucity of data about the prevalence of risk factors in the developing world, including Africa. They cited poor financial support, lack of trained medical personnel to identify deaths due to coronary artery disease and lack of facilities for invasive procedures such as cardiac catheterization, as the main reasons for poor data collection in developing countries. Furthermore, they projected an alarming increase in the number of cases of coronary artery disease in developing countries, as urbanization and exposure to major risk factors, including a Westernized diet rich in refined sugars and fats, become more entrenched in societies undergoing what they termed “epidemiologic transition.” They projected coronary artery disease mortality rates to double from 1990 to 2020, with about 82% of that increase occurring in developing countries. In Africa alone, their literature search suggested that less than 1% of the African population was accounted for within cause-of-death statistics, in contrast to 94% registered by the World Health Organization for European countries. This suggests that the prevalence of coronary artery disease in developing

countries may be highly underestimated. The authors warned of an impending epidemic if prevention and targeted control of patient risk factors were not implemented.

In contrast, aggressive screening drives and lowering of traditional risk factors in Western countries have resulted in declining rates of deaths from coronary artery disease in these countries with little variation in the profile of coronary artery disease across racial groups [1]. In an American retrospective chart review conducted in 2002, Whittle et al looked at the extent of coronary artery disease in Blacks compared to Caucasian patients with acute coronary syndromes, who underwent coronary angiography during the same admission. They found that Blacks were more likely than Caucasians to have no significant coronary obstructions. However, there were no racial differences in the severity of coronary artery disease among patients with at least one significant obstruction [2]. Furthermore, racial differences in coronary obstructions remained after correcting for coronary artery disease risk factors and characteristics of the acute myocardial infarction [2]. The authors concluded that Black patients who presented with acute coronary insufficiency, were less likely than Caucasians to have significant coronary obstruction. However, they were not able to provide an explanation for this apparent difference and indeed, more favourable prognostic factor of coronary artery disease in Black subjects [2].

Recently, in the landmark American REACH study published in 2011, strikingly higher rates of cardiovascular mortality, related to athero-thrombotic

disease were found in Black patients when compared to their Asian, Caucasian and Hispanic counterparts [3]. The study showed that although medical therapies reduced cardiovascular risk uniformly in all ethnic groups, the risk factor profile of Blacks and two year death rate from cardiovascular causes were significantly higher [3].

GRAPHICAL DEPICTION OF HIGHER RATES OF CARDIOVASCULAR RISK FACTORS AMONG BLACK PATIENTS TAKEN FROM THE REACH STUDY

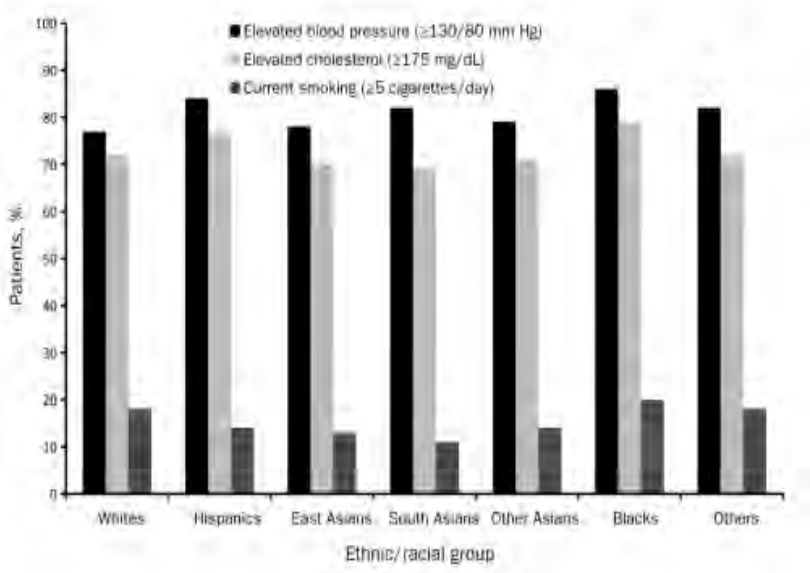


Fig 1. Under-treatment of risk factors among patients with atherothrombotic disease in the Reduction of Atherothrombosis for Continued Health (REACH) Registry by ethnicity. SI conversion factor: To convert cholesterol value to mmol/L, multiply by 0.0259. Mayo Clin Proc. 2011 October; 86(10): 960–967.

It is becoming increasingly apparent that developing countries are in the process of 'epidemiologic transition [4]. Data looking at the prevalence and

severity of coronary artery disease among South African Blacks is also limited. Early case reports from the 1960's and 1970's reflect the low prevalence of coronary artery disease and myocardial infarction in Black African patients during those decades. In 1963, Seftel et al looked at the characteristics of Black African patients who had suffered myocardial infarction and found a significant correlation between diet, socio-economic status and the finding of atherosclerosis at necropsy [5]. They found that of the fifteen subjects (out of a total of thirty) who had undergone autopsy, only six had features of atherosclerotic disease (three had a mix of superimposed thrombus and early atherosclerosis). Furthermore, the six subjects with established atherosclerotic disease had a higher prevalence of hyperlipidaemia and sedentary lifestyle, in addition to an affluent diet high in animal protein and fat. The other six subjects who had demised following myocardial infarction had predominantly occlusive thrombus at autopsy and were from rural areas, were more active physically and had less animal protein and fat -containing diets. While this was a small study with very few subjects, it still highlights that nearly half of all Black African patients in the study did not have established atherosclerosis [5].In another autopsy study of African diabetic patients conducted thirty years ago, no atheromatous coronary artery disease was found [6].

Thandroyen et al, in their 1980 study, showed that hypercholesterolaemia, hypertriglyceridaemia and diabetes were associated with coronary artery disease in the Caucasian and Indian groups at rates roughly equivalent to those reported in the literature, but only hypercholesterolaemia was found to

any significant degree in Blacks [7]. Furthermore, hypercholesterolaemia did not correlate with coronary artery disease severity in the Black group of only seventeen patients [7]. Coronary artery disease was most prevalent in Caucasians and Indians, with Blacks having the lowest prevalence of coronary artery disease. None of the Black subjects in that study had diabetes mellitus, possibly reflecting the very low prevalence of this risk factor for coronary artery disease among Black African patients at that time [7]. The authors concluded that despite the unequivocal demonstration of coronary artery disease in 82% of the seventeen Black African patients, neither hypertriglyceridaemia nor hyperglycaemia appeared to be a significant risk factor, and that hypercholesterolaemia was important in only 50% of the cases. In their abstract, Cassim and Naidoo looked at the profile of African patients with myocardial infarction in Durban over a five year period (1991-1995). They found that myocardial infarction in Africans constituted a relatively small percentage of total patients with myocardial infarction (only 7.4%) [8]. An earlier study conducted in 1991 by Seedat et al reported even lower rates of coronary artery disease among Blacks in Durban at 2.4% [9].

More recently, increasingly severe risk factor profiles for coronary artery disease in Black populations have been described. Vezi and Naidoo, in their 2005 cross-sectional study, showed that Black African patients with Type 2 diabetes had a higher likelihood of diabetic dyslipidaemia (DD) that involved all major subclasses of cholesterol and triglyceride, unlike the “typical” low high density lipoprotein cholesterol and high triglyceride reported in other ethnic groups with DD [10].

Conversely, other studies have suggested a milder form of dyslipidaemia thus conferring a favourable prognostic factor and therefore lower prevalence of coronary artery disease in Black populations: As put forth by Kalk and Joffe, Black African patients with Type 2 diabetes were found to have lower total cholesterol levels and lower TG:HDL-C levels (marker of insulin resistance) than their Caucasian diabetic counterparts. They concluded that this contributed to the lower prevalence of coronary artery disease in diabetic Africans [11] , a finding not dissimilar to Naidoo and Cassim in their earlier South African study, which found overall lower rates of hypercholesterolaemia among Black African patients with myocardial infarction. Indeed, Naidoo and Cassim showed, in contrast to Vezi et al 2005, that hypercholesterolaemia did not appear to be a significant risk factor for Black African patients with myocardial infarction [8]. The lower prevalence of dyslipidaemia among Black subjects was also demonstrated by Thandroyen et al in their 1980 study [7].

The global rise in the clustering of risk factors for coronary artery disease has been described previously. The landmark INTERHEART trial analysed 14 international clinical studies of patients presenting with acute coronary syndrome, [12]. The study showed that 85% of patients with acute coronary syndrome had at least one conventional risk factor [12]. The most recent study to date, showing a similarly disturbing trend, published in October 2014, was the Mexican study by Gonzalez-Pacheco et al [13]. They looked at the clustering of risk factors among patients with acute coronary syndrome and significant coronary artery disease confirmed during angiography. In their sample of over 3000 patients with angiographically proven coronary artery

disease, they found an alarmingly high prevalence of conventional risk factors in these patients with a male predominance where STEMI was the commonest ACS. They found that 95.7% of all patients in the study had at least one risk factor for acute coronary syndrome and significant coronary artery disease, the highest number ever reported in patients with acute coronary syndrome [13]. In their study, smoking and hypertension were the most frequent risk factors. What was indeed notable was the finding of a high prevalence of dyslipidaemia with low HDL-C being the commonest lipid abnormality [13].

The increasing burden of the metabolic syndrome, diabetes and hypertension in South African Blacks, was demonstrated by Ntyintyane et al, who showed that 60% of Black African patients with established coronary artery disease had metabolic syndrome. Waist circumference, hypertension and elevated glucose was the most frequent risk factor combination [15] reflecting an increase in the prevalence of clustering of risk factors in patients with significant coronary artery disease. The findings in these studies reflecting the ever increasing burden of the metabolic syndrome merits further study in our local population.

The 2001 NCEP guidelines outline the five diagnostic criteria for metabolic syndrome [14]. A finding of three or more criteria are required for a diagnosis of metabolic syndrome to be made. They are:

1. Central Obesity: waist circumference >/= 102cm (40 inches) for males and >/= 88cm (36 inches) for females

2. Triglycerides (TG): >/= 1.7 mmol/L

3. High density lipoprotein cholesterol (HDL-C) <1.03mmol/L (males), <1.29 mmol/L (females)

4. Blood Pressure: >/= 130/85mmHg

5. Fasting plasma glucose: >/= 6.1 mmol/L

As informative as these studies are, they are few, with data showing conflicting results on the overall outcomes of coronary artery disease in Black African patients. Also, local studies tackling the issue are sparse and further investigations looking at the spectrum and outcomes of coronary artery disease in South African Blacks are needed.

Rationale for this study

Such findings of the increasing burden of cardiovascular risk factors, warn of the ever changing spectrum of coronary artery disease in Blacks and makes ongoing studies highly relevant for future preventive measures to curb the rise of these diseases of “westernization.” Such conflicting data became the driving force behind this study, which aimed to establish whether the severity of coronary artery disease among our local Black population reflected current local and international data.

The spectrum of chronic, non - communicable diseases is clearly changing amongst Blacks with an increasing prevalence of metabolic syndrome, diabetes, hypertension and dyslipidaemia [15]. There is however, still the

perception that coronary artery disease is uncommon in Black subjects. Yet, we have observed an increasing number of Black African patients presenting to Grey's Hospital with myocardial infarction. This study was performed to raise awareness of the presence of coronary artery disease in Blacks and to show that the spectrum of coronary artery disease in this population group is changing rapidly, calling for urgent population measures in disease prevention.

Chapter 2: Aims and Objectives

2.1 Aim of the Study

The aim of this study was to describe the spectrum of coronary artery disease in Black African patients referred with myocardial infarction to a tertiary level, referral centre i.e. Grey's Hospital in Pietermaritzburg, which provides regional services to both the Umgungundlovu district with an approximate population of 1 million people and five surrounding health districts with a population of 3.5 million people. Grey's hospital is a public facility that serves the lower to middle income group. The aim was to then compare these patients in the study group to Indian and Caucasian patients with myocardial infarction.

2.2 Specific Objectives

A retrospective chart review of all Black African patients who were referred to Grey's Hospital (a tertiary level centre in Pietermaritzburg) with myocardial infarction over a 20 month period was performed in order to:

2.2.1 Objective 1:

Describe the risk factor profile of these patients

2.2.2 Objective 2

Determine the site and extent of myocardial infarction (based on ECG and enzyme markers)

2.2.3 Objective 3:

Describe the spectrum of coronary vessel involvement at angiography

2.2.4 Objective 4:

Determine the immediate outcome at thirty days in Black subjects as compared to gender and age-matched Indian and Caucasian patients referred with myocardial infarction during the same period

2.2.5 Objective 5:

Describe the prevalence of metabolic syndrome among Black African patients presenting with myocardial infarction

Chapter 3: Materials and Methodology

3.1 Study Design

The study was retrospective with a case control design, comparing variables related to coronary artery disease between Black, Indian and Caucasian groups, with Black African patients forming the study group and Indian and Caucasian patients used for comparison.

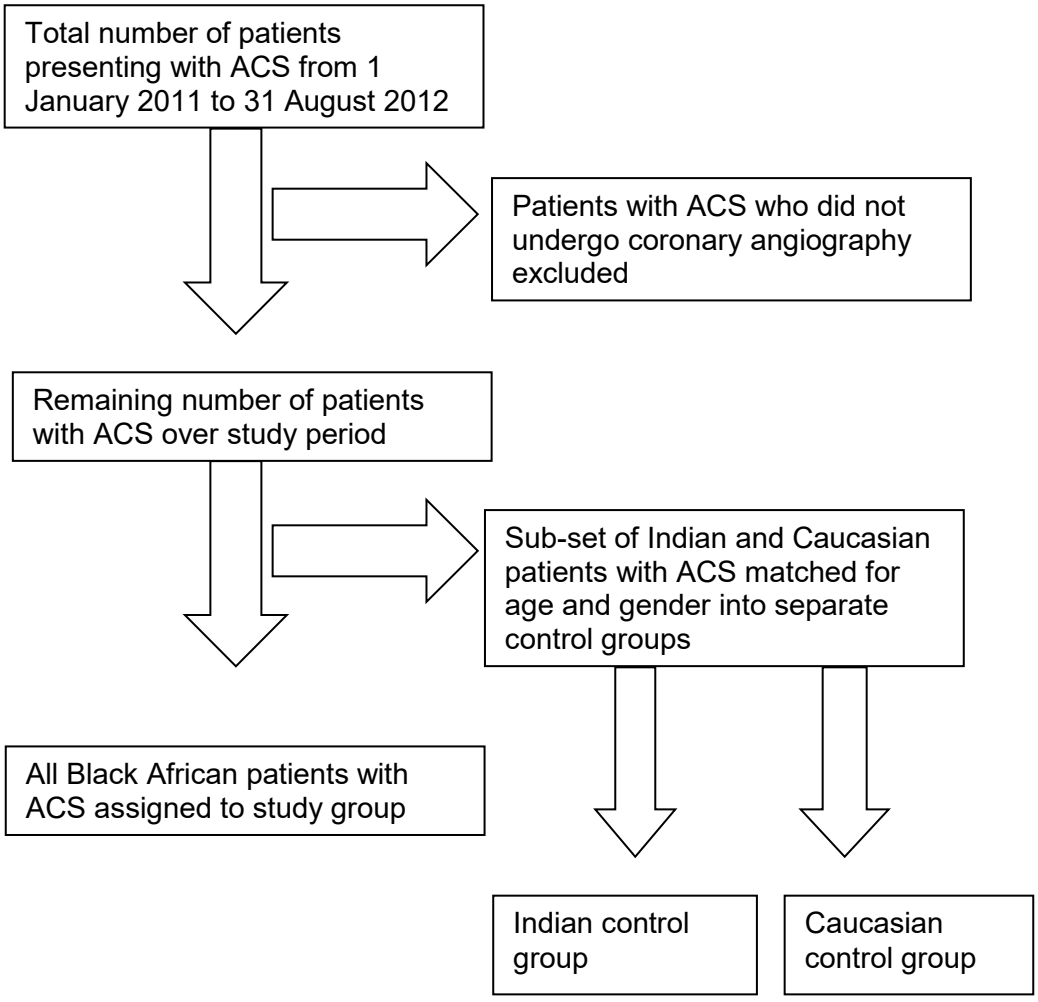
3.2 Patient Selection

Race was defined on admission when subjects were admitted to hospital. Patients were classified according to race as Black African, Indian, Caucasian or Coloured. Most Black subjects in the province of Kwa-Zulu Natal are of Zulu extraction. The term acute coronary syndrome as outlined by Braunwald et al encompasses unstable angina, non ST-segment elevation [non-Q wave] MI [NSTEMI], and ST-segment elevation [Q wave] MI [STEMI] [16]. Every Black African patient presenting with acute coronary syndrome during the study period was selected. A subset of Indian and Caucasian patients, matched as closely as possible, within five years for age and gender, were consecutively assigned to separate comparative groups. The first Indian and Caucasian patient of the same age and gender to present with myocardial infarction in the study period, was consecutively selected for comparison with the Black African patient presenting with myocardial infarction at the same time during the study period.

3.2.1 Inclusion Criteria

Only subjects with a diagnosis of acute coronary syndrome who subsequently underwent coronary angiography at Grey's Hospital were included in the study.

Figure 2. Stepwise depiction of patient selection for the study group:



3.2.2 Exclusion Criteria

There were 11 patients with acute coronary syndrome who did not undergo coronary angiography and they were excluded. Patients who underwent coronary angiography where the primary indication was not acute coronary syndrome e.g. screening angiography prior to valve replacement or prior to pacemaker insertion, were also excluded. There were seven patients with irretrievable files who were also excluded (one Black African, three Indians and three Caucasians).

3.3 Data Collection

A retrospective chart review was conducted at Grey's Hospital in Pietermaritzburg. Data was collected spanning a twenty month period from 1 January 2011 up to 31 August 2012. (Figure 2). We collected the charts of all Black subjects diagnosed with acute coronary syndrome for the period 1 January 2011 to 31 August 2012 and compared them to other race groups, i.e. Indians and Caucasians. Demographic data like age and gender, as well as proven risk factors for coronary artery disease such as diabetes, hypertension, dyslipidaemia, family history of coronary artery disease and smoking, were collected from the files.The policy in this unit is to perform fasting blood glucose and lipid profiles on all subjects prior to undergoing coronary angiography. For the purposes of comparison with previous local studies, cut-offs for hypercholesterolaemia were taken as a total cholesterol>5

[8]and LDL > 2.5[17]. Dyslipidaemia included a triglyceride level of >/=1.7, HDL-C<1.29 in females and <1.03 in males [18].

Data was also collected in order to screen for metabolic syndrome among the patients selected for study. As outlined by the NCEP from 2001 [14], a person would be considered to have metabolic syndrome if at least three of the following criteria are met:

1. Central obesity: waist circumference >/= 102 cm (40 inches) (for males) and >/=88cm (36 inches) (in females)
2. Triglycerides: >/= 1.7 mmol/L
3. High-density lipoprotein cholesterol (HDL-C) < 1.03 mmol/L in males, <1.29 mmol/L in females
4. Blood pressure: >/= 130/85 mmHg
5. Fasting plasma glucose: >/= 6.1 mmol/L

Furthermore, clinical characteristics were collected. The initial presentation described whether patients presented to their referring hospital with acute chest pain i.e. chest pain experienced for the first time, a change in character of their existing, chronic angina, or with other symptoms like syncope. Biochemical parameters including cardiac enzymes, renal function and haemoglobin were also collected. In addition to these laboratory parameters, changes on the electrocardiogram were described. Angiographic findings describing the site and extent of myocardial infarction were also extracted from the files. In addition, outcomes were determined on the basis of a new myocardial infarction after the index myocardial infarction, the number of

months until a new myocardial infarction, functional status of the patient following myocardial infarction and employment status post-myocardial infarction. A functional status questionnaire was presented to patients telephonically and looked for suggestive symptoms of heart failure like lower limb oedema, orthopnoea and paroxysmal nocturnal dyspnoea and whether or not these patients suffered from chronic angina, or had complete resolution of symptoms following the myocardial infarction. Information pertaining to the abovementioned outcomes was obtained telephonically one year after the study period. Parameters were entered onto EXCEL spreadsheets for comparison of the Black group with Indian and Caucasian groups.

3.4 Ethical Considerations

Full ethical approval was obtained from BREC prior to commencement of the study (BREC Number: BE299/12). The names of patients selected for study were encoded in numerical sequence to preserve confidentiality. Telephonic consent was obtained from each patient during the follow-up part of the study before any questions were asked.

3.5 Statistical methods and analysis

Data was entered into SPSS version 21 (Statistical Packages for the Social Sciences) for analysis. Data analysis was initiated with a check of the data for outliers, missing data, and normality through skewness and kurtotis values that could affect relations between variables. A descriptive statistical analysis

of the data (means, standard deviations, ranges, frequencies and percentages) was initially conducted prior to computing the inferential statistics. One way analysis of variance (ANOVA) between groups was used to compare means differences of single normally distributed interval dependent variables (e.g. age) by selected categorical variables e.g. race, gender etc. A factorial ANOVA was used for two or more categorical independent variables (either with or without the interactions). If the selected covariate was not normally distributed (base on the Shapiro-Wilk test) then a non-parametric equivalent, namely the Kruskal-Wallis equality-of-populations rank test, was used instead. A Pearson chi-squared ($\chi 2$) test was used to assess significant differences in proportions of categorical cross tabulations. If the expected cell count in any cross tabulation was less than 5, then a non-parametric Fishers exact test was used. Logistic regression was used to compare clinical and other characteristics by Black ethnicity versus Indian and Caucasians combined. Coefficients were exponentiated to represent odds ratios with 95% confidence intervals (CI's). Adjustment for multiple testing using the Simes method was also used. A p-value <0.05 was considered as statistically significant for all tests.

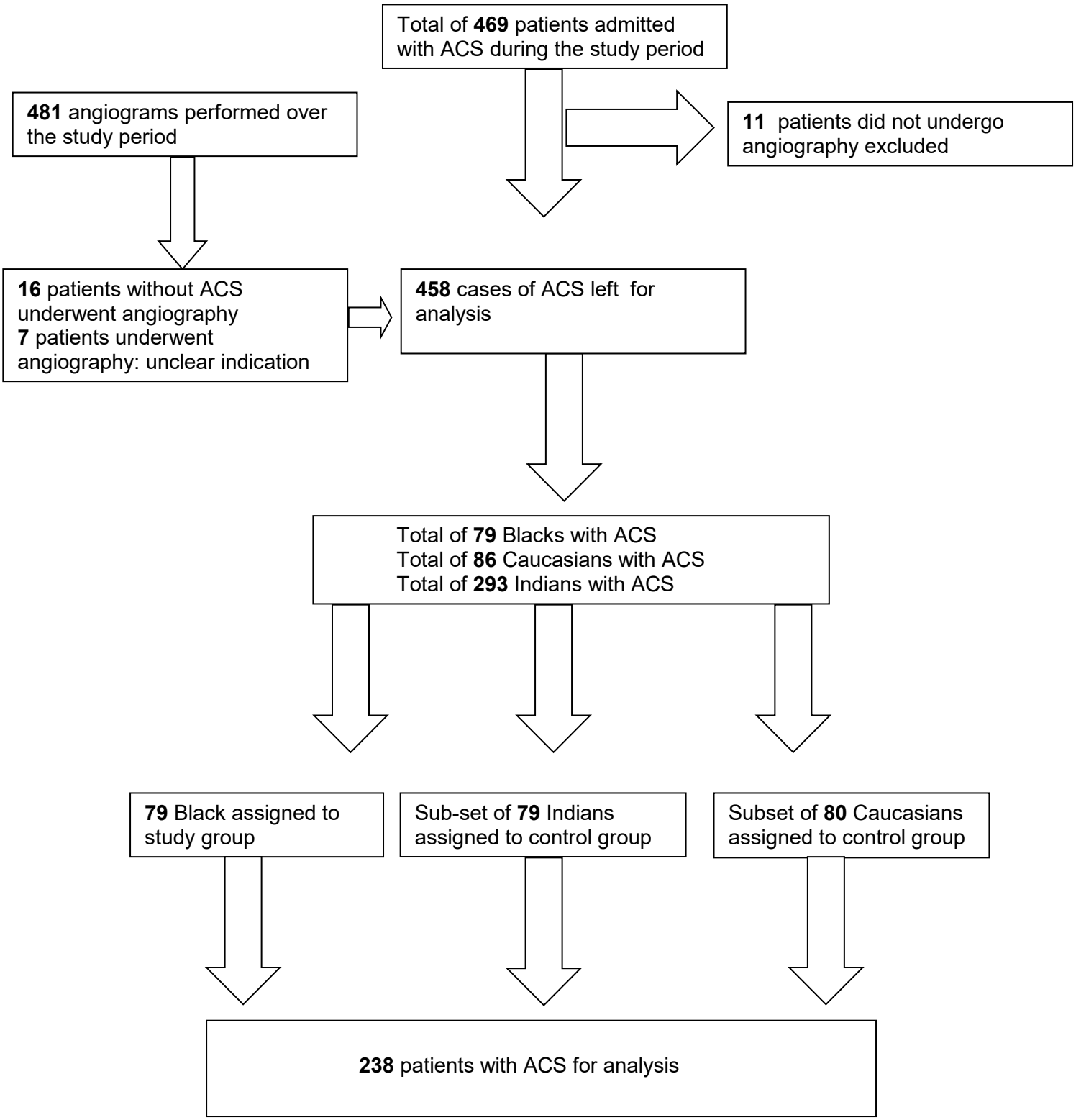
Chapter 4: Results

4.1 Prevalence of acute coronary syndrome

During the study period, we identified 469 patients who were admitted to Grey's Hospital with acute coronary syndrome (UA, NSTEMI and STEMI), 458 of whom underwent coronary angiography. Eleven patients did not undergo angiography and were excluded.

A total number of 481 angiograms were performed during the study period. There were 16patients who underwent angiography for which the primary indication was not acute coronary syndrome (screening pre-valve repair/during pacemaker insertion). Files were not found in seven patients and it was unclear whether myocardial infarction was the primary indication for angiography. All these patients were thus excluded leaving four hundred and fifty eight subjects with acute coronary syndrome for analysis. (Figure 3)

Figure 3. Selection of the study group:



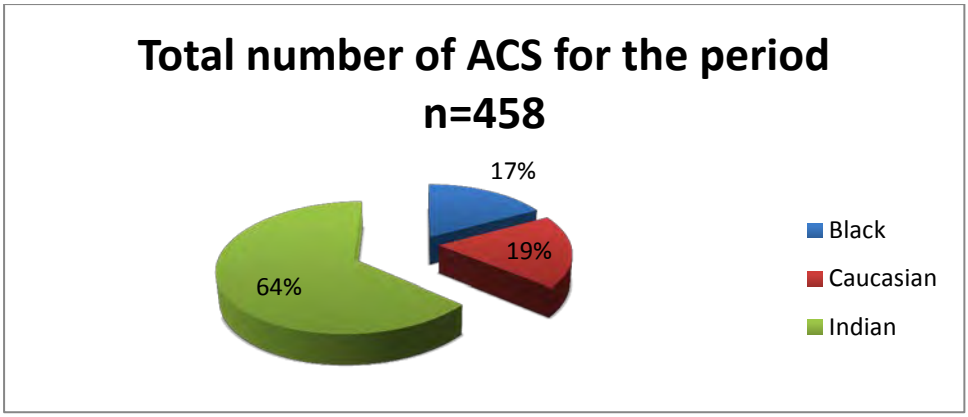


Fig. 4. Number of ACS over 20 months. The highest proportion of MI was among Indian patients. Number of MI in Blacks and Caucasians was similar.

There were 79 Blacks (17.24%), 293 Indians (64%) and 86 Caucasian patients (19%) with acute coronary syndrome, yielding an in-hospital prevalence of ACS in Black subjects of 17.24% of the total number of patients with ACS over the study period. (Figure 4). All of the 79 cases of acute coronary syndrome among Black African patients were assigned to a study group. A subset of 79 Indians and 80 Caucasians from the total number, matched within 5 years of age and for gender were consecutively selected as comparative subjects.

4.2 Demographic data

By design, Blacks, Caucasians and Indians comprised three equal groups. The demographic data are summarised in Table 1 below. Median age amongst Blacks and Indians was similar by design but tended to be significantly higher in Caucasians (54 v. 56 v. 61; p = 0.008), despite the best

efforts to match them for age. The mean age of all males and females in the three groups was not significantly different (56.0 v. 57.8, p = 0.295). Males comprised 65.8% of patients in the Black group. Within the Black group, females were significantly older than males (58.8 v. 52.8, p = 0.033).

Table 1. Baseline characteristics of the study population

Characteristic	Black N = 79	Indian N = 79	Caucasian N = 80	Overall (%) N = 238	p-value
Mean age (SD)	54.8 (12.0)	55.1 (10.0)	59.7 (11.9)	56.5 (11.5)	0.010*
Median age (IQR)‖	54(46-62)	56 (47-63)	61(51-71)	56 (48-64)	0.008 ┼
Diabetes: n (%)	37 (46.8)	40 (50.6)	30 (37.5)	107 (45.0)	0.230ǂ
Hypertension: n (%)	53 (67.1)	54 (68.4)	48 (60.0)	155 (65.1)	0.491ǂ
Dyslipidemia: n (%)	44 (56.4)	62 (79.5)	69 (87.3)	175 (73.5)	0.001ǂ
Family history: n (%)	4 (5.1)	52 (65.8)	34 (42.5)	90 (37.8)	0.001§
Smoking: n (%)	32 (40.5)	51 (64.6)	50 (62.5)	133 (55.9)	0.004 §
Mean smoking pack years¶ (SD)	16.4(11.22)	24.3 (21.6)	32.9 (20.1)	25.6 (19.71)	0.005*

*: t-test; ┼: Wilcoxon rank=sum test; ǂ: Chi-squared (χ^2) test; §: Fishers exact test
¶: Smoking pack year data only collected from 24/32 Black smokers, 31/51 Indian Smokers and 35/50 Caucasian smokers.
‖: Interquartile range

There is a high prevalence of exposure to selected risk factors across all the racial groups. There was no significant difference in the prevalence of diabetes and hypertension across the groups (p = 0.230 and p = 0.491 respectively). Dyslipidaemia and smoking was significantly lower in the Black group (p = 0.001 and 0.004 respectively).

4.3 Risk factor profiles

In the group of two hundred and thirty eight subjects selected for study, 45.0% had diabetes, 65.1% had hypertension and 73.5% had dyslipidaemia. A family history of CAD was present in 37.8% and 55.9% of the group were smokers. The smoking prevalence was lowest in the Black group, and highest in the Indian and Caucasian groups (40.5% v. 64.6% v. 62.5%; p = 0.004).

The prevalence of diabetes among Blacks, Indians and Caucasians was similar with no significant difference between the groups (46.8% v. 50.6% v. 37.5%; p = 0.230). Similarly, there was no significant difference in the prevalence of hypertension (67.1% v. 68.4% v. 60.0%; p = 0.491) between the groups. Blacks had the lowest proportion of dyslipidaemia (56.4% v. 79.5% v. 87.3%; p <0.001) compared to Indians and Caucasians. Table 2 shows that hypercholesterolaemia was significantly different by race with the lowest prevalence in the Black group (14.3% v. 25% v. 41.4%; p = 0.003) compared to the Indian and Caucasian groups. Blacks had a marginally significantly lower total cholesterol compared to Indians and Caucasians(see Table 3); (4.0 v. 4.5 v. 4.6; p = 0.017). Blacks also had significantly lower LDL levels compared to Indians and Caucasians (2.2 v. 2.9 v. 2.9; p = 0.004). Hypertriglyceridaemia was not significantly different in Blacks compared to Indians and Caucasians (37.1% v. 50.8 v. 38.2%; p = 0.209). Blacks had marginally comparable rates of atherogenic dyslipidaemia to Indians and Caucasians (31.9% v. 44.6% v. 25.8%; p = 0.067). Of significance however is the median HDL-C was identical for all three groups at 0.9 mmol/L. Blacks

had the lowest prevalence of family history of coronary artery disease compared to Indians and Caucasians (5.1% v. 65.1% v. 42.5%; p < 0.001).

Table 2. Lipid profile cut-offs

Parameter mmol/l	Black N = 70	Indian N = 65	Caucasian N = 68	Total N = 203	p-value*
Triglycerides (TG) >/= 1.7 n (%)	26 (37.1)	33 (50.8)	26 (38.2)	85 (41.9)	0.209
HDL-C < 1.29 (females) n (%)	22 (95.7)	16 (84.2)	13 (72.2)	51 (85)	0.113
HDL-C< 1.03 (males) n (%)	34 (73.9)	36 (78.3)	35 (71.4)	105 (74.5)	0.743
Total cholesterol> 5 n (%)	6 (14.3)	13 (25.0)	14 (41.4)	33 (19)	0.003
LDL >2.5 n (%)	9 (30.6)	33 (56.9)	36 (64.3)	88 (50)	0.001
>TG and low HDL n (%)	22 (31.9)	29 (44.6)	17 (25.8)	68 (33.5)	0.067

*Chi-squared (χ^2) test

Table 3. Biochemical lipid parameters (Median (IQR))

Parameter mmol/l	Black	Indian	Caucasian	Overall Median (IQR)	p-value*	p-value┼
TC╪(IQR)	4 (3.4-4.5)	4.5 (3.8-5.9)	4.6 (3.8-5.5)	4.4 (3.6-5.3)	0.005	0.017
LDL §(IQR)	2.2 (1.8-2.8)	2.9 (2.0-3.7)	2.9 (2.2-3.5)	2.6 (1.9-3.4)	0.004	0.017
Triglyceride¶(IQR)	1.4 (0.8-2.1)	1.7 (1.3-2.5)	1.5 (1.1-2.1)	1.5 (1.1-2.2)	0.054	0.081
HDL-C ‖(IQR)	0.9 (0.7-1.1)	0.9 (0.7-1.0)	0.9 (0.7-1.1)	0.9 (0.7-1.1)	0.782	0.782

*: Kruskal Wallis test; ┼: Adjusted for multiple test comparisons using the Simes method; ╪: Number of non-missing observations: Black, Indian, Caucasian= 71, 65, 70; §: Number of non-missing observations: Black, Indian, Caucasian= 63, 58, 56; ¶: Number of non-missing observations: Black, Indian, Caucasian = 70, 65, 68; ‖: Number of non-missing observations: Black, Indian, Caucasian= 69, 65, 67

4.4 Clinical data

The major aspects of the clinical presentation that were examined are summarised in Table4. Significantly more Blacks presented with new-onset chest pain (OR = 2.61; p= 0.003) and sweating (OR = 2.68; p= 0.010) as the initial symptom, and were significantly less likely to present with worsening of chronic angina compared to Indians and Caucasians (OR = 0.31; p< 0.001). Blacks were significantly more likely to present with a first acute coronary syndrome compared to Indians and Caucasians(88.6% v. 58.2% v. 63.8%; OR = 4.80; p< 0.001).

STEMI was the most common acute coronary syndrome in the Black group (57% v. 38% v. 35%; OR = 3.74; p< 0.001) compared to Indians and Caucasians.

Unstable angina was significantly lower among Black African patients compared to Indians and Caucasians(15.2% v. 43% v. 35%; OR = 0.26; p< 0.001). NSTEMI prevalence did not significantly vary by race (26.6% v. 19.0% v. 28.8%; OR = 1.21; p = 0.543).

Anterior and apical myocardial infarction were the commonest sites of infarction in the Black group compared to Indians and Caucasians (45.6% v. 35.1% v. 26.3%; OR = 1.87; p= 0.032 for anterior, 27.6% v. 13.3% v. 15.6%; OR = 2.09; p= 0.037 for apical). Left ventricular ejection fraction was similar in all three groups (mean: 48.6% [95% CI: 47.1-50.1]; p = 0.372). There were no significant differences in the risk of complications between the groups.

Table 4. Clinical Characteristics of the study population

Characteristic: n (%)	**Black N = 79**	**Indian N = 79**	**Caucasian N = 80**	**Total N = 238**	**Odds ratio (OR)**	**p-value***
Symptoms						
Acute pain	60 (75.9)	43 (54.4)	46 (57.5)	149 (62.6)	2.61 [1.40-4.87]	0.003
Acute on chronic pain	15 (19)	35 (44.3)	31 (38.8)	81 (34)	0.31 [0.16-0.61]	0.001
Syncope	2 (2.5)	2 (2.5)	2 (2.5)	6 (2.5)	1.37 [0.23-8.26]	0.728
Palpitations	10 (12.7)	4 (5.1)	6 (7.5)	20 (8.4)	2.13 [0.83-5.50]	0.117
Dizziness/Collapse	5 (6.3)	1 (1.3)	2 (2.5)	8 (3.4)	5.05 [0.60-44.51]	0.145
Sweating	18 (22.8)	5 (6.3)	11 (13.8)	34 (14.3)	2.68 [1.30-5.65]	0.010
Nausea/vomiting	9 (11.4)	3 (3.8)	3 (3.8)	15 (6.3)	3.40 [1.13-10.1]	0.029
Heart failure/ Dyspnoea	2 (2.5)	4 (5.1)	2 (2.5)	8 (3.4)	0.62 [0.12-3.30]	0.573
Event type						
1st MI	70 (88.6)	46 (58.2)	51 (63.8)	167 (70.2)	4.80 [2.23-10.34]	<0.001
NSTEMI	21	15 (19)	23 (28.8)	59 (24.8)	1.21[0.65-	0.543

	(26.6)				2.28]	
STEMI	45(57)	30 (38)	28 (35)	103 (43.3)	3.74 [1.80-7.78]	<0.001
Unstable angina	12 (15.2)	34 (43)	28 (35)	74 (31.1)	0.26 [0.13-0.53]	<0.001
New LBBB	1 (1.3)	0 (0)	1 (1.3)	2 (0.8)	1.77 [0.12-29.31]	0.69
ECG						
Anterior	36 (46.2)	27 (35.1)	21 (26.3)	84 (35.3)	1.20 [1.1-3.41]	0.026
Inferior	27 (34.6)	20 (26)	35 (43.8)	82 (34.5)	1.03 [0.60-1.83]	0.931
Lateral	31 (39.7)	29 (37.7)	31 (38.8)	91 (38.2)	1.05 [0.60-1.85]	0.859
Septal	11 (14.1)	17 (22.1)	12 (15)	40 (16.8)	0.72 [0.33-1.53]	0.388
Posterior	2 (2.6)	2 (2.6)	2 (2.5)	6 (2.5)	0.87 [0.15-4.98]	0.879
RV infarct	3 (3.8)	1 (1.3)	0 (0)	4 (1.7)	5.33 [0.53-53.27]	0.154
No new ischaemic changes on ECG	7 (9)	17 (22.1)	18 (22.5)	42 (17.6)	0.34 [0.14-0.81]	0.015
Angiographic findings[‡]						
Infarct site						
- Anterior	28 (45.6)	24 (35.1)	14 (26.3)	66 (27.7)	2.06 [1.07-3.98]	0.031
- Inferior	4 (6.9)	7 (11.1)	5 (8.1)	16 (6.7)	0.71 [0.22-2.31]	0.569
- Lateral	30 (51.7)	29 (46)	19 (30.6)	78 (32.8)	1.67 [0.88-3.18]	0.119
- Septal	17 (29.3)	12 (19)	8 (12.9)	37 (15.5)	2.1 [0.97-4.37]	0.059
- Posterior	11 (19)	15 (23.8)	20 (32.3)	46 (19.3)	0.62 [0.29-1.35]	0.232
- Apical	28 (27.6)	19 (13.3)	15 (15.6)	62 (26.1)	2.44 [1.25-4.76]	0.009
- Basal	11 (19)	14 (22.2)	18 (29)	43 (18.1)	0.69 [0.32-1.50]	0.354
- No RWMA	11 (19)	24 (38.1)	25 (40.3)	60 (25.2)	0.36 [0.17-0.77]	0.008
- Global hypokinesis	4 (6.9)	0 (0)	1 (1.6)	5 (2.1)	10.85 [1.13-104.30]	0.039
EF(%): median (IQR)[§]	50 (40-54)	52 (43-57)	52 (48-55)	48.6 (47.1-50.1)	---	0.372
Complications						
None	67 (84.8)	62 (78.5)	64 (80)	193 (91)	1.36 [0.64-2.88]	0.424
Ventricular tachycardia	5(6.3)	2 (2.5)	12 (15)	18 (7.6)	0.79 [0.27-2.34]	0.673
Complete heart block	2 (2.5)	3 (3.8)	0 (0)	5 (2.1)	1.61 [0.25-10.5]	0.617
Heart failure	8 (10.1)	7 (8.9)	2 (2.5)	17 (7.1)	1.98 [0.71-5.50]	0.191

Death on admission	1 (1.3)	0 (0)	1 (1.3)	2 (0.8)	2.10 [0.10-41.91]	0.629

*: logistic regressions adjusted for age and gender; ┼: zero events in Black ethnicity; ╪: Number of non-missing observations: Black, Indian, Caucasian = 61, 61, 61; §: Number of non-missing observations: Black, Indian, Caucasian = 61, 67, 51

¶ [95% CI] Black versus Indians/Caucasian as reference group

‖ Ejection Fraction

4.5 Biochemical data

As shown in Table 5, Blacks had significantly higher troponin I levels when compared to Indians and Caucasians (5.94 v. 0.85 v. 1.6; p = 0.02). Blacks also had significantly lower haemoglobin levels compared to Indians and Caucasians(13.05 v. 14.1 v. 14.3; p = 0.010). Renal function was similar across all three groups with a normal serum urea (4.25 v. 5.2 v. 5.1; p = 0.052) and normal serum creatinine (85 v. 85 v. 85; p = 0.782). HbA1C was elevated among all three race groups and was not significantly different between Blacks, Indians and Caucasians (6.65 v. 6.4 v. 6.3; p = 0.118). This is not surprising since the prevalence of diabetes was similar across the groups.

Table 5. Biochemical parameters

Parameter [Unit of measurement]: median (IQR*)	**Black**	**Indian**	**Caucasian**	**Overall Median [IQR]**	**p-value‡‡**	**p-value‡‡**
CKMB fraction [ug/l]‡	9 (3-126)	4 (2-33)	6 (3-47)	6 (2-47)	0.057	0.081
Troponin I [ug/l]‡	5.94 (0.52- 35.52)	0.85 (0.02-4.53)	1.6 (0.03-13.96)	2.29 (0.03-20.35)	0.008	0.020
Haemoglobin [g/dl]§	13.05 (12-14.4)	14.1 (13.1-15.3)	14.3 (13.3-14.3)	13.9 (12.7-15)	0.001	0.010
Urea [mmol/l]¶	4.25 (3.05-6.2)	5.2 (3.9-6.6)	5.1 (4-6.3)	5.5 (3.5-6.3)	0.026	0.052
Creatinine [umol/l]‖	85 (71-99)	85 (74-107)	89 (74-101)	85 (72-102)	0.760	0.782
HbA1c [%]**	6.65 (6.2-9.05)	6.4 (5.95-8)	6.3 (5.9-7)	6.4 (6-7.9)	0.094	0.118

*: Interquartile range; ‡: Number of non-missing observations: Black, Indian, Caucasian = 67, 67, 71; ‡: Number of non-missing observations: Black, Indian, Caucasian=, 76. 73, 74 ; §: Number of non-missing observations: Black, Indian, Caucasian = 76, 77, 79; ¶: Number of non-missing observations: Black, Indian, Caucasian = 76, 79, 79; ‖: Number of non-missing observations: Black, Indian, Caucasian = 76, 79, 79; **: Number of non-missing observations: Black, Indian, Caucasian = 48, 48, 49; ‡‡: Kruskal Wallis test; ‡‡: Adjusted for multiple test comparisons using the Simes method

4.6 Angiographic findings

As outlined in Table 6, a significant association exists between the severity of coronary vessel involvement and race. Black African patients had a lower prevalence of three vessel disease (TVD) compared to Indians and Caucasians(17.9% v. 46.2% v. 30.4%; $p < 0.001$). Blacks were similar to the Caucasian group in the number of patients with double vessel disease (DVD) (15.4% v. 20.5% v. 15.2%; $p < 0.001$) and single vessel disease (SVD) (32.1% v. 20.5% v. 30.4%; $p < 0.001$). A significantly higher proportion of Blacks with acute coronary syndrome had normal epicardial coronaries compared to Indians and Caucasians (23.1% v. 6.4% v. 8.9%; $p < 0.001$).

Table 6. Angiographic findings

Characteristic: n (%)	Black N = 79	Indian N = 79	Caucasian N = 79	Total N = 238	p-value*
Left main stem disease	0 (0)	1 (1.3)	0 (0)	1 (0.4)	┼
Triple vessel disease	14 (17.9)	36 (46.2)	24 (30.4)	74 (31.1)	0.001
Double vessel disease	12 (15.4)	16 (20.5)	12 (15.2)	40 (16.8)	
Single vessel disease	25 (32.1)	16 (20.5)	24 (30.4)	65 (27.3)	
Non-occlusive atheroma	9 (11.5)	4 (5.1)	12 (15.2)	25 (10.5)	
Normal	18 (23.1)	5 (6.4)	7 (8.9)	30 (12.6)	

*: Pearson chi-squared (χ^2) test; ┼: excluded from test statistic

There was significantly less severe involvement of coronary arteries in the Black group (p = 0.001), which had the highest number of single vessel disease and the least triple vessel disease.

4.7 One year follow up

Patients were contacted telephonically 1 year after the study period. Unfortunately, follow-up at one year was poor. Only 40% of Black African patients and 60% of Indians and Caucasians could be contacted (See Table 7). Recurrent myocardial infarction was more frequently documented in Indians followed by Caucasians, than Blacks, but there was no significant difference between the groups. There was no significant difference in numbers of new myocardial infarction after the index myocardial infarction by race ($p = 0.364$). Blacks had a significantly lower incidence of recurrent angina ($p = 0.044$) and were marginally significantly more likely to be stable one year following myocardial infarction ($p = 0.052$). No significant difference in recurrent heart failure was observed by race ($p = 0.122$). More Indians had undergone or were awaiting coronary artery bypass grafting followed by Caucasians than Blacks, but this was also not statistically significant ($p = 0.425$). More Indians and Caucasians underwent stent insertion as compared to Blacks, though not statistically significant ($p = 0.857$). Although more Indians had died at one year follow up as compared to Blacks and Caucasians this finding was not statistically significant ($p = 0.200$).

Table 7. Follow-up at one year

Characteristic: n (%)	Black N = 34	Indian N = 53	Caucasian N = 55	p-value
New MI	9 (26.5)	19 (34)	12 (21.8)	0.364*
CABG†	10 (29.4)	23 (43.4)	20 (36.4)	0.425*
Stent	9 (25)	13 (24.5)	17 (28.8)	0.857*
Deceased	3 (9.4)	7 (14.3)	3 (6)	0.200‡
Stable	15 (51.7)	11 (26.2)	21 (44.7)	0.052*
Chest pain	10 (35.7)	27 (64.3)	21 (44.7)	0.044*
Heart failure	5 (17.9)	15 (35.7)	9 (19.1)	0.122*
Employed	7 (24.1)	12 (28.6)	16 (34)	0.644*

* : Chi-squared (χ^2) test; †: Had already undergone or were awaiting CABG; ‡: Fishers exact test

4.8 Estimated minimum prevalence of metabolic syndrome

In order to establish the prevalence of risk factor clustering among the groups, we also evaluated the number of patients who presented with three or more criteria of the metabolic syndrome in Table 8 below.

TABLE 8: Estimated prevalence of Metabolic Syndrome in the study cohort

MS Criteria	Blacks n =79 (%)	Indians n = 79 (%)	Caucasians n = 80 (%)	Total n = (%)
Diabetes	37 (46.8)	40 (50.6)	30 (37.5)	107 (45)
BP >/= 130/85	25 (31.6)	28 (35.4)	32 (40)	85 (36)
HDL < 1.03 M	34 (73.9)	36 (78.3)	35 (71.4)	105 (74.5)
< 1.29 F	22 (95.7)	16 (84.2)	13 (72.2)	51 (85)
Tg>/= 1.7	26 (33)	33 (41.7)	26 (32.5)	85 (35.7)
2 MS criteria	25 (31.6)	24 (30.4)	35 (43.8)	84 (35.3)
3 MS criteria	16 (20.3)	17 (21.5)	12 (15)	45 (18.9)

For the purposes of this analysis, metabolic syndrome was diagnosed according to the NCEP criteria [14]. For most subjects however, there was no data on waist circumference. Thus, our statistics presented on the metabolic syndrome in all likelihood underestimated the true prevalence. Based on any three criteria the minimum prevalence of metabolic syndrome was equally common in the Black, Indian and Caucasian groups (52% v. 52% v. 59%).

Chapter 5: Discussion

This study aimed to describe the changing spectrum of coronary artery disease in Blacks and see how it differed when compared to other race groups in South Africa. The results show that this spectrum has clearly changed with an increase in the prevalence of myocardial infarction in Blacks, a finding in agreement with recent studies which showed a strikingly high prevalence of risk factors for coronary artery disease in urbanised Black subjects [15].Indeed, this study shows that the risk factor profile of myocardial infarction in Blacks and Indians is almost identical.

Blacks matched Caucasians in the number of cases of myocardial infarction, constituting 17% of all cases of myocardial infarction referred during the study period. This is in stark contrast to Naidoo and Cassim's 1996 abstract, where they estimated the prevalence of Black myocardial infarction to be just under 8% in their study cohort [8]. Our finding also contrasts with the earlier study by Seedat et al, which showed an even lower prevalence of Black myocardial infarction (2.4%) in that cohort [9].

We can explain this finding if we look once more at the Okrainec review article [1], which described how developing countries are undergoing rapid urbanization and epidemiologic transition, thus exposing larger numbers of lower socioeconomic groups to multiple risk factors for coronary artery disease despite a lack of affluence. South Africa is a country with both affluent and impoverished communities and illustrates this progressive urban

transition as more people move to urban areas looking for work and are exposed to risk factors for coronary artery disease. Westernization of the traditional African diet coupled with increasing rates of obesity and metabolic syndrome are likely contributors to this observation. A nutrition transition [1] which describes the shift in the global diet from complex carbohydrates and fiber to higher proportions of sugars and fats, is likely to be a significant factor in explaining the high number of patients with metabolic syndrome and coronary artery disease in our study.

There was a strong family history of coronary artery disease amongst Indians and Caucasians but only 5% of Blacks had a positive family history of coronary artery disease. Early studies describing much lower rates of atherosclerotic disease as well as fewer risk factors for coronary artery disease in Black African patients have already been discussed [5], [6], [7], [8], [9], and highlight how dramatic the change has been over the last three decades, as shown in our study and others [15]

Caucasian patients presenting with myocardial infarction tended to be significantly older than Black subjects even with attempts to match the two groups by age. Previous studies have already reflected that Blacks with coronary artery disease were younger than their Caucasian counterparts [11]. Our study confirms this, making early screening for coronary artery disease an important aspect of primary prevention in this group. Having said this, it is possible that younger, more affluent Caucasian patients with myocardial infarction, are presenting to private hospitals for treatment and thus the

observation that Caucasian patients tended to be significantly older may not be an accurate reflection of the general population in Kwa-Zulu Natal and just reflects the demography at Grey's Hospital. More than two thirds of Black African patients in the study were male, a finding that is consistent with previous reports which have shown that coronary artery disease is three-fold higher in males than females, and mortality five-fold higher [19].

What was indeed startling was that the prevalence of traditional risk factors among Blacks was similar to Indians and Caucasians. It is known that hypertension is a global health burden affecting both developed and developing countries, including South Africa [20]. So it is not surprising that hypertension was frequently present in two thirds of subjects and affected all groups equally. Unexpectedly, Blacks appeared to have as much diabetes compared to Indians. This finding is compatible with a recent report by Ntyintyane et al. of the increasing burden of diabetes in urbanized Black South Africans with CAD [15].These authors found a high prevalence of obesity which, coupled with a sedentary lifestyle are likely driving the emergence of Type 2 diabetes and thus predisposition to CAD in urbanised Black South Africans. It is noteworthy that of the total cohort of two hundred and thirty eight study participants, 31 patients (14 Blacks, 5 Indians and 12Caucasians), i.e. 13% of patients were not screened for diabetes and this may have underestimated the prevalence of diabetes in the cohort. Poor documentation of diabetic status may have also contributed to this result, illustrating some of the challenges of a retrospective study. Indians had the highest rates of diabetes and smoking which are proven major risk factors in

the progression of atherosclerosis and consistent with previous studies showing that smoking decreases HDL-C levels and increases the risk of myocardial infarction through long term effects on the atherosclerotic process [21].

The finding of a lower prevalence of hypercholesterolaemia and dyslipidaemia in Blacks is consistent with previous reports [7], [8], [11]. It is notable however that one third of Blacks in our study had atherogenic dyslipidaemia (Table 2). Atherogenic dyslipidaemia (low HDL cholesterol and raised triglycerides) is a typical feature of obesity, insulin resistance, and Type 2 diabetes, and has emerged as an important risk factor for MS and a subsequent predisposition to cardiovascular disease [22].

It is also noteworthy that in our study, 95% of Black females and 70% of males had low HDL-C levels, in keeping with the presence of metabolic syndrome and diabetes, resulting in a predisposition to coronary artery disease and MI. Indeed, one in two Black African patients had diabetes, explaining the atherogenic lipid profile in these patients. The very high prevalence of low HDL-C in our Black subjects with MI suggest that this may become an effective screening test in order to identify Black African patients with a high risk of coronary artery disease at an earlier stage. This finding is in agreement with a recent study in Mexico in which 85.1% of all patients with myocardial infarction had some form of dyslipidaemia, with low HDL-C levels having the highest prevalence(68.6%) of all the alterations in the lipid profile [13].

The estimated prevalence of metabolic syndrome in Black African patients with myocardial infarction was 20% and was very similar to the Indian group (21.5%) in the study. These findings correlate with previous reports of the high burden of cardiovascular risk factors and metabolic syndrome in Black African patients [15]. However, the lack of documentation of waist circumference in patient's files has also likely underestimated the true prevalence of metabolic syndrome in our study (especially as 95% of females had low HDL and nearly half of all Black African patients had proven diabetes). Had we measured waist circumference in our study, the true prevalence of metabolic syndrome may have been closer to the 60% MS prevalence reported in Ntyintyane's 2006 study [15] .

The main risk factors that have emerged from our study were diabetes and an atherogenic lipid profile – two important components of the metabolic syndrome. Our study clearly shows that Black African patients with MI already have a high prevalence of metabolic syndrome and other risk factors for CAD that is comparable to Indians.

The study also found that Blacks were more likely to present with their first myocardial infarction on admission, with anterior ST segment elevation myocardial infarction (STEMI) and with first-time chest pain. This suggests that Black African patients may not have warning signs like preceding angina or an established history of coronary artery disease when they present to hospital, which makes aggressive screening programs and control of risk factors in this group exceedingly important. In contrast to the sudden, notably

anterior ST segment elevation myocardial infarction in Blacks, the study showed that Indians and Caucasians present more frequently with a change in character of their chronic angina. Studies have shown better clinical outcome in patients with preceding angina with less left ventricular remodelling than those with no preceding angina on the basis of ischaemic preconditioning [23]. Indian and Caucasian patients had significantly higher rates of unstable angina (UA) and non - ST segment elevation myocardial infarction (NSTEMI) when compared to Black African patients. They were also more likely to present with a second or third myocardial infarction, have a background of pre-existing coronary artery disease and were more likely to have undergone interventions such as stenting and coronary artery bypass grafting. Sweating was an uncommon symptom possibly due to underlying diabetic autonomic neuropathy. Blacks however, did present significantly with sweating as a concomitant symptom although rates of diabetes in this group were similar to controls.

Our results also show that Blacks have a similar spectrum of coronary vessel involvement at angiography as Caucasians. Single vessel disease and double vessel disease were the commonest findings in these two groups. This contrasts with previous reports, where double vessel disease was the commonest finding in all three racial groups [7]. Indeed, a significantly higher proportion of Black African patients (32.1%) had single vessel disease as compared to Indians (20.5%). These findings are in contrast to the observations of Whittle et al, whose study showed that Blacks had a higher likelihood of non-occlusive disease than Caucasians [2]. Although a higher

number of Blacks had normal epicardial coronaries at angiography, our study shows a significantly greater severity of coronary vessel involvement in Blacks that was comparable to Caucasians. Our study shows a significantly greater severity of coronary vessel involvement in Blacks that was comparable to Caucasians. Indians had the highest prevalence of three vessel disease, which is not surprising considering the high burden of diabetes and coronary artery disease in this group [19].

Eighteen Black subjects with MI had normal coronary angiograms. Of these, three had received fibrinolysis, which could have explained these findings. The finding of normal epicardial vessels amongst Black MI may reflect microvascular ischaemia, spontaneous thrombolysis, occult atherosclerosis or some other unexplained phenomenon. In our study, more Blacks underwent thrombolysis compared to Indians and Caucasians (35% v. 16.1% v. 34.4%).Another explanation for the finding of normal coronary vessels could be related to angiographic spontaneous reperfusion of the culprit infarct-related artery, which is a recognised feature of ST-segment elevation myocardial infarction and is known to be associated with better clinical outcomes in patients [24].

Furthermore, it is known that acute coronary syndromes can frequently occur as a result of disruption of modestly stenotic plaques, not detectable by angiography, but only by intravascular ultrasound, which may account for the higher number of normal coronaries in the Black group and suggests a possibly milder form of coronary artery disease in this group [25].

An analysis of previous and current literature shows a clear change in the spectrum of coronary artery disease among South African Black patients as outlined in Table 9, which shows the gradual increase in the prevalence of conventional risk factors for coronary artery disease in Black African patients.

An early study by Seftel et al suggests an already higher prevalence of hypercholesterolaemia and diabetes [26]; however there was small number of patients in this study. Our findings contrast with Seedat's study [9] showing a low prevalence of hypercholesterolaemia and diabetes as well as with Thandroyen's article [7] in which no cases of diabetes in Black subjects were found. Our finding of a 95% prevalence of low HDL-C in females, correlates with Ntyintyane's study [15], which showed that up to 57% of females with MS had low HDL levels. Furthermore, our finding of an increased prevalence of diabetes is in agreement with Ntyintyane's 50% prevalence of glucose dysregulation. In keeping with the Interheart study [12] our study suggests that major risk factors are the driving factors behind the development of MI in Black subjects. Diabetes and its associated dyslipidaemia with a low HDL-C were the commonest major risk factors in our study. Of importance, our 79 subjects were collected over a period of 20 months reflecting an increase in the incidence of coronary disease in Black subjects over a relatively short period of time.

Table 9. The Changing Spectrum of CAD in South African Blacks

Year	Author	Black MI	Lipid profile	Diabetes %
1970	Seftel et al.[26]	N = 24	TC:MI v. Controls:195 v 172mg/100ml TG: MI v Controls129 v 68 mg/100ml	(10/24) 40%
1980	Thandroyen et al. [7]	N = 17	High TC 50% High TG-23% High TG: No correlation with severity of CAD	0
1992	Seedat et al. [9]*	N = 458	"Hypercholesterolemia less common" TG – 11.2% (males), 3.5% (females) "Protective levels of HDL in 81.3%"; Low HDL:TC ratio (23% males, 17% females)	4.9% (males), 2.9% (females)
1995	Cassim, Naidoo [8]	N = 104	Hypercholesterolaemia : 40%	10%
2006	Ntyintyane et al. [15]	N = 40	Low HDL: 33% (males), 57% (females) Hypercholesterolaemia: not shown	20% 30% IGT
2014	Dela	N = 79	TC: 14.3% TG: 37.1% Low HDL in 95% of females, 57% of males	46.8%;

*This study was a community survey as opposed to the other studies which were performed in Black subjects with MI.

Outcomes were difficult to assess due to poor follow-up rates in all three groups, particularly the Black group.Rather than underreporting this information, the authors believe that presenting this data reflects the logistical challenges and oftentimes poor documentation at hospitals. The lack of follow-up also demonstrates the social and economic challenges in our environment. Notable challenges relating to poor follow up included no contact details being available, phone numbers often not being given to the

admitting nurse as well as expired and incorrect numbers being recorded in files. Although not significant, the results at one year follow-up suggest that Caucasians had the lowest number of myocardial infarction after the index acute coronary syndrome. Indians had the highest rate. Had follow-up been better, we could have assessed how Blacks fared in the medium term following the initial myocardial infarction. Indians and Caucasians were referred for coronary artery bypass grafting more often than Blacks, reflecting greater severity of coronary artery disease in the Indian and Caucasian groups. Stent insertion also appeared higher in the Indian and Caucasian groups, with more Black African patients managed with optimum medical treatment. More Indians had died at one year follow-up, but this again needs to be proven through larger cohorts and prospective studies. Blacks had the lowest incidence of chest pain and heart failure and were more likely to be stable one year following myocardial infarction. Although not significant due to poor follow-up, these results may reflect a better outcome in Blacks, but greater numbers are needed to prove this. It is difficult to comment on return to employment although more Caucasians and Indians had returned to work after myocardial infarction.

OVERSIGHT, LIMITATIONS, CHALLENGES AND RECOMMENDATIONS

Several limitations of this study relate to its retrospective design. The lack of data regarding abdominal circumference and body mass index, as well as fasting glucose levels and glucose tolerance tests reduced the strength of the study and the accuracy of data to diagnose metabolic syndrome and diabetes. Had these variables been recorded, they would have provided greater information regarding the prevalence of metabolic syndrome in each race group. Furthermore, no records were found of waist circumference measurements that in all probability, also underestimated the prevalence of metabolic syndrome in our study. A diagnosis of hypertension was made either based on a previous diagnosis or from the final discharge summary. There was no indication as to whether the diagnosis was based on established guidelines.

Low follow up rates were a challenge.The initial objective of the study was to follow-up patients at 30 days following myocardial infarction, but this even this was not possible although the clinic was in a tertiary environment. Home visits, confirmation of telephone numbers and more effective communication with patients could be beneficial. Most of our patients in the Black group were of Zulu extraction with isiZulu being their first language. Communication of follow-up plans following discharge from the ward may have been compromised if patients were unable to understand, especially if they were informed about their follow-up plan in English. Furthermore all discharge summaries are typed out in English and this could also have been difficult to

understand for the patient possibly accounting for lack of follow-up. Emphasis on the need for clinic follow-up must be undertaken and in patients with poor socio-economic conditions, who cannot afford transport to hospital, improved communication with the referring hospital must be done to prevent patients being lost to follow-up and may help solve this problem.

Chapter 6: Conclusion

In summary, while CAD remains a common disease among Indians and Caucasians, this condition has clearly increased from previous anecdotal reports to four per month among Blacks at our institution. The increasing incidence of myocardial infarction in Black subjects is clearly attributable to the dramatic changes in their risk factor profiles.

Almost one in two Black subjects with myocardial infarction were diabetic and almost a third have atherogenic dyslipidaemia. What is alarming is that almost all Black females and three quarters of Black men have low HDL-C suggesting a greater predisposition to coronary artery disease. The high prevalence of major risk factors, with the exception of a positive family history, clearly places them at high risk. Although Blacks still have overall lower rates of hypercholesterolaemia and smoking, other traditional risk factors are found in similar numbers of Blacks with myocardial infarction compared to Indians and Caucasians, especially diabetes and atherogenic dyslipidaemia. The prevalence of metabolic syndrome in this group is also rising. The change in risk factor profile in the absence of family history suggests that this change has happened in the last generation. This is clearly attributable to the rapid urbanization of our country since 1994 and calls for urgent primary and secondary prevention programs for chronic diseases of lifestyle in Black communities.

Blacks had less triple vessel disease at angiography than Indians and they were more likely to present at a younger age than Caucasians, with anterior ST-segment elevation myocardial infarction, first myocardial infarction, and without preceding angina making them a high risk group.

Indeed the high risk factor profile of Black subjects with MI, indicates that it is almost too late for primordial prevention measures in this group since these risk factors are already established in the urbanised Black population [15]. Primary prevention is therefore critical. This race group should no longer be regarded as a low risk group for ACS.

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