Metabolic syndrome indicators and target organ damage in urban active coping African and Caucasian men: The SABPA study

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ABSTRACT

Psychosocial stress relating to an urban environment or acculturation increases the prevalence of metabolic syndrome (MetS). The objectives of this study were firstly to indicate and compare differences regarding appraisal of stress or active coping responses in urban African

(n=88) and Caucasian (n=101) male teachers of South Africa, in accord with the prevalence of MetS indicators. And secondly to investigate the extent to which utilisation of active coping responses, together with MetS indicators, predict target organ damage, in these men. The Coping Strategy Indicator determined high and low active coping responses in male teachers from the Sympathetic Activity and Ambulatory Blood Pressure in Africans (SABPA) study. SABPA inclusion and exclusion criteria were used. Additionally, diabetic medication users (n=8), and participants with renal impairment (n=2) or HIV positive (n=13), were excluded. MetS indicators included glucose, triglyceride, high-density lipoprotein cholesterol, blood pressure, and waist circumference, independent of confounders (age, physical activity, gamma glutamyl transferase). Microalbuminuria and carotid intima-media thickness indicated target organ damage. More MetS indicators exceeded the IDF cut-off points in high active coping African men (14.71%) than in their Caucasian counterparts (3.33%), as determined from χ^2 analyses. Furthermore, stepwise regressions indicated that more MetS indicators predicted endothelial dysfunction, especially in the high active coping African men. High active coping African men showed more manifestation of MetS, compared to their Caucasian counterparts, and revealed progress towards endothelial dysfunction.

Keywords: Metabolic syndrome; endothelial dysfunction; coping; ethnicity.

INTRODUCTION

It is estimated that a quarter of the world's adult population suffer from metabolic syndrome (MetS) and that individuals with MetS face double the risk of dying from myocardial infarction or stroke than those without the syndrome (Alberti et al., 2009). Studies from 2005 and 2006 concur that the trend towards developing MetS and related cardiovascular

complications is on the increase, especially in an urban environment (Danaei et al., 2006, Port et al., 2005, Malan et al., 2006).

Additionally, in urban Africans, active coping (AC) responses have been associated more with MetS and the related pathology than avoidance (Du Plessis et al., 2010, Malan et al., 2008). A synergistic effect of MetS and AC responses was also revealed in African men, in strong associations with both subclinical atherosclerosis and renal impairment (Du Plessis et al., 2009). Furthermore, the albumin-to-creatinine ratio was determined to be four times higher in Africans with four or more MetS indicators than in those without any MetS indicators (Okpechi et al., 2007). It has been stated that sub-Saharan Africans experience a high prevalence of cardiovascular disease (CVD) even though they exhibit a lipid profile that is anti-atherogenic (Gaillard, 2010), in contrast to Caucasians who are more prone to develop dyslipidaemia (Budoff et al., 2006, Oosthuizen et al., 2002, Norman et al., 2007).

The main aims of this study were firstly to compare coping responses and MetS indicator prevalence between African and Caucasian men, and secondly, to evaluate the extent to which MetS indicators predict target organ damage (renal impairment and subclinical atherosclerosis) in these ethnic groups.

MATERIALS AND METHODS

STUDY DESIGN

This comparative target population study forms part of the SABPA study, conducted from February until the end of May in 2008 (Africans) and 2009 (Caucasians), in order to avoid seasonal changes. The sub-study was approved by the Ethics Committee of the North-West University, and all volunteers gave written informed consent prior to participation. All procedures were conducted according to the institutional guidelines of the Declaration of Helsinki (World Medical Association Declaration of Helsinki, 2008).

RESEARCH PARTICIPANTS

Our study included urban African and Caucasian male teachers (n= 202) from the North-West Province, South Africa. African (n= 88) and Caucasian (n= 101) teachers aged between 25 and 60 years were included. Exclusion criteria were: users of alpha and beta blockers, ear temperatures > 37°C, vaccination or blood donation 3 months prior to participation. Furthermore, diabetic medication users (n= 8), and participants with renal impairment (n= 2) or HIV positive (n= 13), were excluded.

PROCEDURES

On four working days of the week, between 07h00 and 08h00, four participants were each fitted with the Cardiotens CE120® for ≈23 hours blood pressure (BP) measurements, as well as the Actical® accelerometers for physical activity (PA) measurements. The participants thereafter resumed their usual daily activities, reporting any anomalies such as headache, nausea, visual disturbances, fainting, palpitations, PA and stress, in the diary cards provided. At 16h30 they were transported to the North-West University's Metabolic Unit Research Facility to stay overnight. Upon arrival, participants received pre-counselling regarding HIV/AIDS, after which they were thoroughly briefed on the experimental setup to lessen the stress of anticipation (Suzuki et al., 2003).

Registered clinical psychologists supervised completion of the battery of psychosocial questionnaires. The participants were advised to go to bed at approximately 22h00, fasting overnight. They were wakened after the last BP recording at 06h00. The Cardiotens CE120® and Actical® were disconnected, and a fasting 8 hour overnight collected urine sample obtained from each participant. Anthropometric measurements followed; thereafter participants were placed in the semi-Fowler position and blood sampling commenced after a resting period of 30 minutes. Scanning of the carotid intima-media wall was performed in the

supine position. On completion of the protocol, each participant was thanked for cooperation and privately received feedback, post-counselling for HIV and referral to a physician, where applicable. They enjoyed breakfast and were transported back to school.

QUESTIONNAIRES

The Coping Strategy Indicator (CSI) 33-item questionnaire was used to determine each participant's favoured coping style and has previously been used successfully in an African context (Amirkhan, 1990, Amirkhan, 1994). A Cronbach's alpha reliability coefficient of 0.84 was determined for the three coping strategies of the CSI.

The CSI is a self-report measure of situational coping, which aims to determine which coping style an individual utilises most in stressful situations. The following coping styles are included in the three subscales of the questionnaire: problem-solving, avoidance, and seeking social support (Amirkhan, 1990). The problem-solving and avoidance strategies will hereafter be referred to as AC and PC (passive coping) styles, respectively. An AC response is characterised by a defensive effortful focus on the problem, acceptance of it as a reality and commitment to tasks until success is achieved in eliminating the problem (Suzuki et al., 2003, Ross and Deverell, 2004). On the other hand PC involves escape responses that could include physical and/or psychological withdrawal, and is often recognised by uncontrollability and distress (Ross and Deverell, 2004, Desmond et al., 2005). The participants, keeping a recent stressful event in mind, rated each statement describing the utilisation of one of the three coping strategies, by a three point Likert scale, as follows: a lot (3), a little (2), or not at all (1) (Amirkhan, 1990). The higher scores were thus indicative of greater use of a specific coping style, during the specific event or stressor. AC responses were not normally distributed and were adjusted by median splits. Participants were stratified according to ethnicity as well as into above median (high) and below median (low) AC groups.

ANTHROPOMETRIC MEASUREMENTS

Waist circumference (WC), body mass index (BMI) and PA were measured and calculated in triplicate by registered anthropometrists. The Actical® accelerometers (Montréal, Québec) calculated PA in kilocalories per 24 hours, taking resting metabolic rate into account (World Health Organisation, 2010). Furthermore, WC was measured perpendicular to the long axis of the trunk, at the midpoint between the iliac crest and lower costal border, while BMI was calculated from the height and weight in kilograms per square metre. Participants were considered abdominally obese with WC values of ≥ 94 cm, using the 2009 IDF guidelines for MetS (Alberti et al., 2009).

BLOOD PRESSURE

The Cardiotens CE120® (Meditech, Budapest, Hungary), validated by the British Hypertension Society, was fitted together with a suitable obese or non-obese cuff to each participant's non-dominant arm. The apparatus was programmed to measure ambulatory blood pressure oscillometrically, in intervals of 30 minutes during the day (08h00 – 22h00) and 60 minutes at night (22h00 – 06h00) (Kohara et al., 1995). The CardioVisions 1.15 Personal Edition software (Meditech®) was employed for data analyses. The European Society of Hypertension (ESH) guidelines stipulate a successful inflation rate as ≥ 70%: our rates were 72.60% (2008) and 84.64% (2009) (European Society of Hypertension and European Society of Cardiology, 2007). Hypertension was classified, according to the ESH guidelines, as ambulatory SBP of ≥ 125 mmHg, and DBP of ≥ 80 mmHg (European Society of Hypertension and European Society of Cardiology, 2007). However, the International Diabetes Federation (IDF) cut-off points stipulate an even higher SBP of ≥ 130 mmHg and DBP of ≥ 85 mmHg (Alberti et al., 2009); these guidelines were therefore used in MetS diagnosis.

BIOCHEMICAL MEASUREMENTS

A registered nurse obtained resting fasting serum and sodium fluoride blood samples from the brachial vein branches of each participant's dominant arm with a winged infusion set. Blood samples were handled according to standardised procedures and frozen at -80°C until analysis. MetS indicators [glucose, triglyceride, and high-density lipoprotein cholesterol (HDL-C)], together with gamma glutamyl transferase (cGGT), cotinine, and ultra-high sensitivity C reactive protein (hs-CRP), were analysed with Konelab™ 20i (ThermoScientific, Vantaa, Finland). The following IDF MetS cut-off points were used: HDL-C $\leq$ 1.03 mmol/L, triglycerides $\geq$ 1.70 mmol/L, and fasting glucose $\geq$ 5.60 mmol/L (Alberti et al., 2009).

MARKERS OF TARGET ORGAN DAMAGE

The SonoSite Micromaxx® (SonoSite Inc.) high resolution ultrasound system scanned the far wall of the carotid intima-media, as a marker of subclinical atherosclerosis. Measurements were taken according to the Rudy Meijer protocol, longitudinally with the 38 mm broadband linear array transducer, whilst each participant was in the supine position with the head contra lateral to the side being examined, with the neck extended (Meijer et al., 2010).

A fasting 8 hour overnight collected urine sample was gathered from each participant. The albumin-to-creatinine ratio (ACR) determined the presence of micro- or macro-albuminuria, and thus renal impairment. ACR was determined by means of the Turbidimetric method with Unicel DXC 800 (Beckman and Coulter, Germany), after immuno-precipitation enhanced by polyethylene glycol at 450 nm.

STATISTICAL ANALYSES

Data was analysed with the computer software package Statistica® version 10.0 (Statsoft Inc., Tulsa, USA, 2011). Kolmogorov-Smirnov tests determined normality and hs-CRP was logarithmically transformed. 2×2 ANCOVAs determined significant interactions between

ethnicity and AC for each variable. T-tests for independent groups determined differences between groups. Chi-square (χ^2) statistics calculated proportions. ANCOVAs determined significant differences from least square means analyses, independent of age, PA and alcohol consumption. Partial correlations between MetS indicators and target organ damage (TOD) markers were performed within each ethnic and AC group, and were adjusted for confounders. Forward stepwise regression analyses were performed for eight models (separately for ethnic groups and AC scores), firstly with microalbuminuria and secondly with CIMT as dependent variables. Covariates considered were WC, glucose, SBP, DBP, social support, and hs-CRP, as independent variables. Significant values were noted as $p \leq 0.05$, $r \geq 0.350$ and adjusted $R^2 \geq 0.25$.

RESULTS

A single 2 x 2 ANCOVA showed interaction on the main effects (ethnicity x coping) for avoidance [F (1, 193), 19.54; p = 0.00]. In Table 1, characteristics of low and high AC men are portrayed. Low and high AC Caucasian men were physically more active than their African counterparts and had higher cholesterol levels, whilst alcohol consumption and hs-CRP levels were significantly heightened in African men. Psychological variables revealed higher avoidance scores in high AC Caucasian men and higher social support scores in both low and high AC African men. More African men were diagnosed hypertensive at the time of the study and received medication, compared to Caucasian men. BP were higher ($P \leq 0.05$) in the low and high active coping African men in comparison with their Caucasian counterparts.

According to Table 2, 14.71% high AC African men had all 5 MetS indicators exceeding cut-off points, in comparison with 3.33% of their Caucasian counterparts. The MetS indicator combination of HDL-C, WC and fasting glucose indicated the highest prevalence (33.33%) in high AC Caucasian men, while the HDL-C, WC and BP combination was highest (29.41%) in

Table 1: Comparing baseline characteristics of urban African and Caucasian low and high active coping men

	LOW ACTIVE COPING MEN			**HIGH ACTIVE COPING MEN**		
	African (n=48)	Caucasian (n=40)	*P*	African (n=40)	Caucasian (n=61)	*P*
Age (years)	43.23 ± 8.40	41.75 ± 11.82	*0.50*	**42.85 ± 8.15**	**47.07 ± 10.12**	***0.03***
Body mass index (kg/m^2)	27.58 ± 5.61	29.41 ± 5.43	*0.13*	27.59 ± 5.98	28.79 ± 5.07	*0.28*
Physical activity (kcal/h)	**2694.40 ± 693.78**	**3466.49 ± 744.94**	***0.00***	**2688.38 ± 926.55**	**3810.65 ± 2580.40**	***0.01***
Cotinine (ng/ml)	29.56 ± 52.82	26.70 ± 80.78	*0.84*	29.88 ± 62.90	33.64 ± 106.41	*0.84*
Gamma glutamyl transferase (µg/L)	**80.58 ± 69.39**	**38.18 ± 36.02**	***0.00***	**87.81 ± 108.10**	**32.46 ± 24.39**	***0.00***
Cholesterol (mmol/L)	**4.89 (4.48, 5.31)**	**5.65 (5.19, 6.12)**	***0.03***	**4.68 (4.33, 5.04)**	**5.58 (5.30, 5.86)**	***0.00***
C-reactive protein (mg/L)	**5.53 (4.08, 6.99)**	**1.53 (-0.09, 3.15)**	***0.00***	**6.29 (3.63, 8.74)**	**2.27 (0.33, 4.21)**	***0.02***
Hypertension n (%)	**25 (52.08)**	**7 (17.50)**	***0.00***	20 (50.00)	10 (16.39)	*0.22*
MEDICATIONS						
Drugs for hypertension n (%)	**8 (16.67)**	**1 (2.50)**	***0.03***	**9 (22.50)**	**8 (13.11)**	***0.00***
PSYCHOLOGICAL VARIABLES						
Avoidance score	22 (21, 23)	21 (20, 22)	*0.25*	**20 (19, 22)**	**25 (24, 26)**	***0.00***

Social support score	**23 (22, 25)**	**19 (17, 21)**	***0.00***	**26 (24, 27)**	**18 (17,20)**	***0.00***
METABOLIC SYNDROME INDICATORS						
Fasting glucose (mmol/L)	5.87 (5.46, 6.28)	5.98 (5.52, 6.44)	0.75	6.28 (5.67, 6.89)	6.00 (5.52, 6.48)	0.51
Triglycerides (mmol/L)	1.80 (1.30, 2.31)	1.84 (1.28, 2.40)	0.93	1.45 (1.18, 1.72)	1.54 (1.33, 1.75)	0.63
HDL-cholesterol (mmol/L)	1.03 (0.94, 1.12)	1.04 (0.93, 1.14)	0.91	1.10 (0.96, 1.22)	0.99 (0.90, 1.08)	0.16
Systolic blood pressure (mmHg)	**138.88 (134.55, 143.21)**	**125.22 (120.40, 130.04)**	**0.00**	**137.03 (132.70, 141.37)**	**128.63 (125.21, 132.05)**	**0.01**
Diastolic blood pressure (mmHg)	**88.52 (85.50, 91.54)**	**78.95 (75.59, 82.32)**	**0.00**	**87.15 (84.41, 89.90)**	**79.72 (77.55, 81.89)**	**0.00**
Waist circumference (cm)	98.13 (94.80, 101.46)	96.87 (93.16, 100.58)	0.65	95.44 (90.41, 100.46)	99.88 (95.92, 103.84)	0.20
TARGET ORGAN DAMAGE MARKERS						
Microalbuminuria (mg/mmol)	1.28 (0.84, 1.72)	0.59 (0.10, 1.08)	*0.06*	6.40 (1.04, 11.75)	0.06 (-4.16, 4.28)	*0.09*
Carotid intima-media thickness (mm)	0.69 (0.66, 0.73)	0.65 (0.60, 0.69)	*0.13*	0.73 (0.68, 0.78)	0.69 (0.65, 0.73)	*0.22*

Values are arithmetic mean ± SD for T-tests, proportions as n (%) and ANCOVA's as geometric mean (5^{th} to 95^{th} percentile interval).

Covariates included age, physical activity and alcohol consumption. Significant values are depicted in bold, $P \leq 0.05$.

Table 2: The International Diabetes Federation diagnosis of metabolic syndrome, most prevalent in low and high active coping men

	LOW ACTIVE COPING MEN		**HIGH ACTIVE COPING MEN**	
	African (n=46)	**Caucasian (n=40)**	**African (n=34)**	**Caucasian (n=60)**
Metabolic syndrome with 3 indicators	n (%)	n (%)	n (%)	n (%)
HDL-C + WC + FG	5 (10.87)	10 (25.00)	8 (23.50)	20 (33.33)
HDL-C + WC + BP	7 (15.22)	4 (10.00)	10 (29.41)	4 (6.67)
Metabolic syndrome with 5 indicators				
HDL-C + WC + FG + BP + TRIG	3 (6.52)	3 (7.50)	5 (14.71)	2 (3.33)

Where: AC, active coping; HDL-C, high-density lipoproteins; WC, waist circumference; FG, fasting glucose; BP, blood pressure; TRIG, triglycerides. International Diabetes Federation metabolic syndrome cut-off points: HDL-C ≤ 1.03 mmol/L, triglycerides ≥ 1.70 mmol/L, fasting glucose ≥ 5.60 mmol/L, waist circumference ≥ 94 cm, SBP of ≥ 130 mmHg and DBP of ≥ 85 mmHg (Alberti et al., 2009).

high AC African men. Overall, high AC African men showed a greater trend in the manifestation of MetS.

In Table 3, in model 1, glucose predicted microalbuminuria in high AC Africans. In model 2, cholesterol and decreased HDL-C predicted CIMT in high AC Africans. In model 3, glucose and social support predicted microalbuminuria in high AC Caucasians. In model 5, SBP predicted microalbuminuria in low AC Africans.

Table 1: Comparing baseline characteristics of urban African and Caucasian low and high active coping men

Values are arithmetic mean ± SD for T-tests, proportions as n (%) and ANCOVA's as geometric mean (5^{th} to 95^{th} percentile interval). Covariates included age, physical activity and alcohol consumption. Significant values are depicted in bold, $P \leq 0.05$.

Table 2: The International Diabetes Federation diagnosis of metabolic syndrome, most prevalent in low and high active coping men

Where: AC, active coping; HDL-C, high-density lipoproteins; WC, waist circumference; FG, fasting glucose; BP, blood pressure; TRIG, triglycerides. International Diabetes Federation metabolic syndrome cut-off points: HDL-C ≤ 1.03 mmol/L, triglycerides ≥ 1.70 mmol/L, fasting glucose ≥ 5.60 mmol/L, waist circumference ≥ 94 cm, SBP of ≥ 130 mmHg and DBP of ≥ 85 mmHg (Alberti et al., 2009).

Table 3: Forward stepwise regression analyses of MetS indicators, coping scores and endothelial dysfunction in low and high active coping men.

Covariates considered in MODEL 1: systolic blood pressure, glucose, CIMT; MODEL 2: high-density lipoprotein, cholesterol, glucose, social support, microalbuminuria; MODEL 3:

Table 3: Stepwise regression analyses of MetS indicators, coping scores and endothelial dysfunction in low and high active coping men.

	HIGH AC AFRICAN MEN		**HIGH AC CAUCASIAN MEN**	
	MODEL 1 (n=40)	**MODEL 2 (n=39)**	**MODEL 3 (n=61)**	**MODEL 4 (n=60)**
	Microalbuminuria (mg/mmol)	CIMT (mm)	Microalbuminuria (mg/mmol)	CIMT (mm)
ADJUSTED R^2	0.21	0.52	0.28	0.06
	β (± 95% CI)	**β (± 95% CI)**	**β (± 95% CI)**	**β (± 95% CI)**
Glucose (mmol/L)	**0.48 (0.20, 0.74)**	-	**0.45 (0.23, 0.67)**	-
HdL-C (mmol/L)	-	**-0.66 (-0.43, -0.89)**	-	-
Cholesterol (mmol/L)	-	**0.58 (0.35, 0.81)**	-	-
Social support	-	-	**0.40 (0.18, 0.62)**	-

	LOW AC AFRICAN MEN		**LOW AC CAUCASIAN MEN**	
	MODEL 5 (n=48)	**MODEL 6**	**MODEL 7**	**MODEL 8**
	Microalbuminuria (mg/mmol)	CIMT (mm)	Microalbuminuria (mg/mmol)	CIMT (mm)
ADJUSTED R^2	0.23			
	β (± 95% CI)	**β (± 95% CI)**	**β (± 95% CI)**	**β (± 95% CI)**
Systolic blood pressure (mmHg)	**0.50 (0.25, 0.75)**	-	-	-

Covariates considered in MODEL 1: systolic blood pressure, glucose, CIMT; MODEL 2: high-density lipoprotein, cholesterol, glucose, social support, microalbuminuria; MODEL 3: waist circumference, glucose, social support; MODEL 4: C-reactive protein; MODEL 5: systolic blood pressure, diastolic blood pressure; MODELS 6- 8: No entry. Covariates included age, physical activity, alcohol consumption, and additionally blood pressure and C-reactive protein in CIMT models. Where: MetS, metabolic syndrome; AC, active coping; CIMT, carotid intima-media thickness of the far wall. Significant values are depicted in bold, $P \leq 0.05$.

waist circumference, glucose, social support; MODEL 4: C-reactive protein; MODEL 5: systolic blood pressure, diastolic blood pressure; MODELS 6- 8: No entry. Covariates included age, physical activity, alcohol consumption, and additionally blood pressure and C-reactive protein in CIMT models. Where: MetS, metabolic syndrome; AC, active coping; CIMT, carotid intima-media thickness of the far wall. Significant values are depicted in bold, $P \leq 0.05$.

DISCUSSION

Our aim was to compare MetS indicators and its associations with TOD in two South African ethnic male groups, with a focus on their coping preference. Various studies have identified modern living and unhealthy lifestyles as being the corner stone of CVD risk, but this not only influences physiological well-being, it also amplifies psychosocial stress, in turn increasing susceptibility to a variety of health risks. It was established that abdominal obesity, diabetes, hypertension, dyslipidaemia, and smoking are some of the most common risk factors for both CVD and chronic kidney disease (Alberti et al., 2009, Chen et al., 2004).

Results emanating from the SABPA study (2008) revealed AC responses to be a cardiovascular risk in men of African descent; therefore we focused on this coping style and its pathological effects (Du Plessis et al., 2009). Our study revealed that MetS indicators were generally higher in the African men, especially in the high AC groups, in comparison with their Caucasian counterparts, while all 5 of the MetS indicators were present in 14.71% of the high AC African men against 3.33% of their Caucasian counterparts. More high AC African men also manifested MetS by 3 indicators, although in one category, owing to the combination of increased fasting glucose, WC and lowered HDL-C concentrations, the high AC Caucasian men exhibited a 9.83% higher prevalence of MetS. These findings are also in accord with results from the THUSA study, where urban high AC African men presented with

a clearly higher incidence of MetS than both their female and rural counterparts (Malan et al., 2006, Malan et al., 2008). In addition, the literature revealed that a higher resting BP was evident among urban Africans (Malan et al., 2006, Malan et al., 2008), which is in line with the significantly higher ambulatory SBP (8 – 13 mmHg) and DBP (7 – 9 mmHg) we found in both the low and high AC urban African groups, compared to their respective Caucasian counterparts. As this augmented BP is independent of coping response, it could most probably be due to the racial differences in renal physiology (Seedat, 2009).

It is important to note that in our study, a general higher prevalence of MetS indicators was found in the high AC African men. Previous studies have found that utilising AC responses increases the risk for hypertension and MetS in Africans (Malan et al., 2006, Malan et al., 2008). This pathological trend in urban Africans utilising AC responses was also revealed ten years earlier in the THUSA study (Malan et al., 2008). When an individual experiences an event as challenging, the AC style takes effect, and this is usually accompanied by seeking social support, whilst all other activities are suppressed until success is achieved in solving the problem at hand (Stapelberg, 1999). Africans are collectivistic and what the group needs, desires and values takes precedence over those of the individual; Africans also view experience of social support from their extended families and/or churches as very important. In addition, utilising social support has been said to exert a protective effect on cardiovascular well-being (Dressler, 1996). Our results revealed a definite greater use of social support in both the low and high AC African groups, yet manifestations of MetS and cardiovascular risk in these groups were still noteworthy. In addition, social support predicted microalbuminuria in the high AC Caucasian men, but not in their African counterparts. As Caucasians are more individualistic compared to Africans, it might be that the Caucasian men only utilise social support as a last ditch effort to cope; but by then stress has already taken its toll.

The high AC Caucasian men were older and more abdominally obese. Furthermore, their total cholesterol concentrations were higher and HDL-C concentrations lower than those of their African counterparts. In accord with the THUSA study, we found more dyslipidaemia in the high AC Caucasian men (Oosthuizen et al., 2002), but in contrast to literature, subclinical atherosclerosis was associated with dyslipidaemia in the high AC African men, who supposedly have less atherogenic lipid profiles than Caucasians (Gaillard, 2010, Budoff et al., 2006). Augmented hs-CRP concentrations were reported to indicate a low-grade inflammation in Africans (Ntyintyane et al., 2009), and it has been found that African Americans have higher hs-CRP concentrations (Watson and Topol, 2004), which may also be true for Africans in South Africa. Our results revealed significantly higher hs-CRP concentrations (3-4 mg/L) in the low and high AC African men, in comparison with their Caucasian counterparts. The high AC African men not only displayed higher hs-CRP levels, but also higher CIMTf values. Albeit insignificant, these markers of subclinical atherosclerosis could increase the risk for cardiovascular events (American Heart Association, 2010). Moreover, African men evidently exhibited more MetS indicators and endothelial dysfunction than Caucasian men. Of the MetS indicators, only glucose predicted microalbuminuria in the high AC African and Caucasian men, whilst SBP also predicted significant increases in microalbuminuria in the low AC African men, whereas decreased HDL-C predicted CIMTf in the high AC African men.

In summary, more high AC African men manifested MetS. Furthermore, in both the low and high AC African men, MetS indicators revealed associations with endothelial dysfunction, including renal impairment and subclinical atherosclerosis. Additionally, the low and high AC African men exhibited the same trend in cardiovascular pathology, verifying the notion of dissociation between physiological and behavioural AC responses in this ethnic group (Malan et al., 2008).

The SABPA study was limited with regards to the number of participants and the power of the present study is greatly influenced by the subdivision in coping and ethnic groups; thus it is recommended that the research be repeated with larger and more diverse ethnic groups to represent the South African population better. Also, follow-up is recommended as the cross-sectional design of this study cannot infer causality.

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