

# Fatal and non-fatal cardiovascular events in two communities within the Dr Kenneth Kaunda District

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## INTRODUCTION

- Cardiovascular diseases' (CVDs) incidence and prevalence rising in Sub-Saharan Africa. [1].
- Spotlight on black people in African context [2] because most studies on CVDs in black populations conducted in high-income countries [3, 4], different healthcare systems, different access to healthcare [5] and different epidemiological transition rates [6].
- In SA, CVDs (coronary heart disease [CHD], stroke, angina, myocardial infarction, heart failure) steadily leading causes of mortality in working group and older people [7].
- CVDs in past uncommon amongst black SA population, due to a number of possible reasons [8].
- Rapid epidemiological transition rate [9], leading to health transition, rural-urban migration and improved living conditions in rural South Africa [10].
- Increase in CVD prevalence among black South Africans linked to increase in hypertension, diabetes, obesity and cholesterol [11, 12] in young adults and old people.
- CVDs linked to and complicated by social determinants of health (see figure 1).

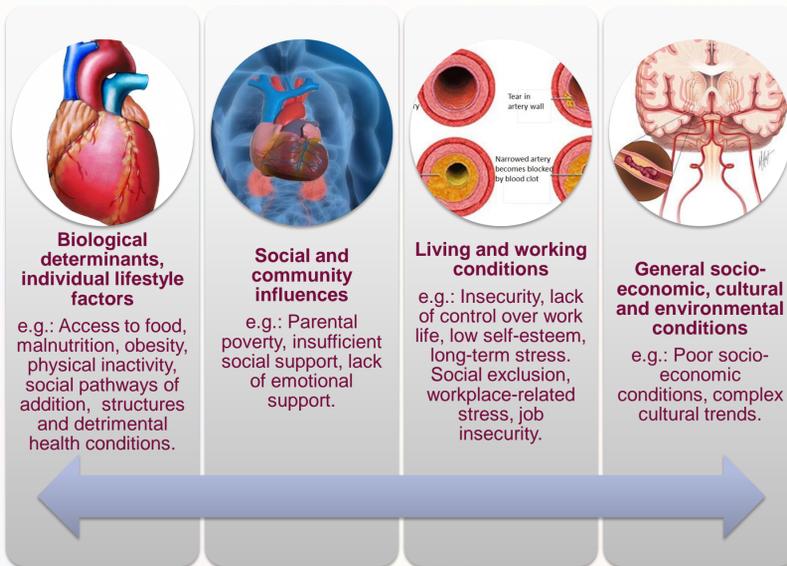


Figure 1: Social determinants of health [13] linked to cardiovascular diseases

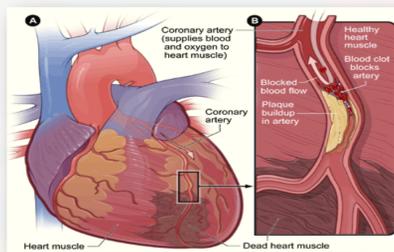


Figure 2: An overview of a heart and coronary artery showing damage (dead heart muscle) caused by a heart attack, B) is a cross-section of the coronary artery with plaque build-up and a blood clot [14].

## RESEARCH AIM

**Aim:** Identify most significant cardiovascular risk factors associated with fatal and non-fatal cardiovascular events over a period of 5-years within a selected group of black South Africans residing in the Dr Kenneth Kaunda District, North West, South Africa.

## METHODOLOGY

Table 1: Research methodology

<b>Design</b>	<ul style="list-style-type: none"> <li>Sub-study of South African leg (North West Province) of Prospective Urban and Rural Epidemiology (PURE) study.</li> <li>PURE: examines relationships: societal influences on human lifestyle behaviours, cardiovascular risk factors, incidence of chronic noncommunicable diseases [14].</li> <li>Baseline data collected 2005, follow-up data 2010.</li> <li>Quantitative approach, non-experimental, descriptive and correlational design.</li> <li>Retrospective exploration of associations between exposure (modifiable CV risk factors) and outcomes (fatal and non-fatal CV events).</li> </ul>
<b>Population</b>	<ul style="list-style-type: none"> <li>Only participants with cardiovascular event(s) five years after baseline.</li> <li>746 males; 1 263 females; 29-94 years; suffered or passed away from any of these vents: angina pectoris, coronary heart disease, stroke, myocardial infarction, heart failure.</li> </ul>
<b>Questionnaires</b>	<ul style="list-style-type: none"> <li>Trained Setswana speaking African fieldworkers, interviews (semi-structured questionnaires).</li> <li>Educational level, socio-demographic information, smoking and alcohol consumption habits collected, and level of physical activity (validated International Physical Activity Questionnaire [BAECKE]) [15].</li> </ul>
<b>Outcome variables</b>	<ul style="list-style-type: none"> <li>Medical diagnosis of CVD, received medication, list of all medications.</li> <li>CVDs from self-reported information, verified with clinic cards at 1<sup>st</sup> annual follow-up.</li> <li>Verbal autopsies by qualified researchers.</li> <li>Events with supporting documents adjudicated and verified by trained medical doctor, ICD-10 code assigned.</li> </ul>
<b>Anthropometry</b>	<ul style="list-style-type: none"> <li>Weight, height, hip, waist circumference.</li> <li>Calibrated instruments, accredited anthropometrists, standardised methods.</li> <li>Body mass index (BMI) was calculated.</li> </ul>
<b>Cardiovascular</b>	<ul style="list-style-type: none"> <li>10 minute rest period, brachial blood pressure performed in duplicate (5 minutes apart), right upper arm, seated upright, right arm supported at heart level.</li> <li>Systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate measured with validated OMRON HEM-757 device (Omron Healthcare, Kyoto, Japan).</li> </ul>
<b>Biochemical analysis</b>	<ul style="list-style-type: none"> <li>Fasting blood samples, collected by professional nurse, from antecubital vein.</li> <li>Serum and plasma samples prepared and stored according to standard protocol, then stored at -80°C in cryotubes until further processing.</li> <li>Sequential Multiple Analyser Computer (SMAC), Konelab analyser (Thermo Fisher Scientific Oy, Vantaa, Finland), to analyse serum lipids.</li> <li>Low-density lipoprotein (LDL) cholesterol: Friedewald formula [16].</li> <li>Plasma glucose: hexokinase method, Vitros DT6011 Chemistry Analyser (Ortho-Clinical Diagnostics, Rochester, New York, USA) and reagents.</li> <li>Glycated haemoglobin: from whole blood (EDTA) samples, based on ion-exchange high-performance liquid chromatography, with D-10 Haemoglobin testing system from Bio-Rad (Bio-Rad Laboratories Ltd., Hercules, CA, USA, #220-0101).</li> </ul>
<b>HIV testing</b>	<ul style="list-style-type: none"> <li>Written informed consent obtained individually after pre-counselling.</li> <li>Participants given a choice to proceed with testing.</li> <li>HIV status: First Response rapid HIV card test (PMC Medical, India) from whole blood, according to National Department of Health protocol.</li> <li>If test positive: confirmed with Pareeshak card test (BHAT Bio-tech India).</li> <li>Feedback on results given by two trained counsellors during individual sessions.</li> <li>Infected: referred to local clinic/hospital for follow-up, determination CD4-cell counts.</li> </ul>
<b>Framing-ham Risk Score (FRS)</b>	<ul style="list-style-type: none"> <li>For major risk factor measurements.</li> <li>Useful for patient and clinician to decide about lifestyle modification and preventive medical treatment [16].</li> <li>Ten-year CHD risk in three categories (<math>\leq 10\%</math> low risk, 10-20% intermediate risk, <math>&gt;20\%</math> as high risk) [17].</li> </ul>
<b>Statistical analysis</b>	<ul style="list-style-type: none"> <li>Statistical Package for Social Sciences (SPSS) version 24 (IBM SPSS, Chicago, USA).</li> <li>Frequencies (N) reported as percentage (%), arithmetic means, medians, standard deviations (SD) and 95% confidence intervals (CI) used to summarise data.</li> <li>Parametric (continuous data) and non-parametric (categorical data) statistical analysis.</li> <li>Data presented as mean and interquartile ranges (IQR) [Q1-Q3] in case where data not normally distributed.</li> <li>ANOVA and two-sample z-tests performed to compare means and proportions, respectively.</li> <li>Point-biserial correlations used to determine associations between risk factors (continuous data) and cardiovascular event outcomes (categorical dichotomous data).</li> <li>Binomial logistic regression used to determine associations between categorical dependent variables (cardiovascular event outcomes) and categorical risk factors.</li> <li>Receiver Operating Characteristic (ROC) curves assessed for analysis of prognostic value of independent predictors on cardiovascular event outcomes.</li> <li>All probabilities were two-tailed and p values of <math>&lt;0.05</math> reported to show associations or differences between groups; 95% confidence intervals (CI) were also reported.</li> </ul>

## RESULTS

Table 2: Maximum likelihood estimates for binary logistic regression of predicting non-fatal and fatal cardiovascular outcome

Variables	Non-fatal cardiovascular outcomes			Fatal cardiovascular outcomes		
	$\beta$	p-value	95% C.I. for e <sup><math>\beta</math></sup>	$\beta$	p-value	95% C.I. for e <sup><math>\beta</math></sup>
Age	0.044	0.004*	1.015 1.077	0.074	0.001*	1.030 1.125
Education	0.645	0.050*	1.000 3.635	-0.442	0.385	0.238 1.740
Weighted physical activity index	-0.893	0.001*	0.238 0.705	-0.559	0.243	0.224 1.461
Systolic Blood Pressure (mmHg)	0.012	0.158	0.995 1.029	-0.004	0.806	0.961 1.031
Diastolic Blood Pressure (mmHg)	0.008	0.583	0.979 1.038	-0.032	0.257	0.916 1.024
Glycated haemoglobin (%)	-0.427	0.082	0.403 1.056	-1.163	0.024*	0.114 0.858
Fasting glucose (mmol/l)	0.106	0.473	0.673 1.201	0.112	0.691	0.642 1.949
Framingham risk score	0.038	0.042*	1.001 1.077	-0.057	0.310	0.846 1.054
Blood lowering meds (yes)	-0.550	0.180	0.259 1.288	-0.501	0.535	0.124 2.952
Constant	-3.112	0.125	-	-	3.337	0.378

- Positive correlation between suffering from non-fatal CV event and age ( $r_{pb}=0.14$ ,  $p<0.01$ ), all blood pressure parameters where systolic blood pressure (SBP) revealed the strongest correlation ( $r_{pb}=0.14$ ,  $p<0.01$ ).
- Binary logistic regression analysis found age ( $\beta=0.044$ ), education ( $\beta=0.645$ ), weighted physical activity index ( $\beta=-0.893$ ) and Framingham risk score ( $\beta=-0.038$ ) as important predictors of non-fatal CV events, whereas age ( $\beta=0.074$ ) and glycated haemoglobin ( $\beta=-1.163$ ) were important predictors of fatal CV events.
- ROC curve analyses reported all blood pressures and Framingham risk score to be risk factors likely associated with both fatal and non-fatal cardiovascular outcomes.
- High blood pressure and Framingham risk score the most significant risk factors of fatal and non-fatal cardiovascular events.

**CONCLUSION:** Blood pressure remains one of the most difficult modifiable risk factors to manage due to its strong behavioural change component. This raises the need to mobilise communities towards self-care of modifiable risk factors such as blood pressure.

## ETHICAL CONSIDERATIONS

- Each participant sign written informed consent form, participation was voluntary. Study protocol complied with Declaration of Helsinki (as revised in 2004) and approved (04M10, NWU-00016-10-A1) by Health Research Ethics Committee, North-West University, Potchefstroom, South Africa.
- Reporting of the study conforms to the STROBE statement along with references to STROBE [18] and the broader EQUATOR guidelines [19].

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