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Distribution and characteristics of risk factors for cardiovascular–metabolic disease in a rural Kenyan community

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ABSTRACT

Background: The rising prevalence of non-communicable diseases and associated premature mortality in Sub-Saharan Africa contradicts the widely accepted premise that African countries are only dominated by infectious diseases, malnutrition, maternal and child deaths. Among the non-communicable diseases, hypertension and diabetes mellitus continue to be the leading cause of death worldwide, with 10–20 million people estimated to have hypertension in Sub-Saharan Africa and 12 million people reported to have diabetes mellitus in Africa. The purpose of this study was to assess the cardiovascular–metabolic characteristics of individuals living in one rural community in Central Kenya and to propose interventions to address their needs.

Methods: A convenience sample of 262 individuals was screened/treated for cardiovascular–metabolic disease (CVMD) risk factors at a government operated community health center in Central Kenya. Self-reported estimates of physical activity, dietary intake, smoking and perceived health were obtained using questions drawn from the validated Behavioral Risk Factor Surveillance Survey. Standardized protocols (Jackson Heart Study) directed collection of physiologic measures (blood pressure, glucose, anthropometrics). Clinical data was abstracted and analyzed using Stata©. USA/Kenyan IRB/ethics approval was obtained.

Results: $N = 262$, mean age 54 (SD ± 17.02) years; 81% women, 99% Kikuyu ethnicity. Self-reported history of diabetes mellitus was 4%, overweight (BMI $\geqslant$ 25) 34%, and hypertension 47%. Systolic blood pressure $\geqslant$140 mmHg increased with age [(12%, 39%, 52%) (<45, 45–64, 65+), respectively <!–Q4: The symbols "=< and >=" have been changed to their appropriate symbols. Please check and correct if necessary.--> ($p \leqslant .001$)]. Glucose measures indicative of diabetes mellitus ($\geqslant$126 mg/dL fasting or $\geqslant$200 mg/dL non-fasting) were 8.3%. Women were more likely than men to be overweight (39% vs 15%) ($p = <0.001$) and have elevated waist circumference (30% vs 6.3%). Self-reported lifestyle risk factors included: 10% were inactive; 68% of participants consumed <3 servings of vegetables per day; 69% used solid (saturated) fat for cooking; 89% added salt to cooking [with 28% adding salt at the table]; 9% drank soda daily/weekly, 3% currently smoked cigarettes. Overall 65% ($n = 170$) of the sample had moderate to high risk for cardiovascular factors on the Gaziano Global Risk Score Scale.

Conclusions/recommendations: The prevalence of CVMD was high but some risk factors usually associated with CVMD were not observed. There is need for locally-tailored approaches in treatment and prevention of CVMD at the local level.

1. Introduction

The rising prevalence of non-communicable diseases and associated premature mortality in Sub-Saharan Africa contradicts the widely accepted premise that African countries are only dominated by infectious diseases, malnutrition, and maternal and child deaths. Among the non-communicable diseases, hypertension

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and diabetes mellitus continue to be the leading cause of death worldwide (World Health Organization, 2013). Due to the dearth of metabolic and clinical data in Sub-Saharan Africa, the true prevalence of diabetes and hypertension in the region is not well known. However, a systematic review of population based studies has approximated diabetes prevalence to range from 1% in rural Uganda to 12% in urban Kenya; the World Health Organization (WHO) estimates the prevalence of hypertension to be over 40% in the adult population of many African countries. About ten to twenty million people are estimated to have hypertension in Sub-Saharan Africa (Opie, 2005; World Health Organization, 2014). It is also estimated that twelve million people have diabetes in Africa (International Diabetes Federation (IDF), 2010). These statistics have led the African Union to declare hypertension as one of the greatest public health challenges facing the continent after HIV/AIDs (Opie, 2005).

Most of the diabetes and hypertension cases in Sub-Saharan Africa remain undiagnosed. Currently, it is estimated that up to 85% of individuals with diabetes and 66.3% of individuals with hypertension are undiagnosed (Schnabel, Adeloye, & Basquill, 2014). In some Sub-Saharan Africa countries like Malawi, population based studies have reported up to 95% of hypertension cases being undiagnosed and about three quarters of the participants reported to have never had their blood pressure checked (Msyamboza, Kathyola, Dzowela, & Bowie, 2012).

The delays in diagnosing CVMD leads to missed opportunities for primary and secondary prevention culminating in early onset of cardiovascular events and premature mortality in Sub-Saharan Africa compared to other regions. Unless proactive steps are taken to increase clinicians' index of suspicion for screening and treating CVMD, this trend is likely to worsen in the near future. The WHO projections and meta-regression epidemiological modeling indicate that by 2030, Africa will have about 23.9 million cases of diabetes, and an estimated 216.8 million cases of hypertension (Diabetes Leadership Forum, 2010; Schnabel et al., 2014). Many of these cases could be avoided and/or treated with low-cost interventions, which would significantly reduce the risk of morbidity and premature mortality associated with CVMD.

Several studies have explored the barriers to screening and timely identification and management of CVMD in Sub-Saharan Africa aaa(BeLue et al., 2009; Maina, Ndegwa, Njenga, & Muchemi, 2011; Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). In a study to determine the knowledge, attitudes and practices related to diabetes management in Kenya, Maina et al. (2011) identified historical absence of diabetes education, cultural value for people with high body mass index, and reluctance for dietary modification as major barriers for early detection and optimal treatment (Maina et al., 2011). In rural and urban areas, weight and obesity are misperceived as a sign of good health and a social marker that commands respect and high social status. This may drive many people to shun weight loss strategies which are critical in prevention and control of diabetes. These misconceptions should be carefully addressed with understanding that they are based on the contextual environment of poverty and a long history of perennial malnutrition (Mbanya et al., 2010).

Whereas more researchers and policy makers are increasingly paying attention to the evolving epidemic of CVMD in Sub-Saharan Africa, most of the efforts so far have been directed to the urban areas. This is largely in response to the widely held view that hypertension and diabetes are more prevalent in urban areas compared to rural areas due to the westernization associated with urbanization. Studies and reports have documented that urbanization is associated with CVMD risk factors in Africa (Assah, Ekelund, Brage, Mbanya, & Wareham, 2011; Diabetes Leadership Forum, 2010; Institute of Medicine, 2010). For instance, a study conducted in rural and urban Cameroon reported significantly higher prevalence of glucose intolerance, obesity, high blood pressure and lower physical activity energy expenditure in urban than in rural dwellers (Assah et al., 2011). Another study in Sub-Saharan Africa observed that urban residents are 1.5–4.0 times more likely to have higher prevalence of diabetes than rural residents (Mbanya & Ramiaya, 2006).

However, recent studies in Sub-Saharan Africa have also reported a rapid increase in prevalence of CVMD risk factors in rural areas. A cross-sectional study involving 2282 adults in rural Uganda reported that age-standardized high prevalence of hypertension was 14.6% compared to low prevalence cited by other studies citing 1–3% prevalence of hypertension in rural Sub-Saharan Africa (Kotwani et al., 2013; Mbanya et al., 2010). A recent population based cross-sectional survey of 4396 individuals aged above 49 years in Nakuru County of Kenya revealed a high prevalence of hypertension (50.1%) and diabetes (6.6%). Although the highest prevalence of cardiovascular risk factors in this study was reported in urban areas, clustering of multiple cardiovascular risk factors was more pronounced among rural dwellers compared to the urban dwellers (Mathenge, Foster, & Kuper, 2010). These findings are consistent with our previous findings in rural Central Kenya where we have reported the prevalence of hypertension and diabetes to be 55.6% and 9.2% respectively in convenience samples of community dwelling Kenyans (Stuart-Shor et al., 2012).

In Kenya and most Sub-Saharan Africa countries, there exists no comprehensive screening or management strategy for hypertension and diabetes mellitus. Episodic health education is usually done in the health care facilities for the few patients already diagnosed with diabetes and hypertension. Such an approach makes self-management strategies and other cost effective interventions inaccessible to those at risk or those with undiagnosed CVMD (Kiberenge, Ndegwa, Njenga, & Muchemi, 2010). Although it is widely acknowledged that most countries in Sub-Saharan Africa need policies that enable people to make and maintain healthy living choices so as to effectively control CVMD, such policies are likely to succeed if backed by robust surveillance of CVMD epidemiology in the region (Hunter & Reddy, 2013).

This study aims to contribute to these efforts by describing the distribution and characteristics of CVMD risk factors in a rural community in Central Kenya. In the context of the observed distribution of risk factors, the study makes a case for a multidisciplinary approach that maximizes the potential of nurses and community health workers in screening and management of hypertension and diabetes mellitus especially in rural areas.

2. Methods

Using community based participatory research a convenience sample of consecutive patients seen at one government community health clinic were screened for cardiovascular–metabolic risk factors. The research was supported by a US/Kenyan partnership (Kenya Heart and Sole: *Afya Njema* Project) that included the Ministry of Health, clinicians at the community health center and four Schools of Nursing. The sample for the present study represents one clinic from the parent Kenya Heart and Sole study ($N = 941$) which was carried out in six community health centers in June 2012 in Kenya.

2.1. Procedures/protocol

2.1.1. Screening

Individuals interested in being screened for CVMD risk factors came to the clinic and were registered by a member of the clinic community. US/Kenyan students, clinicians and faculty who comprised the Kenya Heart and Sole team were paired 1:1 to assure

culturally appropriate care. The trained US/Kenyan team collected demographic, medical, physiologic and lifestyle data. The team was trained by the project principal investigator in collaboration with experienced US/Kenyan faculty, clinicians and graduate students who had prior training and encounter with the screening protocol. The team was trained on the screening protocol regarding obtaining an accurate medical history, measures of anthropometrics, blood pressure, and blood sugar and lifestyle questions. The team was also instructed in obtaining informed consent as well as ethics in research and entry of data in the research tools. Individual level data gathered at the screening was shared with the participant along with general information on how to prevent and treat CVMD risk factors. Prior to the screening all participants were asked if their information could be included in the research database and if they agreed consent was obtained. Individuals who wished to be screened, but who did not wish to be included in the research database were screened but their data was not included in the research.

2.1.2. Data collected

Individual level data collected included: age, race/ethnicity, medications, and a brief medical history of relevant CVMD risk factors. Once registered participants moved to a testing and counseling station where a trained US/Kenyan team using a standardized protocol from a race concordant sample (Jackson Heart Study) measured blood pressure, random blood glucose (point-of-service), anthropometrics (waist circumference, height, weight) and calculated the body mass index (BMI) (Jackson Heart Study., 2008). In Kenya, at the community level point of service glucose testing is routinely used for both diagnostic and treatment purposes; laboratory testing is expensive and for the most part not available at the community level. Laboratory or point of service measures of lipids is expensive and not feasible at the community level in Kenya; however, BMI was used as a proxy for lipids in non-laboratory based algorithms for cardiovascular risk (Gaziano, Young, Fitzmaurice, Atwood, & Gaziano, 2008). The study goal was to collect measures that are feasible, clinically relevant and sustainable outside the confines of the research project. In addition to physical measures the team obtained self-reported estimates of physical activity, dietary intake, smoking and perceived health using questions drawn from the validated Behavioral Risk Factor Surveillance Survey (BRFSS) and WHO World Health Survey (Center for Disease Control and Prevention, 2008a; World Health Organization, 2002). Based on the data collected, participants were risk stratified using the Gaziano non-laboratory based Global Risk Algorithm (Gaziano et al., 2008). Data was entered into the statistical software Stata©. If indicated, abnormal results or symptoms were reviewed by the Umass Boston nurse practitioner and a plan for follow-up established with the clinic.

2.1.3. Instruments

The protocols for the measurement of physiological data were drawn from the race concordant Jackson Heart Study (Jackson Heart Study, 2008). The lifestyle questionnaire included physical activity, dietary patterns and smoking questions drawn from the WHO World Health Survey questions (World Health Organization, 2002), the Behavioral Risk Factor Surveillance Survey and the National Health and Nutrition Survey (Center for Disease Control and Prevention, 2008a; Center for Disease Control and Prevention, 2008b). To assure face validity of the lifestyle questions the questions were reviewed by the Kenyan team and community for meaning. To assure content validity the questions were translated in the local community's language (Kikuyu and Kiswahili) and pretested at the community which did not participate in the actual study (near the School of Nursing). The Gaziano risk-prediction tool was used to risk stratify individual participants in relation to gender, history of diabetes, smoking status, systolic blood pressure, body mass index and age. This method which uses non-laboratory-based risk factors has been shown to predict cardiovascular events as accurately as one that relied on laboratory-based values and has been tested in Sub-Saharan Africa (Gaziano et al., 2008).

2.1.4. Data abstraction

The research team reviewed the de-identified raw data from each participant and abstracted the data into Stata for analysis.

2.2. Data analysis

Included unadjusted, univariate descriptive statistics to describe the characteristics of the study population. Adjusted chi-square analyses were performed to examine the association between the presence of CVMD risk factors, age and gender. Significance was set at the <.05 level.

2.2.1. Ethical considerations

Human subjects review was sought and approved from the Institutional Review Board at the University of Massachusetts Boston and the Ethics Review Committee at the Kenyatta National Hospital and University of Nairobi. All the participants were assured of confidentiality in the study and signed an informed consent. Administrative permission to carry out the study was obtained from the Ministry of Health in Kenya.

2.2.2. Setting

The government clinic in this study is a level 2 community health facility in Nyeri County, Kenya. It is headed by a Kenya registered community health nurse, offering both curative and preventive health services to the community. A School of Nursing in Central Kenya partnered with the government clinic to implement a health change strategy in addressing the increasing CVMD.

3. Results

The sample consisted of 262 individuals with a mean age of 54 (SD ± 17) years. They were predominantly women and of Kikuyu ethnicity. The self-reported history of diabetes, hypertension and obesity was 5% ($n = 14$), 33% ($n = 51$) and 28% ($n = 11$) respectively. Table 1 summarizes the self-reported sample characteristics.

Physiological measures included blood pressure, fasting or random blood sugar and anthropometrics. The overall prevalence of cardiovascular risk factors in the sample was high and significant gender and age differences were noted (see Table 2). Women compared to men, were more likely to be overweight [BMI $\geqslant 25$; 39% ($n = 84$) vs 15% ($n = 8$) ($p < 0.001$)]; and have a high waist circumference [women $\geqslant 94$ cm vs men $\geqslant 80$ cm; 30% ($n = 63$) vs 6% ($n = 31$); $p < 0.001$]. In contrary, men were more likely to have high

Table 1
Sample characteristics ($N = 262$).

Variable	*n*	%
Age (mean/SD)[a]	54	17
Female	211	81.47
Tribe (Kikuyu)[a]	254	98.83
Hx of HTN[a]	51	32.9
Anti-HTN meds[a]	37	72.55
Hx DM[a]	14	5.47
Hx Obesity[a]	28	10.94

Abbreviations: HTN, hypertension; meds, medications; Hx, history of; DM, diabetes mellitus.

[a] Indicates self report data.

Table 2
Physiologic measures.

Physiologic measure	*n*	%
Fasting BS > 126 mg/dL[a]	7	4.4
Random BS > 200 mg/dL [a]	2	0.76
DM(Hx|FBS > 126|RBS > 200)[b]	19	8.3
SBP ⩾ 140[a]	92	35.11
HTN(Hx|SBP ⩾ 140)[b]	73	47.1
Waist ⩾ 80 cm F|⩾94 cm M[a]	73	27.86
BMI ⩾ 25[a]	90	34.48
BMI ⩾ 30[a]	24	9.2

Significant gender differences: BMI ⩾ 25; men/women [14.58%, 39.52%; $p < 0.001$]; SBP ⩾ 140 mmHg; men/women [54.17, 30.81%; $p = 0.045$]; High waist circumference; men/women [6.25%, 29.86%; $p < 0.001$].
Abbreviations: BS, blood sugar; DM, diabetes mellitus; Hx, history of; FBS, fasting blood sugar; RBS, random blood sugar; SBP, systolic blood pressure; F, female; M, male; BMI, body mass index.
[a] Means physiologically tested by a medical equipment.
[b] Means combination of self report and physiological measure.

systolic blood pressure than women [SBP ⩾ 140 mmHg; men 54% ($n = 28$) vs women 31% ($n = 65$); ($p = 0.45$)]. Systolic blood pressure was found to increase with age as follows [SBP ⩾ 140; (12%, 39%, 52%) (<45, 45–64, 65+) ($p < .001$)]. Diabetes prevalence (fasting blood sugar >126 mg/dl or ⩾200 non-fasting) was 8.3%, which is slightly lower than the global prevalence of 9% (World Health Organization., 2015). Table 2 summarizes the physiological measures.

Adverse dietary patterns observed included adding salt during cooking was 89% ($n = 196$) and at the table was 28% ($n = 63$) and 68% ($n = 178$%) consumed less than three servings of vegetables per day. Sixty-nine percent ($n = 152$) of the respondents used solid (saturated) fat for cooking; thirty-four percent ($n = 75$) reported having red meat several times a week, 9% ($n = 61$) drank soda daily or weekly and 3% ($n = 6$) smoked. Physical inactivity, a common risk factor in western countries, was not common; only 10% ($n = 23$) of the participants reported getting less than the recommended one hour of physical activity per day. Table 3 presents the self-reported lifestyle characteristics of the sample. Overall, 65% ($n = 170$) of the sample had moderate to high risk for CVMD factors based on the Global Risk Score Scale (Gaziano et al., 2008). Risk factors used to estimate the Global Risk Score included: gender, history of diabetes, smoking status, blood pressure, age and BMI. Table 4 describes the distribution Global Risk Scores in the sample.

4. Discussion

This study was conducted in rural Kenya where most of the dwellers are farmers and with no formal employment. The main economic activity of the people in this region is crop and dairy farming. Hypertension and diabetes were associated with older age with hypertension being more common in men. This is supported by a similar study done in Nakuru, Kenya where prevalence of diabetes and hypertension increased with age, both in rural and urban areas (Mathenge et al., 2010). History of diabetes, hypertension and overweight was found to be high and underdiagnosed. Forty percent of individuals with a blood pressure greater then 140 mmHg were unaware of their high blood pressure status. Similarly, observed blood pressure, blood sugar and anthropometrics including waist circumference and BMI were also high, as also reported by another cross-sectional study in Sub-Saharan Africa (Hendriks et al., 2012).

Similar to western countries, the consumption of vegetables was low (unexpected in a rural, agrarian economy) and the consumption of salt was high. Many people reported using solid (saturated) fat for cooking; however the consumption of red meat (the usual source of saturated fat in western cultures) was low. Of note, while the overall self-reported prevalence of smoking and harmful alcohol intake was low, when adjusted for gender the rates for males approximated that of western countries which indicates a higher prevalence of smoking and alcohol intake (American Heart Association, 2015). Different from western countries where consumption of sugary drinks and sedentary lifestyle is common, the consumption of sugary drinks and the prevalence of physical inactivity were low in this community. According to American Heart Association (2015) statistics, most Americans do not meet the required federal physical activity requirements and still have high intake of sugary drinks (American Heart Association, 2015; Center for Disease Control, 2013).

Among the notable findings was low intake of vegetables among members of this rural area which has plenty of vegetables especially during the rainy season. Inadequate intake of vegetables has been implicated to increase blood pressure in all populations. Adding of salt at the table and use of solid (saturated) cooking fats for cooking was found to be common among the participants and can result in high blood pressures. Interestingly, the participants were highly active, living in rural area and consumed very low amounts of sugary foods. This does not explain the usual western lifestyle risk factors for CVMD (Mbanya et al., 2010). Even in absence of the above mentioned risk factors, CVMD still remains high. This clearly shows that the global risk factors for CVMD are not necessary the same in every part of the world; hence, local health solutions need to be investigated to help address these challenges.

Table 3
Self-reported lifestyle characteristics.

Variable	*n*	%
Smoking	6	2.69
ETOH	14	5.45
Stress	99	44.59
Depression sx (PHQ ⩾ 3)	31	13.91
<1 h/day physical activity	23	10.45
Add salt to cooking	196	89.09
Add salt at table	63	28.38
Eat beef/pork/chic daily	75	33.78
3+ serv veg/day	84	31.95
Daily beans (protein)	84	38
Never/rarely drink soda	201	90.54
Cook with solid fat	152	68.78

Abbreviations: PHQ, patient health questionnaire; sx, score; chic, chicken; serv, servings; veg, vegetables.
All characteristics are self report.

Table 4
Global risk assessment.

Composite risk			Gaziano Global Risk Score-NHNES 1		
	n	%		*n*	%
0 risk factors	32	12.17	Low risk (<10%)	92	35.2
1 risk factors	69	26.52	Mod risk (10-20%)	59	22.4
2 risk factors	96	36.52	High risk (>20%)	111	42.4
3+ risk factors	65	24.88		262	100

Composite risk includes: systolic blood pressure ⩾140 mmHg or Hx HTN) diabetes mellitus, BMI ⩾ 25 of Hx of obesity, age > 65 years.
History of coronary artery disease, history of dyslipidemia, age ⩾ 65 years.
Gaziano global risk score is the risk of developing CVD in the next 10 years.
GRS includes: gender, history of diabetes, smoking, blood pressure, age, BMI.

5. Limitations

The sample is a convenience sample, thus limiting the ability to generalize the results or calculate true prevalence of disease. However, that said, it is reassuring to note that the data presented for this community correlates well with the hypothetical models

proposed for the region. And while the sample does not represent true prevalence, the description of the risk profile (pattern) for individuals within the group does represent the true risk for those individuals and the high clustering of risk factors observed and high Global Risk Score is alarming.

6. Conclusions/recommendations

The high rates of CVMD observed in this study, particularly the clustering of risk factors and high global risk scores, are alarming. Results point to the urgent need for appropriate action focused on prevention and management of the risk factors and CVMD. Nurses, being the major health work force in most parts of Sub-Saharan Africa need to be empowered in order to help patients prevent and manage CVMD. In Kenya, nurses are present in every primary care facility and they are the first contact with most of the hypertensive and diabetic patients. With this in mind, urgent measures are needed to evaluate community-based, cost effective and culturally sensitive approaches to management of CVMD in rural Kenya. More population-based studies need to be conducted to evaluate the effectiveness of such interventions in the rural areas in Sub-Saharan Africa.

Partnerships such as those in this study between a clinic and a School of Nursing to carry out community screenings and implement evidence-based treatment protocols is a novel way to increase the number of individuals screened and treated for CVMD in resource constrained settings. This type of partnership leverages the importance of nursing as the primary providers of care at the community level. The clinic and the School of Nursing partnership in this study provided increased numbers of nurses and nursing students available to screen for disease and linked those individuals identified at high risk for, or with, CVMD to follow-up care in the community clinic. The partnership also provided a critical need to locally tailor the approach to treating cardio-metabolic disease.

Another novel approach to addressing the emerging epidemic of CVMD is the development of peer-led/nurse-directed self-management groups. The Kenya Heart and Sole partners in this study have formed such a program at the clinic where this study was carried out. The peer-led/nurse-directed hypertension/diabetes support group has 30 registered members with the majority aged above 45 years, having both diabetes and hypertension. In the group is a 14 year pupil with type 1 diabetes mellitus. The main activities of the group include health education on cardiovascu lar–metabolic disease, risk factor reduction, screening and testing for diabetes and hypertension. They also have a demonstration kitchen garden for education on production of healthy foods.

The power of partnerships is central to the goals of the current study. Partnering clinically focused Schools of Nursing, Kenyan and US university Schools of Nursing and the Ministry of Health clinics allowed the Kenya Heart and Sole project to assure that the project is evidence-based, clinically excellent and locally tailored. It also allows for research to be carried out and clinical initiatives to be designed that can advance the role of nursing in the prevention, detection and treatment of CVMD in a manner that promotes the patient as central to his or her care.

Conflict of interest

None.

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