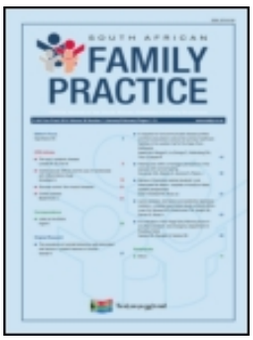

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RESEARCH

Multiple cardiovascular disease risk factors in rural Kenya: evidence from a health and demographic surveillance system using the WHO STEP-wise approach to chronic disease risk factor surveillance

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Background: To describe the distribution of obesity, hypertension, dysglycaemia and dyslipidaemia (which are risk factors for cardiovascular disease) using a Health and Demographic Surveillance System (HDSS) site in western Kenya.
Design: Descriptive cross-sectional population survey.
Setting: Webuye Health and Demographic Surveillance System (HDSS) site in western Kenya.
Participants: Persons aged 18 years and above.
Interventions: Body mass index (BMI), blood pressure levels, fasting blood sugar and fasting lipid profile.
Main outcome measures: Cardiovascular disease risk factors in a rural Kenyan population.
Results: The mean age was 44 years and 57% were female. The distribution of BMI was: mean = 20 kg/m^2 (range 24–36); 18.5–25 kg/m^2 = 57%;< 18.5 kg/m^2 = 35%.
Distribution of blood pressure levels: Normal in 40%; pre-hypertensive 40%; hypertension stages 1 and 2 was 13% and 8% respectively. Nearly all affected were unaware of their elevated blood pressure.
Impaired fasting glucose was found in 4.5% while 6.5% were diabetic.
Fasting serum lipid profile was normal in over 85% of the population.
Conclusions: This rural population had low BMI with 92% having a BMI below 25 kg/m^2 and about 20% of them being in hypertension stage 1 and 2 and nearly all unaware of it. Despite the majority having below normal BMI, it was noted that rates of hypertension increased with increasing BMI. There was significant presence of dysglycaemia but not dyslipidaemia.

Keywords: cardiovascular disease, dysglycaemia, dyslipidaemia, rural adult population, Webuye Health and Demographic Surveillance Systems site

Introduction

Obesity and hypertension are well-documented risk factors for cardiovascular disease (CVD), and a growing cause of morbidity and mortality in low- and middle-income countries. Obesity as diagnosed by body mass index, waist circumference and waist–hip circumference is associated with increased CVD risk.[1–3] In sub-Saharan Africa (SSA), it has been documented that overweight and obesity are on the rise and could reach epidemic proportions in the near future.[4] Central obesity has been associated more with type 2 diabetes and possibly increased CVD than general obesity.[5] It has been observed that the prevalence of central obesity in Africa is higher among women than in men in contrast to findings from high-income countries where it is the same across genders.[6] In SSA obesity is reported to be most prevalent among urban middle-aged women.[7]

Hypertension has been documented as the commonest risk factor for cardiovascular-related morbidity and mortality globally.[8] Studies conducted in SSA show that the burden of hypertension is higher than in other parts of the world.[9,10] It is also the most frequently observed CVD risk factor in both urban and rural communities in this region.[11]

The estimated prevalence of hypertension in the different Kenyan ethnic groups ranges from 6% to 24%.[12–15] The lower prevalence is among the rural populations. It has also been demonstrated that the socioeconomic position (material resources and highest level of education) of the individual provided different aspects of protection as well as risk.[16]

Studies in SSA have reported diabetes prevalence ranging from 1% to 12% in different countries.[18] Systematic reviews on the prevalence of diabetes and impaired glucose tolerance (IGT) reported equal prevalence in men and women in Eastern, Central and Southern Africa with slightly higher impaired fasting glucose (IFG) in men than women of Eastern and Southern Africa. The average prevalence of diabetes and IGT in SSA is reported as 6% and 5% respectively.[19]

The national prevalence of diabetes in Kenya was estimated at 5% by the International Diabetes Federation (IDF) 2011.[20] Different studies in different communities have reported different prevalence.[21–23] One study in Western Kenya reported a prevalence of 8% in a neighbouring rural population.[24]

Dyslipidaemia is an abnormal lipid profile that is evidenced by any or all of the four (elevated levels of total plasma cholesterol, low-density lipoprotein cholesterol, triglycerides and reduced levels of high-density lipoprotein cholesterol).[25–29] Through atherosclerosis, dyslipidaemia is a well-documented risk factor for CVD. Data on the prevalence of dyslipidaemia in sub-Saharan Africa (SSA) are scanty, although more studies on cardiovascular disease risk factors in low- and middle-income countries (LMICs) have been documented in the last decade than in the preceding

five decades.[30–32] The increased attention to these risk factors has been due to an apparent surge in the prevalence of CVDs in these countries in the last two decades.

In Kenya, the available data are mainly on dyslipidaemia associated with HIV infection, diabetes and renal disease.[33,34] Data on the prevalence of dyslipidaemia in the general population are very scanty.

The findings of our study were to guide decisions on whether routine screening for these risk factors among 'healthy adults' would be appropriate and for which specific age group(s) it was needed. It will also inform the health workers, academe and policy-makers in Kenya and SSA.

Our study was conducted in Webuye Health and Demographic Surveillance Systems (WHDSS) site. The demographic data of this population are updated twice a year and members of the population have identification numbers from censuses conducted in the past.

We adopted the World Health Organization (WHO) STEP-wise approach (which involves three steps, where step one interviews the participant to determine self-reported CVD risk factors (alcohol abuse, cigarette smoking, dietary habits and physical activity levels); the second step measures pulse rate, blood pressure levels, height, weight, waist and hip circumferences, while the third step determines fasting levels of blood sugars and lipids). An earlier study in the same population documented alcohol, tobacco abuse and inadequate consumption of fresh fruits and vegetables as the common risk factors in this rural Kenyan population.[17]

Methods

The study was conducted within the WHDSS site that conducts biannual cyclic demographic data updates. The WHDSS was developed between 2006 and 2008 through collaboration of the Moi University and Belgian Universities' projects. It is in Bungoma County of western Kenya about 40 kilometres from the Kenya–Uganda border. According to the latest census, the WHDSS area has a population of about 40 000 adults (≥ 18 years old). The main ethnic community is the Luhya. The majority are subsistence farmers on small parcels of land where they practise mixed farming of maize, beans, sorghum and also keep indigenous cows and chicken, mainly for domestic use. Sugar cane growing is the main commercial farming activity even on some of the small parcels of land (less than two acres).

Study design and participants

This was a descriptive cross-sectional study on a random sample of adults (≥ 18 years old). The WHDSS demographic data-collection cycles preceding our study had personal identification numbers that were based on the household global positioning system (GPS) coordinates and relationship to the head of household. A query for all adults of 18 years and above yielded the list from which computer random sampling was used to select individuals who were stratified by sub-location and village. We used a stratified probability proportional to size method to obtain the number of participants to be sampled per administration unit of the WHDSS site. This was based on proportions of total adult population per unit with each administrative unit participant sample proportionate assignment based on its total adult population. One thousand two hundred participants were selected. Ninety (7.5%) could not be traced. Of these, 50 were students in far away boarding schools/colleges, 17 had moved out of the area, 13 were pregnant while 9 had died. All those available consented to participate. The participants who required intervention, including hospital care, were assisted by our team.

Sample size

The estimated prevalence of diabetes from pilot surveys ranged from 1% to 5% (averaged to 3%). This being a descriptive study where the interest is in a population proportion and the primary outcome is binary, the formula used was: $n = 4z\alpha^2P(1\text{-}P)/W^2$, where prevalence (0.03) is the expected proportion (P) of the characteristic of interest; W (0.05) is the width of the confidence interval (margin of error), and $z\alpha$ (1.96) is a constant value for normal distribution related to the confidence interval (95%).

That is, $n = 4(1.96)^2(0.03)0.97/0.05^2 = 179$. The total study population was calculated by multiplying 179 by six sub-locations and making a 10% allowance for any losses due to migration, death and those who may not be interested in participating in the study. That is, 179 x 6 x 1.1 = 1181 (rounded up to 1 200).

Data collection

The selected participants were invited with the help of research assistants and community leaders to assembly centres where research assistants confirmed their identity details at a registration desk. The assistants then obtained signatures for informed consent before registering consenting eligible persons. A higher diploma medical technologist drew venous blood from all the participants (who reported to have fasted for more than eight hours) and was responsible for its storage and separation of serum for determination of the lipid profile. Fasting blood sugar was determined on the spot using an Abbott Optium™ glucose meter (Abbott Diabetes Care, Maidenhead, UK). Impaired fasting blood glucose (IFG) and diabetes were diagnosed based on the WHO and American Diabetes Association guidelines.[35,36]

The samples taken in the field were stored in cool-boxes for at most four hours. Serum was separated from the whole venous blood and stored in the Webuye district hospital laboratory refrigerators for several hours. It was then transported in cool-boxes before being transferred by private transport to the Moi Teaching and Referral Hospital Reference Laboratory for determination of lipid profile (a distance of about 75 kilometres). A Cobas Integra 400 Plus Biochemistry Analyser™ (Roche Diagnostics, Rotkreuz, Switzerland) was used. The determination of dyslipidaemia followed the guidelines of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III).[37]

Ethical clearance

Ethical clearance for this study was obtained from the Moi University College of Health Sciences' Institutional Research and Ethics Committee (IREC). Approval was also sought from the Moi University Health Sciences Team that is in charge of the WHDSS site. Approval to enter the participants' homes was sought from community leaders before getting informed signed consent from the individuals concerned.

Results

Of the 1 200 included in the analysis 684 (57%) were female. Mean age was 44 years (SD 16), age range 19–81 years (median 41 years). Age categories included: 18–24 years = 156 (13%); 25–34 years = 288 (24%); 35–44 years = 240 (20%); 45–54 years = 192(16%); 55–64 years = 168 (14%) and > 64 years = 156 (13%)

Discussion

This study population is lean, with over 92% having a BMI below 25 kg/m^2 (Tables 1 and 2). There is a significant presence of hypertension with about 20% prevalence of hypertension stages 1 and 2 (Tables 3 and 4). It was noted that the rate of hypertension rose with rising BMI (Table 5).

Socio-economic dynamics mainly due to rural-to-urban migration and epidemiologic transition from communicable to non-communicable disease are said to have contributed to the apparent rapid rise in the prevalence of CVD in low- and medium-income countries.[38,39] In Nairobi, Kenya's capital city, a cross-sectional survey across five socioeconomic classes reported a mean prevalence of metabolic syndrome of 35% (40% in women compared with 29% in men).[40] An autopsy study of the cardiovascular disease causes of death by the University of Nairobi reported a prevalence of 13% with the common conditions being myocardial infarction, cardiomyopathy, subarachnoid haemorrhage, pulmonary thromboembolism, ruptured aortic aneurysm and hypertensive heart disease.[41] The University of Nairobi laboratory, though a national referral hospital, still serves many Nairobi urban residents who are not national referrals. So these numbers probably apply to the Nairobi population and only for families who used the Nairobi University autopsy services.

Higher prevalence of pro-inflammatory indices (high C-reactive protein levels) and lower prevalence of other features of the metabolic syndrome have been reported in rural SSA populations, which are affected by communicable diseases, when compared with populations in the developed economies. In these developed countries, obesity has been positively associated with increased adult mortality in multiple prospective studies. These

Table 1: BMI distribution (n = 1 161)

BMI range (kg/m^2) (WHO reference doc)[31]	Male n1 (%)	Female n2 (%)	Total and proportion of total population (%)
< 18.5	184 (44)	234 (56)	418 (36)
18.5–24.99	304 (46)	358 (54)	662 (57)
25–29.99	13 (23)	45 (77)	58 (5)
≥ 30	0	23 (100)	23 (2)

Note: In total, 57% are in the normal BMI category while slightly more than a third (35%) are underweight and only 2% are in the BMI category above 30 kg/m^2. The missing data of 24 women and 15 men were from those with physical disability in whom determination of height was not possible.

Table 2: BMI by age (Pearson's chi-square = 32.1224 Pr. = 0.006; n = 1 161)

BMI category (kg/m^2)	18–24 years n1 (%)	25–34 years n2 (%)	35– 44 years n3 (%)	45–54 years n4 (%)	55–64 years n5 (%)	> 64 years n6 (%)	Total [n1 + n2 + n3 + n4 + n5 + n6] (%)
< 18.5	46 (11)	67 (16)	113 (27)	84 (20)	50 (12)	58 (14)	418 (100)
18.5–24.99	99 (15)	212 (32)	106 (16)	93 (14)	86 (13)	66 (10)	662 (100)
25–29.99	0	0	5 (8)	13 (23)	27 (46)	13 (23)	58 (100)
≥ 30	0	5 (20)	9 (40)	0	5 (20)	4 (20)	23 (100)
Total = n	145 (13)	284 (24)	233 (20)	190 (16)	168 (14)	141 (12)	1161 (100)

Table 3: Blood pressure distribution (n = 1 200)

Systolic blood pressure category by JNC classification[32]	Males n1 (%)	Females n2 (%)	Total and proportion of total population (%)
Normal	178 (37)	302 (63)	480 (40)
Pre-hypertension	226 (47)	254 (53)	480 (40)
Hypertension stage 1	55 (39)	89 (61)	144 (12)
Hypertension stage 2	53 (55)	43 (45)	96 (8)
Total = n	516 (43)	684 (57)	1200 (100)

Note: In total, 40% were found to be pre-hypertensive, 13% were hypertensive stage 1 and 8% were hypertensive stage 2.

Table 4: Blood pressure by age (Pearson's chi-square = 0.0462 Pr = 0.977; n = 1 200)

Blood pressure category	18–24 years n1 (%)	25–34 years n2 (%)	35– 44 years n3 (%)	45–54 years n4 (%)	55–64 years n5 (%)	>64 years n6 (%)	Total [n1 + n2 + n3 + n4 + n5 + n6] (%)
Normal	77 (16)	168 (35)	82 (17)	72 (15)	48 (10)	29 (6)	480 (100)
Pre-hypertension	57 (12)	106 (22)	149 (31)	91 (19)	53 (11)	24 (5)	480 (100)
Stage 1	14 (10)	18 (13)	10 (7)	23 (16)	42 (29)	37 (26)	144 (100)
Stage 2	0	0	0	10 (10)	29 (30)	57 (60)	96 (100)
Total	156 (13)	288 (24)	240 (20)	192 (16)	168 (14)	156 (13)	1200 (100)

Note: Blood pressure prevalence rises with increasing age after 35 years of age.

Table 5: Relationship between BMI and hypertension (n = 1 161)

BMI	Normal n1 (%)	Pre-hypertension n2 (%)	Hypertension stage 1 n3 (%)	Hypertension stage 2 n4 (%)	Total n1+n2+n3+n4 (%)
< 18.5	209 (51)	152 (37)	29 (7)	20 (5)	410 (100)
18.5–24.99	245 (37)	266 (40)	93 (14)	60 (9)	664 (100)
25–29.99	14 (23)	25 (39)	14 (23)	10 (15)	63 (100)
≥ 30	5 (20)	5 (20)	14 (60)	0 (0)	24 (100)

Note: Higher rates of obesity are associated with higher rates of hypertension.

studies documented an above 30% higher all-cause mortality for each 5 kg/m^2 rise of BMI above 25 kg/m^2.[26]

In SSA more data on hypertension as a CVD risk factor are available compared with data on obesity and conclusions made that it was a more frequently observed risk factor for CVD than obesity in this region.[9–11]

Rural Kenyan communities, though different, share similar socio-economic challenges such as poverty and high prevalence of communicable diseases. Some studies have reported varying prevalence in CVD risk factors among different ethnic communities in semi-urban and urban settings [12,22]

BMI patterns

In this rural adult population over 92% were below 25 kg/m^2, 35% were thin (BMI < 18.5 kg/m^2) while only 2% had a BMI above 30 kg/m^2. This is discordant with the report of high prevalence of obesity among HIV+ patients in this region by Bloomfield et al.[14] Advancing age was not significantly associated with increased obesity. Cheng et al. reported low prevalence of obesity and a high prevalence of food insecurity in diabetic patients attending follow-up clinics in three hospitals in Western Kenya.[42] Mbochi et al. reported overweight and obesity in Nairobi adult women, which was associated with higher socioeconomic status and higher age.[43] The majority in our study population lived below the poverty line.

Hypertension patterns

About 40% of this rural adult population had normal blood pressures while an equal proportion were pre-hypertensive. Hypertension stages 1 and 2 were present in 21%. The large proportion of pre-hypertensive adults is of great interest because of the urgent need for intervention. Studies in the same region have reported hypertension prevalence at 6–12%.[13,14] Van de Vijver et al. reported a prevalence of 12% in slum dwellers in Nairobi of whom 20% knew that they were hypertensive. This urban slum population comprised 47% on hypertension medication.[15] The variance in awareness levels could be attributed to the effects of urbanisation where more health education may be available. The prevalence of hypertension stages 1 and 2 was almost the same for males and females. The prevalence of hypertension increased with age as documented in many other studies in diverse communities.

Obesity and hypertension

Obesity-related hypertension is attributed to the hormone leptin that is produced in fat and is known to activate the sympathetic nervous system. Other associated abnormalities include the activation of the renin-angiotensin system with subsequent increased sodium retention.[44] Underweight-related hypertension is mainly observed as secondary hypertension due to chronic renal disease and in non-obese persons genetically predisposed to pro-inflammatory and anti-endothelial mechanisms that contribute to hypertension.[45]

Our study population was lean with the remarkable observation that the majority of the hypertensive participants (stage 1 and 2) were in the normal BMI category.

Dysglycaemia

Dorland's Pocket Medical dictionary 29th edition defines dysglycemia as 'any disorder of blood sugar metabolism'. In our study the term is used to refer to impaired fasting blood sugar and diabetes as diagnosed based on the WHO and American Diabetes Association guidelines.[35,36]

Most of the national data on the prevalence of diabetes in countries in the SSA region are usually extrapolated from regional trends[1,2,4–6,46] We report the prevalence of impaired fasting glucose and diabetes as 5% and 7% respectively in this rural population (Table 6). The International Diabetes Federation (IDF) estimates the National Kenya prevalence of diabetes as 4.5–5%.[20]

Studies done among Kenya urban dwellers report similar

Table 6: Fasting blood sugar levels by age (n = 1 200)

Fasting blood sugar category	16–24 years n1 (%)	25–34 years n2 (%)	35–44 years n3 (%)	45–54 years n4 (%)	55–64 years n5 (%)	≥64 years n6 (%)	Total n1+n2+n3+n4+n5+n6 (%)
Normal (≤ 6 mmol/L)	139 (13)	267 (25)	235 (22)	171 (16)	128 (12)	128 (12)	1068 (100)
IFG (6.1–6.9 mmol/L)	10 (18)	5 (9)	5 (9)	14 (28)	10 (18)	10 (18)	54 (100)
Diabetes	5 (6)	19 (25)	0	5 (6)	34 (44)	15 (19)	78 (100)
Total n (%)	144 (12)	288 (24)	240 (20)	192 (16)	168 (14)	168 (14)	1200 (100)

Note: The prevalence of impaired glucose tolerance is 4.5% while the prevalence of diabetes is 6.5%. The prevalence of dysglycaemia rises with age after 54 years.

Table 7: Fasting blood sugar levels by gender (*n* = 1 200)

Fasting blood sugar category	Male n1 (%)	Female n1 (%)	Total n1+n2 (%)
Normal (≤ 6 mmol/L)	619 (58)	449 (42%)	1068 (100)
IFGT (6.1–6.9 mmol/L)	30 (55)	24 (45)	54 (100)
Diabetes	44 (56)	34 (44)	78 (100)
Total *n* (%)	684 (57)	516 (43)	1200 (100)

Note: The prevalence of dysglycaemia (IFGT and diabetes) is slightly higher in males.

prevalence but more than 10.5% has been reported in particular Kenyan ethnic communities.[15,16,21–23] The variation of prevalence between ethnic rural communities is attributed to variation in dietary habits and influence of proximity to major urban centres.

Males and females had similar prevalence in our study (Table 7) to that documented in other studies from this region. There are some studies within the same region that have reported male-to-female prevalence ratios ranging from 1:2 to 1:3.[27,42]

Dyslipidaemia

Dyslipidaemia is a disorder of lipoprotein synthesis that may be manifested by elevation of the total cholesterol, low-density lipoprotein (LDL) cholesterol and the triglyceride concentrations, and a decrease in the high-density lipoprotein (HDL) cholesterol concentration in the blood.

Association of dyslipidaemia and chronic diseases such as HIV

Table 8: Serum cholesterol categories in the population

Serum cholesterol categories	Mean	Standard deviation	Minimum	0.25	Median	0.75	Max
Total (TC)	4.09	1	0.69	3.44	4.09	4.73	6.43
LDL cholesterol	2.44	0.86	0.52	1.8	2.39	2.96	6.40
HDL cholesterol	1.81	0.34	0.38	1.08	1.32	1.6	3.20
Triglycerides	0.9	0.52	0.27	0.61	0.81	1.06	6.95

Notes: The mean and median serum total cholesterol, LDL and triglyceride levels are within desirable levels. The mean serum HDL cholesterol levels are within optimal levels while the median is slightly lower than normal.

Table 9: Fasting total cholesterol levels by age (*n* = 1 185)

Serum cholesterol categories	16–24 years	25–34 years	35–44 years	45–54 years	55–64 years	≥64 years	Total
1.Total serum cholesterol (mmol/L)	n1 (%)	n2 (%)	n3 (%)	n4 (%)	n5 (%)	n6 (%)	n1+n2+n3+n4+n5+n6 (%)
Desirable (< 5.18)	131 (13)	231 (23)	221 (22)	181 (18)	141 (14)	100 (10)	1 005 (100)
Borderline (5.19–6.19)	15 (11)	34 (25)	19 (14)	10 (7)	29 (21)	29 (21)	136 (100)
High (> 6.2)	1 (11)	2 (22)	0	1 (11)	2 (22)	3 (33)	44 (100)
Total *n* (%)	142 (12)	284 (24)	237 (20)	190 (16)	178 (15)	142 (12)	1 185 (100)
LDL cholesterol categories							
Optimal/near normal (< 3.4)	143 (14)	246 (24)	235 (23)	164 (16)	123 (12)	113 (11)	1 024 (100)
Borderline (3.4–4.1)	5 (4)	10 (9)	19 (17)	14 (13)	39 (35)	25 (22)	112 (100)
High/very high (> 4.1)	0	14 (30)	5 (10)	10 (20)	10 (20)	10 (20)	49 (100)
Total*n* (%)	142 (12)	284 (24)	237 (20)	190 (16)	178 (15)	154 (13)	1 185 (100)
HDL cholesterol categories							
Optimal (> 1.55)	31 (9)	86 (25)	63 (18)	55 (16)	63 (18)	48 (14)	346 (100)
Borderline (1.04–1.52)	84 (14)	144 (24)	120 (20)	90 (15)	90 (15)	72 (12)	600 (100)
Low (< 1.04)	33 (14)	60 (25)	60 (25)	43 (18)	24 (10)	19 (8)	239 (100)
Total *n* (%)	142 (12)	284 (24)	237 (20)	202 (17)	178 (15)	142 (12)	1 185 (100)
Triglyceride category levels							
Normal (< 1.695)	137 (12)	285 (25)	240 (21)	182 (16)	160 (14)	137 (12)	1 141 (100)
Borderline high (1.695–2.259)	0	0	5 (17)	10 (33)	10 (33)	5 (17)	29 (100)
High (2.260–5.649)	5 (50)	0	0	0	5 (50)	0	10 (100)
Very high (> 5.650)	0	0	0	0	5 (100)	0	5 (100)
Total, *n* (%)	142 (12)	284 (24)	237 (20)	202 (17)	178 (15)	142 (12)	1 185 (100)

Notes: Fifteen serum specimens were not analysed due to loss or haemolysis. None of the participants was on any statins or had known history of dyslipidaemia.
In total, 85% of the participants had desirable total cholesterol levels while 4% had high total cholesterol levels; 86% had optimal HDL cholesterol while 4% had high/very high LDL cholesterol.
The majority of this rural adult population had borderline levels of HDL cholesterol and > 96% had desirable levels of serum triglycerides. No significant dyslipidaemia was observed with ageing.

Table 10: Cross-tabulation dysglycaemia and dyslipidaemia

Serum cholesterol categories	Other n1 = 1 063	Diabetes n2 = 54	Impaired Fasting Blood sugar n3 = 78	Total *n* = 1 185	*p*-value
Total cholesterol					
Desirable	902 (90)	50 (5)	50 (5)	1002 (100)	
Borderline	111 (79)	0 (0)	30 (21)	141 (100)	0.012
High	42 (100)	0 (0)	0 (0)	42 (100)	
LDL					
Optimal	923 (90)	41 (4)	61 (6)	1025 (100)	
Borderline	91 (79)	5 (4)	20 (17)	116 (100)	0.214
High	40 (90)	4 (10)	0 (0)	44 (100)	
HDL					
High	314 (93)	0 (0)	24 (7)	338 (100)	
Borderline	540 (90)	42 (7)	18 (3)	600 (100)	0.019
Low	202 (82)	10 (4)	35 (14)	247 (100)	
TGS					0.000
Normal	1014 (90)	45 (4)	68 (6)	1127 (100)	
Borderline	4 (66.7)	0 (0)	2 (33.3)	29 (100)	
High	5 (50)	0 (0)	5 (50)	10 (100)	
Very high	0 (0)	5 (100)	0 (0)	5 (100)	

Note: Dyslipidaemia more present in non-diabetics than in the diabetics in this population.

infection and antiretroviral therapy, diabetes, hypertension and kidney disease among others have been studied and documented in hospital-based studies in SSA.[31,33,34,41,47–50]

Some of the few population studies we accessed in SSA compare prevalence in rural and urban populations.[23,34] Sabir et al. documented significantly lower prevalence of dyslipidaemia among rural dwellers compared with urban non-hospital participants in Hausa-Fulani in north-western Nigeria.[51] Oladapo et al. reported 43% of low HDL cholesterol and 2% high triglyceride prevalence in rural Yoruba in south-western Nigeria.[52] Bimenya et al. reported a high prevalence of dyslipidaemia among a randomly selected 'healthy' group of urban executives in Kampala.[53] Njelekela et al., in a study that compared cardiovascular disease risk factors among rural and urban Tanzanians, reported a significantly lower prevalence of dyslipidaemia among rural people.[54]

The four related Kenyan studies that our search yielded were all done at Kenyatta National Hospital.[33,34,40,41]

Our study population (Table 8) had prevalence of 4% high total cholesterol, 14% suboptimal HDL cholesterol, 4% high/very LDL cholesterol and < 4% high triglyceridaemia. Thus the prevalence of dyslipidaemia is much lower when compared with dysglycaemia in this rural population

Our study (see Table 6) found that there was significant presence of poor blood glucose control, which rose significantly with age after 54 years, and its presence was equal in males and females. Abnormal fasting lipid levels (Tables 8–10) were not significantly present in this population and were not significantly different between diabetics and non-diabetics.

Much more has been documented on dysglycaemia even among rural populations than on dyslipidaemia.[1,2] In Kenya, a few hospital studies have provided data on diabetes but not much is available on dyslipidaemia in community surveys. Our study complements the Bloomfield study by taking fasting blood samples of venous blood to determine the prevalence of dysglycaemia and dyslipidaemia in this rural community whose demographic dynamics are monitored through the WHDSS biannual demographic data cycles.[17]

Data on dyslipidaemia among rural populations in SSA, who are probably spared from the major effects of urbanisation, are scanty with most of what is available being mainly from hospital-based studies.[51,54]

Conclusions

This rural sub-Saharan Africa population, though not obese, has a significant presence of hypertension. The rates of hypertension are lowest amongst those with low BMI scores and highest among those with higher BMI scores. The main cause of low BMI would be lack of adequate food, unlike in the developed countries where it is associated with better feeding habits. More attention on need to change dietary habits and regular screening for hypertension is needed by the 'better off' members of these rural communities and not those that are still struggling to put food on the table. Bloomfield et al. reported over 93% above-average physical activity (a major determinant of BMI) in this study population.[17]

The relatively high prevalence of dysglycaemia in this rural community and the fact that the majority are not aware of their health status calls for enhanced health-prevention and -promotion campaigns. Involvement of the mass media through radio (a popular source of information), which is available in a majority of households, public address in churches/mosques, markets and during other gatherings such as weddings and funerals would go a long way in sensitising these rural populations to the importance of screening for diabetes for those over the ages of 45 years.

The author is leading in preparations to give feedback and set up health promotion and the need for early detection for diabetes for those at risk. It is hoped that the findings of this study will be used to influence policy that guides a public health approach to addressing cardiovascular disease risk factors among rural dwellers in Kenya.

Though dyslipidaemia prevalence is not significantly high, this and other cardiovascular disease risk factors would also be talked about during public health campaigns.

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References

1. World Health Statistics: World Health Organization. Geneva; 2011. Available from: http://www.who.int/ncd_surveillance/infobase.
2. Whitlock G, Lewington S, Sherliker P, et al. Prospective studies collaboration: body –mass index and cause specific mortality in 900,000 adults: collaborative analysis of 57 prospective studies. Lancet. 2009;373:1083–96.
3. Donini LM, Savina C, Generao E, et al. A systematic review of the literature concerning the relationship between obesity and mortality in the elderly. J Nutr Health Aging. 2012;16(1):275–84.
4. Ziraba AK, Fotso JC, Ochako R. Overweight and obesity in urban Africa. A problem of the rich or the poor? BMC Public Health. 2009 Dec;9(1):465.
5. Frank LK, Heraclides A, Danquah I, et al. Measures of general and central obesity and risk of type 2 diabetes in a Ghanaian population. Trop Med Int Health. 2013 Feb;18(2):141–51.
6. Puoane T, Steyn K, Bradshaw D, et al. Obesity in South Africa: the South African demographic and health survey. Obes Res. 2002;10:1038–48.
7. Abubakar AR, Lauder W, Agyemang C, et al. Prevalence and time trends in obesity among adult West African populations: a meta-analysis. Obes Rev. 2008;9:297–311.
8. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for global burden of disease study 2010. Lancet. 2012 Dec 15;380(9959):2224–60.
9. Williams EA, Keenan KE, Ansong D, et al. The burden and correlates of hypertension in rural Ghana: a cross-sectional study. Diabetes Metab Syndr. 2013 July-Sep;7(3):123–8.
10. Twagirumukiza M, De Bacquer D, Kips JG, et al. Current and projected prevalence of arterial hypertension in sub-Saharan Africa by sex, age and habitat: an estimate from population studies. J Hypertens. 2011 Jul;29(7):1243–52.
11. Hendriks ME, Wit FW, Roos MT, et al. Hypertension in Sub-Saharan Africa: cross-sectional surveys in four rural and urban communities. PLoS ONE. 2012;7(3):e32638.
12. Christensen DL, Eis J, Hansen AW, et al. Obesity and regional fat distribution in Kenyan populations: impact of ethnicity and urbanization. Ann Hum Biol. 2008 March–Apr;35(2):232–49.
13. Sonak DP, Shamim MA, Kamano JH, et al. Screening for diabetes and hypertension in a rural low income setting in western Kenya utilizing home-based and community-based strategies. BioMed Central, Global Health 2013;9:21.
14. Bloomfield GS, Hogan JW, Keter A, et al. Hypertension and obesity as cardiovascular risk factors among HIV seropositive patients in western Kenya. PLoS ONE.;6(7):e22288.
15. van de Vijver SJ, Oti SO, Agyemang C, et al. Prevalence, awareness, treatment and control of hypertension among slum dwellers in Nairobi, Kenya. J Hypertens. 2013 May;31(5):1018–24.
16. Ploubidis GB, Mathenge W, De Stavola B, et al. Socioeconomic position and later life prevalence of hypertension, diabetes and visual impairment in Nakuru, Kenya. Int J Public Health. 2013 Feb;58(1):133–41.
17. Bloomfield GS, Mwangi A, Chege P, et al. Multiple cardiovascular risk factors in Kenya: evidence from a health and demographic surveillance system using the WHO STEPwise approach to chronic disease risk factor surveillance. Heart. 2013 Sep;99(18):1323–9. doi: http://dx.doi.org/10.1136/heartjnl-2013-303913. Epub 2013 Jul 19.
18. Hall V, Thomsen RW, Henriksen O, et al. Diabetes in Sub Saharan Africa 1999–2011: epidemiology and public health implications. A systematic review. BMC Public Health 2011 Jul;11(1):564.
19. Hilawe EH, Yatsuya H, Kawaguchi L, et al. Differences by sex in the prevalence of diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance in sub-Saharan Africa: a systematic review and meta-analysis. Bull World Health Org. 2013 Sep 1;91(9):671–682D.
20. Available from: http://www.idf.org/diabetesatlas/5e/africa [cited 2013 Oct 13].
21. Ayah R, Joshi MD, Wanjiru R, et al. A population-based survey of prevalence of diabetes and correlates in an urban slum community in Nairobi, Kenya. BMC Public Health. 2013 April;13(1):371.
22. Mathenge W, Foster A, Kuper H. Urbanization, ethnicity and cardiovascular risk in a population in transition in Nakuru, Kenya: a population-based survey. BMC Public Health. 2010 Sep;10(1):569.
23. Christensen DL, Friis H, Mwaniki DL, et al. Prevalence of glucose intolerance and associated risk factors in rural and urban populations of different ethnic groups in Kenya. Diabetes Res Clin Pract. 2009 Jun;84(3):303–10.
24. Pastakia SD, Ali SM, Kamano JH, et al. Screening for diabetes and hypertension in a rural low income setting in western Kenya utilizing home-based and community-based strategies. Global Health. 2013 May;9(1):21.
25. Park S, Mathis KW, Lee IK. The physiological roles of apolipoprotein J/clusterin in metabolic and cardiovascular diseases. Rev Endocr Metab Disord. 2014 Mar;15(1):45–53.
26. Kones R. Primary prevention of coronary heart disease: integration of new data, evolving views, revised goals, and role of rosuvastatin in management. A comprehensive survey. Drg Des Devel Ther. 2011;5:325–80.
27. Joshi R, Taksande B, Kalantri SP, et al. Prevalence of cardiovascular risk factors among rural population of elderly in Wardha district. J Cardiovasc Dis Res. 2013 Jun;4(2):140–6.
28. Bal SS, Khurana D, Sharma A, et al. Association of metabolic syndrome with carotid atherosclerosis in the young North Indian population. Diabetes Metab Syndr. 2011 Jul-Sep;5(3):153–7.
29. Okafor CI. The metabolic syndrome in Africa: current trends. Indian J Endocrinol Metab. 2012 Jan;16(1):56–66.
30. Pessinaba S, Mbaye A, Yabeta GA, et al. Prevalence survey of cardiovascular risk factors in the general population in St. Loius (Senegal). Ann Cardiol Angio.(Paris). 2013 Aug;62(4):253–8.
31. Iloh G, Njoku PU, Ofoedu JN, et al. The magnitude of abdominal adiposity and atherogenic dyslipidemia among geriatric Nigerians with arterial hypertension in a rural hospital in South-eastern Nigeria. Niger J Clin Pract. 2012 Oct–Dec;15(4):462–8.
32. Micah FB, Nkum BC. Lipid disorders in hospital attendants in Kumasi. Ghana. Ghana Med J. 2012 Mar;46(1):14–21.
33. Manuthu EM, Joshi MD, Lule GN, et al. Prevalence of dyslipidaemia and dysglycaemia in HIV infected patients. East Afr Med J. 2008 Jan;85(1):10–7.
34. Otieno CF, Mwendwa FW, Vaghela V, et al. Lipid profile of ambulatory patients with type 2 diabetes mellitus at Kenyatta National Hospital. Nairobi East Afr Med J. 2005 Dec;82(12Suppl):S173–9.
35. Available from: https://www.idf.org/webdata/docs/WHO_IDF_definition_diagnosis_of_diabetes.pdf.
36. Available from: http://care.diabetesjournals.org/content/29/suppl_1/s43.full.pdf.

37. Available from: http://www.nhlbi.nih.gov/sites/www.nhlbi.nih.gov/files/Circulation-2002-ATP-III-Final-Report-PDF-3143.pdf.
38. Stringhini S, Viswanathan B, Gedeon J, et al. The social transition of risk factors for cardiovascular disease in the African region: Evidence from three cross-sectional surveys in the Seychelles. Int J Cardiol. 2012 Nov 30;pii:SO167-5273(12):01547–1.
39. Okeahialam BN, Ogbonna C, Otokwula AE, et al. Cardiovascular epidemiological transition in a rural habitat of Nigeria: the case of Mangu local government area. West Afr J Med. 2012 Jan–Feb;31(1):14–8.
40. Kaduka L, Kombe Y, Kenya E, et al. Prevalence of metabolic syndrome among an urban population in Kenya. Diabetes Care. 2012 Apr;35(4): 887–93.
41. Ogeng'o JA, Gatonga P, Olabu BO. Cardiovascular causes of death in an East African country: an autopsy study. Cardiol J. 2011;18(1):67–72.
42. Cheng S, Kamano J, Kirui NK, et al. Prevalence of food insecurity in patients with diabetes in western Kenya. Diabet Med. 2013 Jun;30(6):e215–22.
43. Mbochi RW, Kuria E, Kimiywe J, et al. Predictors of overweight and obesity in adult women in Nairobi Province, Kenya. BMC Public Health. 2012;12:823.
44. Re RN. Obesity-related hypertension. Ochsner J. 2009;9:133–136.
45. Salahudeen AK, Fleischmann EH, Bower JD, et al. Underweight rather than overweight associated with higher prevalence of hypertension: BP vs. BMI in haemodysis population. Nephrol Dial Transplant. 2004 Feb;19(2):427–32.
46. Koopman JJE, van Bodegom D, Jukema JW, et al. Risk of Cardiovascular disease in a traditional African population with a high infectious load: a population-based study. PLoS One. 2012;7(10):E46855.
47. Feleke Y, Fekade D, Mezegeb Y. Prevalence of highly active antiretroviral therapy associated metabolic abnormalities and lipodystrophy in HIV infected patients. Ethiop Med J. 2012 Jul;50(3):221–30.
48. Muhammed S, Sani MU, Okeahialam BN. Prevalence of dyslipidaemia among human immunodeficiency virus infected Nigerians. Ann Afr Med. 2013 Jan–Mar;12(1):24–8.
49. Jisieike-Onuigbo NN, Oguejiofor CO, Unuigbe EI. Dyslipidemias in type 2 diabetes mellitus patients in Nnewi South-East Nigeria. Ann Afr Med. 2011 Oct-Dec;10(4):285–9.
50. Iseki K. Epidemiology of dyslipidaemiain chronic kidney disease. Clin Exp Nephrol. 2014 Apr18(2):185–8. doi: 10.1007/s10157-013-0891-8. Epub 2014 Jan 11
51. Sabir AA, Isezuo SA, Ohwovoriole AE, et al. Rural-urban difference in plasma lipid levels and prevalence of dyslipidaemia in Hausa-Fulani of North-Western Nigeria. Ethn Dis. 2013 Summer;23(3):374–8.
52. Oladapo OO, Salako L, Sodiq O, et al. A prevalence of cardiometabolic risk factors among a rural Yoruba south-western Nigerian population: a population-based survey. Cardiovasc J Afr. 2010 Jan–Feb;21(1):26–31.
53. Bimenya GS, Okot JK, Nangosa H, et al. Plasma cholesterol and related lipid levels of seemingly healthy public service employees in Kampala, Uganda. Afr Health Sci. 2006 Sep;6(3):139–44.
54. Njelekela M, Sato T, Nara Y, et al. Nutritional variation and cardiovascular risk factors in Tanzania–rural-urban difference. S Afr Med J. 2003 Apr;93(4):295–9.

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Appendix 1. Map of Webuye Health and Demographic Surveillance System Site