Prevalence of Metabolic Syndrome Among an Urban Population in Kenya

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OBJECTIVE—Developing countries are undergoing an epidemiologic transition accompanied by increasing burden of cardiovascular disease (CVD) linked to urbanization and lifestyle modifications. Metabolic syndrome is a cluster of CVD risk factors whose extent in Kenya remains unknown. The aim of this study was to determine the prevalence of metabolic syndrome and factors associated with its occurrence among an urban population in Kenya.

RESEARCH DESIGN AND METHODS—This was a household cross-sectional survey comprising 539 adults (aged ≥18 years) living in Nairobi, drawn from 30 clusters across five socioeconomic classes. Measurements included waist circumference, HDL cholesterol, triacylglycerides (TAGs), fasting glucose, and blood pressure.

RESULTS—The prevalence of metabolic syndrome was 34.6% and was higher in women than in men (40.2 vs. 29%; $P < 0.001$). The most frequently observed features were raised blood pressure, a higher waist circumference, and low HDL cholesterol (men: 96.2, 80.8, and 80%; women: 89.8, 97.2, and 96.3%, respectively), whereas raised fasting glucose and TAGs were observed less frequently (men: 26.9 and 63.3%; women: 26.9 and 30.6%, respectively). The main factors associated with the presence of metabolic syndrome were increasing age, socioeconomic status, and education.

CONCLUSIONS—Metabolic syndrome is prevalent in this urban population, especially among women, but the incidence of individual factors suggests that poor glycemic control is not the major contributor. Longitudinal studies are required to establish true causes of metabolic syndrome in Kenya. The Kenyan government needs to create awareness, develop prevention strategies, and strengthen the health care system to accommodate screening and management of CVDs.

Diabetes Care 35:887–893, 2012

The global prevalence of leading chronic diseases is increasing, with the majority occurring in low- and middle-income countries, and expected to rise substantially over the next two decades (1). Chronic diseases are responsible for 50% of the total disease burden, with estimated age-standardized death rates being higher for men and women from low-income compared to middle-income countries (2). Major causes are said to be increasing rates of hypertension, dyslipidemia, diabetes, obesity, physical inactivity, and tobacco use.

Kenya is a rapidly developing country of sub-Saharan Africa, where the extent of most cardiovascular diseases (CVDs) and the associated risk factors at population level remain largely unknown. Chronic diseases have not received much attention due to overemphasis on communicable diseases, underreporting, missed diagnosis, misdiagnosis, and misclassification of diseases. According to the Ministry of Health Annual Status Report 2007, the leading causes of deaths in Kenya are malaria, pneumonia, HIV/AIDS, diarrhea, anemia, tuberculosis, meningitis, and heart failure. However, noncommunicable diseases (NCDs) contribute over one-half of the top 20 causes of morbidity and mortality (3). Total mortality attributed to NCDs rose from 31.8% in 2002 to 33% in 2007. This has been attributed to urbanization that brings with it changes in lifestyle that adversely affect metabolism.

In 1993, a hospital-based study in Nairobi found high prevalence of obesity, hypercholesterolemia, cigarette smoking, and electrocardiogram evidence of left ventricular hypertrophy, with hypertension as the most common discharge diagnosis (4). A study by Christensen et al. (5) found the prevalence of overweight (BMI ≥25 kg/m^2) at 39.8 vs. 15.8% and obesity (BMI ≥30 kg/m^2) at 15.5 vs. 5.1% among urban versus rural Kenyan populations, respectively. The same study observed an overall age-standardized prevalence of diabetes and impaired glucose tolerance of 4.2 and 12.0%, respectively (6). These findings, in addition to the prevailing global understanding of CVDs, call for screening and early detection of metabolic abnormalities to help identify people who are at risk and most likely to benefit from intervention efforts.

The term metabolic syndrome refers to the clustering of a number of cardiovascular risk factors (obesity, hypertension, dyslipidemia, and hyperglycemia) believed to be related to insulin resistance. It is estimated that ~20–25% of the world's adult population have metabolic syndrome, and they are twice as likely to die of and three times as likely to have a heart attack or stroke compared with people without the syndrome. In addition, people with metabolic syndrome have a fivefold greater risk of developing type 2 diabetes (7). The aim of this study was to determine the prevalence and factors associated with the occurrence of metabolic syndrome among an urban population in Kenya.

RESEARCH DESIGN AND METHODS

—The study was carried out in Langata constituency of Nairobi province, the capital city of Kenya. Langata constituency covers an area of 223.4 km^2 and has a density of 1,284 dwellings per unit area, a population of 355,188, and a total of 108,477 households. This is in

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Received 17 March 2011 and accepted 3 January 2012.
DOI: 10.2337/dc11-0537

comparison with the entire Nairobi province, which covers an area of 696 km^2 and has a density of 4,509 dwellings per unit area, with a total of 985,016 households, and a population of 3,138,369. The country's population has grown from 28,686,607 in 1999 to 38,610,097, of which ~32% live in urban areas (8). Langata was chosen because of its cosmopolitan nature, and it hosts all the five socioeconomic classes (upper, lower upper, middle, lower middle, and lower), as stratified by the Kenya National Bureau of Statistics. This was a cross-sectional study based on a three-stage, cluster-sampling methodology. The first stage involved the selection of 30 clusters from the total enumeration areas in the constituency, followed by selection of the households, and finally selection of the respondents. The study included urban dwellers of both sexes aged ≥18 years, with no known medical history of a debilitating disease and having resided in Nairobi for at least 2 years before the study.

Sample size estimation and sampling

A comprehensive sampling frame was constructed to represent the target population in which the primary sampling unit was an enumeration area as defined during the 1999 Kenya Population and Housing Census. Enumeration areas are small nonoverlapping units defined according to a specified measure of size and have maps showing the boundaries and structures as well as total households and population by sex. A measure of size is defined as having an average of 100 households with a lower and upper limit of 50 and 149 households, respectively. A total of 30 clusters from all the five socioeconomic divisions were selected using the systematic probability-proportional-to-size sampling method. A quick household count was carried out in each enumeration area to verify the number of the entire households. Enumeration areas that surpassed the maximum number of households were segmented and only one segment randomly selected. The selected segments constituted clusters for the study.

During the sampling process, three weights were generated from selection probabilities of clusters, households, and individuals. The final individual weight (taken as inverse of the three selection probabilities) was applied to the final data in order to be representative of the target population.

Selection of households and respondents

Following the quick household count, a household list was generated for every cluster that included information on household occupants. The total number of households per cluster was selected using the systematic random-sampling method, followed by the selection of only one eligible respondent per household using the Kish Grid technique (9), which allows selection of one person to interview from all eligible household residents. Sensitization, recruitment, and assessment of study subjects were done in three phases. Sensitization at administrative and community levels was done during the mapping and counting exercise, followed by visits to the selected households and respondents to explain the nature of the study, the requirement for fasting blood samples, and the intended day and time of assessments. The third phase involved a visit to the cluster by the medical team for blood collection and assessments.

Assessments

The following assessments were carried out between August and October 2008.

Socioeconomic assessment. Interviews were carried out and information on socioeconomic and demographics collected using a structured questionnaire. Education level was categorized into five levels: none, primary (1–8 years), secondary (9–14 years), university (>14 years), and adult education. Occupation was classified as formal, self-employed, and/or petty trade. Information on monthly income also was obtained. Differences in socioeconomic status were obtained using the wealth quintiles. The study used assets ownership and the principal components analysis procedure in SPSS to compute the index. The cut points in the wealth index at which to form the quintiles were calculated by obtaining a weighted frequency distribution of households and the sampling weight of the household. This resulted in the five categories (i.e., lowest, second, middle, fourth, and highest wealth quintiles).

Anthropometric assessments. Waist circumference was determined using Roche circumference tapes. Subjects were asked to stand upright in a relaxed manner, with their feet comfortably apart, their weight evenly balanced on both feet, and with their arms hanging by their sides. Waist circumference was measured at the point halfway between the lower border of the ribs and the iliac crest in a horizontal plane. Measurements were recorded to the nearest 0.1 cm.

Clinical assessment. Blood pressure was taken using the automated Omron M6 Comfort (HEM-7000-E). Blood pressure was measured with subjects in a sitting position and the arm horizontally supported. Family history of diabetes and CVDs were self-reported.

Biochemical assessments. Fasting venous blood was collected between 7:00 A.M. and 8.00 A.M., and blood glucose was immediately determined using the Hemocue B-Glucose 201+ analyzer (HemoCue, Angelholm, Sweden). Blood lipid profile (triacylglycerides [TAGs], total cholesterol, and HDL cholesterol) was analyzed on a Konelab autoanalyzer using the T Series Triglycerides Kit (cat no. 981301), the T Series Cholesterol Kit (cat no. 981812), and the T Series HDL Cholesterol Kit (cat no. 981823) in accordance with the manufacturer's instructions.

Definition of the metabolic syndrome

Metabolic syndrome was defined according to the new 2009 International Diabetes Federation consensus statement criteria, which is the presence of any three of the five following risk factors. These are waist circumference ≥94 cm for men or ≥80 cm for women, TAGs ≥1.7 mmol/L or specific treatment for this abnormality, HDL cholesterol <1.0 mmol/L for men or <1.3 mmol/L for women or specific treatment for this abnormality, elevated blood pressure ≥130/85 mmHg or treatment of previously diagnosed hypertension, and elevated fasting glucose ≥5.6 mmol/L or treatment of previously diagnosed diabetes (10). The European cutoffs for waist circumference were used because of the unavailability of cutoffs for sub-Saharan Africans.

Ethical considerations

Permission to carry out this study was sought from the Kenya Medical Research Institute (KEMRI) National Ethical Review Committee, and informed consent was obtained from each subject prior to participation in the study.

Statistical methods

Data were weighted and analyzed using SPSS version 16, with $P < 0.05$ considered statistically significant. Results are expressed as means ± SD or as proportions (%). For categorical variables, the χ^2 test and Fisher exact probability were used. Linear associations were calculated

using the Spearman correlation coefficient. Binary logistic regression using the backward conditional method was performed on multiple factors to eliminate confounding and to examine the effect of the independent predictors of metabolic syndrome.

RESULTS—A total of 539 (men: 50.5%; women: 49.5%) participants were assessed for risk factors for metabolic syndrome. The mean age was 38 ± 13 years. Up to 98% of the study participants were black Africans from the following ethnic groups: Luo (16.6%), Bohoran (3.7%), Luhya (22.3%), Kalenjin (1.8%), Kikuyu (11.5%), Kamba (12.7%), Meru (2%), Kisii (7.4%), Mijikenda (2%), Nubian (8.6%), Somali (2.6%), Indian (1.2%), and others (Tanzania, Uganda, Ethiopia, or Arab) 7.6%. The overall prevalence of metabolic syndrome was 34.6% and was higher in women than in men (40.2 vs. 29%, respectively; $P < 0.001$). Table 1 shows the prevalence of each component of the metabolic syndrome by sex in the study population.

Among those with metabolic syndrome, the most frequently observed features were raised blood pressure, a higher waist circumference, and low HDL cholesterol (men: 96.2, 80.8, and 80%; women: 89.8, 97.2, and 96.3%, respectively), whereas raised fasting glucose and TAGs were observed less frequently (men: 26.9 and 63.3%; women: 26.9 and 30.6%, respectively).

Under the new International Diabetes Federation consensus statement criteria, subjects with high waist circumference (men: 76.8%; women: 56.1%), raised TAGs (men: 90.9%; women: 94.3%), reduced HDL cholesterol (men: 52%; women: 53.9%), raised blood pressure (men: 38.6%; women: 63%), and raised fasting blood glucose (men: 77.8%; women: 80.6%) were categorized as having metabolic syndrome. However, missing under the new criteria were 48% of men with low HDL cholesterol and 61.4% with raised blood pressure and 43.9% of women with high waist circumference and 46.1% with reduced HDL cholesterol.

The prevalence of metabolic syndrome among age-groups 18–24, 25–34, 35–44, 45–54, and >55 years was 9.9, 23.8, 39.6, 46.5, and 63.5%, respectively. Table 2 shows the proportions of men and women with risk factors for metabolic syndrome by age categories.

Bivariate analysis

Sex difference was observed in the association with socioeconomic indicators and prevalence of metabolic syndrome, as shown in Table 3. A test for trend revealed age to be significantly associated with occurrence of metabolic syndrome in both men ($\chi^2 = 56.53$, df = 4, $P < 0.001$) and women ($\chi^2 = 20.46$, df = 4, $P < 0.001$). Compared with the age-group 18–24 years, the age-group 35–44 years was significantly associated with the occurrence of metabolic syndrome (odds ratio [OR] 27.2 [95% CI 3.7–201.3]; $P = 0.001$) in men and also in women (2.9 [1.2–7.2]; $P = 0.018$). The association also was significant in the age-group 45–54 years in men (25.9 [3.4–198.6]; $P = 0.002$) and women (5.8 [2.2–15.3]; $P < 0.001$). The highest level of significance was observed in the age-group ≥55 years in both men (99.2 [12.6–783.5]; $P < 0.001$) and women (6.0 [2.2–16.5]; $P < 0.001$). Socioeconomic status and occurrence of metabolic syndrome among men and women revealed different measures of association. Socioeconomic status emerged as a significant factor in men but not in women. In men, middle and high wealth quintiles were significantly associated with the occurrence of metabolic syndrome (3.0 [1.1–8.0], $P = 0.034$, and 9.4 [3.5–24.9], $P < 0.001$, respectively). Level of education emerged as a significant factor in women but not in men. Secondary education among women was significantly associated with protection from metabolic syndrome (0.3 [0.2–0.8]; $P = 0.012$). Average monthly income emerged as a significant factor in men but not in women, with an income ranging between $125 and $375 USD being significantly associated with the occurrence of metabolic syndrome (7.0 [2.3–21.5]; $P = 0.001$). No significant association was observed between the main source of income and the occurrence of metabolic syndrome in both men and women.

Multivariate analysis

Binary logistic regression using the backward conditional method was performed on multiple factors to eliminate confounding and to examine the effect of independent predictors on the occurrence of metabolic syndrome. Four factors, namely age, socioeconomic status, level of education, and average monthly income, found to be associated with the occurrence of metabolic syndrome at $P < 0.1$ during bivariate analysis were considered for multivariate analysis. Table 4 shows factors found to predict occurrence of metabolic syndrome among men and women. Occurrence of metabolic syndrome in men was significantly associated with age-groups 35–44 years (adjusted OR 39.8 [95% CI 3.4–263.0]; $P = 0.002$), 45–54 years (46.0 [4.7–446.6]; $P = 0.001$), and ≥55 years (213.2 [19.5–2326.9]; $P < 0.001$). In women, occurrence of metabolic syndrome was significantly associated with age-groups 45–54 years (4.8 [1.4–15.8]; $P = 0.011$) and ≥55 years (4.8 [1.3–17.8]; $P = 0.018$) and not with age-group 35–44 years (2.6 [0.8–8.3]; $P = 0.097$). Occurrence of metabolic syndrome in men was significantly associated with the middle (OR 6.3 [95% CI 1.6–25.1]; $P = 0.009$) and highest quintiles (adjusted OR 14.9 [95% CI 3.5–62.6]; $P < 0.001$), whereas in women, the occurrence of metabolic syndrome was significantly associated with the fourth wealth quintile (3.7 [1.4–9.8]; $P = 0.009$). Level of education was a significant factor in men. Occurrence of metabolic syndrome was significantly associated with men who had attained a university

Table 1—*Prevalence of risk factors for metabolic syndrome by sex*

Risk factors for metabolic syndrome	Men	Women	*P*
N	272	267	
High waist circumference*	30.1	70.3	<0.001
Reduced HDL cholesterol†	45.2	71.8	<0.001
Raised TAGs‡	20.2	13.1	0.155
Elevated blood pressure§	72.1	57.9	<0.001
Elevated fasting glucose‖	10.3	13.5	0.331

Data are percentages, unless otherwise indicated. *Waist circumference ≥94 cm for men or ≥80 cm for women. †HDL cholesterol <1.0 mmol/L for men or <1.3 mmol/L for women or specific treatment for this abnormality. ‡TAG >1.7 mmol/L or specific treatment for this abnormality. §Elevated blood pressure >130/85 mmHg or treatment of previously diagnosed hypertension. ‖Elevated fasting glucose >5.6 mmol/L or treatment of previously diagnosed diabetes.

Table 2—*Proportions of risk factors for metabolic syndrome among men and women by age-group*

	18–24 years		25–34 years		35–44 years		45–54 years		≥55 years	
Risk factors	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
High waist circumference*	2 (4.2)	15 (35.7)	15 (21.1)	45 (62.5)	22 (30.1)	57 (80.3)	17 (38.6)	38 (90.5)	27 (73.0)	32 (86.5)
Reduced HDL cholesterol†	24 (50.0)	23 (53.5)	26 (37.1)	58 (80.6)	37 (50.7)	54 (76.1)	14 (31.8)	28 (66.7)	21 (58.3)	27 (73.0)
Raised TAGs‡	1 (2.1)	2 (4.7)	6 (8.6)	4 (5.6)	23 (31.5)	10 (14.1)	13 (28.9)	9 (21.4)	13 (35.1)	9 (24.3)
Elevated blood pressure§	35 (72.9)	16 (37.2)	37 (52.9)	35 (48.6)	51 (69.9)	38 (53.5)	40 (90.9)	34 (81.0)	33 (91.7)	30 (81.1)
Elevated fasting glucose‖	0 (0.0)	1 (2.4)	5 (7.1)	3 (4.2)	5 (6.8)	12 (16.9)	7 (15.9)	10 (23.8)	11 (29.7)	9 (24.3)

Data are *n* (%). *Waist circumference ≥94 cm for men or ≥80 cm for women. †HDL cholesterol <1.0 mmol/L for men or <1.3 mmol/L for women or specific treatment for this abnormality. ‡TAG >1.7 mmol/L or specific treatment for this abnormality. §Elevated blood pressure >130/85 mmHg or treatment of previously diagnosed hypertension. ‖Elevated fasting glucose >5.6 mmol/L or treatment of previously diagnosed diabetes.

level of education (9.8 [1.1–86.2]; P = 0.040).

CONCLUSIONS—The epidemiological transition that often accompanies urbanization is characterized by increasing prevalence of etiological risk factors for metabolic syndrome, such as obesity, diabetes, and high blood pressure. The clustering of these risk factors confers a greater risk of premature morbidity and mortality (11). Our study found the overall prevalence of metabolic syndrome at 34.6% and was higher in women than men (40.2 vs. 29%, respectively). Similar patterns have been observed elsewhere in Africa. The prevalence of metabolic syndrome among West African women and men was found to be 42 vs.19%, respectively; Great Tunis 31.2% (women 37.3 vs. men 23.9%, respectively); and Seychelles between 25 and 30% (12–14). The observed sex difference in the distribution of metabolic syndrome in this study could be attributed to differences in socioeconomic status, attainment of higher education, and the interplay of the two. Education attainment has a strong effect on health behaviors and attitudes and, consequently, lifestyle. According to the Kenya Demographic and Health Survey 2008–2009 report, a sex difference exists in educational attainment from the age of 14 years, with more male than female youths attending school (15). The same report shows a direct association between educational attainment and improvement in wealth status for both men and women in Kenya. In this study, the presence of metabolic syndrome was inversely associated with attainment of higher education in women but not in men. There was an association between advancement in socioeconomic status in both sexes, and attainment of university education in men with presence of metabolic syndrome. Thus, there could be other factors in addition to socioeconomic status and education contributing to the difference in the associations observed that need further investigation.

Low HDL cholesterol and high waist circumference were more prevalent in women as opposed to high blood pressure in men. Studies in Brazzaville, Cameroon, and Ghana also have observed high cardiometabolic risk in women than men, with central obesity and high blood pressure as the most prevalent risk factors (16–18). Likewise, black populations in the Caribbean, America, and Europe have been found to have low HDL cholesterol levels and increased waist circumference as the common risk factors for metabolic syndrome, and emphasis has been on controlling central obesity and ethnic-specific reformulation of the metabolic syndrome (12,19,20). Metabolic syndrome presents an increased risk for type 2 diabetes and CVD. Thus, in addition to pharmacologic treatment, lifestyle interventions, such as atherogenic diets, weight loss, and increased physical activity, should be encouraged to address the metabolic risk factors. There is need for more research to establish the true burden and causes of CVDs and diabetes across the country. Additional qualitative research will help better understand the associations observed. The inclusion of NCDs in national surveys such as the Kenya Demographic Health Surveys would serve as a start.

In Kenya, chronic diseases have not received much priority because of the overemphasis on communicable diseases and donor-driven agenda that prioritize infectious diseases. Yet, ~53% of all hospital admissions in Nairobi are attributed to NCDs, and diabetes contributes ~27.3% of the total (3). It is important for the policy makers and planners in Kenya to be cognizant of the overlap between infectious diseases and NCDs. In South Africa for instance, a study by Sliwa et al. (21) observed a high prevalence of modifiable risk factors for atherosclerotic disease and a combination of infectious and noncommunicable forms of heart disease. They noted that epidemiological transition has broadened the complexity and spectrum of heart disease in the urban African community. In Kenya, an autopsy study by Ogeng'o et al. (22) found common conditions associated with cardiovascular deaths, such as myocardial infarction, cardiomyopathy, subarachnoid hemorrhage, pulmonary thromboembolism, ruptured aortic aneurysm, hypertensive heart disease, infective pericarditis, and rheumatic heart disease, suggesting that NCDs do overlap with infectious conditions as causes of cardiovascular mortality.

Various anthropometric and biochemical factors differ with different ethnic populations and with sex. In our study, up to 48% of men with low HDL cholesterol and 61.4% with raised blood pressure and 43.9% of women with high waist circumference and 46.1% with reduced HDL cholesterol were missed under the new International Diabetes Federation consensus statement criteria. The new criteria may fall short in this population and result in failure to appropriately identify individuals for primary prevention and management therapy (23). There is urgent need, therefore, for prospective research data from Africa that will guide the development of risk assessment tools that are population specific and sensitive to ethnic differences.

Identification of the social and economic characteristics associated with occurrence of metabolic syndrome is essential for the success of primary preventive measures. In women, the odds favoring metabolic syndrome are said to significantly increase with age and in unfavorable social

Table 3—*Association of selected risk factors with metabolic syndrome among men and women in an urban population in Kenya*

	Men				Women			
	With metabolic syndrome (*n* = 79)	Without metabolic syndrome (*n* = 193)			With metabolic syndrome (*n* = 107)	Without metabolic syndrome (*n* = 160)		
Factors	*n* (%)	*n* (%)	OR (95% CI)	*P*	*n* (%)	*n* (%)	OR (95% CI)	*P*
Age-group (years)								
18–24	1 (2.1)	47 (97.9)	Reference		8 (18.6)	35 (81.4)	Reference	
25–34	10 (14.1)	61 (85.9)	7.3 (0.9–56.9)	0.059	24 (33.3)	48 (66.7)	2.1 (0.8–5.2)	0.111
35–44	27 (37.0)	46 (63.0)	27.2 (3.7–201.3)	0.001	29 (40.8)	42 (59.2)	2.9 (1.2–7.2)	0.018
45–54	16 (36.4)	28 (63.6)	25.9 (3.4–198.6)	0.002	24 (57.1)	18 (42.9)	5.8 (2.2–15.3)	<0.001
>55	25 (69.4)	11 (30.6)	99.2 (12.6–783.5)	<0.001	22 (59.5)	15 (40.5)	6.0 (2.2–16.5)	<0.001
NR/NA/DK	0	0			0	1		
Socioeconomic status								
Lowest quintile	6 (11.8)	45 (88.2)	Reference		35 (40.2)	52 (59.8)	Reference	
Second quintile	9 (21.4)	33 (78.6)	2.1 (0.7–6.4)	0.197	16 (38.1)	26 (61.9)	0.9 (0.4–2)	0.882
Middle quintile	19 (28.4)	48 (71.6)	2.9 (1.1–8)	0.034	29 (38.2)	47 (61.8)	0.9 (0.5–1.7)	0.747
Fourth quintile	8 (17.4)	38 (82.6)	1.7 (0.5–5.1)	0.383	21 (56.8)	16 (43.2)	2.0 (0.9–4.4)	0.079
Highest quintile	36 (55.4)	29 (44.6)	9.3 (3.5–24.9)	<0.001	6 (24.0)	19 (76.0)	0.5 (0.2–1.3)	0.131
Level of education								
None	7 (43.8)	9 (56.3)	Reference		18 (50.0)	18 (50.0)	Reference	
Primary	21 (21.6)	76 (78.4)	0.4 (0.1–1.1)	0.066	61 (45.5)	73 (54.5)	0.8 (0.4–1.8)	0.647
Secondary	28 (23.9)	89 (76.1)	0.4 (0.1–1.2)	0.097	19 (25.0)	57 (75.0)	0.3 (0.1–0.8)	0.012
University	23 (54.8)	19 (45.2)	1.6 (0.5–4.9)	0.449	4 (28.6)	10 (71.4)	0.4 (0.1–1.4)	0.153
NR/NA/DK	0	0			5	1		
Monthly income (USD)								
<40	5 (12.8)	34 (87.2)	Reference		39 (50.0)	39 (50.0)	Reference	
40–75	11 (22.0)	39 (78.0)	2.1 (0.6–6.7)	0.216	22 (40.0)	33 (60.0)	0.7 (0.3–1.3)	0.262
75–125	13 (19.7)	53 (80.3)	1.8 (0.6–5.7)	0.295	15 (35.7)	27 (64.3)	0.6 (0.3–1.2)	0.164
125–375	22 (48.9)	23 (51.1)	7.0 (2.3–21.5)	0.001	11 (52.4)	10 (47.6)	1.2 (0.4–3.1)	0.759
>375	24 (63.2)	14 (36.8)	12.7 (4.0–40.7)	<0.001	4 (33.3)	8 (66.7)	0.5 (0.1–1.7)	0.249
NR/NA/DK	3	31			15	41		
Main source of income								
Formally employed	30 (29.4)	72 (70.6)	Reference		20 (40.8)	29 (59.2)	Reference	
None	0 (0)	4 (100)	UD[†]	0.999	3 (30.0)	7 (70.0)	0.6 (0.1–2.5)	0.442
Farming	2 (33.3)	4 (66.7)	1.4 (0.3–7.7)	0.688	4 (66.7)	2 (33.3)	4.0 (0.6–26.4)	0.147
Self-employed	31 (32.3)	65 (67.7)	1.2 (0.6–2.1)	0.639	45 (45.0)	55 (55.0)	1.2 (0.6–2.5)	0.542
Petty trade	3 (14.3)	18 (85.7)	0.4 (0.1–1.6)	0.207	15 (41.7)	21 (58.3)	1.1 (0.4–2.6)	0.867
Other	9 (39.1)	14 (60.9)	1.5 (0.6–3.9)	0.388	13 (39.4)	20 (60.6)	1.0 (0.4–2.4)	0.924
NR/NA/DK	3	17			9	24		

DK, do not know; NA, not applicable; NR, no response; UD, undefined.

Table 4—*Risk factors for the occurrence of metabolic syndrome among men and women in an urban population in Kenya*

	Men		Women	
Risk factors	Adjusted OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age (years)				
18–24	Reference		Reference	
25–34	9 (0.4–36.5)	0.230	2.4 (0.8–7.4)	0.139
35–44	29.8 (3.4–263.0)	0.002	2.6 (0.8–8.3)	0.097
45–54	46 (4.7–446.6)	0.001	4.8 (1.4–15.8)	0.011
>55	213.2 (19.5–2,326.9)	<0.001	4.8 (1.3–17.8)	0.018
Socioeconomic status				
Lowest wealth quintile	Reference		Reference	
Second wealth quintile	3.1 (0.8–13.1)	0.115	1.2 (0.5–2.8)	0.751
Middle wealth quintile	6.3 (1.6–25.1)	0.009	1.2 (0.6–2.6)	0.614
Fourth wealth quintile	1.9 (0.5–8.0)	0.372	3.7 (1.4–9.8)	0.009
Highest wealth quintile	14.9 (3.5–62.5)	<0.001	0.7 (0.2–2.1)	0.499
Level of education				
None	Reference			
Primary	1.7 (0.3–11.4)	0.581		
Secondary	1.8 (0.3–12.3)	0.540		
University	9.8 (1.1–86.2)	0.040		

class, as described by occupation and decreased education level. In men, metabolic syndrome increases significantly with increasing age and socioeconomic status (24). Our findings were in support of this observation. Metabolic syndrome was prevalent among men of the highest socioeconomic status, those with secondary education, those who were self-employed, and those of high-income earnings. Women who presented with metabolic syndrome were mostly those from the lowest socioeconomic status, those having attained only primary education, those who were self-employed, and those of lower-income earnings. The high incidence of metabolic syndrome observed among women at lower quintiles probably may be a result of low literacy, limited exposure to sources of relevant information, and/or comprehension of this information (25). Income inequality is an independent contributor to variations in CVD burden globally. According to Salsberry et al. (26), women in the lowest economic group are more likely to be at risk when compared with women in the highest economic group. It also is important to note that, in certain parts of Africa, cultural values and positive social attitudes toward fatness among women largely contributes to feminine obesity and, consequently, metabolic syndrome (27). Thus, interventions must be devised based on the level of economic development, the socioeconomic context of risk factor exposures, and individual characteristics, such as age, sex, income, and education level.

This study helps to create awareness among Kenyan policy makers and planners on the health status of the Kenyan urban population with respect to CVDs and calls for attention to both behavioral and biological CVD risk factors. This study also contributes to the worldwide mapping of metabolic syndrome. This study had a limitation. The cross-sectional design does not allow causal or directional inferences. Longitudinal studies are therefore encouraged.

The prevalence of CVD risk factors among urban dwellers in Kenya remains high. This calls for action to prevent and treat the components of the metabolic syndrome. It is essential that the community is mindful of the important CVD risk factors to help improve on adherence to lifestyle changes and medication among those with established disease. The Kenyan government should encourage development and sustenance of health promotion programs that will use a health education approach focused on major biomedical and behavioral risk factors for development of CVD, while paying attention to both promoters and barriers to change. The primary health care system needs to be strengthened and integrate the care of CVDs and management of risk factors. Additional research is necessary to establish the true burden of diabetes, CVDs, and the concomitant risk factors across the country.

Acknowledgments—This study was supported in part by a scholarship from the Gregory Taylor Memorial Fund (U.K.). The authors thank Prof. Alan Jackson and Dr. Steven Wotton of the Institute of Human Nutrition, University of Southampton, who awarded the scholarship for travel and biochemical analyses costs.

No potential conflicts of interest relevant to this article were reported.

L.U.K. researched data and wrote the manuscript. Y.K., J.K.B., and Z.N.B. researched data, contributed to discussion, and reviewed the manuscript. E.Ke. and E.Ku. contributed to discussion and reviewed the manuscript. M.M. contributed to discussion. L.U.K. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Parts of this study were presented in abstract form at the 4th Africa Nutritional Epidemiology Conference, Nairobi, Kenya, 4–8 October 2010.

The authors acknowledge the editorial assistance of Christine Bukania, formerly of the Aga Khan Foundation, Kenya. The authors especially thank Dr. John Jackson and Christian Gelauf of the Institute of Human Nutrition, University of Southampton (U.K.), for their assistance with the biochemical analysis, as well as Ezekiel Ogutu and Alex Muyera of the Kenya National Bureau of Statistics for their assistance in mapping the study area. The authors also thank Ruth Kayima and Linda Atieno of the University of Nairobi, Salma Abdi and Tobias Oliech of KEMRI for their assistance with nutritional assessments, and Saidi Kisiwa and Ezekiel Mukhaye of KEMRI for their laboratory support. The authors sincerely thank the administrative officers and participants of Langata Constituency for their assistance and collaboration.

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