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SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Supplementary Methods.

Supplementary Results.

Figure S1. Characteristics associated with misidentification of dialysis patients.

Figure S2. Predicted risk using US RDS and MASS-DAC variables.

Table S1. Sensitivity, specificity, positive and negative predictive values in analyses corrected for hospital.

Table S2. Results of mixed-effects model using MASS-DAC dialysis variable for prediction of 30-day mortality in the PCI data sets. Estimates are log-odds ratios.

Table S3. Results of mixed-effects model using USRD dialysis variable for prediction of 30-day mortality in the PCI data sets. Estimates are log-odds ratios.

Table S4. Results of mixed-effects model using USRDS dialysis variable for prediction of 30-day mortality in the CABG data sets. Estimates are log-odds ratios.

Table S5. Results of mixed-effects model using Mass-DAC dialysis variable for prediction of 30-day mortality in the CABG data sets. Estimates are log-odds ratios.

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Community Screening for Diabetes, Hypertension, Nutrition, and Kidney Disease Among Kenyans

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Chronic kidney disease (CKD) has emerged as a major public health concern. It was ranked 27th in the list of causes of total number of global deaths in 1990 and rose to 18th position in 2010.[1] Between 1990 and 2013, the mortality from CKD increased by more than 100%.[2,3] Hypertension, diabetes mellitus (DM), and obesity are growing noncommunicable diseases and are important risk factors for CKD.[4] In Kenya, according to Kenya Renal Association (unpublished data), there has been tremendous growth in the number of facilities offering hemodialysis services across the country. The number of hemodialysis units rose from 10 in 2006 to 102 by March 2018, and the number of patients on chronic hemodialysis increased from 300 to 2400 in the same time period. Detection of CKD in earlier stages provides opportunities for treatment, thus slowing CKD progression and reducing the incidence of complications.[5] It is in this context that we carried out the current study.

METHODS

We carried out a cross-sectional descriptive analysis of data obtained from community screening for kidney disease during World Kidney Days and through outreach in Kenya from 2011 to 2019. We aimed to document the burden of CKD and the risk factors. This included screening for DM, hypertension, and nutrition, and urinalysis as surrogates for kidney disease. The study population included all individuals who presented themselves for the screening exercise. Data captured included age, sex, county of residence, and personal history of smoking, DM, and hypertension. Family history of CKD, hypertension, and DM was also recorded. Measurements of random blood sugar (RBS), blood pressure, body mass index, and urinalysis by dipstick method were performed. The study was approved by the Kenyatta National Hospital—University of Nairobi Ethics Research Committee, registration number P505/07/2018.

RESULTS

Between 2011 and 2019, a total of 5138 individuals' screening records were traced and analyzed. As a group, the individuals resided in 24 of the 47 counties of Kenya. Females constituted 53%. About half of the individuals resided in urban and peri-urban counties (Nairobi and Kiambu); the rest resided in rural counties. The youngest person was aged 5 years, and the oldest was aged 102 years. The mean age was 40.89 years, the mode was 30 years, and the median age was 40 years. Almost 5% were active smokers, 8.4% were known diabetics, and 17.5% were known hypertensives. Family history was found in 29.2% for hypertension, 22.3% for DM, and 7% for CKD. When the risk factors for CKD were stratified by sex, cigarette smoking was found to be more prevalent in men (3.6% vs. 1.2%), and hypertension was more prevalent in women (10.9% vs. 6.5%). Further classification by urbanization revealed that rural residents had greater incidence of DM (10.8% vs. 6.3%) and hypertension (21.6% vs. 13.9%; Table 1). Systolic blood pressure of $\leq$120 mm Hg was recorded in 33.3%, and $>$150 mm Hg in 20%. Almost 60% of individuals had diastolic blood pressure $\leq$80 mm Hg, and 20% $>$90 mm Hg. Half of the individuals who were aged $\geq$18 years (4712) were underweight ($<$18.5 kg/m^2) or normal weight (18.5–24.9 kg/m^2). A third were pre-obese (25.0–29.9 kg/m^2), and 28.7% were obese ($>$30.0 kg/m^2), by World Health Organization classification standards. There were 167 (3.4%) individuals whose RBS was $>$11.0 mmol/L, $>$50% of whom were known diabetics, 41.6% of whom had a family history of DM, and 44.6% of whom were hypertensive. Of the individuals with RBS levels $>$11.0 mmol/L, 74 (1.4%) had no prior knowledge of their high blood sugar state. There was an exponential increase in the prevalence of hyperglycemia after the age of 35 years, found in almost 1 in every 5 individuals aged 56–60 years. Those aged $>$40 years recorded the highest burden of both DM and hypertension. Hypertension and DM were more common among individuals with a higher body mass index. Among the 5138 individuals, 3890 (75.7%) had a urine dipstick test performed, and 12.1% tested positive for proteinuria (+1 to +4).

DISCUSSION

There was no sex preponderance among the screened individuals. The majority were aged $<$50 years. There was a significant history of cigarette smoking, and personal history of DM and hypertension, which are known risk factors for CKD. Emphasis on early detection of CKD and secondary prevention, by controlling several well-known risks, are potential cost-effective solutions.[6] An individual with CKD stage 3 is more than 12 times more likely to die from cardiovascular diseases than to progress to end-stage renal disease.[7] Blood pressure control was not satisfactory in our study. High prevalence rates of hypertension have been reported in sub-Saharan African populations, e.g., Benin, 27.9%; Malawi, 53%; Nigeria, about 32.3%; and Tanzania, about 30%. In the West Indies, self-reporting of hypertension was at 28%, and 53.1% actually had hypertension. DM was more prevalent in rural than in urban areas. In India, various studies have found DM in 7%–18%, and hypertension has been reported at prevalence rates of 23.3%–31.2%, higher than those in our study findings. In our study, 8.4% were already known to be diabetic, and an additional

Table 1. Distribution of smoking history, and personal and family history of diabetes, hypertension, and chronic kidney disease

Characteristic	All	Male	Female	Urban	Rural
Sex	5138 (100)	2405 (46.8)	2730 (53.1)	2736 (53)	2402 (47)
Smoking history	245 (4.8)	183 (3.6)	62 (1.2)	150 (5.5)	95 (3.9)
Diabetes mellitus	432 (8.4)	197 (3.8)	235 (4.6)	173 (6.3)	259 (10.8)
Hypertension	898 (17.5)	335 (6.5)	561 (10.9)	378 (13.9)	520 (21.6)
Family history of hypertension	1498 (29.2)	652 (12.7)	844 (16.4)	945 (34.8)	553 (23.0)
Family history of diabetes mellitus	1,144 (22.3)	533 (10.4)	610 (11.9)	710 (26.1)	434 (18.1)
Family history of chronic kidney disease	359 (7.0)	176 (3.4)	183 (3.6)	232 (8.5)	127 (5.3)

Values are n (%).

1.4% were newly diagnosed with high levels of RBS. A family history of DM was found in 22.3% of the individuals screened. In other African countries, the prevalence of DM has been reported at 18% in Malawi, 6% in Tanzania, 3% in Benin, and 6% in Nigeria. In East Africa, the prevalence of DM in Uganda and Tanzania has been reported to be 10.1%. In the US,[8] rural dwellers are more likely to have DM and hypertension compared with urban dwellers. This finding supports the fact that hypertension and diabetes are more prevalent in developed nations, with developing countries catching up. In our study, 3.4% had RBS levels above 11.0 mmol/L. A study in Haiti reported about 8.2% of participants whose serum glucose level was >11.0 mmol/L, with 0.14% of these individuals being unaware of a diagnosis of diabetes. The rural residents had more DM and hypertension. Cigarette smoking was more common among men. In a community screening in Nigeria, cigarette smoking was reported in 4.5%. Among urban populations in India, the prevalence of smoking has been reported as 4.7%. These findings are comparable to our study findings but the prevalences are lower than those in reports from the US.[9] About one third of our study individuals were pre-obese, and the rest were obese, comparable to findings from Nigeria. Attempts to identify surrogate measures for the presence of kidney disease at an early stage have included the use of proteinuria, which can be a signal to clinicians to diagnose and confirm the presence of kidney disease at an early stage. In our study, 12.1% of the screened individuals had proteinuria, as measured by dipstick test, which is lower than percentages reported in Nigeria but comparable to those reported from India. In conclusion, our population has a high risk for development of CKD, with rural dwellers having a higher burden of risk. This situation calls for more deliberate efforts to screen and confirm for CKD, and employment of strategies and programs to curb advancement to end-stage renal disease, which might not be manageable in poor economies.

DISCLOSURE

All the authors declared no competing interests.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Supplementary Methods.

Supplemental References.

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