Established in 1871
Swiss Medical Weekly
Formerly: Schweizerische Medizinische Wochenschrift
The European Journal of Medical Sciences

Original article | Published 23 December 2014, doi:10.4414/smw.2014.14067
Cite this as: Swiss Med Wkly. 2014;144:w14067

Prevalence and risk factors for chronic kidney disease in a rural region of Haiti

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Summary

BACKGROUND: In the Caribbean region chronic kidney disease (CKD) is an increasing challenge. High rates of non-communicable and infectious diseases and the rise in people suffering from diabetes and hypertension explain the observed and further expected increase of CKD. However, data about the magnitude of the problem are rare and in some countries such as Haiti completely lacking. The aim of our study was to generate data about the prevalence and risk factors for CKD in a rural region in Haiti.

METHODS: In this prospective cross-sectional study, adult patients visiting the medical outpatient clinic of the Hôpital Albert Schweitzer (HAS) in Deschapelles Haiti were included. CKD was assessed by estimated glomerular filtration rate (eGFR) and measurement of proteinuria by dipstick test. Risk factors for CKD were assessed by clinical examinations and questionnaires.

RESULTS: Overall 608 patients were screened for CKD, of whom 27% had CKD. CKD stages 1 to 2 were found in 15.3% and stages 3 to 5 in 11.7%. The prevalence of hypertension and diabetes mellitus was 49.2% and 36.3%, respectively. Risk factors independently associated with CKD were hypertension ($p = 0.0002$) and HIV infection ($p = 0.019$) and age >60 years ($p = 0.0052$), whereas diabetes mellitus was not independently associated ($p = 0.72$).

CONCLUSION: Our data show a high prevalence of CKD and traditional risk factors, and their association with CKD in Haiti. These findings have now to be confirmed in other regions in longitudinal analyses as a basic step to build up screening and prevention programmes for CKD.

Key words: *chronic kidney disease; proteinuria; hypertension; diabetes; prevalence; Haiti*

Introduction

The number of patients with end stage renal disease (ESRD) who require renal replacement therapy (RRT) is increasing all over the world [1], while resources to cover the enormous costs are limited, especially in developing countries. Since RRT is neither feasible nor available in many developing countries, early detection of CKD is a keystone of prevention of the sequels of ESRD [2, 3]. Screening and prevention programmes for CKD have already shown promising results in developed and developing countries [4–7]. However, detailed knowledge of the prevalence and risk factors for CKD is a prerequisite for building up screening and prevention programmes.

In the Caribbean region also CKD is an increasing challenge [8]. However, data about the prevalence of CKD are sparse in the Caribbean region and, to the best of our knowledge, completely missing in Haiti. Since people of Haiti are of black African ancestry and black Africans have an increased risk for ESRD compared with Caucasians the prevalence of CKD in Haiti is expected to be high [9, 10]. Further, in the general adult population of Haiti the prevalence for the two most important risk factors for CKD, hypertension and diabetes mellitus (DM), is very high at 47% and 10%, respectively [11]. Despite the probably high prevalence of CKD in Haiti, a nephrological service is virtually non-existent. There is only one hospital in the capital with a nephrological department, which provides nephrological services for the whole country, and so most patients with CKD, especially in the rural regions of Haiti, have no access to nephrological care.

The aim of the current study was to generate data about the prevalence of and risk factors for CKD in a rural region in Haiti.

Materials and methods

Patient population

In this single centre prospective cross-sectional study, adult patients (age >18 years) visiting the medical outpatient clinic of the Hôpital Albert Schweitzer (HAS) in Deschapelles Haiti, which provides medical support for about 350,000 people over a 610 square-mile area, were included. An average of 51 patients per day visited the outpatient clinic during the study period. Between 18 February and 12 April 2013, every day from Monday to Friday except on public holidays (4 days during the study period) and so in total on 36 days, the first 20 patients visiting the medical outpatient clinic were consecutively asked to participate in the study and were included if they gave their in-

formed consent. Therefore 36 x 20 patients (n = 720) were included. From 112/720 patients (15.6%) no blood or urine samples were obtained. Therefore, the final cohort for analysis consists of 608 patients with full data sets. An individual patient contributed only one data set.

Socio demographic data were recorded by a trained study nurse. Each participant underwent weight and height measurements. The body mass index (BMI) was calculated as weight (in kilograms) divided by height in square meters. BMI over 30 kg/m^2 was classified as obesity according to the 2000 WHO criteria [12].

Blood pressure (BP) was measured by a trained study nurse and according to the guidelines presented in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC VII). Hypertension was defined as systolic blood pressure (SBP) of ≥140 mm Hg and/or diastolic BP (DBP) of ≥90 mm Hg, or use of anti-hypertensive medications irrespective of the BP [13]. Risk factors for CKD (e.g., DM, hypertension, diabetes, sickle cell disease, tuberculosis, HIV infection) were assessed by the treating physician as binary data (yes/no) and current treatment were recorded in a questionnaire. DM was defined as treatment with antidiabetic medication, glucosuria in the dipstick test or positive response to the question of known diabetes in the questionnaire.

All participants were instructed to void a clean morning urine specimen into a 100 ml vessel to perform a dipstick test (Combur-Test®, Bayer Diagnostics) and a sediment for microscopy conducted by a trained person. Haematuria of glomerular origin was defined as >4 erythrocytes per high power field (HFP) of whom >40% had to be dysmorphic erythrocytes or >5% acantocytes. Proteinuria (>30 mg/dl) was only counted as positive when there was no evidence of pyuria (>20 leucocytes /HPF) and no haematuria of non-glomerular origin (≥10 erythrocytes /HPF) in the corresponding microscopic examination of the urine sediment. Serum creatinine was measured with the Vitros DT 60 II analyser (Ortho Clinical Diagnostics). Kidney function was assessed with the estimated glomerular filtration rate (eGFR) according to the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [14].

The CKD stages were defined as follows:

– stage 1: proteinuria ≥30 mg/dl and eGFR >90 ml/min/1.73 m^2;
– stage 2: proteinuria ≥30 mg/dl and eGFR 60 to 89 ml/min/1.73 m^2;
– stage 3a: eGFR of 45 to 59 ml/min/1.73 m^2 with or without proteinuria
– stage 3b: eGFR of 30 to 44 ml/min/1.73 m^2 with or without proteinuria
– stage 4: eGFR of 15 to 29 ml/min/1.73 m^2 with or without proteinuria
– stage 5: eGFR <15 ml/min/1.73 m^2 with or without proteinuria

The protocol was approved by the institutional review board of the University of Basel Switzerland and the local ethics committee at Hôpital Albert Schweitzer Haiti.

Statistical analysis

JMP software version 8.0 (SAS Institute Inc., Cary, NC) was used for statistical analysis. For categorical data, Fisher's exact test or Pearson's chi-square test were used. As the investigated continuous variables were not normally distributed they are given as median (range) and compared with Wilcoxon rank-sum tests. P-values were two-sided and a p-value <0.05 was considered statistically significant. For multivariate analysis a nominal logistic regression was performed.

Results

Patient characteristics

Patient characteristics are shown in table 1. The median age of the study population was 54.2 years (range 18.0–98.0 years). There were more female (64.5%) than male participants. Main reason for medical consultation was in 61.5% (374/608) of cases a regular medical follow-up visit for multiple reasons (e.g., hypertension, DM, asthma, epilepsy, congestive heart failure, pain). In the remaining patients acute illness was leading to the medical consultation of the outpatient clinic. No patient was immediately hospitalised after the visit. The prevalence of hypertension was 49.2%. Of those 40.1% (122/608) had an uncontrolled BP ≥140/90 mm Hg at study visit. There were 36.3% (221/608) of patients with a history of DM and 20.4% (124/608) of patients suffered from DM and hypertension. In 51% (113/221) of patients with DM glycosuria was detectable. There were 17% (38/221) of patients with DM who were treated with insulin, 60% (132/221) with oral medication such as metformin or glyburide, and 17% (38/221) with insulin combined with oral diabetic medication, and 6% (13/221) had no drug therapy. Obesity was found in 12.8% of patients (79/608).

Prevalence of CKD and proteinuria

The overall prevalence of CKD was 27.1% (165/608) (table 2) with equal distribution between males and females (p = 0.36).There were 43.6% (72/165) of patients with an eGFR <60 ml/min/1.73 m^2 (CKD stage ≥3). In total 85.5% (141/165) of patients with CKD had at the least one risk factor for CKD. The remaining 14.5% (24/165) of patients had no obvious risk factor for CKD. Proteinuria (≥30 mg/dl) was detected in 19.7% (120/608) of patients (table 3). Of these 47.5% (57/120) had a treatment with an angiotensin converting enzyme inhibitor (ACEI) or an angiotensin receptor blocker (ARB). In patients with DM 24.9% (55/221) had a proteinuria and 52.7% (30/55) of these were treated with an ACEI or ARB. There were 24.1% (19/79) of patients with obesity with a proteinuria, and 7.6% (6/79) suffered from CKD stage ≥3. In addition there were 17 patients (2.8%) in the whole study population with a haematuria of glomerular origin of whom 11 patients had isolated haematuria of glomerular origin without proteinuria or eGFR <60 ml/min/1.73 m^2.

Risk factors for proteinuria and CKD

Risk factors associated with CKD and proteinuria are described in tables 4 and 5. Independent risk factors for CKD

were hypertension (p = 0.0002), HIV infection (p = 0.019) and age >60 (p = 0.0052). Independent risk factors for proteinuria were hypertension (p = 0.0031) and HIV infection (p = 0.028).

Discussion

CKD is an increasing and major public health problem in developed as well as in developing countries. Data about the prevalence of CKD in developing countries are sparse. To the best of our knowledge this is the first study reporting data on the prevalence of CKD and associated risk factors in Haiti. In our study population, the overall prevalence of CKD was 27%, mostly CKD stage 1 and 2 (15%) whereas CKD ≥ stage 3 was found in 12%. The high prevalence of CKD may be partly explained by the selected population. We assume that patients visiting a medical outpatient clinic have a higher probability to suffer from kidney injury than the general population. Further, the cross-sectional design of the study does not allow distinguishing between acute and chronic kidney injury since longitudinal data are missing. Therefore, our data probably may overestimate the true prevalence of CKD and are not directly applicable to the general population. There are no comparable studies available in a similar population at risk. But in slightly different more rigorous selected populations of the same ethnicity in a cross-sectional study in Senegal where CKD was assessed during a routine health visit of workers as well in a cross-sectional study in the Democratic Republic of Congo in a random selected urban study population of Kinshasa, comparable numbers were found with a prevalence of CKD of 22.4% and 12.4% respectively [15, 16].

The most important risk factor for CKD in our study was hypertension. This finding corresponds with other studies in black Africans where hypertension was also a leading cause of CKD in up to 49% [17]. The prevalence of hypertension in the general population in Haiti is known to be very high, with about 47% [11]. We found an equally high prevalence in our population (49%). It can be speculated that the high prevalence is probably due to genetic factors in black Africans as well as the change to a more western-style diet during the last decades in Haiti [18, 19].

Interestingly, DM was not independently associated with CKD despite the very high prevalence of DM (36%) in our study population, a prevalence rate much higher than observed in the general population of Haiti (about 10%) [11].

Table 1: Population characteristics.

	Total n = 608
Female n (%)	392 (64.5)
Age median years (range)	54.2 (18.0–98.0)
Hypertension n (%)	299 (49.2)
Diabetes mellitus n (%)	221 (36.3)
Obesity n (%)	79 (12.8)
HIV infection n (%)	8 (1.3)
History of tuberculosis n (%)	31 (5.1)
Sickle cell disease n (%)	9 (1.5)

Table 2: Prevalence of CKD (population n = 608 [100%]).

Stages of CKD (eGFR ml/min/ 1.73 m^2)	n (%)
1 (≥90)	54 (8.9)
2 (60 to 89)	39 (6.4)
3a (45 to 59)	48 (7.9)
3b (30 to 44)	15 (2.5)
4 (15 to 29)	5 (0.8)
5 (<15)	4 (0.6)
Overall	165 (27.1)

Table 3: Prevalence and degree of proteinuria by dipstick test (population n = 608 [100%]).

Proteinuria	**n**	**%**
1+ (>30 mg/dl)	84	13.8
2+ (>100 mg/dl)	22	3.6
3+ (>500 mg/dl)	14	2.3
Overall	120	19.7

Table 4: Risk factors for CKD.

Risk factors for CKD	**Univariate analysis**			**Multivariate analysis**		
	CKD yes (n = 164)	**CKD no (n = 444)**	**p-value**	**OR**	**95% CI**	**p-value**
HIV (n = 8)	3.1%	0.7%	0.037	6.02	1.38–31.09	0.019
Hypertension (n = 299)	66.5%	42.8%	<0.0001	2.18	1.45–3.30	0.0002
Male sex (n = 216)	34.8%	35.8%	0.85	1.07	0.72–1.60	0.74
Age >60 (n = 227)	51.8%	32.0%	<0.0001	1.77	0.38–1.19	0.0052
Tuberculosis (n = 31)	6.1%	4.7%	0.53	1.24	0.53–2.71	0.60
Diabetes (n = 221)	36.6%	36.3%	1.0	0.93	0.63–1.37	0.72
Obesity (n = 79)	15.2%	12.2%	0.34	1.25	0.72–2.13	0.41

Table 5: Risk factors for proteinuria.

Risk factors for proteinuria	**Univariate analysis**			**Multivariate analysis**		
	CKD yes (n = 164)	**CKD no (n = 444)**	**p-value**	**OR**	**95% CI**	**p-value**
HIV (n = 8)	3.3%	0.8%	0.053	5.02	1.13–22.35	0.028
Hypertension (n = 299)	63.3%	45.7%	0.0007	1.98	1.26–3.13	0.0031
Male sex (n = 216)	35.0%	35.7%	0.92	1.02	0.64–1.53	0.95
Age >60 (n = 227)	43.3%	35.9%	0.14	1.06	0.68–1.66	0.79
Tuberculosis (n = 31)	6.7%	4.7%	0.36	1.41	0.57–3.19	0.60
Diabetes (n = 221)	40.0%	35.5%	0.397	1.18	0.77–1.8	0.72
Obesity (n = 79)	15.8%	12.3%	0.29	1.26	0.69–2.22	0.41

The high DM rate might be due to the selection bias discussed above.

Infectious diseases are known risk factors for CKD, e.g., HIV infection and tuberculosis (Tbc) [20, 21]. The prevalence for HIV and a history of Tbc in the study population were 1.3% and 5.1%, respectively, which is in the range of the prevalence for the general Haitian population [22]. HIV infection was independently associated with proteinuria and CKD. However, this result has to been taken with caution as the number of patients with HIV infection was very low.

Significant proteinuria in the dipstick analysis was found in nearly 20% of the study population, virtually the same rate as in the CKD screening study in the Democratic Republic of Congo (17%) [7]. Dipstick test is not the gold standard for the evaluation of proteinuria especially for microalbuminuria. Sensitivity for detection of microalbuminuria (Albumin/Creatinine (ACR) ≥30 mg/g) by dipstick test is only about 60% whereas for the detection of macroalbuminuria (ACR >300 mg/g) it is 98.9% [23]. It was shown in the PREVEND study that macroalbuminuria is even a better risk marker than low eGFR to identify individuals at risk for accelerated GFR loss (24). In our study we found only 14 patients with a macroalbuminuria but 50% (n = 7) of them had still an eGFR >60 ml/min/1.73 m^2. So despite the low sensitivity for detection of microalbuminuria, CKD screening with dipstick test for proteinuria might be a feasible option in areas with limited medical facilities to detect patient at very high risk for renal function deterioration [25].

In patient with proteinuria a treatment with ACEI or ARB to prevent further decline of renal function is recommended [26, 27]. About half of all the patients with proteinuria had a treatment with an ACEI or an ARB. Two third of patients with known hypertension had their blood pressure controlled to less than 140/90 mm Hg at study visit. In a country with low income and limited access to treatment this rate is quite high but still needs further improvement. Especially, as prevention for kidney failure, is the only feasible treatment option in a country with very limited access to renal replacement therapy and where ESRD is often a death sentence [2, 3].

The limited access to adequate treatment is also shown in the high rate of glucosuria in patients with DM. In our study population, there were many diabetic patients who would need a more intensive therapy with insulin. But due to shortage of insulin in the rural region of Haiti, only severe cases (patient with history of hyperglycaemic coma or clinical symptoms of hyperglycaemia under oral antidiabetic medication), or young diabetic patients are treated with insulin.

The study has some limitations. The study population consisted of patients of a medical outpatient clinic and does not represent the general population of Haiti but rather a population of higher risk for CKD. In addition the study was performed only in one centre in rural Haiti. So conclusions cannot been made for the prevalence of CKD and its risk factors in other regions of the country or in more urban areas. The urinary screening test for proteinuria was made by dipstick test with low sensitivity for microalbuminuria. Using a more sensitive urinary test for detection of microalbuminuria (e.g., albumin/creatinine ratio in the spot urine) would probable lead to a higher rate of microalbuminuria detection. So there is a possible underestimation of the prevalence of patients with proteinuria in this study. On the other hand we only performed a single measurement of proteinuria and creatinine. A single measurement might lead to an overestimation of CKD prevalence as temporary proteinuria and/or acute kidney damage cannot be ruled out. The strength of the study is that it was performed in a real clinical outpatient setting using the local facilities of a hospital in a developing country.

In conclusion, we found a high prevalence of CKD in a medical outpatient population in rural Haiti. We could confirm the high prevalence of hypertension in Haiti and showed that hypertension is the most important risk factor for CKD. In a next step, prevalence data should be gained in further populations to serve as a basis to build up screening and intervention programmes for reducing CKD and ESRD.

Funding / potential competing interests: No financial support and no other potential conflict of interest relevant to this article was reported.

Authors' contribution: Participated in research design: FB, MM, HS. Participated in the writing of the paper: FB, MM, MD. Participated in the performance of the research: FB, ES, HS. Participated in data analysis: FB.

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