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ORIGINAL ARTICLE

Screening for kidney disease in children on World Kidney Day in Lagos State, Nigeria

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ABSTRACT

Background: Across the world, World Kidney Day (WKD) is marked yearly to increase awareness of kidney diseases. In 2016, its focus was on children for the first time. We report on a WKD screening initiative for kidney disease that was conducted in two public schools in Lagos State, Nigeria.

Methods: Participants were recruited after guardians provided signed consent and older children gave assent. Baseline data were obtained which included family history of chronic diseases like sickle cell disease, hypertension, diabetes, renal disease, and the use of herbal medications. Anthropometric parameters such as height, weight and body mass index (BMI) were recorded. Investigations included urinalysis, measurement of serum creatinine and estimation of glomerular filtration rate (eGFR) using the Schwartz formula.

Results: A total of 405 children were screened; there were 190 (46.9%) males and 215 females. The children were aged 2 to 17 years with a mean age of 9.1 ± 3.0 years. Over 80% of the children had normal nutritional status. Severe thinness was seen in 22 (6.8%) whereas overweight was present in 10 (3.1%). Only 1 was obese. eGFR was above 90 mL/min/1.73 m^2 in 232 (94.3%) of the participants. Hypertension was present in 47 (14.4%), with the highest rate among those 0–8 years old. Proteinuria was detected in 118 (29.2%); none of the children had haematuria. Systolic hypertension, a family history of smoking and the use of herbal medications were associated with proteinuria.

Conclusions: The study has highlighted a high rate of proteinuria, associated with the use of herbal medications, hypertension and a family history of smoking. Screening for renal disease in children with appropriate follow-up and timely intervention to avoid progression to end-stage renal disease is imperative.

Keywords: World Kidney Day; chronic kidney disease; proteinuria; screening.

INTRODUCTION

World Kidney Day (WKD) has clear objectives of raising awareness and increasing the detection of chronic kidney diseases across the world. Since the onset of this laudable campaign, jointly sponsored by the International Society of Nephrology and the International Federation of Kidney Foundations, the focus has largely been on the adult population. WKD 2016 had its focus on children with the theme "Kidney disease and children. Act early to prevent it!". The aim was to heighten awareness that many renal diseases in adults start in childhood and to highlight the importance of identifying kidney disease and risk factors in children so that early interventions are possible.

Chronic kidney disease (CKD) is an epidemic in developing countries, mostly from the increasing prevalence of diabetes and hypertension in the general population [1,2]. Worldwide, there are limited reports on the spectrum of both CKD and acute kidney injury (AKI) in children [3]. The dearth of literature is worse in developing countries and especially in sub-Saharan Africa.

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The 2007 report by Warady et al. [4] documented a wide range in prevalences of 15–75 per million children. Real national and regional differences, as well as differences in methodology, may explain the wide variation [3]. Many reports are on end-stage renal disease registries with scarcely any information on the early stages of CKD [5].

Health education and screening of populations at risk is safe, affordable and effective in preventing many communicable diseases. This is more so in resource-constrained countries. Increasing education and awareness about renal diseases in children will reduce the morbidity and mortality associated with it. Similarly, the screening of children may provide an early opportunity for identification of risk factors and, ultimately, prevent CKD in adulthood [6,7]. During WKD 2016, teachers, pupils and other staff at two public schools in Lagos State were given health education on kidney diseases in general and childhood diseases in particular. The children were then screened for kidney disease. The information obtained provided much-needed data given the paucity of reports on kidney disease in African children.

METHODS

Lagos State is in the south-western part of Nigeria and the economic hub of the country. The population in 2015 was approximately 17 million [8]. The population of children is unknown, but national statistics estimate that children less than 15 years of age account for 42.5% of the population. Lagos has 56 Local Government Areas and Local Council Development Areas. The Lagos State Government operates 1607 state schools, with free basic education, and a special focus on children up to nine years of age. Most of the children attending government-owned primary schools are of a lower socioeconomic class.

During WKD 2016, children from two public primary schools in Oshodi-Isolo, a Local Council Development Area covering about 45 km^2 and having a population of over 600 000 people, were screened by medical staff of Lagos State University Teaching Hospital and their colleagues from secondary level centres within the state. The team included adult and paediatric nephrologists, nephrology fellows, resident doctors, nurses, dieticians and medical students. All staff received training on reading urine dipsticks and taking blood pressure measurements prior to the start of screening.

Children were screened once their guardians provided consent and, in older children, once they had given their assent. Data were collected using a standardised data capture sheet. Baseline data obtained included age, gender and information on diabetes, hypertension, sickle cell disease, cardiac or renal disease, and the use of herbal medications. Height and weight were measured and used to calculate body mass index (BMI). Nutritional status was assessed using BMI percentiles and BMI Z scores. Numbers needed to screen (NNS) were calculated in the standard fashion [9].

Systolic and diastolic blood pressures were measured with manual sphygmomanometers and cuffs appropriate for the patient's size [10]. All participants were asked to provide blood and urine specimens, which were used for measurements of serum creatinine and urinalysis, respectively. Serum creatinine was measured using the Jaffe technique. The urinalysis was performed using Multistix 10 SG (Bayer de Mexico SA de CV, Mexico).

Most of the results were available on the same day. The results with interpretations were conveyed to the parents or guardians of the participating children. Those with abnormal results were referred to our paediatric nephrology clinic for a full assessment.

DEFINITIONS

- Proteinuria: 1+ or greater on urine dipstick analysis [11].
- Haematuria: 1+ or greater on urine dipstick analysis [11].
- Systemic hypertension: measured blood pressure ≥95th percentile for age, gender and height according to published normative values [10].
- GFR: the Schwartz formula using serum creatinine and height was used to estimate GFR in mL/min/1.73 m^2 [12,13].
- BMI: calculated from the weight in kilograms and the height in metres. BMI percentiles were calculated according to normative values [14]. Children older than two years with BMI more than the 95th percentile were classified as overweight. BMI Z score was used to classify the children in terms of severe thinness (Z score < –3), thinness (Z score between –2 and –3), normal (Z score between 1 and –2), overweight (Z score between 1 and 2), and obese (Z score above 2).
- Hospital admission: hospitalization for illnesses in the preceding two weeks; this is important because of the risk of kidney injury.
- Blood transfusion: transfusion of whole blood or blood components in the previous 3 months.
- Family history of smoking: an adult or adolescent in the family who smokes nicotine at home or within the vicinity of the child.

Statistical analyses were performed using Stata version 9.1 (College Station, Texas, USA) and SAS version 9.1 (Cary, NC, USA). Means, standard deviations (SDs) and percentages were used to describe data as appropriate.

Ethical considerations

Written permission was obtained from the parents/guardians of all participants. Assent was obtained from children older than seven years of age. Consent for publication was granted by the hospital ethics committee.

RESULTS

In total, 405 children were screened during WKD 2016. There were 190 (46.9%) males and 215 females. Their demographic and clinical characteristics are as depicted in Tables 1 and 2. The children were aged 2 to 17 years with

Table 1. Demographic and clinical characteristics of children screened on World Kidney Day 2016.

	0–8 yr	9–13 yr	14–17 yr	All
Participant numbers (%)	145 (35.8)	240 (59.3)	20 (4.9)	405 (100.0)
Age (mean ± SD)	5.78 ± 1.80	10.54 ± 1.30	15.05 ± 0.83	9.06 ± 3.02
Males (%)	67 (46.2)	112 (46.7)	11 (55.0)	190 (46.9)
Females (%)	78 (53.8)	128 (53.3)	9 (45)	215 (53.1)
Weight (kg)	18.90 ± 4.68	31.35 ± 8.65	44.95 ± 7.88	28.21 ± 10.31
Height (cm)	114.09 ± 14.38	140.08 ± 9.55	153.00 ± 9.29	132.53 ± 17.21
BMI (kg/m^2)	14.45 ± 2.12	15.91 ± 2.87	19.17 ± 2.78	15.67 ± 2.88
Serum creatinine (μmol/L)	49.63 ± 5.72	49.15 ± 8.30	54.91 ± 8.07	49.68 ± 7.91
eGFR (mL/min/1.73 m^2)	99.94 ± 14.16	117.88 ± 27.62	114.79 ± 26.38	114.50 ± 26.48

eGFR, glomerular filtration rate estimated using the Schwartz equation.

Table 2. Selected clinical characteristics of the screened population.

		Frequency	Percentage (%)
SBP	Normal	295	89.9
	Stage 1	22	6.7
	Stage 2	11	3.4
DBP	Normal	308	93.9
	Stage 1	8	2.5
	Stage 2	12	3.7
eGFR	>90 mL/min/1.73 m^2	232	94.3
	60–90 mL/min/1.73 m^2	14	5.7
BMI %	<5	72	22.1
	5–25	124	38.0
	25–50	63	19.3
	50–75	45	13.8
	75–95	19	5.8
	>95	3	0.9
Nutritional status	Severe thinness	22	6.8
	Thinness	30	9.2
	Normal	262	80.6
	Overweight	10	3.1
	Obese	1	0.3

SBP, systolic blood pressure; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; BMI, body mass index.

Table 3. Prevalence of hypertension and proteinuria across age groups.

	0–8 yr n (%)	9–13 yr n (%)	14–17 yr n (%)	Total n (%)
Systolic hypertension	7/98 (7.1)	24/210 (11.4)	2/20 (10.0)	33/328 (10.1)
Diastolic hypertension	13/98 (13.3)	6/210 (2.9)	1/20 (5.0)	20/328 (6.1)
Hypertension (overall)	16/98 (16.3)	29/210 (13.8)	2/20 (10.0)	47/328 (14.3)
Proteinuria	49/144 (34.0)	62/240 (25.8)	7/20 (35.0)	118/404 (29.2)

a mean age of 9.1 ± 3.0 years, and no differences in the age profiles between boys and girls. Over 80% of the children had normal nutritional status. Severe thinness was seen in only 22 (6.8%) whereas overweight was recorded in 10 (3.1%). Only 1 was obese (Table 2).

Most of the children (94.3%) had eGFR values above 90 mL/min/1.73 m^2. Ten percent had systolic hypertension (Table 2), and 6.7% and 3.4% demonstrated stage 1 and 2 systolic hypertension, respectively. Children aged 9–13 years had higher rates of systolic hypertension (11.4%) but overall, children aged 0–8 years demonstrated a higher occurrence of hypertension (16.3%; shown in Table 3). Proteinuria was present in 29.1% of the participants. The age group with the highest rates was those aged 14–17 years.

Table 4 illustrates the associations between proteinuria and other aspects of the history and clinical findings. A family history of smoking, herbal medication ingestion and systolic blood pressure were significantly associated with proteinuria.

DISCUSSION

There are limited community-based studies on kidney disease in children in Africa. Our study provides information on the renal status of children attending two public primary schools in a metropolitan state in south-western Nigeria.

Childhood renal disease which is detected early has a better outcome [27,28]. GFR was lower than 90 mL/min/1.73 m^2 in 6.7% of the participants but there was none with GFR less than 60 mL/min/1.73 m^2. Proteinuria is another important marker of CKD and was detected in three out of 10 children. Recent data from community-based screening programmes among children in Australia suggest that urine dipsticks have a sensitivity of 62% and specificity of 97% for detecting albuminuria when compared to the urine albumin-to-creatinine ratio [19]. The prevalence of proteinuria in the present study was almost double the rate reported in children worldwide, where the estimated prevalence is 5–15% [20]. Most studies in Nigeria report rates between 2% and 14.8% [21,22]. The reason for the higher values reported in the present study is not immediately clear. It would have been important to follow the children for re-assessment of the proteinuria given the high prevalence on the initial sampling, but the children did not present for their follow-up appointments. In a study from Jalisco, Mexico, where participants were followed up, there was significant persistence of the urinary abnormalities [19].

The variables that were associated with proteinuria in the present study were the use of herbal medicines, smoking by family members living with the children, and hypertension. Nephrotoxicity has been linked to the ingestion of herbal medicines [23-25] and in south-western Nigeria, the use of herbal medicines is common and most people are unaware of their toxic effects [26]. It is important that health education campaigns be conducted in Nigeria to raise awareness about the potential harmful effects of herbal medicines and passive smoking.

The prevalence of hypertension in the present study is comparable with reports from previous studies in Nigerian children [29,30]. The highest prevalence of hypertension was seen in children below nine years of age. This finding is at variance with other reports where hypertension increased with age and was more prevalent amongst adolescents. It is important that children with elevated blood pressure be followed up to exclude or confirm systemic hypertension. The present study used the diagnostic criteria for hypertension based on the 2004 Paediatrics Hypertension Guidelines; we note that a new guideline was published in 2017.

A combination of thinness and severe thinness was documented in 11% of the participants, similar to the 13% reported by Ene-Obong et al. [15] in a multicentre study in south-west and south-eastern Nigeria. Our results differ from most other reports where the prevalence of thinness ranges between 36–60% among Nigerian children attending public schools [16-18]. The reason for this is not clear but may be related to the study locations as the other investigations are from northern and eastern Nigeria. It is

Table 4. Association of aspects of the history and clinical findings with proteinuria.

		Proteinuria present	Proteinuria absent	p
Past medical history		0/118 (0.0)	2/288 (0.7)	1.000
Past history of admission		23/118 (19.5)	66/288 (22.9)	0.449
Past history of transfusion		8/118 (6.8)	18/288 (6.2)	0.826
Family history of smoking		20/118 (16.9)	27/288 (9.4)	0.030*
Herbal medication ingestion		45/188 (38.1)	146/288 (50.7)	0.021*
Fever		1/188 (0.8)	3/285 (1.0)	1.000
Age (yr):	0–8	49 (41.5)	95 (33.2)	0.196
	9–13	62 (52.5)	178 (62.2)	
	14–17	7 (5.9)	13 (4.5)	
SBP:	Normal	92 (90.2)	174 (77.0)	0.008*
	Prehypertension	2 (2.0)	27 (11.9)	
	Stage 1	5 (4.9)	17 (7.5)	
	Stage 2	3 (2.9)	8 (3.5)	
DBP:	Normal	92 (90.2)	202 (90.2)	0.143
	Prehypertension	1 (1.0)	11 (4.9)	
	Stage 1	3 (2.9)	5 (2.2)	
	Stage 2	6 (5.9)	6 (2.7)	
eGFR:	>90 mL/min/1.73 m^2	69 (93.2)	163 (94.8)	0.636
	60–90 mL/min/1.73 m^2	5 (6.8)	9 (5.2)	
Nutritional status:	Severe thinness	9 (9.4)	13 (5.7)	0.211
	Thinness	11 (11.5)	19 (8.3)	
	Normal	71 (74.0)	191 (83.4)	
	Overweight	5 (5.2)	5 (2.2)	
	Obese	0 (0.0)	1 (0.4)	
Hypertension:	SBP normal	94 (92.2)	201 (88.9)	0.37
	SBP above 95	8 (7.8)	25 (11.1)	
	DBP normal	93 (91.2)	215 (95.1)	0.172
	DBP above 95	9(8.8)	11(4.9)	

The number of children needed to be screened to detect one case of proteinuria was 4 (95% CI 3.3–4.8). The number needed to be screened to detect one case of systolic hypertension was 9 (95% CI 6.6–13.4). .

possible that the nutritional status of children in Lagos is improving and is better than that of children in other regions of Nigeria.

In conclusion, there is an increasing burden of chronic kidney disease worldwide and particularly in children. Simple screening such as urinalysis and blood pressure checks should be used as screening tools. Repeat testing and follow up for those children with abnormal findings is imperative for early identification of CKD. This will ensure that these children are treated early and slow the progression of CKD.

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