Tropical Journal of Nephrology Vol.11 No 1, June, 2016, 7-16 Original article

# SYSTEMATIC ANALYSIS OF COMMUNITY STUDIES OF RISK FACTORS AND PREVALENCE OF CKD IN NIGERIA (2006-2014)

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**Abstract:**

**Introduction:** Chronic kidney disease (CKD) is a global health problem, responsible with a high magnitude of human suffering, huge economic loss and high mortality. The low and middle income countries such as Nigeria are equally and possibly more affected. The true prevalence rate of CKD is not known in Nigeria and some other LMIC countries due to absence of renal registries. Most of available data are single centre based hospital data of renal admissions. For proper renal policy formulation, there is need for reliable data on the magnitude of the problem of CKD/ESRD in developing countries such as Nigeria. We conducted a systematic analysis of community based CKD screening reports conducted in all geographic regions of Nigeria between 2006 to 2014, to determine the aggregate prevalence of risk factors and prevalence of CKD in Nigeria.

**Study objectives:** To determine the aggregate prevalence of traditional risk factors and the prevalence of CKD in Nigeria to serve as a reliable date for renal policy formulation and planning in Nigeria.

**Study design:** A retrospective systematic analysis of reports of community based CKD screening reports in Nigeria.

**Study methodology:** Reports of community based CKD screening reports in all parts of estimated adult burden of CKD in Nigeria is 14 million people while that of ERSD is 240,000 adults.

**Conclusions:** The aggregate crude prevalence of CKD of 11.7% derived from a pool of 30 community based CKD screening reports across Nigeria is very likely to be closest to the true prevalence of CKD in Nigeria. We recommend government sponsored large scale multi-regional surveys of prevalence of CKD in Nigeria and the development of Renal registry for renal health planning.

Nigeria from 2006 to 2014, were manually and electronically searched. The aggregate percentage prevalence of CKD risk factors and percentage prevalence of CKD were determined.

**Results**: Thirty (30) reports of CKD screening exercises, within the study period were accessed and found suitable for subsequent analysis. The studies were in 16(53.3%) rural and 14(46.7%) communities respectively, with a total of 17,107(99-1941) subjects, age range 14-84years. The aggregate mean age of subjects in all the studies was 43.4 ±4.4 years (range of mean ages: 28.3-51.5) years, and gender ratio of 1:1.5. Geographic distribution of study sites were North-west 3(10.0%), North-central 3(10.0%), North-east 1(3.3%), South-west 5(16.7%), South-east 3(10.0%) and South-south 15(50.0%). The aggregate percentage prevalence of risk factors of CKD were Obesity 27.5% (12.2-62.7%); Proteinuria 20.3% (3.7-69.1%); Hypertension 32.1% (13.6-57.3%) and diabetes mellitus 4.9 % (2-11.2%). respectively. The aggregate percentage prevalence of CKD (e-GFR <60mls/min/1.73m$^2$) in accordance with kidney disease outcome quality initiative (KDOQI) [1] definition, was 11.7% (1.2-32.6%). Statistically significant difference was found in the prevalence of CKD between the rural and urban communities (16.4% vs 7.0%; p<0.001) but not in the risk factors. The

**Key words**: Chronic kidney disease burden, systematic analysis, community reports, Nigeria

## Introduction

Chronic kidney disease and consequent end stage renal disease (CKD/ESRD) is a problem of increasing public health concern in Nigeria. This is as a result the enormous burden of human suffering, high demand on public health resource and the huge financial cost of care, which is far out of reach of the sufferers and their families.[1,2] Unfortunately Nigeria and most of Sub-Saharan African (SSA) countries do not have a kidney health policy to cater for the increasing population of patients with CKD/ESRD. Apart from Government apathy, there is also no reliable data base for the burden of CKD/ESRD in Nigeria and most other SSA countries necessary for kidney health policy formulation and implementation as obtained in the United states renal disease (USRDS)[3] data base.

The prevalence of kidney disease and kidney failure in Nigeria and most SSA countries are often deduced from single centre hospital based renal admissions and discharge data. Patients in most of such studies however, were presenting for the first time, in kidney failure.[4,5] Such patients represent a wide spectrum of kidney failure patients which include acute on chronic kidney failure, advanced chronic kidney_disease (CKD) and end stage renal disease (ESRD) respectively. Sorting these patients out in their categories can be difficult as most of them die during the incident admission, others abscond even before discharge or are lost to follow up. Thus most the prevalent rates of CKD/ESRD reported in Nigeria , which put the prevalence of CKD and kidney failure between a wide band of 1.6 to16.4%,[6,7,8] may not reflect the true community burden of the disease. Also, the criteria and methodologies for diagnosis of CKD in various clinical settings seem to vary. Isolated gross proteinuria, abnormally elevated serum creatinine concentrations, abnormal albumin creatinine ratio(ACR), and e-GFR levels derived from the different e-GFR formulae or combinations of them, are variously used by different authors as basis for diagnosis of CKD.[9,10] This makes it difficult to know the real prevalence and burden of CKD in the country, necessary for policy formulation, planning and consensus within the nephrology community in the country.

The International society of Nephrology(ISN) driven World Kidney day (WKD ) and the Kidney disease early prevention (KEEP)[11,12] programs in recent times, have provided opportunities for community based CKD screening exercises in Nigeria and other SSA countries. Since the advent of WKD exercises in 2006, there has been a fairly large pool of community based cross sectional screening reports, of the prevalence of risk factors of and prevalence of CKD in several parts of Nigeria, in both rural and urban communities, adults and children, respectively.[13,14,15] Pooling and systematically analysing the data from these resource could yield fairly reliable data on the aggregate prevalence of risk factors of CKD, prevalence of kidney damage, as well as the population prevalence and the distribution of CKD in accordance with the KDOQI 1 definition and criteria.

In this respect we conducted a systematic analysis of community based reports of the prevalence of risk factors of CKD and prevalence of CKD in Nigeria from 2006 to 2014, in an attempt to generate a consensus community based data of the burden of CKD in Nigeria.

**Methods:**

Literature search

We manually and electronically searched for all community based reports on the subjects "prevalence of risk factors of chronic kidney disease in Nigeria" , "prevalence of chronic kidney disease in Nigerian populations, and "kidney or renal failure in Nigeria". The search period covered from 2006 to 2014. Our key search words were "**Nigeria" "Chronic kidney disease" "chronic kidney failure" "community" "kidney failure" "World kidney day".** We searched local Nigerian journal medical journal publications that are general medicine in nature, those specific kidney disorders , conference abstracts published in Tropical Journal of Nephrology(JTN) as well as books of abstracts of the National Association of Nephrology(NAN) annual scientific conferences during the period under consideration.

We also searched the Clinical Nephrology Journal(CNJ) –Supplements, as well as books of abstract of the world congress of nephrology(WCN) satellite symposium conferences on kidney disease in disadvantaged populations (CKDDP), during the period under consideration. Similarly we searched the books of abstracts of world congress of nephrology (WCN) during the period under study were included in the search. Other widely read international journals of nephrology such as the Kidney international (KI), American journal of kidney disease (AJKD) and Nephrology dialysis transplantation (NDT) journal were also searched.

We restricted our search to these literature bases, because the bulk of publications in the subject area, are often published in Nigeria based medical literature, especially the main local nephrology journal, the Tropical journal of nephrology, and the books of abstracts of NAN annual scientific conferences.

**Inclusion criteria:**

- Community based studies of the prevalence of risk factors of CKD and the prevalence of CKD in adult Nigerian populations ($\geq$14years) carried out between 2006 and 2014.

**Exclusion criteria:**

- Eligible studies for inclusion but carried out in children < 14 years of age.
- Hospital based Nigerian studies of prevalence of risk factors and prevalence of CKD.

The relevant data for analysis from each study, was captured from the publication and entered unto pre-designed data framework. For each study, data enlisted include: The name of the first listed author, the site/community of study, the setting of the study, (whether rural or urban as stated by the authors), the year of study or year of publication (where the former is not stated), the number of subjects studied, the age range, mean age and the sex ratio of the study subjects. Other parameters include the percentage prevalence of subjects with obesity (BMI $\geq$ 30kg/m$^2$), significant proteinuria (spot urine protein$\geq$30mg/dl), and spot urinary albumin/creatinine ratio ($\geq$ 30mg/mmol) Others include, percentage of subjects with microhaematuria, diabetes mellitus(Random blood glucose$\geq$ 11.1mol/l)[16] and hypertension(mean blood pressures $\geq$140/90mmHg:JNC-7. [17.] Also included were percentages of subjects with hypercholesterolaemia (mean total plasma cholesterol levels $\geq$5.2mmol/l in accordance with National cholesterol evaluation program Adult treatment panel NCEP ATP-III.)[18.] Finally, the percentage of subjects with mean e-GFR $\leq$60mls/min/1.73m2, determined either by the Cockcroft and Gault(CG),[19] Modification of diet in renal disease(MDRD) [20] or any other formulae for the estimation of eGFR.

**Data management**

The relevant data for analysis were entered into SPSS version 20.0 for analysis. Analysed data are presented as mean ±sd, percentages, ratios, tables and illustrations. Student t-test was used to determine statistical differences between numerical variables, with p- value set at 0.05. The data for rural and urban based studies were compared.

**Results:**

A total of 30 studies were suitable for analysis (Table 1).The studies were carried out in 16(53.3%) rural and 14 (46.7%) urban Nigerian communities from 2006 to 2014 respectively. The highest number of studies, 5 each(16.7%) were carried out in the years 2013 and 2014 respectively, while the least number of studies,1 (3.3%) was carried out in 2012. The distribution of the geographic location of the study sites in Nigeria were as follows: North-west 3(10.0%); North-central 3(10.0%) ; North east-1(3.3 %) ; South-west-5(16.7%) ; South- east- 3(10.0%) and South – south-15(50.0%) respectively.

The total number of subjects studied in the 30 studies was 17,107 (99-1941) with an average of 1098 subjects per study. The individual ages of subjects ranged from 14 to 84 years. The aggregate mean of the mean ages for each study was 43.4 $\pm$ 4.4 (range of mean ages: 28.3-51.5) years. In most of the studies there was female preponderance with an aggregate m/f ratio of 1:1.5. In one study, all 99 subjects were all females.

There were some methodological differences in the determination of risk factors of CKD and the prevalence of CKD across the studies. Only one study had spot urinary albumin-creatinine ratio determined, Two studies each(6.7%) reported plasma cholesterol levels and dip-stick haematuria respectively. Due to their low frequencies, these parameters they were not included in the determination of the percentage prevalence of risk factors in the analysis .The parameters used to for determination of the prevalence of risk factors for

CKD were those for obesity, dip-stick macro-proteinuria , hypertension and diabetes mellitus respectively. Proteinuria was further used to deter mine the evidence for renal injury in the study populations, while percentage prevalence of studies with mean e-GFR $\leq$ 60mls/min/1.73m$^2$ constituted the actual prevalence of CKD. Not all studies evaluated the percentage prevalence of the CKD risk factor parameters and the prevalence of CKD.

**Table 1. Panorama of key findings in the 30 studies**

| S/no. | Authors | Location | Year | Status | No. of subjects | Sex ratio (m/f) | Mean age (yrs) | Proteinuria (%) | Obesity (%) | Hypt(%) | Diabetes (%) | CKD(KDOQI) ($\leq$60m l/min./1.73m$^{2)}$ prevalence[%] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 2.0 | NA |
| 1 | Olarrewaju et al | Illorin | 2006 | Urban | 352 | 1.4:1 | 40.4 | NA | 25.0 | 19.0 | | |
| 2 | Oyebisi et al | Aiyepe | na | Rural | 468 | 1:2 | NA | NA | NA | 28.9 | 4.3 | NA |
| 3 | Olarewaju et-al | Kwarra | 06-14. | Rural | 1,170 | 1:1.3 | 43.7 | NA | 21.0 | 20.7 | 2.4 | 15.8 |
| 4 | Okwuonu et al | Olokor | na | Rural | 328 | 1:1.4 | NA | 5.8 | NA | 36.9 | NA | 4.6 |
| 5 | Umar et al | Minna | 2014 | Urban | 760 | 2.4:1 | 41.2 | 14.8 | NA | 38.2 | NA | NA |
| 6 | Okoye et al | Oghara | 2014 | Rural | 135 | 1:2.5 | 40.0 | 4.4 | 31.8 | 30.2 | 6.7 | NA |
| 7 | Akpan et al | Uyo | 2013 | Urban | 502 | 1:2.5 | NA | 23.5 | 34.8 | 30.2 | 5.8 | NA |
| 8 | Omotoso, et al | Ille-Ife | 2014 | Urban | 1195 | 1:1.4 | 47.9 | 35.3 | 18.7 | 29.7 | NA | 10.7 |
| 9 | Umar,et al [2] | Mairiga | 2008 | Rural | 858 | 1.3:1 | 38.3 | 5.7 | NA | 23.8 | NA | NA |
| 10 | E-chioma-et-al | Odufor | 2008 | Rural | 300 | 1:1.3 | 40.5 | NA | NA | 16.7 | NA | 2.0 |
| 11 | Nadalo et al | N.Nigeria | NA | Rural | 480 | 1:1.7 | 40.3 | NA | NA | NA | NA | NA |
| 12 | Okafor et al | Ido | 2011 | Rural | 99 | 1:3.3 | 50.1 | 36.5 | NA | 39.4 | 7.7 | 32.6 |
| 13 | Ogochukwu ,et al | Edo | NA | Rural | 470 | 1:1.9 | 40.7 | 4.4 | NA | NA | 2.1 | NA |
| 14 | Bassey,et al | Ak.Ibom | NA | Rural | 1484 | 1:2.5 | NA | 15.5 | 43.1 | 42.7 | 3.2 | 16.1 |
| 15 | Effa,et-al | Calabar | 2014 | Urban | 230 | 1:1.1 | 36.4 | 21.7 | 62.7 | 39.0 | 11.3 | 4.8 |
| 16 | E-Chioma et al | PHC | 2014 | Urban | 259 | 1.1:1 | 28.3 | 12.4 | 12.2 | 19.5 | 4.3 | 1.9 |
| 17 | Gimba et-al | Jos | 2013/14 | Urban | 1313 | 1:1 | 42.0 | 11.4 | 54.9 | 46.6 | 7.0 | 1.2 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Wachuku, et al | PHC | 2011 | Urban | 176 | 1:1.3 | 36.3 | 11.9 | 14.3 | 13.6 | 5.7 | NA |
| 19 | Arogundada et al | Ile-Ife | 2011 | Urban | 298 | 1:1.3 | 51.8 | 69.1 | 13.4 | 24.5 | NA | NA |
| 20 | Ibrahim,et al | Giwa | 2011 | Rural | 118 | 1:2 | 42.0 | 10.0 | NA | 36.8 | NA | NA |
| 21 | Okoye, et al | Ogbona | 2014 | Rural | 476 | 1;1.1 | 46.7 | 4.4 | NA | 43.2 | NA | 27.2m |
| 22 | Olarinoye, et al | Ile-Ife | 2010 | Urban | 777 | 1:1.1 | NA | 47.2 | 17.8 | 45.9 | NA | NA |
| 23 | Wokoma,et al | Barako | 2008 | Rural | 154 | 1:1.4 | 48.9 | 27.9 | 13.5 | 27.9 | 5.0 | NA |
| 24 | Adejumo, et al | Benin | 2012 | Urban | 1778 | 1:1.1 | 42.7 | 6.2 | 16.9 | 57.3 | 4.3 | NA |
| 25 | Ulasi,et al | Enugu | 2006 | Urban | 99 | 0:99 | 49.8 | 19.9 | NA | 21.2 | 8.1 | NA |
| 26 | Wokoma,et al [2] | Ogbodo | 2010 | Rural | 125 | 1:1.7 | 46.8 | 57.7 | 27.7 | 26.9 | 2.4 | NA |
| 27 | Emem-Chioma ,et al[3] | Obuama | 2013 | Rural | 155 | 1:1.4 | 50.4 | 35.0 | 59.1 | 51.1 | 5.1 | NA |
| 28 | Wokoma,et al [3] | Ogubolo | 2011 | Rural | 120 | 1:1.3 | 50.1 | 19.2 | 25.8 | 48.7 | 2.5 | NA |
| 29 | Ulasi et al [2] | Enugu | 2013 | urban | 1942 | 1:1.1 | 43.0 | 3.7 | 14.9 | 26.1 | 5.9 | 11.1 |
| 30 | Oluyombo etal | Ile -ife | 2013 | urban | 454 | 1:1.3 | 45.8 | 8.9 | 14.6 | 30.0 | 3.7 | 12.3 |

S*tatus- (Urban or Rural based study); Hypt.-hypertension; CKD-Chronic kidney disease; KDOQI-Kidney disease outcome quality initiative: definition of chronic kidney disease.*

There were some methodological differences in the determination of risk factors of CKD and the prevalence of CKD across the studies. Only one study had spot urinary albumin-creatinine ratio determined, Two studies each(6.7%) reported plasma cholesterol levels and dip-stick haematuria respectively. Due to their low frequencies, these parameters they were not included in the determination of the percentage prevalence of risk factors in the analysis .The parameters used to for determination of the prevalence of risk factors for CKD were those for obesity, dip-stick macro-proteinuria , hypertension and diabetes mellitus respectively. Proteinuria was further used to deter mine the evidence for renal injury in the study populations, while percentage prevalence of studies with mean e-GFR $\leq$ 60mls/min/1.73m$^2$ constituted the actual prevalence of CKD. Not all studies evaluated the percentage prevalence of the CKD risk factor parameters and the prevalence of CKD. The distributions of the studies according to risk factors evaluated are shown in Table 2.

**Table 2. Distribution of aggregate mean percentage prevalence of risks factors for CKD and the prevalence of CKD**

| CKD- risk factor | Number of studies (%) | Range of mean percentages | Aggregate mean percentages |
|---|---|---|---|
| Obesity (BMI $\geq$ 30kg/m2) | 19(63.3%) | 12.2 – 62.7 | **27.5 $\pm$ 12.8** |
| Proteinuria ( $\geq$ 30mg/dl) | 24(80.0%) | 3.7- 69.1 | **20.3 $\pm$ 13.3** |
| Hypertension(BP $\geq$140/90mmHg) | 28(93.3%) | 13.6- 57.3 | **32.1 $\pm$8.9** |
| Diabetes Mellitus(RBS $\geq$11.1mmol/L) | 20(66.7%) | 2.0- 11.2 | **4.9 $\pm$ 1.9** |
| Prev. of CKD based on e-GFR$\leq$ 60mls/min/1.73m$^2$ | 12(40.0%) | 1.2- 32.6 | **11.7 $\pm$7.0** |

*(Number of studies=30; Number of subjects = 17,107 subjects)*
*Overall prevalence of CKD (KDIGO) in the studies=**11.7%;***
**CKD:**- Chronic kidney disease. **RBS:-** Random blood glucose. **Prev:-** Prevalence.

The aggregate mean percentage distribution of the prevalence of risk factors of CKD for all studies as shown in table 2 are : Obesity 27.5%(12.2-62.7% ) ; Proteinuria 20.3%(3.7-

69.1% ); Hypertension 32.1 %(13.6 -53.7%) and diabetes mellitus 4.9%(2-11.2% ) respectively. Taking proteinuria as the indicator for kidney damage (in the absence of data for microhaematuria), gives the percentage prevalence of kidney damage in the entire study population to be 20.3 percent. The prevalence of CKD (e-GFR < 60mls/min./1,73m$^2$) was 11.7% (1.2-32.6%).

Comparing the parametric variables between the urban based and rural based studies showed significant differences (Table 3) in the study population size, the average study population size ,the mean ages and in the prevalence of CKD respectively( p< 0.001). There was no significant differences in the percentage prevalence for all the four risk factors of CKD evaluated (obesity, proteinuria, hypertension and diabetes mellitus) between the urban and rural populations ( p-values >0.05), respectively.

**Discussions**

This is the first systematic analysis of community based studies of the prevalence of CKD and risk factors of CKD in the Nigerian population. It is an effort to have unifying data for the prevalence and burden of CKD in the country. This systematic analysis involved 30 studies with a total pool of 17107 subjects. The aggregate mean age of the subjects in the studies of 43.5(28-51.5) years is in keeping with observations in most low and middle income populations of the world, where CKD/ESRD is more predominant in the young adult and adults less than 65 years old.6,7. This contrast with the situation in developed countries of Europe and N.America where the median age of affectation is about 70 years.[22,23] The gender distribution in this systematic analysis of 1:1.5 show a preponderance of females. Other community based studies in other sub-Saharan African (SSA) countries and elsewhere show similar pattern.

**Table 3. Comparison of Urban and Rural based studies**

*(Number of studies= 3; Total number of subjects=17107)*

| Parameters | Urban studies | Rural studies | P-value |
|---|---|---|---|
| Number of studies | 14(46.7%) | 16(53.3%) | P<0.001(s) |
| Populations size | 10,214(59.7%) (99-1941) | 6,893(40.3%) (99-1484) | P<0.001(s) |
| Average population size. | 729.5 | 430.8 | |
| Mean age(years) | 41.0 $\pm$ 5.1(28-51) | 45.0 $\pm$ 3.88(16-85) | P<0.01(s) |
| Gender ratio(M/F) | 1 : 1.3 | 1:1.7 | |
| Obesity % | 26.8 (12.2-62.7) | 30.1(13.5-51.5) | P>0.05(ns) |
| Proteinuria % | 24.8 (6.2-69.1) | 18.9 (4.4-57.7) | P>0.05(ns) |
| Diabetes mellitus% | 6.4 (2.7- 11.5) | 4.3 ( 2.1-2.7) | P>0.05(ns) |
| Hypertension% | 32.1 (13.6-57.3) | 32.4(11.1-51.1) | P>0.05(ns) |
| Prev.of CKD (e-GFR <60ml/min/1.73m$^2$ | **7.0(1.2-12.3)** | **16.7 (2-32.6)** | P<0.001(s) |

*CKD-Chronic kidney disease. E-GFR-estimated glomerular filtration rate*

Awobusuyi, et al[21] (2015) in a multicentre study of CKD in Nigeria reported a gender ratio of 1:1.2; data from Stanifer et al. [24] in a meta-analysis of CKD studies in SSA showed gender percentage ratio of 49%/51% , similarly data from an Indian25 community based screening for early kidney disease ( SEEK) studies show similar pattern of female preponderance. One reason for female preponderance is that women tend to exhibit a higher health seeking behaviour, during community based health outreach programs. This pattern of female preponderance in community based studies is however different from observed male preponderance in clinical studies of hospitalisations for renal disease in Nigeria and elsewhere.[7,8,26] The reason for the behavioural reversal, whereby men with kidney disease and kidney failure are more hospitalised than women is not understood.

Of the traditional risk factors of CKD: proteinuria, obesity, hypertension and diabetes mellitus were the commonly screened in all 30 studies evaluated, as in most other population screening for CKD. This is because these entities are easily measurable in field settings. The results (Table 2) showed relatively high aggregate mean prevalences of proteinuria, obesity, hypertension, and diabetes respectively across Nigerian populations both urban and rural indicating high risk of CKD. Our results compare favourably with the findings by Awobusuyi, et al [21] in Nigeria and Stanifer, et al[24] in Nigeria and other SSA countries.

The differences between the urban and rural populations in the risk factor parameters were not statistically significant (Table 3). An explanation for this could be the increasing urbanisation of most rural communities in Nigeria, with the advent of creation of 774 local governments across Nigeria in recent times. In Nigeria, the creation of local government administrations as a third tier of government (with line budgets) since 1999, has led to administrative and economic empowerment of the rural populace. The hitherto rural populations, are increasingly adopting urban lifestyles and reducing rural-urban migration. Thus most rural communities in Nigeria today can be better described as semi-urban rather than rural.

The higher percentage prevalence of CKD in rural communities (16.7%) as compared with the urban communities (7.0%) respectively ($p<0.001$) is not expected. Stanifer et al,[24] did not find significant difference in CKD prevalence between urban and rural population studies. Similarly, Ulasi et al[27] (though part of our systematic analysis) in Enugu Nigeria, did not find significant difference between the urban and rural populations. Awobusuyi et al[21] had all their subjects from urban populations.

The disparity between the rural and urban populace in this systematic analysis, may however be due to the higher mean age of the rural population (43.4 vs 41.0: $p<0.001$years) compared to that of the urban population. The rural populace may have a higher preponderance of the elderly people and retired public servants who have returned to their native communities for socio-economic reasons. Data from most studies and from renal registries show that the prevalence of CKD rises incrementally with advancing age.[3,27] In the absence of data for micro-haematuria we took the prevalence of proteinuria (20.3%) to represent the evidence for kidney injury or kidney damage. Awobusuyi et-al [21] reported prevalence of renal damage of 23.47%. Proteinuria is direct evidence of renal damage, progressive CKD and poor cardiovascular outcomes in patients with CKD.[28,29] Thus this systematic analysis and report of Awobusuyi et al confirms that Nigerian adult populations are at high risk for CKD.

The prevalence of CKD based on e-GFR $\leq$ 60mls/min/1.73m$^2$, in this analysis ranged from 1.2_to 32.6% with an aggregate mean of 11.7 %. This is lower than the 17.6% obtained for Nigeria by Stanifer et al,[24] in a meta-analysis of CKD in sub-Saharan Africa, including Nigeria, but closer to 13.9% obtained for the entire SSA counties in the same study. Our figure and that of Stanifer et al are however much higher than the 3.03% reported by Awobusuyi, et al[21] in a recent multicentre study in Nigeria.

The low CKD prevalence rate obtained by Awobusuyi, et al , may be due to differences in the population demographic structure as well as differences in the e-GFR formulae employed . The subjects in Awobusuyi et al study appear to be much younger than those in our studies. Awobusuyi et al study population were relatively young adults belonging predominantly to the 20-39 year age group, constituting 46.7% of the study population. Only 9.6% of their population were over 60 years of age and their mean age(40.1years) is lower than the aggregate mean age(43.3years) in our study population($p<0.001$). Awobusuyi et al population group are expected to have lower serum creatinine levels and therefore lower prevalence of CKD than their older counterparts. Whereas most of the reports for our systematic analysis and those of Stanifer et-al used mainly the Cockcroft and Gault (CG)[19] and MDRD[20] formulae, Awobusuyi, et al used only MDRD formulae for the estimation of e-GFR. Several studies in different population and racial groups have

demonstrated differences in e-GFR outcomes using the different formulae.[30,31]

From the foregoing therefore, the true prevalence of CKD in Nigeria ( based on e-GFR≤ 60mls/min/1.73m$^2$ ) lies between 3.03% reported by Awobusuyi, et al,[21] 17.6% reported for Nigeria by Stanifer, et al[24] and the 11.7% found in this systematic -analysis respectively. However, the prevalence rates by Stanifer et al and that for this systematic analysis are closer to the prevalence rates from other sub-Saharan African countries, such as 17% for Ghana and 14.3% for South Africa as reported in Staniffer et al as well as prevalence rates in some other low and middle income countries(LMIC) as India(17%) respectively.[24,25.] The prevalent rates by Stanifer et al and that of this systematic - analysis are therefore more likely to be closer to the real CKD prevalence in Nigeria. For this reason we are of the opinion that average of Staniffer et al and the result of this systematic analysis which is 14.6% , would be a true representative of the real prevalence of CKD in Nigeria.

Extrapolating to the general population of Nigeria, the burden of CKD in adult population in Nigeria, (with an adult population (>14 years) of about 100 million people)[33], the burden of CKD at 14.6% prevalence rate would be about 14.6 million adults. This is less than 20 million adults with CKD in the United States of America[3]. Furthermore, assuming a 0.2% population prevalence of ESRD ,as reported for most populations and also as reported for Nigerians by Ulasi et al [27], the estimated adult population (≥14yeras) of Nigerians with ESRD would be about 200,000 people. This will translate to ESRD prevalence of 1,176 per million adult(Nigerian) population(pmp), which is a bit lower than the Unites states ESRD prevalence of 1,738 pmp , and much lower than the 5,284 pmp for African Americans in the US.[3]

In the absence of Renal registry in Nigeria, results from this systematic analysis and that of Stanifer et al, for Nigeria and the projections there from could serve as a reliable data for the prevalence of CKD, the burden of CKD and ESRD in Nigerian adult population, for the purposes of renal health policy formulation, planning and administration in Nigeria. They would also serve as a consensus and unifying reference data for clinical practice and research in the country.

The data used in this meta-analysis however suffer some deficiencies. First, the national spread of the studies was skewed in favour of southern Nigeria especially, the South-South geo-political region. There was a poor representation from the northern parts of the country. Awobusuyi, et al[21] study which is an improvement on our studies, in terms of spread, covering all the six geopolitical zones, also had more subjects from the southern Nigeria- 5,749 (71.2%) compared with 2,328 (28.2%) from northern Nigeria. The disparity may be a reflection of the degree of participation and the reporting of WKD screening activities by the various centres in the different geo-political zones of the country. The north-south disparity is due to the known skewed distribution of population of general medical and specialist (especially renal) human resource between the southern and northern parts of the country.

Being a retrospective study it would not have been possible to retrieve all previous screening studies of prevalence of risk factors and prevalence of CKD during the study period. There were disparities in the methodology for determination of the prevalence rates of risk factors and prevalence of CKD among the studies. Some studies did not perform spot urinalysis for glycosuria and proteinuria quantifications, others did not measure random blood glucose or serum creatinine. These deficiencies may be due to lack of adequate funds resulting from non-sponsorships. Often times the investigators used their personal funds to undertake world kidney day sensitization and community screening exercises (our experience). Finally, almost all the studies were cross sectional one-day observational studies. Thus some of the data are not quality controlled. For example spot proteinuria was used in place persistent proteinuria. Also the three months minimum period requirement to satisfy the KDOQI definition of CKD was not attainable. These deficiencies however did not invalidate the results of this systematic meta- analysis. Most population based surveys of risk factors and prevalence of CKD in most parts of the world

have been cross-sectional studies. The number of studies that objectively evaluated the prevalence of risk factors was over 70% (Table 3). The 40 % of studies used for the evaluation of the prevalence of CKD by is similar to the 43 % of studies in Stanifer et al.[24]

**Conclusions and recommendations**

The results from this systematic analysis in combination with the results of Stanifer etal [24] for Nigeria, has provided a dependable national consensus data of the prevalence of risk factors of CKD and the prevalence of CKD in Nigeria for adult population. Extrapolations from the data provide a reliable magnitude of the burden of CKD and ESRD in the county. These data provides a reliable basis for kidney policy planning and administration in Nigeria. The results would also enable a consensus reference data within the renal community in Nigeria for clinical practice and research. There is however need for larger scale multi-regional population studies, larger in study population size than that of Awobusuyi et-al.[21] This is feasible if workers in each of the six geo-political regions undertake large scale studies in their respective zones followed by a meta-analysis of the results from all the zones to provide an aggregate data. Such future community based studies should however endeavour to be as comprehensive as possible to evaluate all key parameters for the adequate determination of the prevalence of CKD and risk factors in accordance with KDOQI definition. There is need for Nephrology Association of Nigeria (NAN) to recommend a most suitable e-GFR formula for Nigeria to ensure uniformity in clinical practice and research. Finally Governments at Federal and state levels are called upon to encourage the development of Renal Registries in the country which will provide reliable and continuously updated data for kidney health policy and implementation for the country.

**Study limitations**

Some difficulties were encountered in getting internet access to some of the searched journals and articles, as most of them were African and Nigerian based journals which are not indexed in the web site of African journal on line (AJOL). Such journals were however few and did not significantly affect the number of the studies used for the analysis. There were also problems of incompleteness of data for determination of risk factor prevalence or estimation of e-GFR. Some studies did not do urinalysis, random blood glucose, serum creatinine and consequently, e-GFR estimations. Virtually all the studies analysed were cross-sectional in nature.

**Disclosures:**

The authors declare no financial interests. The study was funded by the authors.

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