The epidemiology of chronic kidney disease in sub-Saharan Africa: a systematic review and meta-analysis

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Summary

Background Amid rapid urbanisation, the HIV epidemic, and increasing rates of non-communicable diseases, people in sub-Saharan Africa are especially vulnerable to kidney disease. Little is known about the epidemiology of chronic kidney disease (CKD) in sub-Saharan Africa, so we did a systematic review and meta-analysis examining the epidemiology of the disease.

Methods We searched Medline, Embase, and WHO Global Health Library databases for all articles published through March 29, 2012, and searched the reference lists of retrieved articles. We independently reviewed each study for quality. We used the inverse-variance random-effects method for meta-analyses of the medium-quality and high-quality data and explored heterogeneity by comparing CKD burdens across countries, settings (urban or rural), comorbid disorders (hypertension, diabetes, HIV), CKD definitions, and time.

Findings Overall, we included 90 studies from 96 sites in the review. Study quality was low, with only 18 (20%) medium-quality studies and three (3%) high-quality studies. We noted moderate heterogeneity between the medium-quality and high-quality studies (n=21; I^2=47·11%, p<0·0009). Measurement of urine protein was the most common method of determining the presence of kidney disease (62 [69%] studies), but the Cockcroft-Gault formula (22 [24%] studies) and Modification of Diet in Renal Disease formula (17 [19%] studies) were also used. Most of the studies were done in urban settings (83 [93%] studies) and after the year 2000 (57 [63%] studies), and we detected no significant difference in the prevalence of CKD between urban (12·4%, 95% CI 11–14) and rural (16·5%, 13·8–19·6) settings (p=0·474). The overall prevalence of CKD from the 21 medium-quality and high-quality studies was 13·9% (95% CI 12·2–15·7).

Interpretation In sub-Saharan Africa, CKD is a substantial health burden with risk factors that include communicable and non-communicable diseases. However, poor data quality limits inferences and draws attention to the need for more information and validated measures of kidney function especially in the context of the growing burden of non-communicable diseases.

Funding Duke University.

Lancet Glob Health 2014; 2: e174–181

Published Online February 10, 2014 http://dx.doi.org/10.1016/S2214-109X(14)70002-6

This online publication has been corrected. The corrected version first appeared at thelancet.com/lancetgh on April 24, 2014

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Introduction

Amid population ageing, lifestyle changes, and rapid urbanisation, the importance of non-communicable diseases in low-income and middle-income countries is becoming increasingly recognised, and in 2011 the United Nations General Assembly adopted a resolution acknowledging the impending global burden and threat of non-communicable diseases.[1] However, few epidemiological studies of the incidence, prevalence, and cause of these diseases have been done.[1–3] Chronic kidney disease (CKD), which nearly doubled as a cause of death worldwide between 1990 and 2010 and was the 18th highest cause of death worldwide in 2010, falls into this category of diseases.[4]

Sub-Saharan Africa is a vast and heterogeneous region of roughly 24 million km² composed of 47 countries and more than 900 million people.[5] By 2030, more than 70% of patients with end-stage renal disease are estimated to be living in low-income countries, such as those in sub-Saharan Africa, where the gross domestic product per person is on average less than US$1500 per year.[6–8] This estimation is alarming in view of the fact that the global prevalence of maintenance dialysis has doubled since 1990, and that renal replacement therapy was accessed by 1·8 million people worldwide in 2004 with less than 5% of that population coming from sub-Saharan Africa.[9,10]

There are many potential causes of CKD in sub-Saharan Africa, making kidney disease especially burdensome in the region. In addition to non-communicable diseases, communicable diseases such as infectious glomerulonephritis, schistosomiasis, leishmaniasis, and HIV infection are common and can cause CKD. And because more than 22 million people in sub-Saharan Africa have HIV, the potential for an overwhelming burden of CKD in the region is high.[11–14]

As has been noted elsewhere,[15,16] the challenging first step to address the burden of kidney disease in Africa is to establish the epidemiology of CKD. We hypothesised that CKD is an important disease in sub-Saharan Africa with

many potential causes. To assess the extent to which it is a public health and economic burden, we did a systematic review and meta-analysis to find out the prevalence of CKD in adults in the region.

Methods

Search strategy and selection criteria

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[17] We searched PubMed, Embase, and the WHO Global Health Library databases (which include the African [AFRO] Index Medicus, WHO Library Information System [WHOLIS], and Scientific Electronic Library Online [SciELO]) for published reports of kidney disease in sub-Saharan Africa up to March 29, 2012. We used Boolean logic with search terms including "chronic kidney disease", "nephropathy", "renal insufficiency", and "Africa south of Sahara". We used controlled vocabularies (eg, Medical Subject Heading terms) to identify synonyms. We applied no language restrictions. The study protocol and detailed search parameters are available in the appendix.

See Online for appendix

Two authors (JWS and RM) independently reviewed each title and abstract for inclusion. Randomised controlled trials and non-randomised studies including cross-sectional studies, cohort studies (retrospective and prospective), case-control studies, and literature reviews that report a prevalence or a calculable prevalence for CKD in adults from a sub-Saharan African country were eligible for inclusion. We excluded studies that were only composed of pregnant women or people admitted to hospital, or ones that specifically recruited participants on the basis of the presence or absence of kidney disease. We regarded the following terms as equivalent to chronic kidney disease: "renal insufficiency", "chronic kidney failure", "renal impairment", "end/target-organ damage" (if renal function was recorded in some capacity), "end-stage kidney/renal disease", "nephropathy", "proteinuria", "dialysis-dependent", "status-post renal transplant", "sonographic-evidence", and "biopsy-proven renal disease".

Two investigators (JWS and ST) did a second review assessing entire papers and their reference lists. Any disagreement resulted in joint review of the article with reconciliation. Articles in French were translated by one author (NH) and then independently reviewed by two authors (JWS and ST or JWS and RM) for inclusion and extraction (only one article was not in French or English, and it was excluded on the basis of title and abstract alone). Detailed inclusion and exclusion criteria are available in the appendix.

Quality assessment and data extraction

Three authors (JWS, ST, and RM) independently appraised each article for quality using previously described assessment criteria (panel).[18–23] On the basis of these criteria, each article received a quality grade of low, medium, or high, and any disagreement resulted in joint review of the article.

Data were extracted from all included studies by two authors independently (JWS and ST) and in duplicate into a preformulated table; errors of data extraction were resolved by joint review of the original articles. In addition to the overall prevalence reported by each study, we extracted or calculated, as necessary, the prevalence of CKD as defined by proteinuria, a creatinine clearance of less than 60 mL per min by the Cockcroft-Gault formula,

***Panel:* Quality assessment criteria for studies examining the prevalence of chronic kidney disease**

High quality

For studies of the highest quality, assessors should answer yes to the following ten questions

1 *Subject sampling and precision*
   - A Are the included people representative of the general population? (Comment: if people were included on the basis of hospital records, insurance claims, or health-care facilities then they should not be considered representative of the general population.)
   - B People are not included or excluded on the basis of specific risk factors. (Comment: high risk people such as those with diabetes, HIV, or hypertension should not be sought out specifically for inclusion or exclusion.)
   - C Is the sample size adequate to address the question of prevalence in the studied population?

2 *Sampling technique*
   - A Were the people recruited at random? (Comment: methods should address the issue of enrolling consecutive participants, people likely to have the disease or at high risk, and convenience sampling)

3 *Response rate*
   - A Does the article report a response rate in total sample?
   - B Is that response rate 40% or higher?

4 *Exclusion rate*
   - A Does the article report an exclusion rate in total sample?
   - B Is the exclusion rate 10% or less?

5 *Measurement and method of determination of kidney disease*
   - A Does the study report the method used for determination of kidney disease?
   - B Does the study use a consistent method for determination of kidney disease?

Medium quality

For studies of medium quality, assessors should answer yes to the following questions

1 If participants are not representative of the general population, then are they representative of the population in question? (Comment: people can be taken from high-risk groups such as diabetic or hypertensive populations; although not considered representative of the entire population, they can still be representative of that specific population.)
2 If participants were not recruited at random, then were they recruited in a random non-health-care convenience method from the entire population in question?
3 Is the study sample size adequate to answer the question of prevalence in the studied population?
4 Does the study use a consistent method for determination of kidney disease?

Low quality

1 For studies of the lowest quality, assessors would be unable to answer yes to all of the above questions.