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The Burden of Chronic Kidney Disease in Nigeria: A Review
Le Fardeau De La Maladie Renale Chronique Au Nigeria: Une Revue

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ABSTRACT

Chronic Kidney Disease (CKD) is on the increase globally. Regional differences exist in its epidemiology, with non-Caucasians most affected. The prevalence of CKD in Nigeria is between 1.6% - 12.4%. Ninety percent of end-stage renal disease (ESRD) patients may die within 3 months of initiating dialysis. Indices are worse in resource-poor countries like Nigeria, where financial constraints often hamper prevention and adequate intervention. A change in focus, therefore, towards creating more awareness, appropriate legislation, and policies geared towards prevention will be more realistic.

ABSTRAIT

L'insuffisance rénale chronique (IRC) est en augmentation à l'échelle mondiale. Il existe des différences régionales dans son épidémiologie, les non-Caucasiens étant les plus touchés. La prévalence de l'IRC au Nigéria se situe entre 1,6 % et 12,4 %. Quatre-vingt-dix pour cent des patients atteints d'insuffisance rénale terminale (IRT) peuvent mourir dans les 3 mois suivant le début de la dialyse. Les indices sont plus mauvais dans les pays pauvres en ressources comme le Nigeria, où la prévention et une intervention adéquate sont souvent entravées par des contraintes financières. Il serait donc plus réaliste de changer d'orientation, de sensibiliser le public, de légiférer de manière appropriée et de mettre en place des politiques axées sur la prévention.

INTRODUCTION

Chronic Kidney Disease (CKD) is on the upward increase worldwide at a suggested annual growth rate of 8%. Regional differences exist in its epidemiology, and non–whites are more affected. The prevalence of CKD in Nigeria is between 1.6% - 12.4%. Ninety percent of end-stage renal disease (ESRD) patients are said to die within 3 months of initiating dialysis. Indices are worse in resource-poor countries like Nigeria, where prevention and adequate intervention are often hampered by funds. So, it would be much cheaper in a less developed country like ours to prevent CKD than to treat its complications. It is therefore important to identify the common etiologies of CKD in Nigeria and promptly address them before causing irreversible damage to the kidneys.

The purpose of this review exercise is to assess the burden, sociodemographic, clinical characteristics, and referral pattern of CKD patients in Nigeria. This will help determine whether existing preventive nephrology programs and strategies are achieving desired results and identify areas requiring improvement.

The most common causes of CKD in Nigeria include hypertension, glomerulonephritis, and diabetes mellitus. Many of these etiologies are preventable/treatable and should be regarded as a major way to reduce the incidence of CKD in this country. Challenges that we have that tend to run against the reduction of CKD include late presentation, inadequate manpower, diagnostic challenges, and inadequate equipment and facilities. The introduction of a healthy lifestyle, availability of essential medicaments, government legislation and policies aimed at curing drug abuse, health care personnel training, and subsidizing treatment costs all contribute to reducing the burden.

A change in focus, therefore, towards creating more awareness, appropriate legislation, and policies geared towards these preventable causes of CKD will be more realistic towards achieving desired results. The

problem of CKD is enormous with the prevalence of kidney failure rising as a worldwide public health burden. The 2002 World Health Organization and Global Burden of Disease Project report indicates that diseases of the kidney and urinary tract contribute to the global burden of diseases, with about 850,000 deaths every year and 15,010.67 disability-adjusted life years. Globally, they represent the 12th cause of death and the 17th cause of disability (1).

With this background, it is stressed that this review is carried out to highlight the plight of patients with ESRD in a typical developing country and to underscore the need for preventive measures, early detection and intervention to stem the rising prevalence and to alleviate the burden of the disease.

CKD IN NIGERIA, CAUSES

Odubanjo and his co-workers showed that hypertension and chronic glomerulonephritis are the common causes of CKD in Nigeria (2). Similarly, Olanrewaju et al indicated that hypertension is the most common cause of CKD (3). Another study revealed that the common causes were chronic glomerulonephritis, hypertension, diabetes mellitus, and obstructive nephropathy in the following percentages: 34.2%, 23.3%, 18.8%, and 10.4% respectively (4). Various research workers have published the list of CKD etiologies in Nigeria as follows:

Hypertension, diabetes mellitus, sickle cell nephropathy chronic glomerulonephritis, obstructive nephropathy, , autosomal dominant polycystic kidney disease, chronic interstitial nephritis, HIV – associated nephropathy (HIVAN), chronic pyelonephritis and chronic kidney disease of unknown origin (CKDU) (2-5). Most of the above causative factors are preventable and treatable as such, should be particularly searched for as a major way of reducing the incidence of CKD in Nigeria. There is general agreement that hypertension, chronic glomerulonephritis, and diabetes mellitus are the most common causes of CKD in Nigeria (2-5) and this is in keeping with studies in the industrialized world (6,7). It is therefore imperative that most intervention measures towards preventing CKD should be directed at preventing these diseases.

An interesting study by Suleiman and his co-workers in the Northeast of Nigeria made the point that chronic kidney disease of unknown origin (CKDU) comprised a sizable chunk (20.5%) of the causes of CKD in the region, raising the possibility of investigating the environmental and cultural risk factors at the earliest opportunity (8). Nigeria has the highest burden of sickle cell disease worldwide, with about 4 – 6 million individuals affected and about 3.5% of patients with sickle cell nephropathy in end-stage kidney disease (ESKD), ready for renal replacement therapy (9). Akba et al (10) report a general prevalence of 3.33%, while other researchers in Northern Nigeria reported a prevalence of just under 40%, increasing with age (9). This represents a heavy challenge because their outcome is lower in terms of morbidity and mortality in comparison with the non-sickle cell population (9).

Regular and careful follow-up clinic visits and appropriate interventions like hydroxyurea have been shown to slow down the progression of CKD resulting from sickle cell nephropathy. The prevalence of kidney disease among HIV patients is reported to be between 22.9% and 51.8% and is also associated with significantly high morbidity and mortality (11). HIV-associated nephropathy (HIVAN) has become the most common form of kidney disease, resulting from HIV infection (12). Key populations including workers in the commercial sex industry and intravenous drug abusers have been reported as major groups of drivers of HIV infection in Nigeria (11,13). Therefore, it is expected that appropriate policies will be put in place to curb this malady.

There are yet no known reliable statistics that describe CKD in all African countries. Chronic glomerulonephritis and hypertension are the principal causes of CKD in Tropical and East Africa in addition to diabetes mellitus and obstructive uropathy (14,15).

THE ROLE OF LIFESTYLE

Regional differences in the etiology and prevalence of CKD do exist, factors contributing to those regional differences include stress, physical activity, race, ethnicity, genetic predisposition, increasing age, competing mortality, obesity, unhealthy diet, possibly cigarette smoking and alcohol (16,17).

Epidemiological studies in the US have shown that Black Americans, American Indians, and Hispanics, have a higher CKD prevalence compared to whites. Even after making adjustments for confounding factors such as hypertension in blacks, a 4.8-fold greater risk of ESKD still exists in blacks compared to whites (18).

The prevalence of hypertension and diabetes mellitus has been on the increase and is projected to rise further despite the various efforts and initiatives to prevent or manage hypertension, and this trend is thought to be due to some barriers still limiting optimal outcomes (19,20). These barriers can exist at

patient, staff/health system, and administrative levels and include; lack of funding, which affects day to day-to-day operation of health care facilities, scarcity of and difficulty in accessing health care centers in a community, staff shortages in health care centers, shortage of drugs in clinics and dispensaries, limited availability of equipment and insufficient maintenance and patient health education and communication in clinics. Most doctors prescribe lifestyle modifications to treat hypertension, rather than prevent hypertension, hence the opportunity for primary prevention is usually missed (21).

MANAGEMENT CHALLENGES AND SOLUTIONS

The Prevalence of hypertension in Nigeria ranges from 8% to 46.4% but the percentage of people taking their medications is around 60% (22). This is not dissimilar to the non-adherence global figure of 43% - 65.5%. Regular health checks are not a constant feature until people fall sick or develop complications related to long-standing hypertension. This makes it imperative that more awareness and health education of Nigerians is necessary (23). The advent of single-pill combined therapy in the management of hypertensive patients has been shown to improve adherence (22,24). However, they are much more expensive than the single pill in our region (25,26).

Efforts by pharmaceutical companies, at local production of these drugs, at affordable costs without loss of quality, will go a long way to improve the problem of management of hypertension. The control of hypertension is reported to cut down cardiovascular mortality by 15%, consequently impacting the incidence of CKD (27,28).

Late Presentation – is still the 'norm'. Most Nigerian CKD patients still present very late to nephrologists, implying that the present preventive strategies have not yielded the desired results (4). Opportunity for early diagnosis is missed because many patients with kidney disease present late at the hospital (4). Most of these would have first visited the traditional healer who might have prescribed herbs and or 'cocktails' that may have exacerbated the kidney impairment (29).

Early referral of CKD patients to nephrologists is key to retarding progression to end-stage- kidney disease, reducing hospitalization, cost of health care, and improving patients' survival before and eventually after commencement of RRT (30-32). Prevention and early detection of CKD are the main instruments for combating CKD in our world today. To this effect, programs have been initiated to actualize this goal.

The World Kidney Day Initiative (WKDI) is one of such programs. Established by the ISN and the International Federation of Kidney Foundation (IFKF), it has been observed annually worldwide for the past 18 years with the primary objective of educating and enlightening the public on the prevention and early detection of kidney disease as well as giving support to kidney disease sufferers. Nephrologists in Nigeria have been actively involved in the World Kidney Day Initiative, and this has resulted in increased public enlightenment campaigns on CKD.

CHALLENGES OF DIAGNOSIS

The key to the diagnosis of the glomerulonephritides world over is renal biopsy. Results from this procedure contribute in no small way to further management (33,34). Researchers in Nigeria have noticed a decline in requests for renal biopsies attributable to several factors including a lack of trained health personnel, poor or non-existent health insurance schemes, and general lack of facilities (35). Being such an essential procedure in a renal facility, renal biopsy, and its maintenance cost may have to be subsidized by the government or any other allied body so that it can be affordable to all patients. Financial and other support aids should be freely available to physicians and allied workers in the form of financial and career development grants to perform a large number of these procedures thereby improving skills with the opportunity to train younger doctors.

NON STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAID)

Abuse of analgesics in general and NSAIDs in particular is on the rise, especially among youths in Nigeria (36). The prevalence of drug abuse in Nigeria is reportedly as high as 22% (36), almost as high as in the industrialized world 24% (37). 'Over the counter' purchase (without prescription) may be a major contributor (38).

As indicated earlier in this review, appropriate legislative policies and definitive enforcement procedures may be the answer to the prevention of easy availability of these potentially nephrotoxic drugs to the vulnerable, especially youths (39).

Like hypertension, a significant proportion of our patients present with moderate to severe anemia both of which are cardiovascular risk factors that contribute to left ventricular hypertrophy and subsequent mortality in CKD patients (40-42). Anaemia has been reported to be

associated with increased expenditure and hospitalization rates in CKD patients (43,44). Those with severe anaemia receive blood transfusion thereby adding to the cost of care.

Most of the patients receive no vaccination against hepatitis B, which is usually part of pre-dialysis care in CKD patients consequent upon the increased risk of hepatitis B virus infection during haemodialysis and blood transfusion. The recommendation is that hepatitis B vaccination be administered early in CKD for it to be effective (45).

Furthermore, resulting from the late presentation of our patients, they do not have the opportunity to benefit from important interventions. These interventions are early correction and treatment of anaemia, hypertension, proteinuria, calcium, and phosphate abnormalities with appropriate and recommended therapeutic agents found to be cost-effective and also have indirect effects in reducing disability in the early stages of CKD (46,47).

Time spent by these patients on hospital admission would have adverse effects on the overall nation's economic activities and their families since they must have been gainfully employed and contributed economically to the nation. It is also evident that hospitalization of CKD patients has been associated with increased morbidity and mortality, making a valid point for early referral before reaching the advanced stage of CKD (48).

STATUS OF DIALYSIS FACILITIES

Virtually almost all patients requiring dialysis in this country use temporary vascular access due to the patient's poor clinical state at presentation. This is a more expensive process in comparison to the native arteriovenous fistula (AVF) which would offer a higher blood flow rate and better dialysis efficiency.

Initiation of haemodialysis with temporary vascular access would be associated with infection, hospitalization, poor patient survival, increased cost, and mortality in CKD patients in comparison with the use of AV-Fistula (49,50). Haemodialysis has been available in Nigeria since 1981 (1) and remains the dominant option for RRT. Dialysis centers in Nigeria have increased in number from 27 (2006) to 186 (2021) (51,52). The dialysis population increased from 300 in 2006 to over 3,000 in 2018 (51,52) showing that the number of centers in Nigeria compared to the number of patients requiring dialysis is undeniably inadequate.

This brings up the question of public-private partnership (PPP) in haemodialysis delivery for serious consideration. It should be encouraged as the indication is that this partnership has been shown to increase the number and sustainability of haemodialysis centers in Nigeria (53). Relevant authorities should endeavor to encourage drug and equipment manufacturers related to the treatment of kidney diseases and RRT to veer towards local production to make them more affordable, especially to those with restricted means which translates to a vast majority of Nigerians. This is the practice in other countries (54).

THE CASE FOR PERITONEAL DIALYSIS (PD)

PD has not been a popular choice of RRT in Nigeria. Very few patients with end-stage renal disease (ESRD) receive PD as opposed to 11% worldwide (55) and 8% in the US (56). PD may be a more appropriate option for RRT in a country like Nigeria because it could be less expensive and requires less technology to carry out. The dialysis fluid used in Nigeria is imported and because the use of PD is not widespread in the country, the unit cost of dialysis fluid is rather high.

POTENTIAL FOR A PD PROGRAM IN NIGERIA

The use of PD as an important means of RRT in Nigeria needs to be accorded high priority. Funding and organization of any large-scale program must be looked into by the Federal Government. The creation of a CKD registry is an important first step towards a systematized approach to treatment and could lead to a guideline for the allocation of scarce resources. The current situation where PD costs more than 'in-clinic' haemodialysis is largely due to the cost of imported dialysate, a correctable problem if arrangements are effected for the local manufacture of the dialysate.

STATUS OF TRANSPLANT CENTERS

Kidney transplant is the preferred renal replacement therapy for patients with ESRD, but accessibility to it is only to a very few; obviously due to the high cost and non–existent infrastructure. Most transplant recipients had their transplants in India (57,58), the few carried out in Nigeria are more in the private sector (59).

The major limitation to kidney transplants in Nigeria is funding; this is in addition to 'donor sourcing' (59). PPP mentioned earlier on in this review can also be deployed here with more funds allocated to the health sector by the government. A suggestion is that bilateral relationships be formed with high-volume kidney transplant centers to help develop transplant centers in the country.

MANPOWER SHORTAGE

There is a gross shortage of nephrology manpower in Nigeria at the moment amongst others; with about 240 nephrologists, about 700 registered dialysis nurses, and 120 dialysis technicians/technologists many of whom are fleeing the country for 'greener pastures'. This is hardly adequate to cater to the large and increasing population of CKD patients in the country. The suggestion is that policies and incentives (most probably financial) could be put in place as an encouragement to young, up-and-coming doctors to make nephrology their first subspecialty choice. A healthy working environment should go 'hand in hand' and be strongly encouraged.

CONCLUSIONS

CKD is more common in males, the economically productive age group in Nigeria, with the majority of them presenting very late to nephrologists in the ureamic state, commencing RRT without adequate pre-dialysis care.

Present strategies for prevention and early detection of CKD are inadequate and have not yielded the desired results. Most of the causes of CKD in Nigeria are preventable if 'at-risk' individuals are identified early and effectively managed.

Resource-poor settings (such as ours) should focus on generating more awareness and making legislation and policies focusing on these preventable causes of CKD as this is more realistic and effective in these settings.

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CONFLICTS OF INTEREST

There are no conflicts of Interest.

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REFERENCES

1. WHO. World Health Statistics. World health statistics 2021: monitoring health for the SDGs, Sustainable Development Goals (accessed 12/10/24)
2. Odubanjo MO, Oluwasola AO, Kadiri S. The epidemiology of end-stage renal disease in Nigeria: the way forward. Int. Urol Nephrol. 2011;43(3):785-92.
3. Olanrewaju TO, Aderibigbe A, Popoola AA, Braimoh KT, Buhari MO, Adedoyin OT, et al; Ilorin Renal Study Group. Prevalence of chronic kidney disease and risk factors in North-Central Nigeria: a population-based survey. BMC Nephrol. 2020;21(1):467.
4. Adejumo OA, Akinbodewa AA, Okaka EI, Alli OE, Ibukun IF. Chronic kidney disease in Nigeria: late presentation is still norm. Nigerian Med J. 2016;57(3):185-9.
5. Akinsola W, Odesanmi WO, Ogunniyi JO, Ladipo GO. Disease-causing chronic renal failure in Nigerians – a prospective study of 100 cases. Afr J Med Sci. 1989;18(2):131-7.
6. Atkins RC. The epidemiology of chronic kidney disease. Kidney Int Suppl. 2005;(94):S14-18.
7. Charles C, Ferris AH. Chronic kidney disease. Primary Care. 2020;47(4):585-95.
8. Sulaiman MM, Shettima J, Ndahi K, Abdul H, Baba MM, Ummate I, et al. Chronic kidney disease of unknown origin in Northern Yobe, Nigeria: experience from a regional tertiary hospital in Northeastern Nigeria. Borno Med J. 2019;16(2):1-8.
9. Bukar AA, Sulaiman MM, Ladu AI, Abba AM, Ahmed MK, Marama GT, et al. Chronic kidney disease amongst sickle cell anaemia patients at the University of Maiduguri Teaching Hospital, Northeastern Nigeria: a study of prevalence and risk factors. Mediterr J Hematol Infect Dis. 2019;11(1):e2019010.
10. Akaba K, Nwogoh B, Obanife H, Essien O, Epoke E. Prevalence of chronic complications in adult sickle cell aneamia patients in a tertiary hospital in South-South Nigeria. Nigerian J Med. 2020;29(4):665-9.
11. Ekrikpo UE, Kengne AP, Akpan EE, Effa EE, Bello AK, Ekott JU, et al. Prevalence and correlates of chronic kidney disease (CKD) among ART-naive HIV patients in Niger-Delta region Nigeria. Medicine (Baltimore).2018;97(16):e0380.
12. Ibrahim HU, Elechi HA, Rabasa AI, Ashir GM, Farouk AG, Yauba MS, et al. Prevalence and pattern of human immunodeficiency virus-associated nephropathy among human immunodeficiency virus-positive children at the University of Maiduguri Teaching Hospital, Nigeria. Saudi J Kidney Dis Transpl. 2019;30(4):843-52.
13. Awofala AA, Ogundele OE, HIV epidemiology in Nigeria. Saudi J Biol Sci. 2018;25(4): 697-703.
14. Akinsola W, Odesanmi WO, Ogunniyi JO, Ladipo GOA. Diseases causing chronic renal failure in Nigerians - a prospective study of 100 cases. Afr J Med Med Sci. 1989;18:131-135.
15. Naicker S. End-stage renal disease

in Sub-Saharan and South Africa. Kidney Int. 2003;63:56.
16. Okwuonu CG, Ngoka SC, Chimezie OJ, Eze TH, Uwanurochi K, Mbanaso AU. Towards prevention of hypertension in Nigeria: a study of prehypertension and its associations among apparently healthy adults in Umuahia, South-East Nigeria. Int J Prev Med. 2015;6:61.
17. Uloko AE, Musa BM, Ramlan MA, Gezawa ID, Puepet FH, Uloko AT, et al. Prevalence and risk factors for diabetes mellitus in Nigeria: a systematic review and meta-analysis. Diabetes Ther. 2018;9(3):1307-16.
18. US Renal Data System. 1999 Annual Data Report. Bethesda, Md: National Institute of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 1999.
19. Adeloye D, Basquill C, Aderemi AV, Thompson JY, Obi FA. An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. J Hypertens. 2015;33(2):230-42.
20. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al; IDF Diabetes Atlas Committee. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9th Edition. Diabetes Res Clin Pract. 2019;157:107843.
21. Ale OK, Braimoh RW, Adebiyi A, Ajuluchukwu JN. Lifestyle modification and hypertension: prescription patterns of Nigerian general practitioners. Pan Afr Med J. 2020;35:130.
22. Akpa MR, Agomuoh DI, Odia OJ. Drug compliance among hypertensive patients in Porth Harcourt, Nigeria. Niger J Med. 2005;14(1):55-7.
23. Akintunde AA, Akintunde TS. Antihypertensive medication adherence among Nigerian hypertensive subjects in specialist clinic compared to a general outpatient clinic. Ann Med Health Sci Res. 2015;5(3):173-8.
24. Parati G, Kjeldsen S, Coca A, Cushman WC, Wang J. Adherence to single-pill versus free-equivalent combination therapy in hypertension: a systematic review and meta-analysis. Hypertension. 2021;77(2):692-705.
25. Stafylas P, Kourlaba G, Hatzikou M, Georgiopoulous D, Sarafidis P, Maniadakis N. Economic evaluation of a single-pill triple antihypertensive therapy with valsartan, amlodipine, and hydrochlorothiazide against its dual components. Cost Eff Resour Alloc. 2015;13:10.
26. Paczkowsa-Walendowska M, Sip S, Staszewski R, Cielecka-Piontek J. Single-pill combination to improve hypertension treatment: pharmaceutical industry development. Int J Environ Res Public Health. 2022;19(7):4156.
27. Pugh D, Gallacher PJ, Dhaun N. Management of hypertension in chronic kidney disease. Drugs. 2019;79(4):365-79.
28. Carey RM, Muntner P, Bosworth HB, Whelton PK. Prevention and control of hypertension: JACC Health Promotion Series. J Am Coll Cardiol. 2018;72(11):1278-93.
29. James PB, Wardle J, Steel A, Adams J. Traditional complementary and alternative medicine use in Sub-Saharan Africa: a systematic review. BMJ Glob Health. 2018;3(5):e000895.
30. Smart NA, Titus TT. Outcomes of early versus late nephrology referral in chronic kidney disease: A systematic review. Am J Med 2011;124:1073-80.e2.
31. Cass A, Cunningham J, Arnold PC, Snelling P, Wang Z, Hoy W. Delayed referral to a Nephrologist: Outcomes among patients who survive at least one year on dialysis. Med J Aust 2002;177:135-8.
32. Kinchen KS, Sadler J, Fink N, Brookmeyer R, Klag MJ, Levey AS, et al. The timing of specialist evaluation in chronic kidney disease and mortality. Ann Intern Med. 2002;137:479-86.
33. Jennette JC, Falk RJ. Diagnosis and management of glomerular diseases. Med Clin North Am. 1997;81(3):653-77.
34. Yim T, Kim SU, Park S, Lim JH, Jung HY, Cho JH, et al. Patterns in renal diseases diagnosed by kidney biopsy: a single-center experience. Kidney Res Clin Pract. 2020;39(1):60-9.
35. Okani CO, Ekrikpo UE, Okolo CA, Asinobi AO, Salako B, Akang EE. Is the art of renal biopsy on the decline in Nigeria? Ann Ib Postgrad Med. 2014;12(1):30-41.
36. Agaba EI, Agaba PA, Wigwe CM. Use and abuse of analgesics in Nigeria: a community survey. Niger J Med. 2004;13(4):379-82.
37. Cryer B, Barnett MA, Wagner J, Wilcox CM. Overuse and misperceptions of nonsteroidal anti-inflammatory drugs in the United States. Am J Med Sci. 2016;352(5):472-80.
38. Brennan R, Wazaify M, Shawabkeh H, Boardley I, McVeigh J, Van Hout MC. A scoping review of non-medical and extra-medical use of non-steroidal anti-inflammatory drugs (NSAIDs). Drug Saf. 2021;44(9):917-28.

39. Pomeranz JL, Taylor LM, Austin SB. Over-the-counter and out-of-control: legal strategies to protect youths from abusing products for weight control. Am J Public Health. 2013;103(2):220-5.
40. Ulasi II, Arodiwe EB, Ijoma CK. Left ventricular hypertrophy in African black patients with chronic renal failure at first evaluation. Ethn Dis 2006;16:859-64.
41. Jesurobo DE, Odia JO, Uchenna DI. Left ventricular hypertrophy and its correlates in CKD patients in Nigerian tertiary hospital. Int J Med. 2012;1:11-6.
42. Levy D, Garrison RJ, Savage DD, Kannel WB, Castelli WP. Prognostic implications of echocardiographically determined left ventricular mass in the Framingham Heart Study. N Engl J Med 1990;322:1561-6.
43. Li S, Collins AJ. Association of hematocrit value with cardiovascular morbidity and mortality in incident haemodialysis patients. Kidney Int 2004;65:626-33.
44. Collins AJ, Li S, Ebben J, Ma JZ, Manning W. Hematocrit levels, and associated medicare expenditures. Am J Kidney Dis 2000;36:282-93.
45. Grzegorzewska AE. Hepatitis B vaccination in chronic kidney disease: Review of evidence in non-dialyzed patients. Hepat Mon 2012;12:e7539.
46. Trivedi H. Cost implications of caring for chronic kidney disease: Are interventions cost-effective? Adv Chronic Kidney Dis 2010;17:265-70.
47. Menzin J, Lines LM, Weiner DE, Neumann PJ, Nichols C, Rodriguez L, et al. A review of the costs and cost-effectiveness of interventions in chronic kidney disease: Implications for policy. Pharmacoeconomics 2011;29:839-61.
48. Panocchia N, Tazza L, Di Stasio E, Liberatori M, Vulpio C, Giungi S, et al. Mortality in hospitalized chronic kidney disease patients starting unplanned urgent haemodialysis. Nephrology (Carlton) 2016;21:62-7.
49. Dhingra RK, Young EW, Hulbert-Shearon TE, Leavey SF, Port FK. Type of vascular access and mortality in U.S haemodialysis patients. Kidney Int 2001;60:1443-51.
50. Krzanowski M, Janda K, Chowaniec E, Sulowicz W. Haemodialysis vascular access infection and mortality in maintenance haemodialysis patients. Przegl Lek 2011;68:1157-61.
51. Bamgboye EL. Haemodialysis: management problems in developing countries, with Nigeria as a surrogate. Kidney Int Suppl. 2003;(83):S93-5.
52. Arogundade FA, Esezobor CI, Okafor HU, Abdu A, Balogun RA, Effa EE, et al. Nephrology in Nigeria. In: Moura-Neto JA, Divino-Filho JC, Ronco C (Eds.). Nephrology Worldwide. Cham: Springer International Publishing; 2021. Pp. 41-54.
53. Liman HM, Sakajiki AM, Makusidi MA, Isah IB, Ahmed FU, et al. Public-private partnership in haemodialysis in Nigeria: a comparative analysis of renal centers across three Northwestern states. Ann Afr Med. 2021;20(2):121-6
54. Ajayi S, Raji Y, Bello T, Jinadu L, Salako B. Unaffordability of renal replacement therapy in Nigeria. Hong Kong J Nephrol. 2016;18:15-9.
55. Eknoyan G, Lameire N, Barsoum R, Eckardt KU, Levin A, Locatelli F, MacLeod A, Vanholder R, Walker R, Wang H. (2004). The burden of kidney disease: Improving global outcomes. Kidney International, 66(4), 1310-1314. https://doi.org/10.1038/s41581-020-0315-4.x
56. Collins AJ, Foley RN, Gilbertson DT, Chen SC. (2015). United States Renal Data System Public Health Surveillance of chronic kidney disease and end-stage renal disease. In Kidney International Supplements (Vol. 5, Issue 1, pp. 2-7). https://doi.org/10.1038/kisup. 2015.2
57. Okafor UH. Kidney transplant in Nigeria: a single centre experience. Pan Afr Med J. 2016;25:112.
58. Okafor UH. Transplant tourism among kidney transplant patients in Eastern Nigeria. BMC Nephrol. 2017;18(1):215.
59. Arogundade FA. Kidney transplantation in a low-resource setting: Nigeria experience. Kidney Int Suppl (2011). 2013;3(2):241-5.