Original Article

A Prospective Study on the Burden of Renal Replacement Therapy and Pattern of Comorbidities among Chronic Kidney Disease Patients in Clinical Practice

Abstract

Background: The high rate of renal replacement therapy, respective clinical staging, and pattern of associated specific comorbidities/complications among chronic kidney disease (CKD) patients can influence and predispose them to increase morbidity, mortality, and health-care cost. In addition, there could also be a prolongation in the length of hospital stay and recurrent frequency of hospitalization. **Aim:** This study was predominantly designed to highlight and create awareness concerning the burden of renal replacement therapy and pattern of associated specific comorbidities/complications among CKD patients in renal practice. **Materials and Methods:** This was a descriptive, prospective study of 18-month duration that was carried out to review the medical case records of consented adult CKD patients attending a Nigerian Tertiary Kidney Care Hospital from January 2015 to June 2016. **Results:** This study involved 123 consented adult CKD patients made up of 82 (66.67%) males and 41 (33.33%) females with a mean age of 53.81 ± 16.03 years. Eighty-six (69.9%) of the patients were in CKD Stage 5, 15 (12.2%) were in CKD Stage 4, 19 (15.5%) were in CKD Stage 3, 2 (1.6%) in CKD Stage 2, and the remaining one (0.8%) in CKD Stage 1. Regarding the form of nephrological interventions offered, majority of the respondents, i.e. 66 (53.66%) were on maintenance dialysis, followed by 53 (43.09%) on conservative care, while 4 (3.25%) were on renal graft transplant. Among these CKD patients, the prevalence of renal replacement therapy was 56.91%. Most proportion of the respondents 45 (36.59%), were having two number of comorbidities with hypertension 103 (83.70%), diabetes mellitus 39 (31.70%), obesity 24 (19.51%), heart failure 11 (8.90%), obstructive uropathy 8 (6.50%), human immunodeficiency virus (HIV) infection 7 (5.70%), and stroke 5 (4.10%) being the most frequent. **Conclusion:** The prevalence rates for renal replacement therapy, hypertension, diabetes mellitus, and obesity were significantly high among these CKD patients. In this study, the high rate of renal replacement therapy, respective clinical staging, and pattern of associated specific comorbidities/complications among these CKD patients may significantly increase the risk of morbidity, mortality, recurrent frequency of hospitalization, length of hospital admission, and health-care costs.

Keywords: *Chronic kidney disease, pattern of associated specific comorbidities and complications, renal replacement therapy*

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Introduction

Renal replacement therapy (RRT) is a therapy that replaces the normal blood-filtering functional capacity of the kidneys. It is used when the kidneys are not working well, which is called renal failure and includes acute kidney injury (AKI) and chronic kidney disease (CKD). Renal replacement therapy (RRT) includes dialysis (hemodialysis or peritoneal dialysis), hemofiltration, and hemodiafiltration, which are various ways of blood filtration with or without machines.[1,2] Renal replacement therapy (RRT) also includes kidney graft transplantation, which is the ultimate form of renal replacement when a permanently nonfunctional diseased kidney is replaced by an optimally functional healthy donor kidney.[2] These treatments do not offer complete cure for End stage renal disease (ESRD) in the actual medical context. In the context of chronic kidney disease (CKD), they are more accurately viewed as life-extending treatments, although if chronic kidney disease (CKD) is managed well with dialysis and a compatible renal graft is found early with accompanied successful renal transplantation, the clinical course can be quite favourable, with extended quality of life expectancy of many prolonged years.

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Likewise, in certain acute illnesses or trauma resulting in acute kidney injury (AKI), a person could very well survive for many years, with relatively good kidney function, before needing nephrological intervention procedure again, as long as they had good response to dialysis, they got a kidney transplant quite quickly if needed, their body did not reject the transplanted kidney, and they had no other significant health problems. Early dialysis (and, if indicated, early renal transplant) in acute renal failure patient usually brings more favourable outcomes.[3]

Hemodialysis, hemofiltration, and hemodiafiltration can be continuous or intermittent in nature and can also make of use an arteriovenous route (in which blood leaves from an artery and returns via a vein) or a venovenous route (in which blood leaves from a vein and returns via a vein). This results in various types of renal replacement therapy (RRT) which can either be continuous renal replacement therapy (CRRT) or intermittent renal replacement therapy (IRRT). The continuous renal replacement therapy (CRRT) that are available in clinical practice include:[4-6]

- Continuous hemodialysis (CHD) such as continuous arteriovenous hemodialysis (CAVHD) and continuous venovenous hemodialysis (CVVHD).
- Continuous hemofiltration (CHF) such as continuous arteriovenous hemofiltration (CAVH or CAVHF) and continuous venovenous hemofiltration (CVVH or CVVHF).
- Continuous hemodiafiltration (CHDF) such as continuous arteriovenous hemodiafiltration (CAVHDF) and continuous venovenous hemodiafiltration (CVVHDF).

Furthermore, the intermittent renal replacement therapy (IRRT) that are available in clinical practice include:[4-6]

- Intermittent hemodialysis (IHD) such as intermittent venovenous hemodialysis (IVVHD).
- Intermittent hemofiltration (IHF) such as intermittent venovenous hemofiltration (IVVH or IVVHF).
- Intermittent hemodiafiltration (IHDF) such as intermittent venovenous hemodiafiltration (IVVHDF).

Peritoneal dialysis (PD) available in renal practice include continuous ambulatory peritoneal dialysis (CAPD) and intermittent ambulatory peritoneal dialysis (IAPD).

Kidney transplantation or renal transplantation is the organ transplant of a kidney into a patient with End stage renal disease (ESRD). Kidney transplantation is typically classified as deceased-donor transplantation (formerly known as cadaveric transplantation) or living-donor transplantation depending on the source of the donor organ. The living-donor renal transplants are further characterized as genetically related (living-related) or genetically non-related (living-unrelated) transplants, depending on whether a biological relationship exists between the donor and recipient.[5] The indication for kidney transplantation is End stage renal disease (ESRD), regardless of the primary cause. This is defined using an estimated glomerular filtration rate (eGFR) < 15 mL/min/1.73 m² with obvious clinical manifestations and laboratory features of terminal/permanent/irreversible renal impairment. Common diseases leading to End stage renal disease (ESRD) include malignant/accelerated hypertension, severe septicemia, poorly controlled chronic diabetes mellitus, HIV-associated nephropathy, and focal segmental glomerulosclerosis; genetic causes include polycystic kidney disease, a number of inborn errors of metabolism, and autoimmune conditions such as systemic lupus erythematosus (SLE).[6] Diabetes is the most common known cause of kidney transplantation, accounting for approximately 25% of those in the United States (US). The majority of renal transplant recipients are on dialysis (peritoneal dialysis or hemodialysis) at the time of transplantation. However, individuals with chronic kidney disease (CKD) who have a living donor available may undergo pre-emptive transplantation before dialysis is needed. If a patient is put on the waiting list for a deceased donor transplant early enough, they may also be transplanted pre-dialysis. Since medication to prevent rejection is so effective, donors do not need to be similar to their recipient. Most donated kidneys come from deceased donors; however, the utilisation of living donors in Nigeria and worldwide is on the rise. Available data revealed that during the year 2006 in the United States (US), 47% of donated kidneys were from living donors. This varies by country; for example, only 3% of kidneys transplanted during 2006 in Spain came from living donors. In Spain, all citizens are potential organ donors in the case of their death, unless they explicitly opt out during their lifetime.[7] Approximately one in three donations in the United States (US), United Kingdom (UK), and Israel is now from a live donor.[7,8] Potential donors are carefully evaluated on medical and psychological grounds. This ensures that the donor is fit for surgery and has no disease which can brings undue risk or likelihood of a poor outcome for either the donor or recipient. The psychological assessment is to ensure the donor gives informed consent and is not coerced.[8] In countries where paying for organs is illegal, the authorities may also seek to ensure that a donation has not resulted from a financial transaction. In addition, the relationship that donor has to the recipient has evolved over the years. In the 1950s, the first successful living donor transplants were between identical twins. In the 1960s to 1970s, live donors were genetically related to the recipient. However, during the 1980s to 1990s, the donor pool was expanded further to emotionally related individuals (spouses, friends). Now the elasticity of the donor relationship has been stretched to include acquaintances and even strangers (also being referred to as 'altruistic donors').[9,10] The acceptance of altruistic donors has enabled chains of transplants to form. Kidney chains are initiated when an altruistic donor donates a kidney to a patient who has a willing but incompatible donor. This incompatible donor then 'pays it forward' and passes on the generosity to another recipient who also had a willing but

incompatible donor. Michael Rees from the University of Toledo developed the concept of open-ended chains. This was a variation of a concept developed at Johns Hopkins University. On 30th July, 2008; an altruistic donor kidney was shipped via commercial airline from Cornell to the University of California, Los Angeles, thus triggering a chain of transplants. The shipment of living donor kidneys, computer-matching software algorithms, and cooperation between transplant centers has enabled long-elaborate chains to be formed.[9,10] In carefully screened kidney donors, survival and the risk of End stage renal disease (ESRD) appear to be similar to those in the general population. However, some more recent studies[1,2,5,6,7,11] suggest that lifelong risk of chronic kidney disease (CKD) is several-fold higher in kidney donors although the absolute risk is still very small.[11] A recent research published in 2017 also suggests that persons with only one kidney including those who have donated a kidney for transplantation should avoid high protein diet and limit their protein intake to less than one gram per kilogram body weight per day in order to reduce the long-term risk of chronic kidney disease. Furthermore, some studies[1,2,5,6,7,11] also showed that these women who had donated a kidney in the past had a higher risk of gestational hypertension and preeclampsia than matched nondonors with similar indicators of baseline health. Chronic kidney disease (CKD) can be defined as a progressive and irreversible deterioration in the renal function of an individual over a period of at least 3 months regardless of the underlying etiology.[1] In Nigeria and worldwide, poorly controlled chronic hypertension, poorly controlled chronic diabetes mellitus, and HIV-associated nephropathy among others are the common causes of CKD.[2,3] CKD is associated with rising incidence and prevalence, high cost of treatment, and poor outcomes. There is evidence to suggest that early in the course of CKD, appropriate interventions may slow down its progression or completely halt the progression of the disease. Despite this, many patients with CKD present late to the nephrologists, so that at the time of initial patient assessment, all that can be offered is preparation for renal replacement therapy. This is particularly so in resource-poor setting where among several other factors, the lack of awareness, traditional beliefs about the cause and nature of the disease, the need to pay out-of-pocket for health care, and shortage of specialists combine to promote inappropriate with poor health-care-seeking behavior and late presentation to the nephrologist.[4-6] Usually, in CKD, there is a progressive loss of kidney function occurring over several months to years and is characterized by the gradual replacement of normal kidney architecture with fibrous tissue. Individuals with disease can no longer adequately excrete waste products, regulate acid-base balance, and maintain sodium, potassium, and water homeostasis. There are other associated complications such as anemia, hyperkalemia, metabolic acidosis, inability to maintain calcium balance, erectile dysfunction, hyperphosphatemia, and increased cardiovascular disorders such as hypertension, stroke,

Table 1: Characteristics of the study population

Characteristics	Frequency (%)/mean±SD
Gender	
Male	83 (66.67)
Female	41 (33.33)
Mean age (years)	53.81±16.03
Age group (years)	
20-49	48 (39.0)
50-69	52 (42.3)
≥70	23 (18.7)
Level of education	
No formal education	16 (13.0)
Primary	18 (14.6)
Secondary	36 (29.3)
Tertiary	53 (43.1)
CKD stage	
1	1 (0.8)
2	2 (1.6)
3	19 (15.5)
4	15 (12.2)
5	86 (69.9)
Mean comorbidities (diseases)	2.33±1.09
Number of comorbidities (diseases)	
0	4 (3.52)
1	23 (18.70)
2	45 (36.59)
3	36 (29.27)
4	11 (8.94)
5	3 (2.44)
6	1 (0.8)
Specific comorbidities	
HTN	103 (83.70)
Diabetes mellitus	39 (31.70)
Obesity	24 (19.51)
Heart failure	11 (8.90)
Obstructive uropathy	8 (6.50)
HIV infection	7 (5.70)
Stroke	5 (4.10)
Adult polycystic kidney disease	5 (4.10)
HBV infection	5 (4.10)
Form of nephrological interventions	
Maintenance dialysis	66 (53.66)
Conservative care	53 (43.09)
Renal graft transplant	4 (3.25)
Mean BMI (kg/m^2)	25.71±5.09
BMI (kg/m^2)	
Underweight	5 (4.1)
Normal	55 (44.72)
Overweight	39 (31.71)
Mild (Grade 1) obesity	18 (14.63)
Moderate (Grade 2) obesity	5 (4.1)
Morbid (Grade 3) obesity	1 (0.8)

CKD: Chronic kidney disease, SD: Standard deviation, BMI: Body mass index, HIV: Human immunodeficiency virus, HBV: Hepatitis B virus, HTN: Hypertension

ischemic heart diseases, cardiac arrhythmias, and sudden cardiac arrest which lead to increase mortality. Patients with CKD *in vivo* Stages 1–3 (estimated glomerular filtration rate [eGFR] >30 mL/min/1.73 m²) are generally asymptomatic. Typically, it is not until Stages 4–5 (eGFR <30 mL/min/1.73 m²) that endocrine/metabolic derangements or disturbances in water or electrolyte balance become clinically manifest.[7-9] The early stages of CKD are often completely asymptomatic, despite the accumulation of numerous metabolites. Serum urea and creatinine concentrations are measured in CKD since methods for their determination are available, and a rough correlation exists between serum urea and creatinine concentrations and symptoms.[10-12] These substances are, however, in themselves not particularly toxic. The nature of the metabolites that are involved in the genesis of symptoms is unclear. Such metabolites must be products of protein catabolism (since dietary protein restriction may reverse symptoms associated with CKD), and many of them must be of relatively small molecular size (since hemodialysis employing membranes which allow through only relatively small molecules improves symptoms). Little else is known with certainty. Symptoms are common when the serum urea concentration exceeds 40 mmol/L, but many patients develop uremic symptoms at lower levels of serum urea.[13-15] Hypertension and diabetes mellitus are the most common causes of end-stage renal disease worldwide; therefore, control of high blood pressure (BP) and optimization of blood glucose level are essential in delaying and retarding CKD progression.[16-18] These necessitate the use of several medications to improve the quality of life of these patients and slow-down progression of early CKD to full-blown end-stage renal disease. Furthermore, as the disease progresses, the number of prescribed medications usually increases substantially; sometimes, up to 10 or more different drugs are ingested daily by the time a patient is at CKD Stage 5 (eGFR <15 ml/min/1.73 m²).[19-21] The influences of the disease on drugs' pharmacological effects can increase the risk for drug-related problems; these further compound the problems of patients with CKD and may also increase morbidity, mortality, frequency of hospitalization, length of hospital stay, and health-care cost among them.[22-24] CKD is a major public health problem due to its increasing incidence, prevalence, and associated high burden. The global prevalence of CKD is estimated to be 11%–13%.[11-14,25] The prevalence of CKD in Nigeria varied between 11.4% and 18.8% from both community- and hospital-based studies.[11-14,26] Cardiovascular disease burden in CKD patients is high and associated with increased frequency of hospitalization, morbidity, mortality, length of hospital stay, and health-care cost.[27-29] Cardiovascular risk factors such as hypertension, diabetes mellitus, anemia, calcium–phosphate abnormalities, hyperuricemia, and left ventricular hypertrophy are highly prevalent in CKD.[30,31] These are largely responsible for cardiovascular disease burden and some complications in CKD patients. Management of these cardiovascular diseases and risk factors is important in retarding progression of CKD and reducing mortality.[17,32]

This study was designed to unravel the prevalence of renal replacement therapy, respective clinical staging, and pattern

Table 2: Blood pressure severity category and blood pressure grading for the respondents

Table 2A: BP severity category

BP category	Severity	Frequency (%)
Combined systolic-diastolic HTN	Mild	15 (12.19)
	Moderate	23 (18.70)
	Severe	45 (36.59)
Isolated systolic HTN	Mild	9 (7.32)
	Moderate	7 (5.69)
	Severe	2 (1.6)
Isolated diastolic HTN	Mild	2 (1.6)
	Moderate	0 (0.00)
	Severe	0 (0.00)

Table 2B: BP grading (BHS/WHO classification)

BP category	Frequency (%)
Optimal	6 (4.88)
Normal	8 (6.50)
High normal	6 (4.88)
Mild HTN (Grade 1)	26 (21.14)
Moderate HTN (Grade 2)	30 (24.39)
Severe HTN (Grade 3)	47 (38.21)

Mean systolic BP=164.19±35.12 mmHg; Mean diastolic BP=95.73±19.08 mmHg. BP: Blood pressure, BHS: British Hypertension Society, WHO: World Health Organization, HTN: Hypertension

Table 3: Prevalence of renal replacement therapy and specific comorbidities among the chronic kidney disease population

Parameters	Prevalence (%)
Renal replacement therapy	56.91
HTN	83.70
Diabetes mellitus	31.70
Obesity	19.51
Heart failure	8.90
Obstructive uropathy	6.50
HIV infection	5.70
Stroke	4.10
Adult polycystic kidney disease	4.10
HBV infection	4.10

HIV: Human immunodeficiency virus, HBV: Hepatitis B virus, HTN: Hypertension

Table 4: Test for association between diabetes mellitus status and obesity status the for the study population

	Obesity present	Obesity absent
Diabetes mellitus present	16	23
Diabetes mellitus absent	8	76

χ^2=16.83, df=1, P<0·0001 (significant), critical value=3.841, α=0·05

of associated specific comorbidities/complications among CKD patients attending the nephrology clinic of a Nigerian Tertiary Kidney Care Hospital. This will create awareness on the burden of renal replacement therapy and pattern of associated specific comorbidities/complications among CKD patients in renal practice. In addition, it will also highlight the need to appropriately manage these associated comorbid conditions and/or complications in order to retard the disease progression to full-blown end-stage renal disease (ESRD).

Materials and Methods

This was a descriptive, prospective study carried out at the nephrology clinic of a Tertiary Kidney Care Hospital, University of Medical Sciences, Ondo City, Ondo State, Nigeria, Sub-Saharan West Africa. It receives referral from within and outside the state. One hundred and twenty-three consented adult CKD patients who were being managed at the center over a period of 18-month duration between January 2015 and June 2016 were recruited for the study. Patients below the age of 18 years, those being managed for acute kidney injury (AKI), and adult CKD patients who did not grant their informed consent were excluded from the study. The medical case records of all the adult CKD patients were retrieved after a verbal informed consent has been obtained from each of them, and the following information were extracted using a pro forma: sociodemographic data, BP, body weight, height, stage of CKD, and number and list of comorbidities including hypertension, diabetes mellitus, obesity, heart failure, HIV infection, and stroke. In this study, CKD was defined as a progressive and irreversible deterioration in the renal function of an individual over a period of at least 3 months regardless and irrespective of the underlying etiology.[1] The serum creatinine level was used to calculate eGFR using the CKD epidemiology collaboration (CKD-EPI) formula, and CKD staging was done using eGFR based on the National Kidney Foundation-Kidney Disease Outcome Quality Initiative (NKF-KDOQI) guideline as follows: Stage 1 (eGFR of ≥90 ml/min with evidence of kidney damage), Stage 2 (eGFR of 60–89 ml/min with or without evidence of kidney damage), Stage 3 (eGFR of 30–59 ml/min with or without evidence of kidney damage), Stage 4 (eGFR of 15–29 ml/min with or without evidence of kidney damage), and Stage 5 (eGFR <15 ml/min with or without evidence of kidney damage).[27] The British Hypertension Society-World Health Organization (BHS-WHO) guideline criteria were used for the classification category and severity grading of BP in this study. Furthermore, the prevalence rate for renal replacement therapy among these CKD patients was calculated by dividing the total number of patients on renal replacement therapy (that is, those on maintenance hemodialysis and renal graft transplant) by the total number of patients that participated in the study (sample size), while the prevalence rate for individual specific comorbidity among these CKD patients was obtained by dividing the total number of patients having the particular specified comorbidity by the total number of patients that participated in the study (sample size). Data collected were encoded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 17 (released 2008; SPSS Inc., Chicago, Illinois, USA). Results were expressed as mean ± standard deviation or using frequency and percentage values where necessary. The *t*-test and Chi-square test were used to compare means and proportions, respectively. The level of statistical significance was set at $P < 0.05$. Ethical clearance was obtained from the Health Research Ethical Committee of the Tertiary Kidney Care Hospital Ondo about the study. The Ethical Clearance/Protocol Research Number issued for the study was UNIMED/KCCO/NOV 2014/0007. In addition, a verbal informed consent was obtained from each of the adult CKD patients whose medical case records were used, while the medical case records for those who did not grant their informed consent were excluded from the study. Consent was sought from patients' relative where a patient had impaired level of consciousness. Participants' confidentiality was respected and maintained by ensuring that no unauthorized person has access to the information on the questionnaires, that no information can be traced to the respondents (as coding system was used for the questionnaires instead of writing the patients' names on them) and no unauthorized use of information was made.

Results

This study involved 123 consented adult CKD patients, made up of 82 (66.67%) males and 41 (33.33%) females. The mean age of the study participants was 53.81 ± 16.03 years. Forty-eight (39.0%) were between 18 and 49 years, 52 (42.3%) were between 50 and 69 years, and the remaining 23 (18.7%) were 70 years and above [Table 1].

Fifty-three (43.09%) of the study participants had tertiary education, 36 (29.3%) had secondary education, 18 (14.6%) had primary education, while 16 (13.0%) had no formal education. Eighty-six (69.9%) of the study participants were in CKD Stage 5, 15 (12.2%) were in CKD Stage 4, 19 (15.5%) were in CKD Stage 3, 2 (1.6%) in CKD Stage 2, and the remaining one (0.8%) in CKD Stage 1 [Table 1].

Regarding the form of nephrological interventions offered, majority of the respondents, i.e. 66 (53.66%) were on maintenance dialysis, followed by 53 (43.09%) on conservative care, while 4 (3.25%) were on renal graft transplant [Table 1].

In this study, the range for number of associated comorbidities was 0–6 diseases with a mean of 2.33 ± 1.09 diseases per patient. The most proportion of the respondents, i.e., 45 (36.59%) had 2 comorbidities, followed by 36 (29.27%) with 3 comorbidities, 23 (18.70%) had only one comorbidity, while 11 (8.94%)

had 4 comorbidities [Table 1]. The most common specific comorbidities were hypertension in 103 (83.70%), diabetes mellitus in 39 (31.70%), obesity in 24 (19.51%), heart failure in 11 (8.9%), obstructive uropathy in 8 (6.5%), HIV in 7 (5.7%), and stroke in 5 (4.1%) [Table 1].

Their mean body mass index (BMI) was 25.71 ± 5.09 kg/m^2; 55 (44.72%) had normal BMI (18.50–24.99 kg/m^2), followed by 39 (31.71%) with overweight BMI (25.00–29.99 kg/m^2), 18 (14.63%) had mild/Grade 1 obesity (30.00–34.99 kg/m^2), and 5 (4.1%) each were having moderate/Grade 2 obesity (35.00–39.99 kg/m^2) and underweight (≤18.49 kg/m^2), respectively, while only one (0.8%) had morbid/Grade 3 obesity (≥40.00 kg/m^2) [Table 1].

The mean systolic BP of the respondents was 164.19 ± 35.12 mmHg, while their mean diastolic BP was 95.73 ± 19.08 mmHg. Furthermore on BP severity category, 83 (67.48%) had combined systolic–diastolic hypertension, followed by 18 (14.63%) with isolated systolic hypertension, while 2 (1.6%) had isolated diastolic hypertension [Table 2A]. According to the BHS/WHO classification of BP grading, most proportions of the respondents, that is, 47 (38.21%) had severe (Grade 3) hypertension, followed by 30 (24.39%) with moderate (Grade 2) hypertension, 26 (21.14%) had mild (Grade 1) hypertension, 8 (6.50%) had normal BP, while 6 (4.88%) each had optimal BP and high normal BP, respectively [Table 2B].

Among these CKD patients, the prevalence rate for renal replacement therapy was 56.91%, while the prevalence rates for the most common specific comorbidities such as hypertension, diabetes mellitus, obesity, heart failure, obstructive uropathy, HIV infection, and stroke were 83.70%, 31.70%, 19.51%, 8.90%, 6.50%, 5.70%, and 4.10%, respectively [Table 3].

In addition, among these CKD patients recruited for this study, there was also a statistically significant association between those with diabetes mellitus and obesity with $P < 0.0001$. This implies that those patients with obesity are highly predisposed and at risk of developing diabetes mellitus [Table 4].

Discussion

The prevalence of renal replacement therapy in this study was 56.91% which was higher than the report by Marquito *et al*.[20] (6.63%) but lower than the prevalence value reported by Rama *et al*.[17] (68.48%). This showed that about 57 patients out of every 100 diagnosed CKD patients recruited for this study were on renal replacement therapy. This disparity can be attributed to the fact that most respondents in this study were ESRD/CKD Stage 5 as opposed to pre-ESRD CKD Stages 1, 2, 3, and 4 in the Marquito *et al*. study.[20]

Concerning the CKD staging and eGFR, this study where majority of the participants, i.e., 86 (69.92%) belonged to CKD Stage 5 agreed with the Rama *et al*. (2012) study[17] where 113 (68.48%) belonged to CKD Stage 5 but disagreed with the Marquito *et al*. study[20] in which most respondents, i.e., 265 (47.5%) belonged to CKD Stage 3. This disparity can be attributed to the different variations in the serum creatinine levels of the respondents which were used to calculate their eGFRs.

Furthermore, on the form of nephrological interventions offered in this study, majority of the respondents were on maintenance dialysis 66 (53.66%) in contrast to the Marquito *et al*.[20] study where most of the respondents, i.e., 521 (93.37%) were on conservative care. Once again, this disparity can be attributed to the fact that most respondents in this study were ESRD/CKD Stage 5 as opposed to pre-ESRD CKD Stages 1, 2, 3, and 4 in the Marquito *et al*.[20] study.

The most common comorbidities in this study were hypertension and diabetes which agreed with the previous studies conducted by Sgnaolin *et al*.[16] and Marquito *et al*.[20] This can be attributed to the fact that both conditions are the leading etiologies of CKD in Nigeria, Sub-Saharan West Africa region, and worldwide. Therefore, adequate control of high BP with antihypertensives and regular optimization of blood glucose level with antidiabetics are essential in delaying and retarding CKD progression to full-blown ESRD and reducing associated complications, mortality, health-care cost, duration of hospital admission, and recurrent frequency of hospitalizations.[10]

Concerning BMI status, the study conducted by Marquito *et al*.[20] in which majority of the respondents, i.e., 372 (66.7%) were either overweight or obese also agreed with our study in which 68 (55.28%) were either overweight or obese. This increased BMI (overweight or obesity) had a positive correlation with the increasing prevalence of acquired CKD in this study as a risk factor.

In this study, the occurrence of end-stage renal dysfunction signs and symptoms (clinical features), elevated serum urea and creatinine levels, low eGFR, and multiple number of associated specific comorbidities/complications per patient were found to be the major determinants of prevalence rate for renal replacement therapy among these CKD patients.

Regarding sex distribution, our study was similar to the study conducted by Marquito *et al*., 2014[20] on CKD patients at the NIEPEN Federal University of Juiz de Fora, Brazil, where majority of the respondents, i.e., 305 (54.7%) were males. This showed that CKD was more predominant among males which can be attributed to their rugged lifestyles such as indulgence in chronic smoking, chronic alcohol consumption, poor nutritional feeding habit, inadequate exercise, multiple sexual partners, and poor health-care-seeking behavior. On the other hand, our study disagreed with the one conducted by Sgnaolin *et al*., 2014,[16] in a hospital hemodialysis unit in Brazil where 65 patients were included in the study with a mean age of 59.1 ± 14.7 years and 33 (50.8%) were women.

Furthermore, among these CKD patients recruited for this study, there was also a statistically significant association between those with diabetes mellitus and obesity with $P < 0.0001$. This implies that those patients with obesity are highly predisposed and at risk of developing diabetes mellitus.

Regarding risk factors that affect/influence the prevalence of renal replacement therapy and form of nephrological intervention offered in this study, we found out that multiple number of associated specific comorbidities/complications per patient (such as hypertension, diabetes mellitus, obesity/overweight, heart failure, obstructive uropathy, HIV infection, stroke, Adult polycystic kidney disease, HBV infection, and anemia), increasing age (elderly), low eGFR, and clinically symptomatic elevated serum urea and creatinine levels ($P < 0.05$ for all) were risk factors associated with and predisposed CKD patients to renal replacement therapy.

This study has brought to limelight the magnitude and burden of renal replacement therapy with the pattern of associated specific comorbidities/complications among CKD patients in clinical practice. The strength and limitation of this study was that it considered only consented adult medical patients with CKD who were above the age of 17 years. There was exclusion of pediatric renal patients and adult CKD patients who did not grant their informed consent and those with AKI from the study. The number of adult CKD patients who did not grant their informed consent and therefore declined from participating in the study was very small and statistically insignificant (about 3 patients).

Conclusion

The prevalence rates for renal replacement therapy, hypertension, diabetes mellitus, and obesity were significantly high among these CKD patients. In this study, the high rate of renal replacement therapy, respective clinical staging, and pattern of associated specific comorbidities/complications among these CKD patients may significantly increase the risk of morbidity, mortality, health-care costs, length of hospital admission, and recurrent frequency of hospitalization. A cordial integrated relationship between health-care professionals (nephrologists/physicians, nephrology nurses, laboratory scientists, and clinical pharmacists) should be encouraged to optimize CKD patients' care. Regular organization of health education awareness programs on the prevention of CKD and its associated comorbidities or complications among the general public should be done by health-care professionals coupled with adequate support from both governmental agencies and nongovernmental organizations.

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Conflicts of interest

There are no conflicts of interest.

References

1. Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, *et al.* Global prevalence of chronic kidney disease – A systematic review and meta-analysis. PLoS One 2016;11:e0158765.
2. Odubanjo MO, Oluwasola AO, Kadiri S. The epidemiology of end-stage renal disease in Nigeria: The way forward. Int Urol Nephrol 2011;43:785-92.
3. Victoria M, Matteo C, Marco T, Erica G, Roberta C, Speranza R. Polypharmacy in kidney disease patients. Curr Kidney Dis 2014;11:212-9.
4. Akinsola W, Odesanmi WO, Ogunniyi JO, Ladipo GO. Diseases causing chronic renal failure in Nigerians – A prospective study of 100 cases. Afr J Med Med Sci 1989;18:131-7.
5. Ulasi II, Ijoma CK, Onodugo OD, Arodiwe EB, Ifebunandu NA, Okoye JU. Towards prevention of chronic kidney disease in Nigeria: A community-based study in Southeast Nigeria. Kidney Int Suppl 2013;3:195-201.
6. Oluyombo R, Ayodele OE, Akinwusi PO, Okunola OO, Akinsola A, Arogundade FA. A community study of the prevalence, risk factors and pattern of chronic kidney disease in Osun state, South West Nigeria. West Afr J Med 2013;32:85-92.
7. Liu M, Li XC, Lu L, Cao Y, Sun RR, Chen S, *et al.* Cardiovascular disease and its relationship with chronic kidney disease. Eur Rev Med Pharmacol Sci 2014;18:2918-26.
8. Levin A, Hemmelgarn B, Culleton B, Tobe S, McFarlane P, Ruzicka M, *et al.* Guidelines for the management of chronic kidney disease. CMAJ 2008;179:1154-62.
9. Alebiosu CO, Ayodele OE. The global burden of chronic kidney disease and the way forward. Ethn Dis 2005;15:418-23.
10. Riemer E, Werling E, Kribs M, Hamman De Compte A, Dimitrov Y. Medical prescriptions in haemodialysis patients: Critical analysis. Nephrol Ther 2005;1:234-40.
11. Babua C, Kalyesubula R, Okello E, Kakande B, Sebatta E, Mungoma M, *et al.* Cardiovascular risk factors among patients with chronic kidney disease attending a tertiary hospital in Uganda. Cardiovasc J Afr 2015;26:177-80.
12. Edwards IR, Aronson JK. Adverse drug reactions: Definitions, diagnosis, and management. Lancet 2000;356:1255-9.
13. Pirmohamed M, James S, Meakin S, Green C, Scott AK, Walley TJ, *et al.* Adverse drug reactions as cause of admission to hospital: Prospective analysis of 18 820 patients. BMJ 2004;329:15-9.
14. Manley HJ, Cannella CA, Bailie GR, St Peter WL. Medication-related problems in ambulatory hemodialysis patients: A pooled analysis. Am J Kidney Dis 2005;46:669-80.
15. Al-Hajje AH, Atoui F, Awada S, Rachidi S, Zein S, Salameh P, *et al.* Drug-related problems identified by clinical pharmacist's students and pharmacist's interventions. Ann Pharm Fr 2012;70:169-76.
16. Sgnaolin V, Sgnaolin V, Engroff P, De Carli A, Figueiredo AE. Assessment of used medications and drug-drug interactions

among chronic renal failure patients. Sci Med 2014; 24:329-35.
17. Rama M, Viswanathan G, Acharya LD, Attur RP, Reddy PN, Raghavan SV. Assessment of drug-drug interactions among renal failure patients of nephrology ward in a South Indian tertiary care hospital. Indian J Pharm Sci 2012;74:63-8.
18. Al-Ramahi R, Raddad AR, Rashed AO, Bsharat A, Abu-Ghazaleh D, Yasin E, *et al.* Evaluation of potential drug-drug interactions among Palestinian hemodialysis patients. BMC Nephrol 2016;17:96.
19. Flesch M, Erdmann E. The problem of polypharmacy in heart failure. Curr Cardiol Rep 2006;8:217-25.
20. Marquito AB, Fernandes NM, Colugnati FA, de Paula RB. Identifying potential drug interactions in chronic kidney disease patients. J Bras Nefrol 2014;36:26-34.
21. Hedge S, Udaykumar P, Manjuprasad MS. Potential drug interactions in chronic kidney disease patients. A cross-sectional study. Int J Recent Trends Sci Technol 2015;16:56-60.
22. Shad MU, Marsh C, Preskorn SH. The economic consequences of a drug-drug interaction. J Clin Psychopharmacol 2001;21:119-20.
23. Fernández-Llimós F, Tuneu L, Baena MI, Garcia-Delgado A, Faus MJ. Morbidity and mortality associated with pharmacotherapy. Evolution and current concept of drug-related problems. Curr Pharm Des 2004;10:3947-67.
24. Mason NA, Bakus JL. Strategies for reducing polypharmacy and other medication-related problems in chronic kidney disease. Semin Dial 2010;23:55-61.
25. Cardone KE, Bacchus S, Assimon MM, Pai AB, Manley HJ. Medication-related problems in CKD. Adv Chronic Kidney Dis 2010;17:404-12.
26. Manley HJ, Drayer DK, Muther RS. Medication-related problem type and appearance rate in ambulatory hemodialysis patients. BMC Nephrol 2003;4:10.
27. International Society of Nephrology. Kidney Disease Improving Global Outcome 2012. Clinical Practice Guideline for evaluation and management of CKD. Kidney Int Suppl 2013;3:1-150.
28. Manley HJ, McClaran ML, Overbay DK, Wright MA, Reid GM, Bender WL, *et al.* Factors associated with medication-related problems in ambulatory hemodialysis patients. Am J Kidney Dis 2003;41:386-93.
29. Eiam-Ong S, Sitprija V. Comorbidities in patients with end-stage renal disease in developing countries. Artif Organs 2002;26:753-6.
30. Kadiri S, Arije A. Temporal variations and meteorological factors in hospital admissions of chronic renal failure in South West Nigeria. West Afr J Med 1999;18:49-51.
31. Grabe DW, Low CL, Bailie GR, Eisele G. Evaluation of drug-related problems in an outpatient hemodialysis unit and the impact of a clinical pharmacist. Clin Nephrol 1997;47:117-21.
32. Mason NA. Polypharmacy and medication-related complications in the chronic kidney disease patient. Curr Opin Nephrol Hypertens 2011;20:492-7.