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RESEARCH ARTICLE

Compliance to Haemodialysis Regimen among End-stage Renal Disease Patients: A Case Study of three Selected Hospitals in Kwara State, Nigeria

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Abstract:

Aims:

The study investigated the determinants of compliance and outcomes of haemodialysis regimens among patients with end-stage renal disease (ESRD) in Ilorin, Kwara State.

Background:

Chronic kidney disease (CKD), also known as chronic kidney failure, is the persistent decline in glomerular filtration rate (GFR) for more than three months and it often progresses to (ESRD) with permanent loss of kidney function and increased mortality.

Objective:

The study investigated the determinants of compliance and outcomes of haemodialysis regimens among patients with ESRD in Ilorin, Kwara State.

Methods:

Total population and purposive sampling techniques were used to guide the recruitment of 80 participants. The research design was descriptive and cross-sectional research designs using quantitative strategy. Socio-demographic data and compliance level for haemodialysis regimen were determined using standardized questionnaire while biophysical measurements and laboratory investigations were used to determine treatment outcomes. Descriptive and inferential statistics were used for data analysis.

Results:

Findings from the study revealed that 66.3% of the participants were 41 years and above, 45% had up to tertiary education while 76.3% of the participants relied on family members for treatment funding. Regarding treatment compliance, 58.8% and 47.5% had moderate compliance to fluid and diet, respectively. Barriers to compliance were transportation logistics (50%), haemodialysis side effects with machine malfunction (52.2%), changes in lifestyle (50%) and cost (41.3%).

Conclusion:

Exorbitant nature of haemodialysis treatment militated against good outcomes. Thus, nephrology nurses and other healthcare professionals should intensify efforts to promote treatment adherence among patients with ESRD. Government and other policymakers could assist in subsidizing the cost of haemodialysis therapy to aid compliance and improve treatment outcomes. Thereby, promoting patients' quality of life with a reduction in mortality rate.

Keywords: Chronic kidney disease, Compliance difficulty, End-stage renal disease, Haemodialysis, Treatment compliance, Treatment outcomes.

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1. INTRODUCTION

Chronic kidney disease (CKD) is one of the leading public health challenges worldwide with adverse outcomes of kidney failure, cardiovascular disease, and premature death [1, 2]. Chronic kidney disease is also known as chronic kidney failure is a persistent abnormality in the anatomy and physiology of the kidney, characterized by a glomerular filtration rate (GFR) of < 60 mL/min/1.73 m^2, albuminuria of ≥ 30 mg/per 24 hours. Moreover, it can be diagnosed based on kidney damage

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markers like haematuria, polycystic, and dysplastic kidneys occurring for more than three months [3, 4]. It is a progressive and irrecoverable loss of kidney function that encompasses all degrees of decreased kidney function, from damaged to mild, moderate, and severe chronic kidney failure, which leads to death in the absence of intervention or intermittent renal replacement therapy [4].

Chronic kidney disease is categorized based on the degree of renal failure (as assessed by GFR), the presence or absence of structural kidney abnormalities, or other signs of chronic kidney damage, particularly albuminuria. It is divided into five GFR categories based on the degree of kidney dysfunction, ranging from stage 1 with normal or high GFR (90 ml/min/1.73 m2) to stage 5, also known as an end-stage renal disease (ESRD) or kidney failure, with a GFR of less than 15 ml/min/1.73 m2 [5]. Advanced CKD frequently leads to ESRD, which is a long-term decline of kidney function that results in a significant death rate [6]. Treatment of ESRD is known as renal replacement therapy, which includes all modalities of treatment such as haemodialysis, peritoneal dialysis, and kidney transplant is used to replace the waste filtering functions of a normal kidney [7 - 9]. Therefore, the adoption of renal replacement therapy in the care of ESRD has considerably reduced the morbidity of ESRD patients, resulting in improved quality of life. However, the therapy is costly and is not readily affordable and accessible by the patients [5, 10].

Although the best choice for managing kidney failure is renal transplant, the issues of limitation of resources and dearth of kidney donations have paved the way for haemodialysis as a more preferred modality for the management of ESRD patients [10, 11]. Adequate haemodialysis improves the quality of life of patients with ESRD and the success of the therapy highly depends on the patient's dedication alongside other treatment regimens that include fluid restriction, dietary guidelines, dialysis sessions and medication [12]. Non-compliance with haemodialysis regimens, depending on the definition (skipping haemodialysis sessions in a month, reducing haemodialysis period, and interdialytic weight gain (IWG) of more than 5.7% of dry weight, or a serum phosphate level higher than 7.5 mg/dL), occurs most frequently between 2% to more than 50% among ESRD patients undergoing haemodialysis [13 - 16]. Furthermore, it noted that factors such as age, cultural structure, cost of treatment, side effects associated with treatment, feelings that patients have about the treatment, social support resources, and illness perception affect the adherence and outcomes of haemodialysis among ESRD patients [17].

Haemodialysis appears to be the mainstay of treatment for ESRD patients in Nigeria and it has been associated with non-compliance, thus affecting treatment outcomes. A non-adherence rate of 7% to over 50% was reported globally [13]. This study therefore aims at investigating the determinants of compliance and outcomes of haemodialysis regimens among end-stage renal disease patients in Ilorin, Kwara State, Nigeria.

2. MATERIALS AND METHODS

2.1. Research Design and Setting

The study design was descriptive and cross-sectional, using a quantitative strategy. This study was conducted in three selected renal facilities in Kwara State, Nigeria. The facilities are private-owned health institutions that specialise in the management of ESRD patients and offer haemodialysis.

2.2. Target Population, Sample Size and Sampling Technique

The target population included ESRD patients in the selected facilities. According to the hospitals' monthly admission records, total 90 patients with ESRD were recorded.

Total population and purposive sampling technique were used to guide the recruitment of 80 participants. Criteria for inclusion in the study were being an ESRD patient on haemodialysis treatment for at least twice a week with a minimum of 3 hours per session; must be on haemodialysis for at least three months before the study and be willing to participate in the study.

Appointment was booked for participants through the personnel in the renal unit of the selected facilities. To confirm participants' availability, physical visits and follow-up phone calls were conducted. Interviews were conducted at prearranged times at the hospital and participants were recruited from December 2021 to February 2022.

2.3. Instrument and Data Collection

The instrument used for data collection was an adapted questionnaire from similar studies [18 - 20]. The questionnaire consisted of five sections (A-E) with 84 items in accordance with the objectives of the study. Section A was for the participants' socio-demographic data, while Section B focused on information on patient haemodialysis history.

Section C addressed haemodialysis compliance (medication, Fluid diet and haemodialysis treatment). Medication was assessed using 12 points 'yes' or 'no' questions with a total mark of 12. Participants who scored between 0-5 had poor compliance, 6-8 had moderate compliance, and 9-12 had good compliance. Fluid diet and haemodialysis treatment were assessed in sections with 6, 5 and 7 Likert scale questions, respectively. The total score for fluid restriction was 24, with 6-11 poor compliance, 12-17 moderate compliance, and 18-24 good compliance to fluid restriction. Diet had a total of 20 items with 5-9 poor compliance, 10-14 moderate compliance, and 15-20 good compliance with diet regulation. Haemodialysis treatment had a total of 28 items, with 7-13 poor compliance, 14-20 moderate compliance, and 21-28 good compliance with dietary regulation.

Section D focused on compliance factors with 14 questions and a total range of 56 scores with 14-27 little difficulties, 28-41 moderate difficulties, and 42-56 a lot of difficulty. The final Section (E) focused on biophysical measurements.

2.4. Physical Measurements

2.4.1. Anthropometric Measurements

The participants' weight was measured using an analog flat weighing scale. The weighing scale was placed on a hard and leveled surface and it was ensured to be on zero before each

use. The subjects stood on the centre of the scale with their body weight equally distributed between both feet. Weight was then measured and recorded in kilograms to the nearest 0.1 kilograms. Interdialytic weight gain was calculated as the patient's weight at the commencement of each haemodialysis minus the weight after the previous haemodialysis session divided by dry weight. Interdialytic weight gain is a means of measuring haemodialysis compliance.

Interdialytic weight =Pre-dialysis weight – post-dialysis weight ÷dry weight × 100

2.4.2. Blood Pressure Measurements

Blood pressure was measured with the patient in the sitting position using a well-calibrated mercury sphygmomanometer. The arm to be measured was supported at the level of the heart by resting it on the consultation table after the patient might have rested for 5 minutes. An appropriately sized cuff was used and intermittent blood pressure readings were taken on a monitor during haemodialysis to note any deviation.

2.4.2.1. Number of Dialysis Attendance

Patients' record of attendance to dialysis sessions was taken to note compliance with dialysis schedules.

2.5. Laboratory Investigations

2.5.1. Serum Creatinine

About 4cc of venous blood was collected for serum creatinine into lithium heparin sample bottles by one of the research assistants, a medical laboratory scientist. The blood samples were then taken to the laboratory immediately after each day's collection and then centrifuged to separate the plasma and were then stored at 4^{o}C until they were analyzed in batches of 50 samples per time.

The serum creatinine values were determined by Jaffe's method, which was done by mixing the serum with alkaline picrate and was read at 520nm using the spectrophotometer machine by biotech following the manufacturer's protocol.

2.5.2. Serum Phosphate

Venous blood of about 3cc was collected in test tubes containing lithium/ ammonium, this method depends on the principle that phosphate reacts with acid ammonium molybdate of phosphomolybdic acid to form phospho-molybdate which then reacts with malachite green (reducing agent) to give a green colour.

2.5.3. Serum Albumin

Known volume (3.0 ml) of 0.15 mmol/lBCG reagent (in 75 mmol/l; pH 4.2 succinate buffer) was added to the test tubes containing 0.01 ml of serum. The blank and standard were constituted by replacing the serum with 0.01 ml of distilled water and albumin standard, respectively. The solution was incubated at 37° C for 10 minutes.

2.5.4. Urea Reduction Ratio

The urea reduction ratio is used to monitor the efficiency of dialysis, and whether the dialysis session was able to clear the waste products from the body.

Urea reduction ration = urea pre-dialysis -urea post/urea pre-dialysis × 100

2.6. Methods of Data Analysis

Data were analysed using descriptive and inferential statistics. Descriptive data were presented as frequencies and means, while chi-square and logistic regression were used to test for relationships. All statistical analyses were carried out at a probability level of 0.05.

2.7. Ethical Consideration

Ethical approval for the study was obtained from the research ethics committee of the State Ministry of Health, Kwara State, Nigeria, with approval number GHI/ADM/134/VOL.II/399.

All subjects in this study were assigned unique code numbers in place of their names. Information collected was not associated with participants in any way and their names or identifiers were not used in any publication or report from this study. In addition, an informed consent form was designed and given to the participants to fill or assisted to fill after due explanation and adequate information had been provided to them on the process, purposes and objectives of the study. The consent form was written in a simple language that was understood by any literate individual. The researcher explained in a local dialect to the participants who could not read or write.

3. RESULTS

3.1. Socio-demographic and Haemodialysis History of the Participants

As shown in Table **1**, socio-demographic characteristics of the participants revealed that 66.3% were above the age of 41 years, 57.5% of them were male, and 70.0% were married. In addition, 57.5% and 43.3 of the participants were Muslims and Christians, respectively. Over 73% of the participants had their haemodialysis funded by family members, while 25% were earning less than 30,000 Nigerian Naira (less than a hundred dollars).

In the case of haemodialysis history, 46.3% of the study participants had an initial treatment less than 1 year ago, while more than half (63.8%) indicated that they did not restart their treatment. A total of 53.8% of the participants underwent haemodialysis 2 days on a weekly basis, while 42.5% had 4 hours of treatment per session. Only 27.5% of the participants had not defaulted in their haemodialysis session during the last month (Table **2**).

Table 1. Demographic characteristics of the respondents.

Age (years)	**Variables**	**Frequency**	**%**
	< 20	6	7.5
	21 -40	21	26.3
	41 -60	29	36.3
	> 60	24	30
Gender	Male	46	57.5
	Female	34	42.5
Ethnicity	Yoruba	59	73.8
	Igbo	10	12.5
	Hausa	7	8.8
	Others	4	5.0
Religion	Islam	46	57.5
	Christianity	33	41.3
	Traditional	1	1.3
Marita Status	Single/Never married	10	12.5
	Married	56	70.0
	Divorced	4	5.0
	Widowed	10	12.5
Level of education	No formal education	4	5.0
	Primary school	9	11.3
	Secondary school	31	38.8
	Higher education	36	45.0
Occupation	Trading/business	36	45.0
	Skilled artisan	9	11.3
	Civil servant	17	21.3
	Student	6	7.5
	Unemployed	12	15.0
Source of funding	Self	15	18.8
	Family member	61	76.3
	Insurance	2	2.5
	Government	2	2.5
Number of dependants	None	23	28.8
	1 – 2	18	22.5
	3 – 4	31	38.8
	≥ 5	8	10.0
Monthly income (Naira)	None	2	2.5
	< 30, 000	20	25.0
	31,000 – 60, 000	14	17.5
	61,000 – 100,000	22	27.5
	≥ 101,000	22	27.5

Table 2. Haemodialysis history of the respondents.

Items	**-**	**Frequency**	**%**
Onset of haemodialysis treatment	< 1 year	37	46.3
	1-2years	32	40.0
	3-4years	7	8.8
	> 4 years	4	5.0
Restarting of haemodialysis treatment	< 1 year	28	35.0
	1-2 years	1	1.3
	Not applicable	51	63.8

(Table 2) contd.....

Items	-	Frequency	%
Days of weekly haemodialysis treatment	< 2 days	11	13.8
	2 days	43	53.8
	3 days	26	32.5
Hours of treatment per session	<3 hours	11	13.8
	3 hours	26	32.5
	3½ hours	9	11.3
	4 hours	34	42.5
Treatment default rate	None	22	27.5
	1	23	28.8
	2	15	18.8
	> 2	20	25.0
Number of shortened treatments	Not applicable	48	60.0
	Once	18	22.5
	Twice	11	13.8
	Others	3	3.8
Duration of shortened treatment	Not applicable	48	60.0
	≤10 minutes or 10 minutes	11	13.8
	11 to 20 minutes	15	18.8
	>20 minutes	6	7.5

Biophysical characteristics of the respondents revealed that, on average, 80% and 38% of their systolic and diastolic blood pressure were in the abnormal ranges, respectively. Moreover, 16.3% and 52.5% had their serum potassium and serum phosphorus levels to be in abnormal levels. All participants had their pre and post-dialysis creatinine levels outside the normal ranges, while 90% had normal levels of serum albumin (Table **3**).

3.2. Participants' Treatment Compliance and Compliance Difficult

Treatment compliance of the participants revealed that 3.8%, 58.8%, and 37.5% had poor, moderate, and good compliance with fluid, respectively. In the case of diet compliance, 47.5% complied moderately, while 52.5% had good compliance. None of the participants had poor compliance with respect to haemodialysis, with 41.3% and 58.8% having moderate and good compliance, respectively. Apart from the number of shortened haemodialysis during the last month (X^2= 13.55, p= 0.004), none of the participants' socio-demographic characteristics and haemodialysis history showed a significant association with compliance level (Tables **4** and **5**).

In the case of compliance difficulty, 22.6%, 67.5%, and 10% had little difficulty, moderate difficulty, and lots of difficulty, respectively. Generally, among the participants' socio-demographic characteristics and only haemodialysis history (X^2= 12.95, p= 0.04) and hours of treatment for each haemodialysis schedule (X^2= 17.68, p= 0.007) were significantly associated with a compliance difficulty level (Tables **4** and **5**).

3.3. Participants' Serum Potassium, Phosphate, and Albumin Levels

The serum potassium level of the participants revealed that 84% had normal levels after haemodialysis. With respect to serum phosphate and albumin levels, 48% and 90% had normal levels, respectively. Generally, none of the participants' socio-demographic characteristics showed a significant association with either serum potassium, phosphate, or albumin levels (Table **6**).

Table 3. Biophysical measurements and treatment outcomes of the participants.

-	Mean	Normal	Abnormal
Systolic blood pressure level (mmHg)	146.46	16 (20.0)	64 (80.0)
Diastolic blood pressure level (mmHg)	91.68	42 (52.5)	38 (47.5)
Serum potassium level (mmol/L)	4.12	67 (83.8)	13 (16.3)
Serum phosphorus level (mmol/L)	3.57	38 (47.5)	42 (52.5)
Pre-dialysis creatinine level (mmol/L)	853.67	0	80 (100.0)
Post-dialysis creatinine level (mmol/L)	281.63	0	80 (100.0)
Serum Albumin level (mmol/L)	6.58	72 (90.0)	8 (10.0)

Note: Values in brackets represent % participants

Table 4. Association of respondents' socio-demographic profiles with treatment compliance and compliance difficulty levels.

Variable		Haemodialysis Compliance Levels					Compliance Difficulty Levels				
-		A	B	C	X^2	p	D	E	F	X^2	p
Age (in years)	< 20	0	2	4	6.24	0.10	2	4	0	6.48	0.37
	21-40	0	17	4			2	17	2		
	41-60	0	16	13			8	16	5		
	> 61	0	13	11			6	17	1		
Gender	Male	0	28	18	0.34	0.85	10	31	5	0.11	0.11
	Female	0	20	14			8	23	3		
Ethnicity	Yoruba	0	34	25	0.89	0.83	13	41	5	12.95	0.04
	Igbo	0	6	4			4	6	0		
	Hausa	0	5	2			1	4	0		
	Others	0	3	1			0	4	0		
Religion	Islam	0	29	17	1.76	0.42	9	33	4	1.57	0.81
	Christianity	0	19	14			9	20	4		
	Traditional	0	0	1			0	1	0		
Marital Status	Single/never married	0	6	4	2.02	0.57	2	8	0	5.07	0.54
	Married	0	32	24			14	35	7		
	Divorced	0	2	2			0	3	1		
	Widowed	0	8	2			2	8	0		
Level of Education	No formal education	0	3	1	4.34	0.23	0	4	0	8.10	0.23
	Primary school	0	8	1			2	7	0		
	Secondary school	0	18	13			5	20	6		
	Higher education	0	19	17			11	23	2		
Occupation	Trading/business	0	21	15	3.79	0.44	8	25	3	6.05	0.64
	Skilled/artisan	0	7	2			12	7	0		
	Civil servant	0	8	9			4	9	4		
	Student	0	3	3			2	4	0		
	Unemployment	0	9	3			2	9	1		
Monthly income (Naira)	< 30,000	0	13	7	3.71	0.59	3	15	2	12.12	0.28
	31,000-60,000	0	9	5			6	7	1		
	61,000-100,000	0	14	8			2	16	4		
	> 100,000	0	12	10			6	15	1		
	None	0	1	1			0	2	0		
% Treatment compliance level							**% Compliance difficult level**				
Fluid compliance		**3.8**	**58.8**	**37.5**			**22.5**	**67.5**	**10.0**		
Diet compliance		**0**	**47.5**	**52.5**							
Haemodialysis compliance		**0**	**41.3**	**58.8**							

Note: A, B, and C represent poor, moderate, and good compliance, while D, E, and F connote little, moderate, and lots of difficulty, respectively. X^2 and p indicate chi-square and probability values, respectively.

Table 5. Association of respondents' haemodialysis history with treatment compliance and compliance difficulty levels.

Haemodialysis History		Haemodialysis Compliance Level					Compliance Difficulty Level				
-	-	A	B	C	X^2	p					
Onset of haemodialysis treatment	< 1 year	0	25	12	3.79	0.285	7	27	3	8.83	0.183
	1-2years	0	19	13			5	23	4		
	3-4years	0	3	4			4	2	1		
	> 4 years	0	1	3			2	2	0		
Restart of haemodialysis treatment	< 1 year	0	17	11	1.51	0.468	5	20	3	1.09	0.896
	1-2 years	0	0	1			0	1	0		
	Not applicable	0	31	20			13	33	5		

(Table 5) contd.....

Haemodialysis History		Haemodialysis Compliance Level					Compliance Difficulty Level				
-	-	A	B	C	X^2	p					
Days of weekly haemodialysis treatment	< 2 days	0	5	6	1.50	0.473	4	6	1	2.45	0.654
	2 days	0	28	15			10	28	5		
	3 days	0	15	11			4	20	2		
Hours of treatment per session	<3 hours	0	8	3	1.75	0.626	0	8	3	17.68	0.007
	3 hours	0	15	11			2	23	1		
	3½ hours	0	4	5			4	5	0		
	4 hours	0	21	13			12	18	4		
Treatment default rate	None	0	11	11	4.64	0.200	7	15	0	10.88	0.092
	1	0	13	10			6	16	1		
	2	0	8	7			4	8	3		
	> 2	0	16	4			1	15	4		
Number of shortened treatments	Not applicable	0	33	15	13.55	0.004	10	32	6	5.40	0.493
	Once	0	6	12			6	12	0		
	Twice	0	9	2			2	7	2		
	Others	0	0	3			0	3	0		
Duration of shortened treatment	Not applicable	0	33	15	4.56	0.207	10	32	6	7.80	0.253
	≤10 minutes or 10 minutes	0	5	6			2	9	0		
	11 to 20 minutes	0	8	7			5	10	0		
	>20 minutes	0	2	4			1	3	2		

Note: A, B, and C represent poor, moderate, and good compliance, while D, E, and F connote little, moderate and lots of difficulty, respectively. X^2 and p indicate chi-square and probability values, respectively.

Table 6. Participants' serum potassium, phosphate, and albumin levels.

Variable	-	Serum potassium				Serum phosphate				Serum albumin			
-	-	A	B	X^2	p	A	B	X^2	p	A	B	X^2	p
Age (years)	< 20	5	1	0.73	0.87	1	5	2.72	0.44	6	0	0.84	0.84
	21-40	18	3			11	10			19	2		
	41-60	23	6			15	14			26	3		
	> 61	21	3			11	13			21	3		
Gender	Male	39	7	0.09	0.77	23	23	0.27	0.60	43	3	1.46	0.23
	Female	28	6			15	19			9	1		
Ethnicity	Yoruba	48	11	2.49	0.48	31	28	3.71	0.30	52	7	1.45	0.69
	Igbo	8	2			2	8			9	1		
	Hausa	7	0			3	4			7	0		
	Others	4	0			2	2			4	0		
Religion	Islam	36	10	2.46	0.29	21	25	1.18	0.55	42	4	0.70	0.83
	Christianity	30	3			16	24			29	4		
	Traditional	1	0			1	0			1	0		
Marital Status	Single/never married	8	2	3.29	0.35	2	8	7.16	0.07	10	0	2.70	0.44
	Married	45	11			32	24			50	6		
	Divorced	4	0			1	3			4	0		
	Widowed	10	0			3	7			9	2		
Level of Education	No formal education	3	1	0.77	0.86	2	2	0.83	0.05	4	0	2.05	0.56
	Primary school	8	1			4	5			7	2		
	Secondary school	25	6			13	17			28	3		
	Higher education	31	5			19	17			33	3		
Occupation	Trading	30	6	0.82	0.94	15	21	9.30	0.05	31	5	1.64	0.80
	Skilled/artisan	7	2			6	3			8	1		
	Civil servant	14	3			11	6			16	1		
	Student	5	1			0	6			6	0		
	Unemployed	11	1			6	6			11	1		

(Table 6) contd.....

Variable	-	Serum potassium				Serum phosphate				Serum albumin			
-	-	A	B	X^2	p	A	B	X^2	p	A	B	X^2	p
Monthly income (Naira)	< 30,000	19	1	10.28	0.07	8	12	5.40	0.37	18	2	3.00	0.70
	31,000-60,000	10	4			5	9			11	3		
	61,000-100,000	20	2			14	8			20	2		
	> 100,000	17	5			11	11			21	1		
	None	1	1			1	1			2	0		
Overall %		84	16			48	52			90	10.		

Note: A and B represent 'Normal' and 'Abnormal' levels, respectively. X^2 and p represent chi-square and probability values, respectively.

3.3.1. Predictors of Haemodialysis Treatment Compliance and Compliance Difficulty

Apart from the highest educational qualification, which was predicted to be positively correlated (r= 0.316, p= 0.023) with haemodialysis treatment compliance, none of the socio-demographic characteristics or haemodialysis history of the respondents was predicted to have an effect on haemodialysis treatment compliance (Table **7**).

Table 7. Predictors of haemodialysis treatment compliance and compliance difficulty among the respondents.

Model		Coefficients			Sig.
		Unstandardized		Standardized	
		B	Std. Error	Beta	
Treatment Compliance					
Age	.916	.877	.147	.300	
Gender	.793	1.365	.068	.563	
Ethnicity	-.318	.791	-.047	.688	
Religion	-.205	1.297	-.019	.875	
Marital status	-1.998	1.005	-.279	.051	
Educational qualification	2.166	.930	.316	.023	
Occupation	-.471	.502	-.121	.351	
Number of dependents	.416	.723	.072	.567	
Monthly income	-.038	.603	-.008	.950	
Onset of haemodialysis treatment	1.111	.801	.159	.169	
Restart of treatment	.132	.346	.044	.705	
Days of weekly Haemodialysis treatment	-.729	1.017	-.083	.476	
Hours of treatment per session	.228	.591	.045	.700	
Treatment default rate	-1.080	.574	-.213	.064	
Number of shortened treatments	.045	1.339	.007	.973	
Duration of shortened treatment	1.323	1.121	.232	.242	
Compliance difficulty					
	Age (years)	.256	1.248	.030	.838
	Gender	-1.853	1.941	-.118	.343
	Ethnicity	1.000	1.124	.109	.377
	Religion	-.846	1.844	-.057	.648
	Marital status	.260	1.429	.027	.856
	Educational qualification	-1.788	1.323	-.193	.181
	Occupation	.094	.714	.018	.896
	Number of dependents	-.329	1.028	-.042	.750
	Monthly income	.364	.858	.057	.673
	Onset of haemodialysis treatment	-1.614	1.037	-.170	.124
	Restart of treatment	.125	.448	.031	.780
	Days of weekly Haemodialysis treatment	1.324	1.317	.111	.318
	Hours of treatment per session	-1.831	.765	-.265	.019
	Treatment default rate	1.520	.743	.222	.045
	Number of shortened treatments	.367	1.733	.040	.833
	Duration of shortened treatment	-.356	1.452	-.046	.807

In the case of treatment compliance difficulty, none of the socio-demographic characteristics of the respondents showed any significant correlation. However, the hours of treatment sessions (r= -0.265, p= 0.019) and the number of treatment defaults in the previous month (r= 0.222, p= 0.045) were observed to be negatively and positively correlated with compliance difficulty, respectively (Table **7**).

4. DISCUSSION

The socio-demographic characteristics of the participants revealed that 66.3% were 41 years and above. The age group is similar to the findings of Sheikh *et al*. [21], where 41.9% of the study participants were between 41-59 years old. In a related study in Aceh, Indonesia, it was stated that 65.5% of the study participants were between 40-60 years of age [22]. The age similarities could be attributable to the fact that most persons in their forties and beyond develop hypertension and diabetes mellitus, which are the two most common causes of CKD. Regarding marital status, more than two-thirds were married. This is consistent with an earlier study by Halle *et al*. [23], which reported that 76.5% of participants were married.

Majority of the participants in the study were males. The finding is in line with Augustina *et al*. [22] where 61.8% of the participants were male. This is also similar to that of Mukakarangwa *et al*. [19], which reported 58% of male participants. The increased ratio in male to female ratio may be due to the protective effects of oestrogens in women and the effects of the hormone testosterone in males that causes a decline in kidney function. One-fourth of the participants earned a monthly income less than 30,000 Nigerian Naira, this characteristic is similar to the findings of a similar study conducted in Nigeria by Ehwarieme and Awhim [24] in Benin City, Edo State.

According to the study findings, nearly half of the participants received treatment for less than a year, and only a minority had treatment for less than two years. Majority indicated they did not restart their treatment, while a few restarted less than a year of initial treatment. These findings are similar to the study of Ehwarieme and Awhim [24], where 56.5% of participants were diagnosed with ESRD and started treatment 3 months to 1 year, 30.5% were diagnosed within 1-2 years while 2% reported a period of more than 5 years.

On a weekly haemodialysis treatment schedule, two-thirds of the participants had haemodialysis treatment twice a week, almost half had their schedule three times a week, and half of the participants had 4 hours of treatment per session. However, this is at variance with the study of Mukakarangwa *et al*. [19], where only 34% of participants received dialysis sessions twice, 64% three times, while only 2% had four times per week and 100% of ESRD participants received dialysis for a period of not less than 4 hours per session. Findings on treatment default in the previous month indicated that one-third of the participants defaulted once and the majority of the participants indicated that their treatment sessions were not shortened, while a few had their treatment duration shortened by 11-20 minutes. This is in line with the studies of Poveda *et al*. [20] that reported 6.5% default and shortening of dialysis sessions among dialysis patients. The study is however in contrast with the study of Alhawery *et al*. [25], where 25% of participants defaulted once per month and 72% having dialysis sessions shortened by about 10 minutes.

Two-thirds of the participants complied with the haemodialysis regimen (medication, fluid, diet, and haemodialysis treatment), more than half agreed that fluid regulation and diet regimen could improve their condition and the majority agreed with the schedule of their dialysis treatment. Earlier investigators had reported a similar observation [22, 26]. However, Ozen *et al*. [6] reported a contrary finding that showed noncompliance rates of 39.1% dietary and fluid restrictions, 33.6% haemodialysis treatment and 20.1% medication among participants. The variance reported in compliance rate may be linked to the low level of education among the study participants, 45% of participants in the current study had up to tertiary education.

The identified haemodialysis difficulties among the study participants include; transportation, logistics, haemodialysis side effects with machine malfunction, changes in lifestyle, and cost. These difficulties are similar to the population studied by Ehwarieme and Awhim [24], where financial constraints, transportation challenges, forgetfulness, and long waiting times are listed as large constraints to haemodialysis adherence. This is also in line with the studies of Meremo *et al*. [27], where 44.1% compliance difficulty was reported and Poveda *et al*. [20] also reported 48% compliance difficulties that are attributed to side effects of haemodialysis treatment. These similarities occur due to the non-availability of NHIS in haemodialysis treatment in some countries, such as Nigeria.

Findings from the biophysical measurement level for outcomes of compliance to haemodialysis showed that two-thirds of the participants had abnormal blood pressure while all participants had abnormal pre- and post-dialysis creatinine levels, indicating poor treatment outcomes. Hence, there is a need for more sessions of haemodialysis and strict adherence to haemodialysis regimens. The scarcity and exorbitant nature of haemodialysis services militate against compliance for better outcomes. This finding is in line with Dada *et al*. [28] who reported that almost all patients paid from their pockets, and a few benefitted from only six sessions set through the National Health Insurance Scheme (NHIS) with only 1.98% able to undergo 3 sessions of dialysis per week. The findings are also similar to the study of Moremo *et al*. [27] where 66.4% of the participants paid personally for haemodialysis treatment and lack of registration on the NHIF scheme promotes poor outcomes.

CONCLUSION

The research study was able to investigate the determinants of compliance and outcomes of haemodialysis regimens among end-stage renal disease patients in Ilorin Kwara State. It was revealed in the study that more than half of the participants have moderate compliance with the haemodialysis regimen, the identified compliance difficulties include transportation logistics, haemodialysis side effects with machine malfunction, changes in lifestyle and cost. Furthermore, it was observed that there was a significant relationship between participants' level of satisfaction with health care services and compliance level.

The highest educational qualification was predicted to be positively correlated with haemodialysis treatment compliance.

Nurses and other health workers should intensify more efforts to provide awareness on kidney diseases prevention and its complications. Patients diagnosed with chronic kidney disease should be well monitored and emphasis must be made on the importance of strict adherence to the treatment regimen and medical advice to prevent further progression to ESRD. Structured teaching programmes that motivate individuals who have CKD and improve the knowledge of patients undergoing haemodialysis regarding dietary management, fluid restriction, and haemodialysis treatment to reduce poor outcomes can be put in place.

Factors contributing to non-compliance such as transportation and funding should be addressed by policymakers and other concerned stakeholders to improve the compliance rate among patients thus improving patients' quality of life and minimizing complications. Governments should create policies that can help subsidize haemodialysis therapy.

LIST OF ABBREVIATIONS

CKD	=	Chronic Kidney Disease
GFR	=	Glomerular Filtration Rate
ESRD	=	End-stage Renal Disease
IWG	=	Interdialytic Weight Gain
NHIS	=	National Health Insurance Scheme

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval for the study was obtained from the research ethics committee of the State Ministry of Health, Kwara State Nigeria, with approval number GHI/ADM/134/VOL.II/399.

HUMAN AND ANIMAL RIGHTS

No animals were used in this study which are the basis of this research. This research was conducted on humans following the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

The consent form was written in a simple language that was understood by any literate individual.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available within the article.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflicts of interest, financial or otherwise.

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