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Quality of life of Nigerian Chronic Kidney Disease patients: experience from Benin City, Nigeria.

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ABSTRACT

Background: Chronic kidney disease patients have been known to have poor quality of life as a result of the disease process. This affects every area of physical function, mental health and well being. The purpose of this study was to assess the quality of life in Nigerian chronic Kidney disease patients.

Method: The SF-36 quality of life survey questionnaire was used in individual interview in a cross sectional, involving all chronic kidney disease patients seen at the University of Benin Teaching Hospital. The quality of life data collected was compared to that of healthy controls and was analysed to establish any correlation between certain socio-demographic and biochemical variables.

Results: There were statistically significant differences in the quality of life scores between patients and healthy controls. There were also statistically significant differences between the pre-dialysis patients and the patients on dialysis. Paired Pearson's correlation analysis showed that higher Packed Cell Volume (PCV), higher Glomerular Filtration Rate (GFR), higher serum albumin,

higher serum calcium and a higher Kt/V had a significant positive correlation to quality of life scores. Higher fasting blood sugar, higher serum urea and creatinine, higher serum phosphate, presence of more comorbid conditions, edema and uremic symptoms had a significant negative correlation.

Conclusion: Quality of life in chronic kidney disease patients is significantly poorer than that of healthy controls in all domains as assessed by the scores of the SF36 quality of life survey instrument.

INTRODUCTION

Chronic kidney disease (GFR) is a devastating medical, social and economic problem for patients and its management has led to a remarkable improvement in the survival of these patients¹. However, the question now being asked is, if they live longer, do they live better?^{2,3}

In Nigeria, a lot of our CKD patients present late,⁴ often in end stage renal failure and with complications of chronic kidney disease such as anaemia, malnutrition, bone diseases, peripheral and autonomic neuropathies, co-morbid conditions such as diabetes, congestive cardiac failure, cerebrovascular accident and others.^{5,6} In addition, there are also the problems of finances, inadequate health care services, lack of social security, lack of health insurance and the direct effect of illness on the individual. All these can negatively affect quality of life in these patients.

The CKD patient experiences a general feeling of malaise due to certain changes that occur in the body. These body changes mainly and usually include, progressive weakness and effort intolerance, easy bruising, pruritus, urinous fetor, bad taste in mouth, poor sense of smell, and marked progressive decline in all domains of physical functioning and emotional wellbeing⁴. The patient also has body and bone pains due to disordered calcium and vitamin D metabolism, dizziness and postural hypotension which may be due to anemia, autonomic dysfunction and side effects of some antihypertensive drugs. Patients may also have paraesthesias due to peripheral neuropathy, erectile dysfunction, sleep abnormalities, as well as associated and co-morbid conditions such as congestive

cardiac failure, stroke, diabetes mellitus, sickle cell disease and autoimmune disorders like systemic lupus erythematosus. Renal replacement therapy and the unlikelihood of returning to work all impose additional burden on the patient.⁷

The financial implications of renal replacement therapy impose enormous additional stress on the patient^{8,9} Even when transplanted, the chronic kidney disease patient is not entirely free of his kidney disorder since he still has to depend on the hospital and its laboratory services. The fear of tissue rejection is an ever-present reality. In addition, the patient will face a new set of problems as a result of immunosuppressant therapy and immunosuppression. There is also the added uncertainty of inadequate laboratory support services and finances.¹⁰

With such enormous challenges, it is expected that the quality of life in these patients may be affected. Even though assessment of quality of life is believed to be an important element in the assessment of chronic kidney disease patients,¹² quality of life studies,^{13,14} especially those assessing the mental, social and emotional perceptions of CKD patients have not previously been done in Benin City, one of the largest cities in southern Nigeria This study was therefore to compare the quality of life of patients with chronic kidney disease with age and sex matched controls and to identify and assess the important biochemical, physiological and socioeconomic parameters that contribute to quality of life

METHODOLOGY

Study design: This was a cross sectional case control study of chronic kidney disease patients compared with patients without chronic kidney disease.

Patients: This study was carried out on all chronic kidney disease patients (apart from those excluded) irrespective of aetiology seen at the University of Benin Teaching Hospital from May 2002 to October 2003.

Eighty one consecutive chronic kidney disease patients were involved in the study.. The following were excluded: Patients under 16 years of age, those with co morbid HIV infection, diagnosis of psychosis, overt cognitive impairment and patients who did not consent to the study. Sixty control subjects that were age and sex-matched were selected from among the hospital staff, medical students and patient relations. The control subjects had no clinical or biochemical evidence of chronic kidney disease, or any other chronic illness.

Study procedure; A detailed medical history was obtained from each patient and a complete bedside clinical examination was done. The aims and objectives of the study were explained to each patient and a written informed consent was obtained from them.

Definition of terms: Patients with blood pressure above 140/90mmHg or patients on antihypertensive medication irrespective of blood pressure levels were considered hypertensive. Peripheral neuropathy was determined by impairment of light touch, impairment of pinprick sensation at the dorsum of the great toe in the feet and loss of vibration sensation using a 128 Hz tuning fork as well as by loss of joint position sense with any two being taken as evidence of neuropathy. Patient with a fasting blood sugar level greater than 126mg/dl or the use of hypoglycaemic agents was considered diabetic. Level of financial adequacy was judged by assessing those able to pay adequately for their prescribed mode of treatment. Current working

status was ascertained from information obtained from patients and relations. Previous working status was ascertained by finding details from patient .Only patients who have had a minimum of 2 sessions of dialysis were included in the hemodialysis group

Quality of life was determined using the Medical Outcomes Study Short Form 36 (M.O.S-SF 36).¹¹ The MOS SF- 36 was administered to each patient using the interviewer administered version in a personal interview in the dialysis room just before dialysis for dialysis patients, in the consulting room, after the usual medical consultation for outpatients or in the wards for patients on admission. The form was also administered to the control subject. The SF-36 consists of 36 questions identifying 8 areas of health

1. Physical function. (PF)
2. Role limitations due to physical health. (RP)
3. Emotional state. (RE)
4. Bodily pain. (BP)
5. Perception of General state of health. (GH)
6. Vitality. (VT)
7. Social functioning. (SF)
8. Mental Health. (MH)

Scores were calculated and the data analysed using appropriate statistical techniques. The scores are organized so that the highest scores indicated the best state of health (0-100).

The packed cell volume, glomerular filtration rate (GFR) and Fasting blood sugar (FBS) values were obtained before commencing dialysis. The serum creatinine, calcium, phosphates and albumin, values were obtained after a minimum of 2 sessions of hemodialysis

STATISTICAL ANALYSIS

All statistical analysis was done with S.P.S.S for windows version 20.0 (SPSS Inc. Chicago, U.S.A). Results were expressed as mean $\pm$ standard deviation. Patients were categorized into pre-dialysis and haemodialysis subgroups. Differences in baseline characteristics were analysed with one way analysis of variance (ANOVA) in the case of continuous variables (age, PCV, serum creatinine levels, creatinine clearance, serum albumin, serum calcium and phosphate) and chi square tests for categorical variables (percentage of male, diabetic, hypertensive, co-morbidity, kt/V, and adequacy of finances. A multivariate analysis was done considering the mean SF-36 scores in relation to the patient variables, and the type of treatment. The analysis considered the eight SF-36 subscales (PF, RP, BP, GH, VT, SF, RE, MH) as dependent variables. The independent variable was type of treatment. Covariates were age, PCV, serum creatinine, GFR, serum calcium, serum phosphates, serum albumin, presence or absence of hypertension, diabetes, comorbid conditions, finances, and Kt/V. Bivariate (Pearson's) correlation was done between physical function/mental health and the various demographic, physiological and biochemical variables. P-values less than 0.05 were taken as significant.

RESULTS

The results are set out below.

There were significant differences in the age and gender of the patient and control groups but there were statistically significant differences in the biochemical parameters of patients and controls (Table 1)

There were statistically significant differences in all the domains of the SF36 between patient and controls $p < 0.001$ Table 2.

This was also highlighted in the bar chart (Figure 1)

Table 1: Comparison of demographic, clinical and laboratory profiles of patients and controls

Parameters	Patients n =81 ± SD	Controls n = 60± SD	P value	Sig
Mean age(Years)	44.56 (±10.58)	44.51 (±11.23)	0.08	NS
Gender (M /F)	46 (42)	31 (29)	0.17	NS
PCV(%)	22.48 (±6.56)	35.6 ±4.37	<0.05	S
Serum Urea(mg/dL)	94.23 (±44.08)	33.47±5.5	<0.05	S
Serum creatinine(mg/dL)	7.21±3.4	0.92±0.13	<0.05	S
Serum albumin(g/L)	3.07±0.34	3.92±0.36	<0.05	S
Cr. Clearance(mls/min)	15.81±12.02	113±12.54	<0.05	S
Calcium(mg/dL)	7.59±.95	10.1±0.54	<0.05	S
Phosphates(mg/dL)	5.31±0.80	3.04±0.45	<0.05	S
Hypertension	85(96.6%)	0(100%)	<0.05	S
Diabetes	15(17%)	0(100%)	<0.05	S
Comorbidity	18(20.5%)	0(0%)	<0.05	S
Financial inadequacy	54(61.5%)	60(100%)	<0.05	S
Neuropathy	42(41.6%)	0(0%)	<0.05	S
Edema	52(57.8%)	0(0%)	<0.05	S
Uremic symptoms	62 (68.9%)	0 (0%)	<0.05	S
Number Working	16 (18.2%)	46 (76.7%)	<0.05	S

Table 2. Comparison of mean SF-36 Quality of life scores of patient and control groups.

Parameters	Patients	Controls	P-Value	Sig.
Physical function (PF)	43.16±23.81	90.6(±10.2)	P<0.001	S
Role physical (RP)	30.68±29.05	84.1±15.3	P<0.001	S
Bodily Pains (BP)	44.19±15.84	17.38±14.1	P<0.001	S
General Health (GH)	39.42±22.53	77.4±13	P<0.001	S
Vitality (VT)	36.19±22.65	71.4±14.9	P<0.001	S
Social function (SF)	35.22±22.09	80.64±16.6	P<0.001	S
Role emotional (RE)	26.87±24.66	79.22±19.4	P<0.001	S
Mental Health (MH)	39.53±19.46	78.75±9.6	P<0.001	S

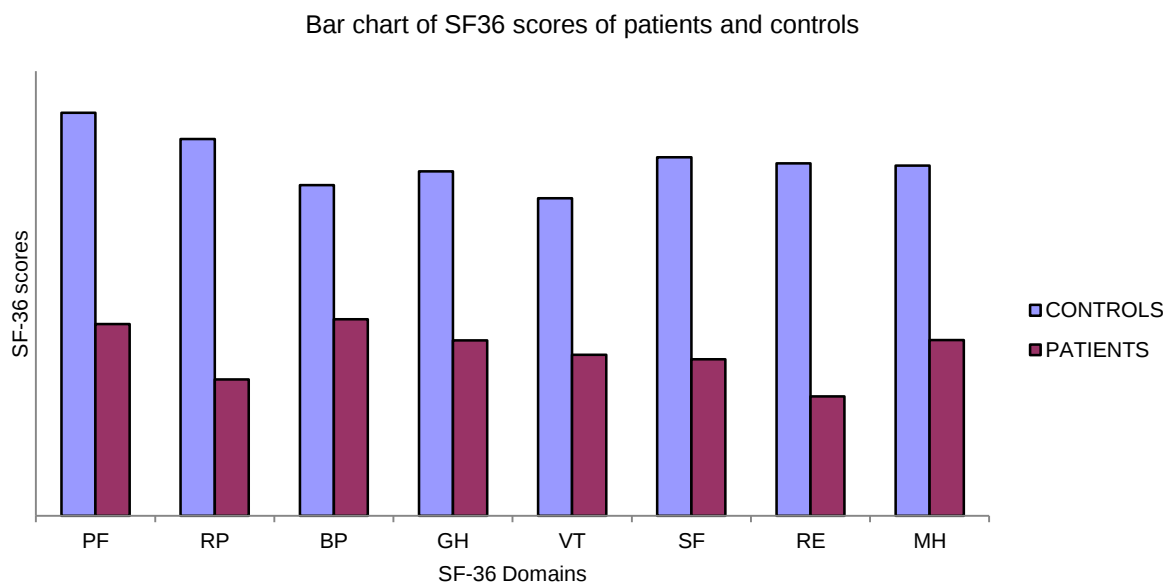


Figure 1. Bar chart illustration of SF36 quality of life scores of patients and controls.

Quality of life scores were higher in controls.

Table 3. Comparism of demographic, clinical and biochemical variables across treatment groups

	N=37 Pre-dialysis	N=44 hemodialysis	P value
Age (Years)	43.14±10.23	44.7±11.29	0.714
Hypertension	36 (97%)	44 (100%)	0.705
Diabetes	8 (21.6%)	5 (1.4)	0.252
Comorbidity	8(21.6%)	44	<0.05
Financial Inadequacy	5 (13.56)	42 (95.5%)	<0.05
Neuropathy	5 (13.56)	23 (52.3%)	<0.05
P.C.V.(%)	26.46±3.57	20.73±6.02	<0.05
Serum urea(mg/dL)	75.24±11.6	103.73(23.08)	<0.05
Serum creatinine(g/L)	4.5±2.3	8.96±2.72	<0.05
Serum Albumin(mg/L)	3.25±0.34	2.96±0.31	<0.05
Creatinine clearance(mls/min)	27.8±8.46	7.45±4.03	<0.05
Calcium(mg/dL)	8.29±0.73	7.12±0.76	<0.05
Phosphate(mg/dL)	4.88±0.78	5.57±0.64	<0.05
Edema	9 (24.3%)	37 (84.1%)	<0.05
Working	50	4	<0.05

Table 4. SF – 36 scores across treatment groups

Parameters	Predialysis	Haemodialysis	p value
PF	63.65±14.42	31.32±16.73	<0.01
RP	52.7(20.23)	17.05±24.55	<0.01
BP	53.62±13.43	38.75±14.41	<0.01
GH	56.62±13.43	29.65±19.71	<0.01
VT	53.65±15.84	25.68±18.44	<0.01
SF	52.26±14.28	25.65±17.94	<0.01
RE	43.21±17.31	17.42±13.27	<0.01
MH	52.41±15.65	31.93±16.67	<0.01

Table 5. Bivariate(Pearson's) correlation of SF36 scores against clinical biochemical and demographic variables

Physical Function				Mental Health			
VARIABLE	CORR. COEFF.	P. VALUE	SIG		CORR. COEFF.	P. VALUE	SIG.
Age	-.228	.032	S		-.187	.081	NS
Gender	-.132	.220	NS		-.077	.475	NS
Bp	-.054	.620	NS		-.091	.398	NS
Diabetes	-.258	.015	S		-.230	.031	S
PCV	.800	.000	S		.748	<0.01	S
Creatinine	-.727	.000	S		-.650	<0.01	S
GFR	.738	.000	S		.555	<0.01	S
Albumin	.616	.000	S		.537	<0.01	S
Urea	-.445	.000	S		-.416	<0.01	S
Calcium	.658	.000	S		.579	<0.01	S
Phosphate	-.513	.000	S		-.396	<0.01	S
Comorbidity	-.418	.000	S		-.410	<0.01	S
Edema	-.772	.000	S		-.603	<0.01	S
Marital Status	.144	.180	NS		.091	.398	NS
Finances	.833	.000	S		.736	<0.01	S
Education	.080	.644	NS		.099	.360	NS
Kt/V	.786	.000	S		.790	<0.01	S
Uraemic symptoms	-.709	.000	S		-.620	<0.01	S

EFFECT	VALUE	F	P value	
Age	0.968	542	0.784	NS
Blood pressure	0.924	1.248	0.225	NS
Diabetes	0.942	587	0.816	NS
PCV	0.777	2.438	0.022	S
Creatinine	0.890	1.046	0.411	NS
GFR	0.715	3.382	0.003	S
Albumin	0.826	1.789	0.094	NS
Calcium	0.946	0.483	0.864	NS
Phosphate	0.864	1.33	0.239	NS
Comorbidity	0.840	1.615	0.137	NS
Edema	0.921	0.771	0.640	NS
Uremic symptoms	0.800	2.125	0.045	S
Marital Status	0.898	0.937	0.500	NS
Finances	0.716	3.369	0.003	S
Level of education	0.913	0.795	0.613	NS
Mode of treatment	0.673	1.865	0.029	S

Table 6. Multivariate analysis of SF36 scores against clinical biochemical and demographic variables. PCV, Uremic symptoms, finances and mode of treatment were the most significant contributors to quality of life.

RESULTS:

DISCUSSION

This study showed marked and statistically significant differences in quality of life between CKD patients and control groups. Patients with CKD perceived their quality of life as being low in all domains of physical and mental health. They reported more problems with physical function and perceived themselves as being limited in performance of various types of physical activities, including work. It is important to note that 18.9% of the chronic kidney disease patients under

study were actually working (employed) as against 76.7% of the control group. While this is expected, hemodialysis did not succeed in returning those in the dialysis group back to work

About 36.1% of our patients had evidence of peripheral neuropathy. This is higher than the figures reported by Imam et al. and that showed peripheral neuropathy in 28.5% of the CKD patients in Ibadan, Nigeria.¹⁵

Mean Kt/V in all dialysing CKD patients was 0.659. This shows marked inadequate dialysis. The recommended minimum Kt/V in dialysis patients is about 1.2(16). Virtually all the patients were grossly under dialysing and their frequency of dialysis was in most cases less than once weekly on the average. Higher Kt/V was associated with higher scores on the SF-36, suggesting that adequacy of dialysis as measured by urea kinetic modelling may influence quality of life scores.¹⁷

Anemia was found in this study to be an independent risk factor for poor quality of life scores. This is in agreement with various other studies.^{18,19}

Financial constraints have also been found in this study to be a strong independent risk factor for low quality of life. The reason may be that provision of all other things, such as regular dialysis, drugs, appropriate medical care and purchase of erythropoietin may be directly linked to the adequacy (or inadequacy) of finances. Most patients are unable to afford erythropoietin and other prescribed drugs and treatment methods. The high number of those unable to pay for dialysis (95.5-100%) is in keeping with reports from other centres in Nigeria where patients have to bear the entire burden of renal replacement therapy.^{20, 21, 22}

The presence of residual renal function (creatinine clearance) has been associated with better quality of life scores in patient with CKD.²³ Most of our renal failure patients had low residual renal function, probably because most of them presented late.

Treatment modality has been found in this study to affect quality of life. Those on conservative therapy seem to have better quality of life than those on haemodialysis. These findings agree with

earlier studies by Evans et al; Simmonds et al;²⁴ and the NECOSAD study group¹⁶ which showed that renal transplantation was associated with better quality of life than haemodialysis, which was in turn associated with better quality of life scores than peritoneal dialysis.

Mode of treatment in this study may not be a proper evaluation of the real effects of haemodialysis on quality of life because patients were not dialyzing adequately and their Kt/V much was lower than recommended target levels.

The effect of poor physical function and wellbeing is most noticed when assessing the percentage of those able to work when checked across treatment groups. Whereas 76% of pre-dialysis treatment patients who had jobs were still able to work, only 8.7% of haemodialysis patients who had jobs were able to continue with work after commencing dialysis. These figures are much lower than figures from other studies.^{25,26}

The mental health score of 52.4 ± 15.65 for the pre-dialysis treatment group is close to the reported U.S. average.²⁷ This indicates that the average CKD patient on conservative treatment, in this study, did not perceive himself as being markedly emotionally impaired. The reasons for this would need to be further researched into.

Mental health scores of 31.93 ± 16.67 for the haemodialysis group is quite low and studies have indicated that a mental component score of below 40 indicates depression.²⁷ However, these studies were not done in our environment.

Our study revealed that PCV, creatinine clearance, finances, and treatment modality contributed most to the observed differences in SF36 quality of life scores.

Pearson's correlation showed that younger age, lower fasting blood sugar levels, higher PCV, lower serum creatinine, higher GFR, higher serum albumin, lower serum urea, higher calcium, lower phosphates, absence of uremic symptoms, higher Kt/V, lesser levels of edema and fewer comorbid conditions had significant positive correlation with quality of life scores.

CONCLUSION

The quality of life of chronic kidney disease patients in Benin City is significantly lower than that of age and sex matched controls in the general population.

Low packed cell volume, low serum albumin, reduced glomerular filtration rate, higher serum creatinine, higher serum urea, Kt/V, low calcium and elevated phosphates, more comorbid conditions, marked edema and inadequate finances were all associated with poorer quality of life.

REFERENCES

1. Riyadh Said. Quality of life in end stage renal disease patients. Saudi Kidney disease and transplantation bulletin. 1992. Vol. 3, No 2. 81-87.
2. McSharry. M. Quality of life – but in whose judgment? E.D.T.N.A E.R.C.A J. 1996. July-Sept. (3) 15-18.
3. Kimmel P.L. Quality of life in end stage renal disease. Am. Journal of Kid. Dis. 2000. 35 (4 Suppl. 1) 132-140.
4. Kadiri S, Arije A. Temporal variations and meteorological factors in hospital admissions of chronic renal failure in South West Nigeria. West African Journal of Medicine 1999.Vol. 18, No. 1 49-51.
5. Kamyar Kolantar Zedeh, Joel D Kopple, Gladys Block, Michael Humphreys. Association among SF36 Quality of Life measures and Nutrition, Hospitalization and Mortality in haemodialysis. Journal of Am. Soc. of Nephrology 2001 12: 2797-2806.
6. Kidney disease Quality Outcome initiative Clinical practice guidelines for chronic kidney disease. Evaluation, classification and stratification. 2002. Part 6, Association of level of GFR with complications in adults. American Journal of Kidney Diseases Volume 39, Issue 2, Supplement 1, Pages S111–S169, February 2002
7. Evans RW, Manninen DL, Garrison LP Jr, Blagg CR, Gutman RA Hart LG et al. The Quality of life of patients with end stage renal disease. N Engl J Med. 1985 Feb 28;312(9):553-9
8. Akinsola A, Adelekun, T.A. Arogundade F.A. C.A.P.D practice in O.A.U.T.H.C, Ile Ife, Nigeria. A preliminary experience. Dialysis and Transplantation 2000. Vol, 29, No. 12, 714-782.
9. Kadiri S, Tanimu D, Arije A. Evaluation of dialyser reuse in a developing country. African Journal of Health Sciences. July – Dec 1998. Vol. 5, No 3-4,162-164.
10. OE Ojeh-Oziegbe, E Okaka, E Oviasu Cost Evaluation of Haemodialysis for End Stage Renal Disease Patients: Experience from Benin City, Nigeria Annals of Biomedical Sciences Vol 12,(2) 2013
11. Ware J.E, Kosinski M.A and Gandek MS. The SF-36 Health survey manual and interpretation guide. 2002. Introduction. Page 2.1.
12. Francesca Baiardi, E Degli Esposti, Roberto Cocchi, Alba Fabbri, Alessandra Sturani, Giorgia Valpiani,et al :Effects of clinical and individual variables on quality of life in chronic renal failure patients. Journal of Nephrology, 2002 pages 1562-1567.

13. Evans RW, Manninen DL, Garrison LP Jr, Hart LG, Blagg CR, Gutman RA, Hull AR, Lowrie EG . The quality of life of patients with endstage renal disease. *New Engl. J. of Med.* 1985. 312: 553-9
14. Edlund M., Tancredi L.R. Quality of Life an ideological critique. *Perspectives in biology and Medicine* 1988. 28; 591-607
15. Imam I., Salako B.L, Akinola A. Peripheral neuropathy in Nigerian subjects with chronic renal failure. *Niger J Med.* Apr-jun; 2003. 12(2): 72-5,
16. _Merkus MP, Jager KJ, Dekker FW, Boeschoten EW, Stevens P, Krediet RT Predictors of poor outcomes in chronic dialysis patients. The Netherlands Cooperative Study on Adequacy of Dialysis (NECOSAD 1). *Am J Kidney Dis.*2000. Jan 35(1): 69-79.
17. Evans R. W., Ruder B., Manninem D.L., The quality of life of haemodialysis recipients treated with recombinant human erthropoietin. Cooperative multi-centre EPO clinical trial group. *JAMA.* 1990. 26: (6) 825-830.
18. Moreno F¹, Sanz-Guajardo D, López-Gómez JM, Jofre R, Valderrábano F Increasing the heamatocrit has a beneficial effect on quality of life and is safe in selected haemodialysis patients. Spanish cooperative, Renal patients Quality of Life study Group of the Spanish society of Nephrology.
19. Leanza, H. Gicoletto S., Najun C. et al Heamoglobin levels and probability of better quality of life in chronic haemodialysis patients. *Nefrologica*, 2000; Sept. to Oct. 20(5) 440-444.
20. Agaba EI¹, Lopez A, Ma I, Martinez R, Tzamaloukas RA, Vanderjagt DJ, et al Chronic haemodialysis in a Nigerian Teaching Hospital Practice and cost. *Int J Artif Organs.* 2003 Nov;26(11):991-5
21. Bamgboye E.L. Haemodialysis-management problems in developing countries with Nigeria as a surrogate kidney int. suppl. 2003 Feb; (83): S93-5
22. Ijeoma CK, Ulasi I I, Kalu A O Cost implications o treatment of End stage renal disease in Nigeria. *Journal of college of medicine* vol 3 no. 2 pp95-96 1998
23. Kutner N.G. Assessing end stage renal disease patients functioning and wellbeing. Measurement approaches and implications for clinical practice. *Am. J Kidney Dis.* 1999. 24-321-333
24. Simmonds R.G, Abress L. Quality of life issues for end stage renal disease patients; *Am J. Kidney Dis.* 1990. 15(3): 201-8.
25. Johansen K.L: Physical functioning and exercise capacity in patients on dialysis. *Adv. Renal. Repl. Ther* 1999.6:141-148,
26. Manninem D.l. Evans R.W., Dugan M.K. Work disability, functional limitations and the health status of kidney transplantation recipients post transplant. *Clin. Transpl.* 1999, 193-205
27. Ware J.E: SF-36 Health Survey. A Users Manual and Interpretation Guide 1993, 2000. Lincoln R., Quality Metric incorporated. Page 2.4.