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Original Research Article

Assessment of Medication Adherence in Chronic Kidney Disease Patients: A Tertiary Care Experience

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ABSTRACT

Background: Non adherence to management of chronic kidney disease (CKD) remains a remarkable barrier to effective management of CKD patients. In resource poor countries management of chronic disease patients with poor adherence causing more health care burden and overall poor health outcome. Hence the aim of this study was to evaluate the impact of basic education of disease on adherence to treatment by using MMSA-4, MMSA-8 and BMQ questionnaire.
Materials and Methods: The study was conducted on 100 adult patients of CKD selected from K&D clinic PGIMS, Rohtak. All the patients went under detailed socioeconomic, clinical, biochemical and radiological examination. Patients were assessed for basic and subsequent adherence to medication with basic education of disease and their management by using MMSA-4, MMSA-8 and BMQ on each visit and evaluate with demography profile.
Results: Out of total 100 patients, 62 were male and 38 were female. The study results revealed, that adherence measured by different tool were comparable and the post total and sub-total adherence scores of the study subjects is also increased significantly ($p < 0.001$). Patients who belong to higher socio-economical status and higher basic education had more adherences to prescribed treatment. Most common reason for non-adherence in our study was high cost of drugs.
Conclusion: Poor adherence to treatment remains a major hurdle in the effective management of CKD patients. There is need for assess adherence in chronic disease patients by effective tool that eliminate or minimize the contributory factors to non-adherence in CKD patients. The study emphasizes that provision of continuous education to chronic kidney disease patients would increase the medication knowledge of the patients and improve their adherence to management. It is also worth to mention that adherence measured by various tool was comparable in our study which would be helpful for busy clinician to find out adherence by simple tool like MMSA-4 instead of comparatively more complex tool like BMQ and MMSA-8. It is also essential to find out other factors leading to poor adherence to management as it would be beneficial for healthcare providers to recognize patients who may benefit from interventions to improve medication adherence.

Key words: chronic kidney disease (CKD), medication adherence, tertiary care, kidney function.

INTRODUCTION

Chronic kidney disease (CKD) encloses a spectrum of different pathophysiological processes which is associated with decline kidney function. Chronic kidney disease is defined as abnormalities of kidney structure or function, present for more than 3 months, with implications on health. [1,2]

In India the overall prevalence of chronic kidney disease is 17.2% and with increasing prevalence making it a matter of serious and urgent concern as the ultimate outcome of CKD is the end stage renal disease (ESRD). Recently age-adjusted incidence rate of ESRD in India has been found to be 229 per million populations, and every year more than 100,000 new patients enter renal replacement programs in India. [3,4]

Patients with chronic kidney disease are required multifaceted and comprehensive treatment that is difficult to pursue. Comprehensive management of CKD patients includes dietary modification, fluid management, appropriate medication and renal replacement therapy (RRT). This comprehensive patient care is crucial in slowing the progression and complications of CKD. [5] However, evidence indicates that a considerable numbers of CKD patients are run away from prescribed treatment causing ongoing challenges in the health care. [6] This imposes a high personal and monetary burden on patients and their families. Chronic diseases patients do not adhere to their prescribed treatment and it has been reported, that many patients modify their drug dosage as well as frequency of drugs. Hence, adherence is a major tool to achieve goal of therapy in CKD patients to halt the progression of CKD as well as to prevent the complications of CKD.

Adherence is defined as the extent to which individuals follow instructions they are given for prescribed treatments. [7] Non-adherence has been shown to vary depending on diseases and nature of prescribed regimen. Non-adherence to chronic drug therapy is known to significantly increase the disease burden in developing economies. The major predictors of the poor adherence include cost of medication, missed appointments, side effect(s) of medication, psychological problems, treatment complexity, asymptomatic disease, inadequate follow up, poor patient provider relationship, patients' lack of insight in illness, patients' lack of belief in benefit of treatment and barrier to access the healthcare facilities. Pill burden is one of the most common reasons for medication non-adherence in patients of CKD. Wide variability in rates of non-adherence is reported in various studies depending on the type of instrument used. [8-9] Non-adherence rates among CKD patients found in previous studies range from 2% to 98%. [6,10-11] Hence, it is necessary to understand non-adherence to medications in a particular disease and study the factors affecting it.

Measurement of medication adherence is challenging because it depends on individual patient behavior. Various subjective and objective modalities have been used to assess adherence in past. Subjective measurements are obtained by using various questionnaires like Brief Medication Questionnaire (BMQ), Morisky Medication Adherence Questionnaire (MMAQ) and End Stage Renal Disease Adherence Questionnaire (ESRD-AQ). Objective measurements can be obtained by counting pills, examining pharmacy refill records or using electronic medication event monitoring systems. Biochemical measurements can be obtained by adding a non-toxic marker to the medication and detecting its presence in blood or urine.

Brief Medication Questionnaire (BMQ) consists of three screens: 5-item Regimen Screen that asks patients how they took each medication in the past week, a 2-item Belief Screen that asks about drug effects and bothersome features, and a 2-item Recall Screen about potential difficulties in remembering. All BMQ screens consist of a positive and a negative screen. A score of ≥ 1 denotes a positive screen which represents non-adherence to medication regimen, while a score zero denotes a negative screen, representing adherence to the prescribed medication regimen. Thus, higher the BMQ score, higher the rate of non-adherence. [12]

Morisky Medication Adherence Questionnaire (MMAQ) includes MMAS-4

and MMAS-8 scores based on number of questions asked to the patient. Adherence is graded as high, medium or low. Higher score indicates low adherence. [13]

World Health Organization estimated that only 50% of the people with chronic diseases take their medications properly as advised. [14] Thus, non-adherence to prescribed medications is associated with poor clinical outcomes, accelerated disease progression and huge economic burden of health care system. Therefore, assessment of adherence to prescribed treatment regimen is important for dealing with the complexities of chronic disease and their better management. Several studies showed that patient medical education can retard the progression of chronic renal disease and improve survival, improve illness related understanding, and boost quality of life. [15] Hence, the present study was planned to assess the adherence to medication therapy in CKD patients by using various existing tools.

MATERIALS AND METHODS

The study was conducted in 18-75 years adult patients of CKD, undergoing treatment as outpatient in the Kidney and Dialysis clinic, PGIMS, Rohtak and consenting to participate in the study. Patients with any psychiatric illness, multiple organ system failure, having altered sensorium and memory impairment were excluded from the study. Patients who were unable to speak/write/understand English and Hindi (local language) were also not included in the study. Study was approved from the institutional ethics committee.

Data including Patient demographics age, sex, occupation, marital status, level of education, employment status and income status as per Kuppuswamy's scale was collected.[16] Past medical & medication history, duration of treatment, medications prescribed [name, dose, frequency, route, duration of the drug] were obtained by direct patient history interview and review of the patient medical records and documented in the data collection forms specially designed for the study. Patients were counseled verbally (15-30 min/patient) on their regular OPD visit days regarding their disease, dialysis procedure, drugs, diet and fluid restrictions.

The medication adherence pattern of the patients was assessed by using Morisky Medication Adherence Questionnaire-8 [MMSA-8]. MMSA-8 consists of total 8 questions, out of them first 7 questions have two options "YES" and "NO" and the last question has 5 options and a total score graded as low (0), medium (1-2) and high (≥3). Higher the score indicative of poor adherence and decreasing score after education indicative of improving in adherence to treatment and similarly Morisky Medication Adherence Questionnaire-4 [MMSA-4]. MMSA-4 consists of total 4 questions, all questions have two options "YES" and "NO" and a total score graded as low (0), medium (1-2) and high (≥3). [13]

Third questionnaire was Brief Medication Questionnaire (BMQ) consists of three screens: 5-item Regimen Screen that asks patients how they took each medication in the past week, a 2-item Belief Screen that asks about drug effects and bothersome features, and a 2-item Recall Screen about potential difficulties in remembering. All BMQ screens consist of a positive and a negative screen. A score of ≥1 denotes a positive screen which represents non-adherence to medication regimen, while a score zero denotes a negative screen, representing adherence to the prescribed medication regimen. Thus, higher the BMQ score, higher the rate of non-adherence. [12]

All these questionnaires were administered at the baseline, on the sixth week and on the twelfth week. The responses obtained from the patients were scored as stated in the questionnaires and were subjected to statistical analysis.

Statistical Analysis

The association between patient education, reported medication adherence pattern and patients' knowledge about the medications was examined using the two tailed independent paired T- test. The correlation between patients medication knowledge and medication adherence was assessed using Pearson's correlation coefficient. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 100 patients were selected according to inclusion and exclusion criteria and interviewed for this study. Out of total 100 patients, 62 were male and 38 were female. There was a male predominance in this study. The most common etiology of kidney disease was hypertension (29%) followed by diabetes mellitus (24%) and chronic glomerulonephritis (19%). Most of the patients were from lower and middle family income class. The most common educational status was primary school (32%) followed by 26% of higher secondary. Base line demographic characteristics of study group are enumerated in table-1

In this study the average age of the patients was 48.02±15.40years. Out of 100 patients 51 % were below age 50 years. 42% patients belonged to lower middle class on the basis of Kuppuswamy's scale. [16] Most of patients were from rural background. Over half of the patients had associated comorbidity in this study diabetes and hypertension. Most patients were in advance stage of CKD and 51% of the patients were on hemodialysis.

Table 1 shows the demographic characteristics of study sample N= 100)

Variables	N
SEX	
• Male	62
• Female	38
AGE	
• <20 years	4
• 21-30 years	14
• 31-40 years	13
• 41-50 years	20
• 51-60 years	22
• 61-70 years	24
• >70	3
MARITAL STATUS	
• Married	90
• Unmarried	10
KUPPUSWAMY SCORE {INCOME SCALE} (per month)	
• Score-1 (< 2091)	0
• Score-2 (2092-6213)	39
• Score-3 (6214-10356)	12
• Score-4 (10357-15356)	15
• Score-6 (15536-20714)	10
• Score-10 (20715-41429)	20
• Score-12 (>41430)	4
RESIDENCY	
• Urban	36
• Rural	64
LEVEL OF EDUCATION	
• Primary	28
• Middle	12
• Secondary	16
• Higher secondary	26
• Graduation	18
EMPLOYMENT STATUS	
• Employed	37
• Unemployed	50
• Retired	13
CO-MORBID CONDITIONS	
• Hypertension	20
• Diabetes	23
• Hypertension & diabetes	14
• Cardiac diseases	12

Table 2- Renal function of patients on each visit

Basic investigation	Mean ± SD		
	First visit	Second visit	Third visit
Hemoglobin	8.38 ± 1.63	8.29 ± 1.63	7.97 ± 1.88
Total leucocyte count	8481 ± 2459.93	8373 ± 2292.71	8037.66 ± 2825.01
Absolute platelet count	2.65 ± 1.08	2.69 ± 1.24	2.86 ± 1.09
Blood sugar	107.49 ± 33.6	107.51 ± 28.34	108.66 ± 34.02
Blood urea	157.95 ± 68.5	159.17 ± 58.44	160.67 ± 68.41
Serum uric acid	9.44 ± 2.56	8.36 ± 2.46	7.64 ± 2.68
Serum sodium	138.78 ± 5.68	136.78 ± 4.61	138.74 ± 6.14
Serum potassium	5.44 ± 0.76	4.56 ± 0.86	4.46 ± 0.86
Serum creatinine	6.9 ± 3.72	5.9 ± 3.44	6.8 ± 3.41
Serum calcium	8.36 ± 1.42	8.49 ± 1.44	8.44 ± 1.44
Serum phosphate	8.49 ± 3.54	7.28 ± 3.06	6.78 ± 2.68
Serum protein	6.37 ± 0.9	5.87 ± 0.9	6.16 ± 0.95
A:G	0.99 ± .21	0.89 ± 0.22	0.99 ± 0.22
eGFR	16.57 ± 10.96	16.57 ± 10.96	16.26 ± 10.4

Renal function of patients on each visit re summarized in table-2. Mean serum creatinine in study group was 6.9±3.72, 5.9±3.44 and 6.8±3.41, respectively in each visit.

Table 3–Reasons for non –adherence

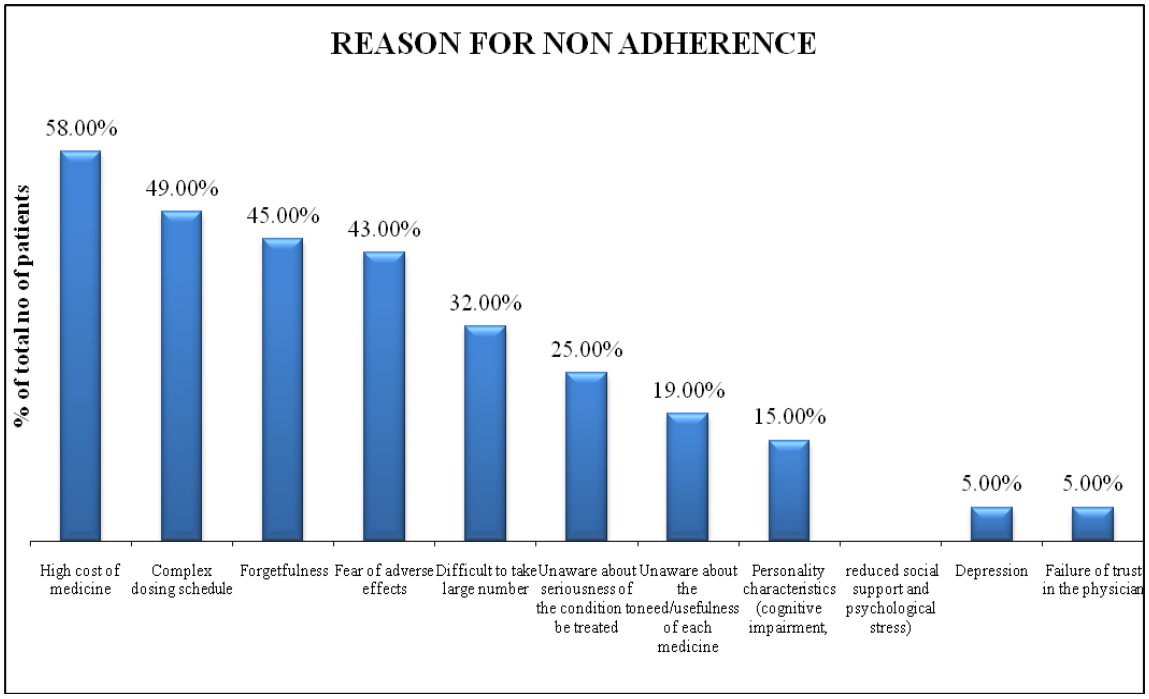

Table 4- Paired t-test comparing total adherence (MMSA-4) score (N=100)

Assessment time	Mean±SD	Comparison	P-value
Pre-program	3.05 ± 0.72	Pre-program with After 6 weeks	<0.0001
After 6 weeks	1.82 ± 0.69	Pre-program with After 12 weeks	<0.0001
After12 weeks	1.25 ± 0.96	After 6 weeks with After 12 weeks	<0.0001

Table 5- shows the Total and subtotal adherence (MMSA-4) before and after intervention (N=100)

Area of adherence assessment		Pre-program			After 6 weeks			After 12 weeks			P-vale
		Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	
Fluid	N	86	9	5	38	32	30	24	28	47	<0.001
Diet	N	84	10	6	36	35	29	24	27	48	<0.001
Medication	N	74	14	12	29	36	35	19	31	50	<0.001
Basic renal parameter	N	88	8	4	40	43	27	33	22	45	<0.005
Total Adherence	N	83	10	7	36	37	27	25	27	48	<0.001

Table 6- Paired t-test comparing total adherence (MMSA-8) score (N=100)

Assessment time	Mean±SD	Comparison	P-value
Pre-program	5.34±1.62	Pre-program with After 6 weeks	<0.0001
After 6 weeks	2.51±0.1.53	Pre-program with After 12 weeks	<0.0001
After12 weeks	1.7±1.6	After 6 weeks with After 12 weeks	<0.0001

Table 7- shows the Total and subtotal adherence (MMSA-8) before and after intervention (N=100)

Area of adherence assessment		Pre-program			After 6 weeks			After 12 weeks			P-vale
		Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	Low [score ≥'3']	Medium [Score '1-2']	High [Score '0']	
Fluid	N	86	9	5	38	32	30	24	28	47	<0.001
Diet	N	84	10	6	36	35	29	24	27	48	<0.001
Medication	N	74	14	12	29	36	35	19	31	50	<0.001
Basic renal parameter	N	88	8	4	40	43	27	33	22	45	<0.005
Total Adherence	N	83	10	7	36	37	27	25	27	48	<0.001

Table 8- Correlation between socio-demographic characteristics and Total Adherence (MMSA-8 score)

Variables	Pre-program		After 12 weeks	
	Mean ± SD	P-value	Mean ± SD	P-value
SEX				
• Male	5.37 ± 1.55	>0.05	1.69 ± 1.42	>0.05
• Female	5.29 ± 1.74		1.71 ± 1.89	
AGE				
• <20 years	4.75 ± 2.22		1.5 ± 1.73	
• 21-30 years	5.57 ± 1.5		1.36 ± 1.5	
• 31-40 years	5.38 ± 1.76		0.92 ± 1.61	
• 41-50 years	5.2 ± 1.99		1.85 ± 1.39	
• 51-60 years	5.41 ± 1.56	>0.05	2.27 ± 1.8	>0.05
• 61-70 years	5.46 ± 1.25		1.83 ± 1.61	
• >70	4.33 ± 2.08		0.67 ± 0.58	
MARITAL STATUS				
• Married	5.37 ± 1.59	>0.05	2.48 ± 1.49	>0.05
• Unmarried	5.1 ± 1.91		2.8 ± 1.93	
INCOME SCALE (per month)				
• 2	5.92 ± 0.97		2.32 ± 1.44	
• 3	5.86 ± 1.07		2.71 ± 2.69	
• 4	5.81 ± 0.98	0.001	1.81 ± 1.6	0.008
• 6	5.13 ± 2.03		0.75 ± 0.71	
• 10	4.26 ± 1.97		1 ± 1.27	
• 12	4.75 ± 2.63		0.25 ± 0.5	
RESIDENCY				
• Urban	4.81 ± 1.98	>0.05	1.81 ± 2.08	>0.05
• Rural	5.64 ± 1.29		1.64 ± 1.28	
LEVEL OF EDUCATION				
• Primary	5.86 ± 1.09		2.34 ± 1.42	
• Middle	5.67 ± 1.07		2.5 ± 1.78	
• Secondary	5.56 ± 1.15	<0.0001	1.63 ± 0.89	<0.001
• Higher secondary	5.58 ± 1.65		1.46 ± 1.92	
• Graduation	3.65 ± 2		0.47 ± 0.87	
EMPLOYMENT STATUS				
• Employed	4.55 ± 2.05	<0.0003	0.95 ± 1.21	<0.0002
• Unemployed	5.92 ± 0.95		2.33 ± 1.64	
• Retired	5.46 ± 1.27		1.54 ± 1.61	

Table 9- Paired t-test comparing total Adherence (BMQ) score (N=100)

Assessment time	Mean±SD	Comparison	P-value
Pre-program	4.74±1.18	Pre-program with After 6 weeks	<0.0001
After 6 weeks	1.81±0.1.17	Pre-program with After 12 weeks	<0.0001
After12 weeks	0.7±0.79	After 6 weeks with After 12 weeks	<0.0001

In this study the average age of the patients was 48.02±15.409 years. Out of 100 patients 51 % below age 50 years. 42% patients belonged to lower middle class on the basis of Kuppuswamy scale. [16] Most of patients were in rural background. (Table 1)

Over half of the patients had associated comorbidity in this study, diabetes, hypertension (23%, 4 and 20% respectively. Most patients were in terminal stage and 51% of the patients were found to be on hemodialysis (Table 1).

In this study significant improvement in total and subtotal adherence score in subsequent visit with medical education. There was a statistically significant relation was observed between monthly income and total adherence measured by MMSA-8 score as higher monthly income patients had a higher degree of adherence than lower income. It was also observed that level of education also statistically significantly associated with total adherence score which was measured by MMSA-8 score. It was also apparent that employment status also significantly associated with total adherence.

In this study more than half (58%) patient of study group reported that the main cause of not taking treatment as prescribed is due high cost of treatment which is also correlate with patient income status as patient with higher economic status was more adherent to their prescribed treatment.

Table 10- Correlation between socio-demographic characteristics and Total Adherence (BMQ score)

Variables	Pre-program		After 12 weeks	
	Mean ± SD	P-value	Mean ± SD	P-value
SEX				
• Male	4.73 ± 1.28	>0.05	0.76 ± 0.79	>0.05
• Female	4.77 ± 1.01		0.6 ± 0.79	
AGE				
• <20 years	4.96 ± 0.77		0.17 ± 0.24	
• 21-30 years	4.65 ± 1.16		0.61 ± 0.76	
• 31-40 years	5.21 ± 1.1		0.46 ± 0.74	
• 41-50 years	4.07 ± 1.23	>0.05	0.76 ± 0.87	>0.05
• 51-60 years	4.81 ± 1.07		0.79 ± 0.85	
• 61-70 years	5.12 ± 0.86		0.88 ± 0.77	
• >70	3.83 ± 2.89		0.28 ± 0.35	
MARITAL STATUS				
• Married	4.76 ± 1.21	>0.05	0.71 ± 0.8	>0.05
• Unmarried	4.58 ± 0.94		0.57 ± 0.7	
INCOME SCORE (per month)				
• 2	4.91 ± 0.78		1.24 ± 0.72	
• 3	4.52 ± 1.59		0.71 ± 0.95	
• 4	5.15 ± 0.61	>0.05	0.34 ± 0.43	<0.0001
• 6	4.38 ± 1.09		0.42 ±062	
• 10	4.48 ± 1.6		0.41 ± 0.71	
• 12	4.5 ± 2.09		0.25 ± 0.5	
RESIDENCY				
• Urban	4.86 ± 0.91	>0.05	0.41 ± 0.62	0.003
• Rural	4.68 ± 1.31		0.86 ± 0.83	
LEVEL OF EDUCATION				
• Primary	4.87 ± 0.7		1.16 ± 0.8	
• Middle	4.96 ± 0.9		1.33 ± 0.69	
• Secondary	4.91 ± 1.38	>0.05	0.61 ± 0.74	<0.0001
• Higher secondary	4.76 ± 1.19		0.22 ± 0.43	
• Graduation	4.2 ± 1.69		0.26 ± 0.58	
EMPLOYMENT STATUS				
• Employed	4.54 ± 1.38	>0.05	0.27 ± 0.59	
• Unemployed	4.84 ± 0.92		1.07 ± 0.8	<0.0001
• Retired	4.97 ± 1.44		0.53 ± 0.56	

There was a statistically significant relation was observed between residential status and total adherence measured by BMQ score, as urban patient was more adherent than rural. Also; it was observed that income status, level of education and employment status were also significantly associated with total adherence (BMQ).

Thus, in this study patients level of education, employment, monthly income and residential status were significantly associated with total adherence which was measured by both score MMSA-8 as well as BMQ. In this study most common cause for non-adherence was high cost of treatment which is seen in around 58 % 0f patient an followed were complex dosing schedule, forgetfulness, fear of adverse effects, difficult to take such a high number pills daily, unawareness about seriousness of disease etc.

DISCUSSION

Chronic kidney disease (CKD) is a global health problem in the modern world. Most CKD tend to progress, and with declining renal function various complications such as anemia, hypertension, and inflammation, malnutrition, metabolic and mineral-bone disorders gradually develops. ESRD patients on maintenance hemodialysis, tend to develop co-morbidities that require complex management which lead to poor adherence. The challenge for treating team is to better understand the factors that limit patient communication, so that patients' knowledge and understanding of their kidney disease may be improved. [17]

The burden of chronic disease on health care services worldwide is growing and the increased development of educational interventions which help patients to better manage their conditions is evident internationally. Adherence to

medication is a core part of patient management and outright necessary for attaining desired goals. It has been recognized that poor adherence can be a serious risk to the health and wellbeing of patients. Adherence by patients to prescribed treatment regimens can be considered as the interface between effective therapy and effective disease management, as well adherence can be affected by the nature of the relationship between the treating team and the patient, and their attitudes towards each other, also it has been suggested that treating team behavior can influence patient behavior and health status.

Measuring adherence is, therefore, necessary for clinicians for appropriate management. Effective treatments may be judged as ineffective, expensive diagnostic procedures may be ordered, and therapy may be unnecessary and dangerously intensified. Moreover, accurate estimates of medication adherence will provide better evidence on the consequences, predict risk factors, and plan to improve treatment adherence.

Therefore, a study to evaluate the impact of patient education in improving adherence to medication therapy in chronic kidney disease patients and that will be contribute in developing a better management of these health issues in CKD patients. The MMSA and BMQ score has been validated as an effective tool to assess adherence in patients with chronic illness. In India there have been only limited studies which have evaluated treatment adherence and their socio-demographic correlation in different stages of CKD. The objective of this study was to evaluated impact of education and treatment adherence in the patients of CKD and their correlation with socio-demographic variables.

Keeping in view of these facts, the study was planned to evaluate the impact of patient education in improving adherence to medication therapy in 100 CKD patients. In this study 51% patients below the age of 50 years. It is important to appreciate that the clinical spectrum of CKD in India is different from the western world. The average age of population with kidney disease in India is approximately 20 years younger than that reported in westerns countries. The probable explanation to this difference is due to genetic predisposition and the common causes of CKD like diabetes mellitus and hypertension sets in at a younger age in Indian population. [18] There is also more rapid progression of CKD which may be due to lack of access to medical facilities, poor economic status of peoples, more believes in traditional methods of treatments, delayed referral to specialist clinician and inadequate management. [19]

Out of total 100 patients, 62 were male and 38 were female. There was a male predominance in this study. The most common etiology of kidney disease was hypertension (29%) followed by diabetes mellitus (24%) and chronic glomerulonephritis (19%). Less frequent causes included obstructive uropathy, nephrotic syndrome, SLE and adult polycystic kidney disease. Chronic glomerulonephritis and chronic interstitial nephritis were reported to be the most common cause of ESRD in India in older, single center based reports. This spectrum seems to be changing with more recent literature reporting diabetic nephropathy as the commonest cause of ESRD in India. Rani et al. shown male preponderance and most common comorbidity was hypertension. [20] Danguilan et al. was also reported that 60% were males with a mean age of 49 years. [21]

In our study most of the patients were from lower and middle family income class. The most common educational status was primary school (32%) followed by 26% of higher secondary. Only 12% patients had middle school educational status. Danguilan et al reported 38% had an average monthly income of <8000. The authors also reviewed the efficacy of education and counseling program in improving chronic kidney disease (CKD) knowledge and found

majority (70%) had a high-school education, 23% had attended college, and 2% had been to graduate school. [21] Ghimirey et al also found that 35.9% had no formal education at all, 42.2% were educated up to class 10, and only 6.3% had education beyond class 12. [22]

Patients of CKD in our study were unemployed (50%) followed by employed individuals 37% and retired were 13%. Most of the patients reside in rural area (64%) and remaining population were residents of urban area (36%).Various study reported that CKD patients were mostly in lower socio-economic status and majority of the CKD patient were unemployed. [9,11]

In the present study, according to MMSA-4 and MMSA-8there was significant improvement in total and subtotal adherence from pre-program to subsequent visits at 6 weeks and 12 weeks after education. Total adherence significantly improved after 3 months of education, declining non-adherent for treatment were 80% to 25% respectively. There was significant improvement in adherence to fluid, diet medication and Renal parameter and were statistically ($P<0.001$) significant. Total adherence score also had significant correlation with demographic parameters viz. education, employment and income status of patients. Chronic kidney disease patients with higher income, higher education and employed status were more adherents to their prescribed treatment. Level of education has also been cited as a determinant in adherence behaviour in chronic illnesses such as CKD. Low education has been found to cause decreased adherence due to poor correlation with knowledge of disease and treatment. Patients with low health literacy find it difficult to follow appropriate schedule. [23] Similar finding were reported by Hala et al. [24] They found Statistical significant correlation between total adherence scores and levels of education, ($f = 11.902$, $p <0.05$). Abdulmalik et al. Reported that there was a significant difference in adherence ($P = 0.024$) between participants who had lower education compare to participants who have high education. [25]

In our study, total adherence score (measured by BMQ) was significantly associated ($p<0.0001$)with respect to period of assessment. Significant improvement in total adherence scores (measured by BMQ) was seen in subsequent visit after education. It was observed in our study that according to BMQ score there was significant association with many of the socio demographic characteristics. BMQ score was statistically significant association were found with Residential status, education, employment and income status at 12th week of study. Abdulmalik et al., (2014) reported that there was a significant difference in adherence ($P = 0.024$) between participants who had lower education compare to participants who have high education. [25]

Most common reason for non-adherence coming out in our study was high cost of medicine (58%), followed by complex dosing schedule (49%), forgetfulness (45%), fear of adverse effects (43%), difficult to take large number (32%), unaware about seriousness of the condition to be treated (25%), unaware about the need/usefulness of each medicine (19%) and personality characteristics(15%).Only 5% of the patients were non adherent due to depression and failure of trust in the physician. High cost of medication was found as one of the most common reasons for non-adherence to drug therapy in present study (58%). Frankenfield et al. has also reported that cost is a major factor for non-adherence in 23% of the ESRD patients. [26] Varleta et al. reported forgetfulness as the most common factor responsible for non-adherence in 67% of the patients ($n = 310$) using Morisky Green questionnaire; the present study finds this only in 45% of the patients. [27] Sontakke et al. also reported that high cost (62.74%), complex dosing schedule (58.82%), and fear of adverse effects (47.05%) were the common causes of nonadherence. [28]

To conclude, health care provider can play a crucial role in solving most of the barriers to adherence. It is also equally important to consider patients' priorities and limitations for appropriate management of their condition. The study emphasizes that provision of continuous education to chronic kidney disease patients would increase the medication knowledge of the patients and improve their adherence to management. It is also worth to mention that adherence measured by various tool was comparable in our study which would be helpful for busy clinician to find out adherence by simple tool like MMSA-4 instead of complex tool like BMQ. It is also essential to identify other factors leading to poor adherence to medication regimens as it would be beneficial for healthcare professionals to recognize patients who may benefit from interventions to improve medication adherence. By making patients understand the significance of the medications being prescribed for them, an increased adherence with long-term medication therapies can be achieved.

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