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Effect of Pharmacist-Mediated Educational Intervention on Knowledge, Attitude, Practice Toward Chronic Kidney Disease (CKD): A Hospital-Based Quasi-Experimental Study

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ABSTRACT

Introduction: Chronic kidney disease (CKD) is a major concern of the world, in terms of public health and requires improved patient education and effective disease management interventions. Pharmacists are among the other healthcare professionals these days that play a very crucial role in patient education and managing chronic diseases. This paper set out to assess the effects of the pharmacist-facilitated educational program on the knowledge, attitude and practice (KAP) of patients on the management of CKD.

Methods: A quasi experimental study was done in a hospital setting to a sample of 392 patients having CKD. The participants took part in structured pharmacist-delivered education and KAP questionnaires were conducted three times: at baseline, during the first follow-up (n=388) and during the second follow-up (n=384) at the interval of four months. Quality KAP questionnaires were to be used on every period to measure the changes with time.

Results: Substantially, the intervention by pharmacists enhanced patient knowledge as the score was 12.36 3.18 at the baseline and 16.50 2.46 at the second follow-up ($P < 0.001$). There was also a statistically significant increase ($P = 0.002$) in attitude scores from 21.65 4.29 to 22.80 3.66. The number gathered by the practice scores showed a significant increase, going up by 1.86 or a 34.03 percent difference (5.45 2.12 to 7.31 1.58; $P < 0.001$). In addition, the percentage of participants, who showed proper CKD knowledge, increased by 21.68 points, as the initial percentage was 61.13 and changed to 82.81, whereas the percentage, who showed proper CKD management practices, increased by 48.61 points, as the initial value was 33.16 and changed to 81.77.

Conclusion: The results highlight the very crucial role of pharmacists in strengthening CKD-related KAP. To put an end to long-term adherence to healthy behaviors, sustenance of educational interventions and proper follow-up are critical to ensuring better CKD results.

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1. INTRODUCTION

Chronic Kidney Disease (CKD) is a global health concern, that have a significant impact on mortality, morbidity, quality of life, and economic consequences due high health care costs associated with the management [1-3]. Globally, it was estimated that 700 million people are suffering from CKD. Evidence on 2017 revealed that 1.2 million people died worldwide due to CKD. Various nephrology societies or organizations such as International Society of Nephrology, European Renal Association, and American Society of Nephrology made a joint statement that advocates the inclusion of

CKD in the current WHO statement on major non-communicable diseases that act as drivers for pre-mature death [4]. A recent community based systematic review in India shows that there was a significant rise trend of CKD from 11.12% during 2011 to 2017, to 16.38% between 2018 to 2023. The rise epidemiology of diabetes and hypertension in India is the major cause for heightened CKD burden. CKD can be manifested from a mild condition with no or few symptoms to a serious condition called kidney failure where kidney stops working [5,6]. CKD can lead to various systemic complications such as cardiovascular, endocrine, metabolic, gastro-intestinal, neurological, and musculoskeletal disorders. Management of CKD is complex which is mediated by multidisciplinary approach that involves, regular monitoring health parameters, lifestyle changes, medication management based renal function, and dealing with complications of CKD. Patients' awareness about CKD, medication indicated, drug induced kidney injury, laboratory testing and interpretation, dietary modifications, role of physical activity, and lifestyle modifications are vital to enhance positive clinical outcomes, and economical outcomes [7]. Evidence shows that about one-third of the patients have no or limited knowledge about their disease condition and medication used. Various studies revealed that educational strategies targeted to enhance knowledge, attitude, and practice (KAP) of patients towards disease and its management shown a significant improvement in the outcomes. However, KAP levels of CKD patients can be influenced by various factors such as age, education, occupation, family income, stage of CKD, and clinical parameters. So, it is essential to explore factors that can affect the KAP levels among CKD patients to develop and implement educational interventions [8]. Low knowledge, negative attitude, irrational practices of CKD patients towards disease management can result in poor prognosis and outcome. Among healthcare professionals, pharmacist play a critical role in providing pharmaceutical care services and reduce the drug induced morbidity, mortality and healthcare costs [9,10]. Also, pharmacist well recognized in providing patient specific education or counselling in improving outcomes in chronic disorders such as hypertension, diabetes, COPD, asthma, hypothyroidism, and CKD. The evidence revealed that KAP studies in CKD patients were majorly focused to assess the level of KAP and explore the factors associated with KAP [11-13]. To the best of our knowledge, this is the first educational interventional study mediated by the pharmacist to enhance the KAP levels of CKD patients. The study area Anantapur is the largest district in Andhra Pradesh, India. Most of the population in this district are from rural backgrounds, living below the poverty line, are illiterate, and have poor access to primary health care. Like other chronic diseases, CKD can impact the patient's socioeconomic life; however, no evidence addressed the effect of pharmacist educational interventions on KAP of CKD patients in the Anantapur region. This research aims to evaluate how pharmacist-controlled educational interventions change the knowledge, attitude and practice (KAP) status of CKD patients in Anantapur, Andhra Pradesh, India. With the growing rates of CKD in India and its aggravation by such risks as diabetes and hypertension, the proposed study will touch upon the ways specific educational interventions may enhance patient knowledge of CKD management, along with medication, dietary interventions, and lifestyle changes. Through this investigation of the effectiveness of such interventions, the study aims at improving both clinical and economic outcomes in CKD patients, and especially those in rural settings with low access to health care.

2. METHODOLOGY

2.1 Study design and setting

A hospital-based, quasi-experimental, interventional, before and after, no control design was used to evaluate the effect of pharmacist-delivered educational intervention on KAP of CKD patients attending the Nephrology Department of Government General Hospital (GGH), Anantapur, Andhra Pradesh, India. The GGH is a tertiary care teaching, government owned, and one of the biggest hospitals in the district that serves more than four million people in the region. On average 55 patients visit monthly to the Nephrology Department to get treatment for kidney disorders. This was an interventional study that was conducted after baseline study (January 2022 to February 2023) that aimed to explore the factors associated with KAP of CKD patients regarding CKD and its management. The interventional study was conducted for a period of one year from March 2023 to April 2024 with two follow-up visits that were scheduled after four months of the intervention.

2.2 Study criteria

Patients aged more than 18 years, irrespective of gender, diagnosed with CKD, and visiting the Nephrology unit for dialysis, inpatient, or outpatient care were included in this study. Patients who were not willing to participate, and suffering from any other mental illness were excluded from this study [14,15].

2.3 Sample size and sampling

There was no study in Indian context regarding KAP toward CKD and its management [16]. So, we considered the 50% of the patients have adequate knowledge about CKD, which can give maximal sample size. By using single proportional population formula, considering 5% margin of error (MOE), 95% confidence interval, and 80% power, the sample size was determined as 384. After addition of the 10% non-response rate, the targeted sample size for our study was 422. A non-random, convenient sampling technique was adopted to select the eligible participants from in-patient, out-patient, and dialysis units. The selection procedure continues up to the attainment of the required sample size calculated.

2.4 Data collection tool

The data collection tool was prepared based on the existing literature on KAP towards CKD and its management among patients. The tool was composed with four sections. It includes: 1. Socio-demographics and clinical characteristics; 2. Knowledge about CKD; 3. Attitude about CKD and its management; and 4. Practice toward CKD and its management.

2.4.1 Socio-demographic and clinical characteristics

Socio-demographic variables like age, gender, marital status, educational level, employment details, family income, healthcare job in the family, and lifestyle habits. Clinical variables such as duration of CKD in years, presence of co-morbidity, CKD stage, family history of renal failure, suffering from osteoarthritis, and under painkillers or herbal medicine use.

2.4.2 Knowledge

A total of 20 questions were used in the section to assess the knowledge levels of CKD patients. The questions pertinent about patients' knowledge regarding CKD disease, laboratory tests and interpretation, dietary requirements in CKD, and pharmacological and non-pharmacological management of CKD. The comprehensive illustration of the KAP questions were presented in Annexure I. Based on the score attained for knowledge questions, patients were categorized by using Bloom's cut-off criteria in to good (>80%), moderate (60-80%), and poor (<60%) knowledge levels.

2.4.3 Attitude

Patient's beliefs, opinions, and perceptions regarding CKD and its management was measured by using 12 statements. The response for each statement was graded on 3-point Likert scale (1 disagree, 2 neutral, and 3 agree), which yields '3' lowest and '36' highest value. Patients scored more than or equal to the median (18) of highest score were categorized to have favourable attitude, and less were categorized to have unfavourable attitude toward CKD and its management.

2.4.4 Practice

The practice domain measures patient practices regarding regular clinical follow-up visits, laboratory checkups, dietary modifications, medication intake as per instruction, avoiding risk factors, and not on use of traditional or home remedies to manage disease. The practice question comprises a total of 8 questions. Patients scored about eight were categorized in to appropriate practice and less than eight were claimed as inappropriate practice toward CKD and its management.

2.5 Data collection and educational interventions

The study goals, protocol, and expected outcomes were clearly explained to the eligible participants before getting informed consent. All eligible patients who were willing to participate were enrolled in the study after getting informed consent. During the study frame, a face-to-face interview was conducted among study to obtain socio-demographics, and baseline KAP regarding CKD and its management [17]. After getting baseline data, educational interventions were implemented immediately, and after four months of the first interventions by the pharmacist to enhance the KAP levels among study participants. The data was collected at three points, one is at baseline, another was at four months of the post intervention, and the last one is after four months of the first educational intervention. The same data collection tool was used to obtain follow-up data from the participants.

The pharmacist provided educational interventions to improve the KAP of CKD patients regarding disease and its management. The intervention was focused on general understanding about CKD disease, interpretation of lab data, dietary modifications required in CKD, and role of medication in CKD management. Educational interventions were also tailorized based on the predictors of KAP levels observed at baseline study. The education was aided with the use of patient information leaf-lets and SMS reminder regarding medication intake and clinical visits.

2.6 Data analysis

IBM SPSS software for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used to analyse the data [18]. Descriptive statistics like frequency, proportion, mean, and SD will be used to represent the socio-demographics, clinical, and KAP levels. A paired t-test was employed to assess the effect of pharmacist mediated educational interventions on KAP of CKD patients. A two-way p-value of less than 0.05 is a statistically significant value.

2.7 Ethical considerations

The study proposal, data collection tools, and informed consent procedure were approved by the IRB of GGH. Prior initiation of the study, official permission was sought from the hospital's medical superintendent. All study participants were informed about the study objectives, withdrawal from the study, and assurance of confidentiality of data provided. Oral and written informed consent were obtained before data collection from each participant. To maintain confidentiality,

personnel identifiers were masked and codes were encrypted for each patient that can be only accessible to the principal investigator [19].

3. RESULTS

The study cohort had a mean age of 41.06 ± 11.89 years, with the highest representation from the 31-40 years (34.69%) and 41-50 years (32.40%) age groups. The majority of participants were male (71.43%) and married (76.02%). Educational status varied significantly, with 29.59% being illiterate, while only 9.44% had postgraduate qualifications. Employment data revealed a higher proportion of unemployed individuals (58.16%), suggesting potential financial dependence, which was reflected in the 41.84% of participants earning between INR 35,001-45,000 per month. Regarding chronic kidney disease (CKD), most participants had CKD for less than three years (74.23%), while Stage 2 CKD (47.19%) was the most prevalent. Comorbidities were common, with 22.96% having hypertension and 17.35% having diabetes, while 41.84% reported no associated disease. Lifestyle habits showed a significant proportion of smokers (40.31%) and alcohol users (48.98%), but 70.92% engaged in adequate physical activity. Family history and healthcare exposure revealed that 22.70% had a history of renal failure, while only 14.29% had family members in healthcare. Additionally, 12.24% suffered from osteoarthritis, while 14.54% used painkillers, and 10.71% consumed herbal medicine, highlighting the role of alternative therapies. The socio-demographics and clinical characteristics of the study participants are represented in Table 1 and Fig. 1.

Table 1 Baseline characteristics of study participants (N=392), including demographic details, education, employment, income, CKD duration, comorbidities, lifestyle habits, CKD stage, and history of healthcare-related employment, renal failure, osteoarthritis, and medication use.

Variable	Frequency (%)
Age (Mean ± SD)	41.06 ± 11.89
≤ 20	22 (5.61)
21-30	47 (11.99)
31-40	136 (34.69)
41-50	127 (32.40)
> 50	60 (15.31)
Gender	
Male	280 (71.43)
Female	112 (28.57)
Marital status	
Single	65 (16.58)
Married	298 (76.02)
Divorced/Separated/Widowed	29 (7.40)
Education status	
Illiterate	116 (29.59)
Primary	68 (17.35)
Secondary	56 (14.29)
Intermediate	74 (18.88)
Graduate	41 (10.46)
Postgraduate	37 (9.44)
Employment status	
Employed	164 (41.84)

Unemployed	228 (58.16)
Family income (INR)	
<15,000	50 (12.76)
15,001-25,000	47 (11.99)
25,001-35,000	69 (17.60)
35,001-45,000	164 (41.84)
> 45,000	62 (15.82)
Duration of CKD (in years)	
< 3 years	291 (74.23)
3-5 years	53 (13.52)
> 5 years	48 (12.24)
Co-morbidities	
Diabetes	68 (17.35)
Hypertension	90 (22.96)
CVD	56 (14.29)
Others	14 (3.57)
No disease	164 (41.84)
Lifestyle habits	
Smoker	158 (40.31)
Non-smoker	234 (59.69)
Alcoholic	192 (48.98)
Non-alcoholic	200 (51.02)
No physical activity	114 (29.08)
Adequate physical activity	278 (70.92)
CKD stage	
Stage 1 (GFR ≥ 90)	112 (28.57)
Stage 2 (GFR B/W 60 & 89)	185 (47.19)
Stage 3 (GFR B/W 30 & 59)	82 (20.92)
Stage 4 (GFR B/W 15 & 29)	11 (2.81)
Stage 5 (GFR < 15)	2 (0.51)
Does anyone in your family work in the healthcare sector (doctor, nurse, pharmacist, dietician)?	
Yes	56 (14.29)
No	336 (85.71)
Do you have any family history of renal failure?	
Yes	89 (22.70)

No	303 (77.30)
Are you suffering from osteoarthritis?	
Yes	48 (12.24)
No	344 (87.76)
Do you consume any painkillers?	
Yes	57 (14.54)
No	335 (85.46)
Do you take any herbal medicine?	
Yes	42 (10.71)
No	350 (89.29)

SD=Standard Deviation, INR=Indian rupee, CKD=Chronic Kidney Disease, GFR=Glomerular Filtration Rate

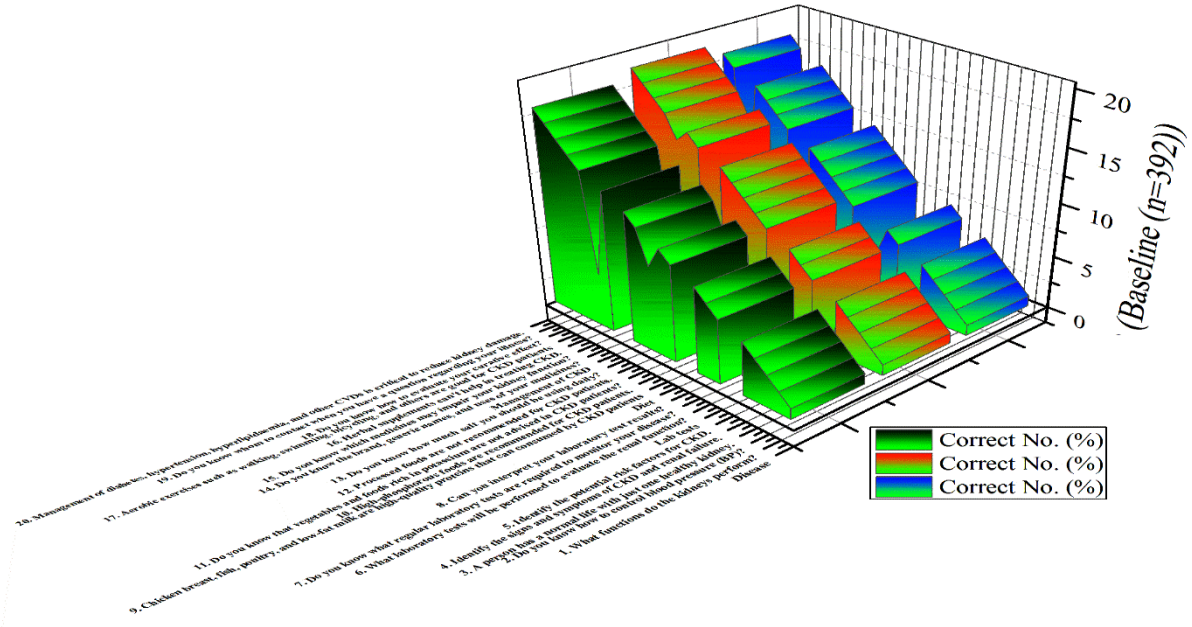

Fig. 1 3D bar chart depicting the percentage of correct responses to CKD-related knowledge questions at baseline (n=392). The color-coded bars represent different follow-up stages, showing progressive knowledge improvement over time

Knowledge Improvement Over Follow-ups

The study observed a progressive improvement in participants' knowledge about chronic kidney disease (CKD) across three follow-ups. At baseline, knowledge levels were moderate, with correct responses ranging from 54.34% to 71.17%. By the first follow-up, there was a noticeable improvement in all knowledge domains, with correct responses increasing to a range of 59.28% to 78.61%. By the second follow-up, knowledge levels improved significantly, with most correct responses exceeding 80%, demonstrating the effectiveness of the educational interventions.

Regarding disease awareness, 84.11% of participants correctly identified kidney functions by the second follow-up, compared to 66.84% at baseline. Awareness of blood pressure control improved from 61.22% to 78.65%, while the ability to recognize signs and symptoms of CKD increased from 66.33% to 87.76%.

Knowledge about renal function tests and monitoring laboratory results also showed significant growth, reaching 89.84% and 87.76%, respectively. Similarly, dietary awareness improved, with correct responses on salt intake increasing from 58.67% to 83.59% and processed food avoidance reaching 88.02%.

Knowledge about medications, CKD management, and exercise also showed substantial growth, confirming that educational initiatives significantly enhanced participants' understanding, ultimately promoting better self-management of CKD **Table 2** and **Fig. 2.**

Table 2 Changes in CKD-related knowledge over three follow-ups among study participants (N=392 at baseline, N=388 at first follow-up, N=384 at second follow-up). Knowledge was assessed across four domains: disease awareness, laboratory tests, diet, and CKD management. Percentages indicate correct responses at each time point.

Knowledge question	**Baseline (n=392)**	**1st Follow-up (n=388)**	**2nd Follow-up (n=384)**
	Correct No. (%)	**Correct No. (%)**	**Correct No. (%)**
Disease			
1. What functions do the kidneys perform?	262 (66.84)	289 (74.48)	323 (84.11)
2. Do you know how to control blood pressure (BP)?	240 (61.22)	262 (67.53)	302 (78.65)
3. A person has a normal life with just one healthy kidney.	254 (64.80)	277 (71.39)	316 (82.29)
4. Identify the signs and symptoms of CKD and renal failure.	260 (66.33)	290 (74.74)	337 (87.76)
5. Identify the potential risk factors for CKD.	243 (61.99)	273 (70.36)	324 (84.38)
Lab tests			
6. What laboratory tests will be performed to evaluate the renal function?	275 (70.15)	305 (78.61)	345 (89.84)
7. Do you know what regular laboratory tests are required to monitor your disease?	251 (64.03)	272 (70.10)	336 (87.50)
8. Can you interpret your laboratory test results?	221 (56.38)	253 (65.21)	337 (87.76)
Diet			
9. Chicken breast, fish, poultry, and low-fat milk are high-quality proteins that can consumed by CKD patients	228 (58.16)	259 (66.75)	319 (83.29)
10. High-phosphorous foods are recommended for CKD patients.	223 (56.89)	264 (68.04)	332 (86.46)
11. Do you know that vegetables and foods rich in potassium are not advised in CKD patients?	221 (56.38)	252 (64.95)	307 (79.95)
12. Processed foods are not recommended for CKD patients.	245 (62.50)	280 (72.16)	338 (88.02)
13. Do you know how much salt you should be using daily?	230 (58.67)	257 (66.24)	321 (83.59)
Management of CKD			
14. Do you know the brand, generic names, and uses of your medicines?	234 (59.69)	255 (65.72)	328 (85.42)
15. Do you know which medicines may impair your kidney function?	243 (61.99)	276 (71.13)	315 (82.03)
16. Herbal supplements can't help in treating CKD.	224 (57.14)	255 (65.72)	300 (78.13)
17. Aerobic exercises such as walking, swimming, bicycling, and others are good for CKD patients	233 (59.44)	256 (65.98)	292 (76.04)

18. Do you know how to evaluate your curative effect?	279 (71.17)	293 (75.52)	316 (82.29)
19. Do you know whom to contact when you have a question regarding your illness?	213 (54.34)	230 (59.28)	251 (65.36)
20. Management of diabetes, hypertension, hyperlipidaemia, and other CVDs is critical to reduce kidney damage.	257 (65.56)	265 (68.30)	280 (72.92)

BP=Blood Pressure, CVD=Cardio Vascular Disease, CKD=chronic kidney disease

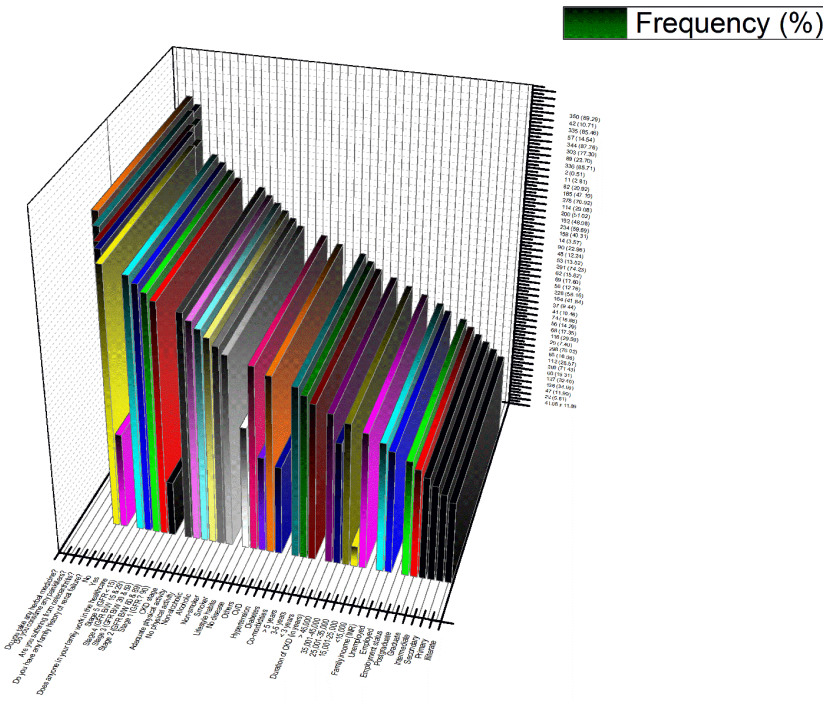

Fig. 2 3D bar chart illustrating the frequency distribution (%) of various demographic, clinical, and lifestyle factors among study participants. Each color represents a different variable, highlighting comparative data across categories

Changes in Attitude Over Follow-ups

The study observed gradual improvements in participants' attitudes toward CKD management across three follow-ups. At baseline, a favourable attitude was present in 72.96% of participants, which increased to 82.99% by the first follow-up and 89.84% by the second follow-up. A significant decline in disagree responses was observed over time. Initially, the proportion of participants disagreeing with key attitude statements was high, ranging from 41.07% to 48.98%. However, by the first follow-up, there was a moderate shift towards agreement, and by the second follow-up, favourable attitudes further increased, with disagreement rates dropping below 42% across most statements. Key improvements were noted in attitudes towards disease awareness, lifestyle modifications, and adherence to CKD management strategies. For example, agreement with A1 (importance of kidney function) increased from 33.16% to 42.71%, while disagreement decreased from 41.07% to 31.77%. Similarly, agreement with A3 (lifestyle changes and treatment adherence) improved from 29.34% at baseline to 34.64% at the second follow-up. Overall, the findings suggest that educational interventions successfully enhanced participants' positive perceptions of CKD management, which is critical for improving long-term health outcomes. Further reinforcement through counselling and patient education could sustain and strengthen these positive attitude changes Table 3 and Fig. 3. Changes in Practice Over Follow-ups The study demonstrated a substantial improvement in CKD-related practices among participants across the three follow-ups. At baseline, adherence to recommended practices was relatively low, with Yes responses ranging from 31.12% to 70.66%, indicating gaps in self-management. However, by the first follow-up, there was a notable increase in adherence, with Yes responses improving to a range of 80.15% to 81.96%, suggesting an effective impact of the intervention. By the second follow-up, practice levels significantly improved, with 91.15% to 92.45% of participants adhering to recommended CKD management behaviors. Among the most improved areas:

P1 (awareness of kidney functions) increased from 70.66% to 91.41%.

P3 (understanding life with one kidney) improved from 69.39% to 91.41%.

P6 (understanding disease management) increased from 66.84% to 92.45%.

P7 and P8 (awareness of medical consultations and routine follow-ups) improved from ~31% at baseline to over 91% by the second follow-up.

Table 3 Attitudinal changes towards CKD management among study participants (N=392 at baseline, N=388 at first follow-up, N=384 at second follow-up). Responses were categorized as Agree, Neutral and Disagree across 12 attitude-related statements. Percentages indicate shifts in participant perspectives over time.

Attitude	Baseline (n=392)			1st Follow-up (n=388)			2nd Follow-up (n=384)		
	Agree	Neutral	Disagree	Agree	Neutral	Disagree	Agree	Neutral	Disagree
A1	130 (33.16)	101 (25.77)	161 (41.07)	151 (38.92)	101 (26.03)	136 (35.05)	164 (42.71)	97 (25.26)	122 (31.77)
A2	106 (27.04)	104 (26.53)	182 (46.43)	113 (29.12)	111 (28.61)	164 (42.27)	124 (32.29)	110 (28.65)	149 (38.80)
A3	115 (29.34)	89 (22.70)	188 (47.96)	122 (31.44)	93 (23.97)	173 (44.59)	133 (34.64)	88 (22.92)	162 (42.19)
A4	108 (27.55)	101 (25.77)	183 (46.68)	119 (30.67)	103 (26.55)	166 (42.78)	133 (34.64)	104 (27.08)	146 (38.02)
A5	96 (24.49)	110 (25.77)	186 (47.45)	105 (27.06)	113 (29.12)	170 (43.81)	115 (29.95)	111 (28.91)	157 (40.89)
A6	95 (24.23)	105 (26.79)	192 (48.98)	103 (26.55)	107 (27.58)	178 (45.88)	116 (30.21)	108 (28.13)	159 (41.41)
A7	95 (24.23)	120 (30.61)	177 (45.15)	102 (26.29)	126 (32.47)	160 (41.24)	110 (28.65)	123 (32.03)	150 (39.06)
A8	99 (25.26)	106 (27.04)	187 (47.70)	106 (27.32)	107 (27.58)	175 (45.10)	108 (28.13)	106 (27.60)	169 (44.01)
A9	106 (27.04)	114 (29.08)	172 (43.88)	112 (28.87)	114 (29.38)	162 (41.75)	114 (29.69)	113 (29.43)	156 (40.63)
A10	106 (27.04)	113 (28.83)	173 (44.13)	110 (28.35)	113 (29.12)	165 (42.53)	111 (28.91)	112 (29.17)	160 (41.67)
A11	101 (25.77)	104 (26.53)	187 (47.70)	104 (26.80)	106 (27.32)	178 (45.88)	102 (26.56)	105 (27.34)	176 (45.83)
A12	102 (26.02)	98 (25.00)	192 (48.98)	102 (26.29)	97 (25.00	189 (48.71)	101 (26.30)	96 (25.00)	186 (48.44)

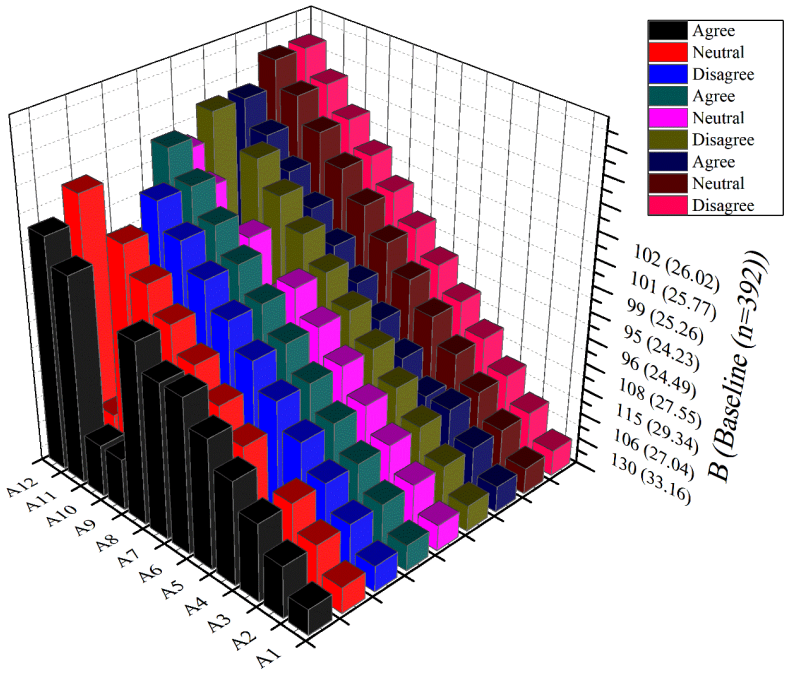

Fig. 3 3D stacked bar chart illustrating baseline (n=392) attitude responses toward CKD management. Bars represent the proportion of participants who agree (black), neutral (red), and disagree (blue/pink) with each attitude statement (A1–A12)

These findings indicate that continuous education, structured follow-ups, and reinforcement strategies significantly enhance self-care practices, leading to better CKD management and adherence to clinical recommendations. Sustained interventions could further improve long-term compliance and disease outcomes Table 4 and Fig. 4.

Table 4 Changes in practice-related behaviours among study participants (N=392 at baseline, N=388 at first follow-up, N=384 at second follow-up). The table presents the proportion of participants responding Yes or No to eight practice-related questions over time, indicating improvements in CKD management adherence.

Question	Baseline (n=392)		1st Follow-up (n=388)		2nd Follow-up	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
P1	277 (70.66)	115 (29.34)	317 (81.70)	71 (18.30)	351 (91.41)	33 (8.59)
P2	260 (66.33)	132 (33.67)	312 (80.41)	76 (19.59)	347 (90.36)	37 (9.64)
P3	272 (69.39)	120 (30.61)	311 (80.15)	77 (19.85)	351 (91.41)	33 (8.59)
P4	266 (67.86)	126 (32.14)	314 (80.93)	74 (19.07)	349 (90.89)	35 (9.11)
P5	263 (67.09)	129 (32.91)	314 (80.93)	74 (19.07)	348 (90.63)	36 (9.38)
P6	262 (66.84)	130 (33.16)	318 (81.96)	70 (18.04)	355 (92.45)	29 (7.55)
P7	124 (31.63)	268 (68.37)	311 (80.15)	77 (19.85)	350 (91.15)	34 (8.85)
P8	122 (31.12)	270 (68.88)	314 (80.93)	74 (19.07)	350 (91.15)	34 (8.84)

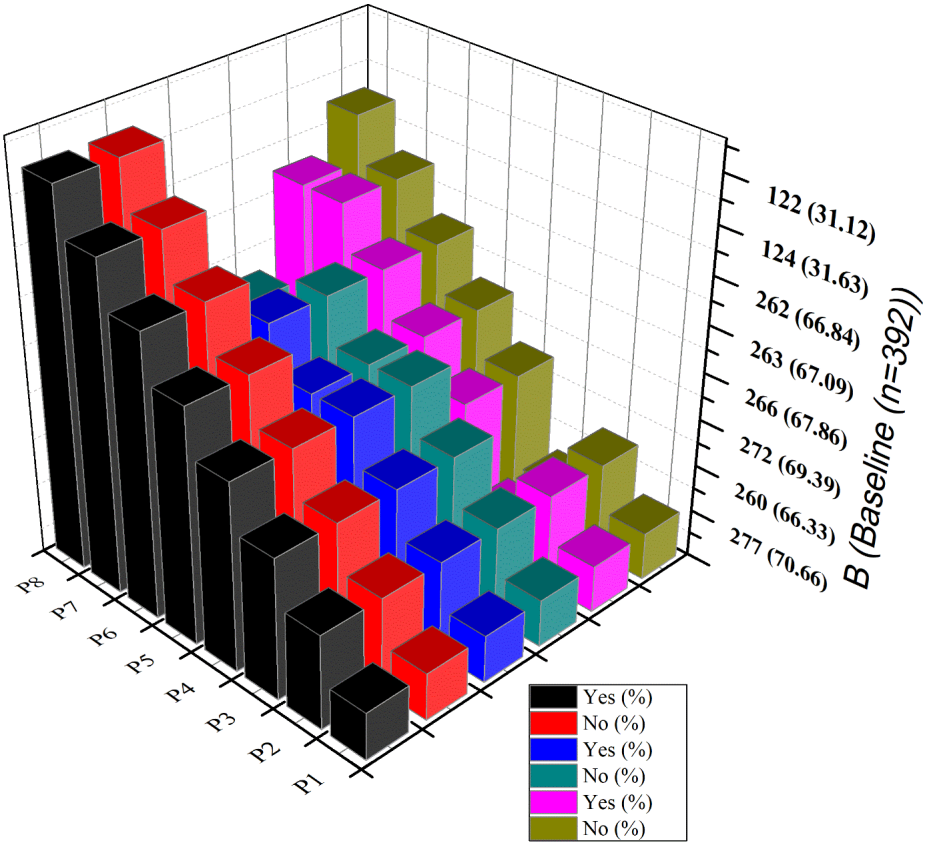

Fig. 4 3D bar chart illustrating baseline (n=392) responses to practice-related questions (P1–P8) regarding CKD management. Bars represent the proportion of participants who responded Yes (black, blue, pink) and No (red, cyan, gold) to each practice statement

Progressive Improvement in Knowledge, Attitude, and Practice (KAP) Over Follow-ups

The study showed a significant positive shift in knowledge, attitude, and practice (KAP) levels across the three follow-ups, indicating the effectiveness of educational interventions and patient engagement strategies.

Knowledge Improvement

At baseline, only 21.68% of participants had good knowledge, while 46.17% had poor knowledge. By the first follow-up, the proportion of participants with good knowledge increased to 35.05%, and by the second follow-up, it reached 82.81%. Meanwhile, the percentage of participants with poor knowledge decreased drastically from 46.17% at baseline to just 7.03% by the second follow-up. These results indicate that structured education effectively enhanced CKD awareness and understanding.

Attitude Shift

A favourable attitude toward CKD management increased from 72.96% at baseline to 82.99% at the first follow-up and further improved to 89.84% by the second follow-up. This shift highlights that participant became more receptive to disease management strategies, lifestyle changes, and treatment adherence.

Practice Enhancement

At baseline, only 33.16% of participants followed appropriate CKD management practices, while 66.84% had inappropriate practices. By the first follow-up, appropriate practice levels increased to 59.02%, and by the second follow-up, they reached 81.77%, showing a strong correlation between knowledge gain and behavioural change.

These findings confirm that targeted interventions significantly improved CKD-related knowledge, attitudes, and practices, reinforcing the need for sustained educational

programs to maintain long-term disease management outcomes Table 5 and Fig. 5.

Table 5 Progression of knowledge, attitude, and practice (KAP) levels among study participants (N=392 at baseline, N=388 at first follow-up, N=384 at second follow-up). The table illustrates improvements in CKD-related knowledge, attitude, and practice over time, with increasing proportions of participants demonstrating good knowledge, favourable attitudes, and appropriate practices.

Domain	Baseline Frequency (%) n=392	1st Follow-up Frequency (%) n=388	2nd Follow-up Frequency (%) n=384
Knowledge			
Good	85 (21.68)	136 (35.05)	318 (82.81)
Moderate	126 (32.14)	167 (43.04)	39 (10.16)
Poor	181 (46.17)	85 (21.91)	27 (7.03)
Attitude			
Favourable	286 (72.96)	322 (82.99)	345 (89.84)
Unfavourable	106 (27.04)	66 (17.01)	38 (10.16)
Practice			
Appropriate	130 (33.16)	229 (59.02)	314 (81.77)
Inappropriate	262 (66.84)	159 (40.98)	69 (18.23)

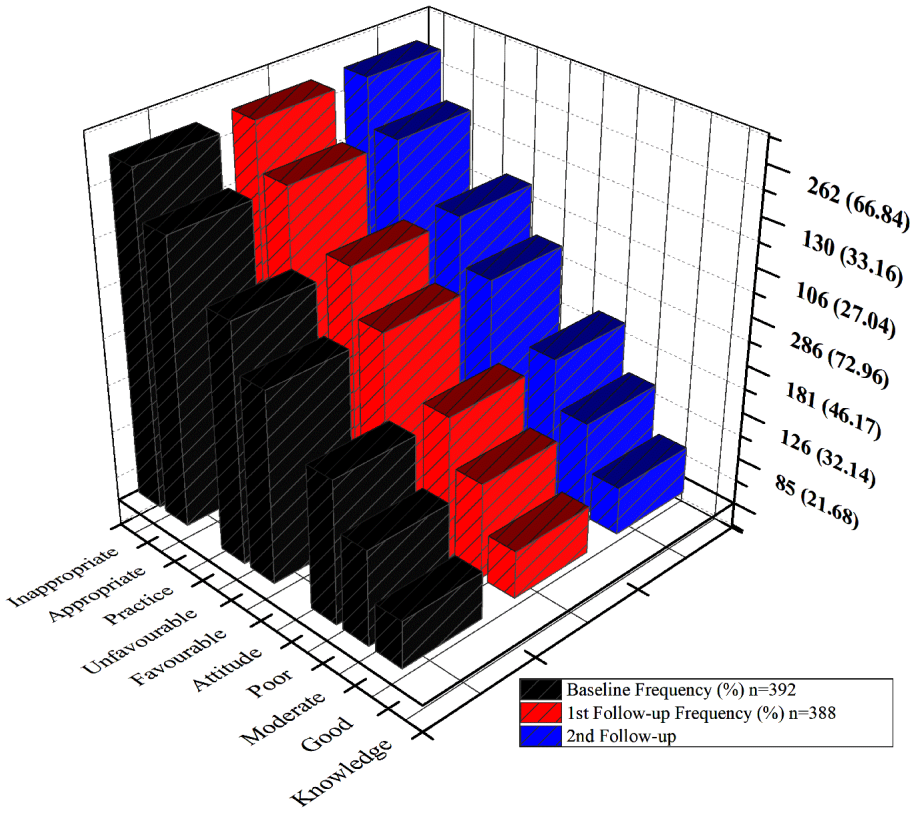

Fig. 5 3D bar chart illustrating changes in knowledge, attitude, and practice (KAP) levels across baseline (n=392), first follow-up (n=388), and second follow-up. Bars represent knowledge (good, moderate, poor), attitude (favourable, unfavourable), and practice (appropriate, inappropriate) with progressive improvement over time

Statistical Evaluation of Knowledge, Attitude, and Practice (KAP) Scores Over Time

The mean scores for knowledge, attitude, and practice (KAP) domains showed a significant improvement over the follow-up periods, demonstrating the effectiveness of educational interventions in enhancing CKD awareness and management.

Knowledge Improvement

The mean knowledge score significantly increased from 12.36 ± 3.18 at baseline to 13.82 ± 3.10 at the first follow-up (P = 0.6157, NS) and further to 16.50 ± 2.46 at the second follow-up (P < 0.001, statistically significant). The substantial increase indicates progressive knowledge acquisition among participants, with a strong impact of educational sessions.

Attitude Enhancement

The attitude score improved moderately, increasing from 21.65 ± 4.29 at baseline to 22.28 ± 3.96 at the first follow-up and 22.80 ± 3.66 at the second follow-up (P = 0.002, significant). Although the improvement was less dramatic than knowledge and practice, the gradual positive shift suggests growing acceptance of CKD management strategies among participants.

Practice Changes

The practice score showed a substantial increase, from 5.45 ± 2.12 at baseline to 6.47 ± 2.03 at the first follow-up (P = 0.3927, NS) and 7.31 ± 1.58 at the second follow-up (P < 0.001, highly significant). The significant increase indicates better adherence to CKD management practices over time.

The statistically significant improvements in knowledge and practice scores (P < 0.001) highlight the effectiveness of structured educational interventions in CKD management. Although attitude scores improved gradually, further reinforcement strategies may be needed to sustain long-term behavioural changes and treatment adherence Table 6 and Fig. 6.

Table 6 Comparison of mean scores (Mean ± SD) across knowledge, attitude, and practice (KAP) domains at baseline (N=392), first follow-up (N=388), and second follow-up (N=384). Statistically significant improvements (*P* < 0.001) were observed in knowledge and practice over time, while attitude showed a moderate but non-significant increase.

Domain	**Baseline (Mean ± SD)**	**First follow-up (Mean ± SD)**	***P*-value**
Knowledge	12.36 ± 3.18	13.82 ± 3.10	0.6157
Attitude	21.65 ± 4.29	22.28 ± 3.96	0.1149
Practice	5.45 ± 2.12	6.47 ± 2.03	0.3927
	1st Follow-up (Mean ± SD)	2nd Follow-up (Mean ± SD)	*P*-value
Knowledge	13.82 ± 3.10	16.50 ± 2.46	<0.001
Attitude	22.28 ± 3.96	22.80 ± 3.66	0.123
Practice	6.47 ± 2.03	7.31 ± 1.58	<0.001
	Baseline (Mean ± SD)	2nd Follow-up (Mean ± SD)	*P*-value
Knowledge	12.36 ± 3.18	16.50 ± 2.46	<0.001
Attitude	21.65 ± 4.29	22.80 ± 3.66	0.002
Practice	5.45 ± 2.12	7.31 ± 1.58	<0.001

SD=Standard Deviation

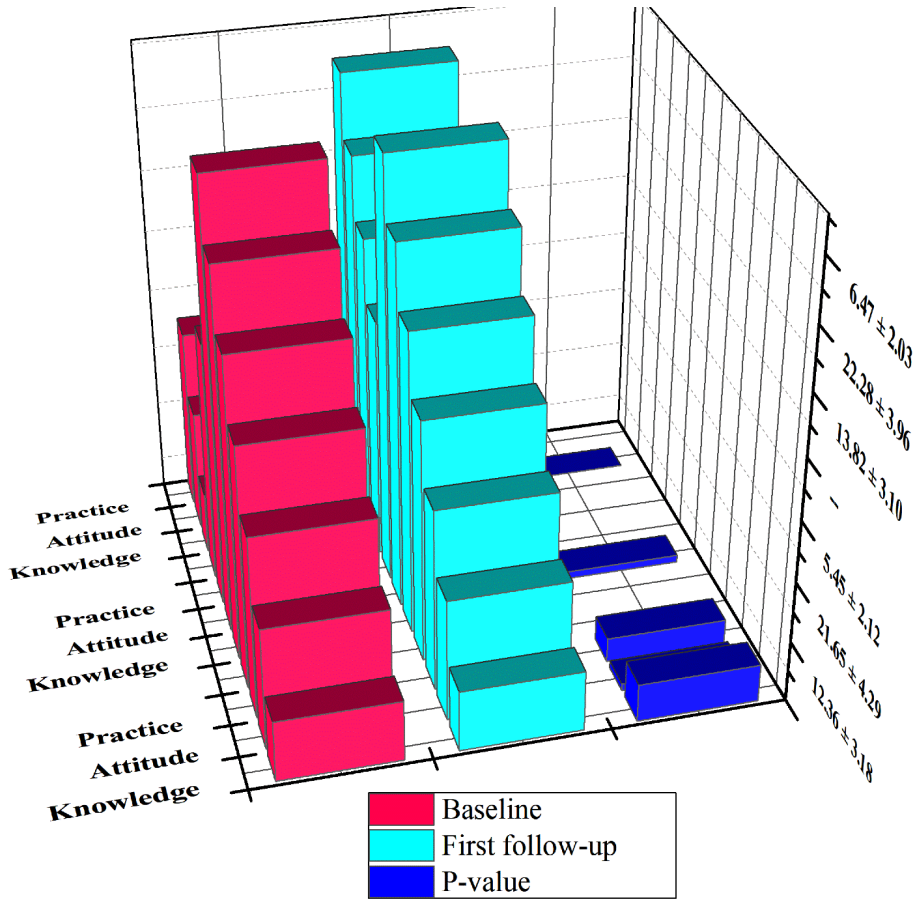

Fig. 6 3D bar chart comparing knowledge, attitude, and practice (KAP) mean scores at baseline and first follow-up. The bars represent baseline (red), first follow-up (cyan), and statistical significance (P-value, blue), showing improvements in all three domains over time

4. DISCUSSION

Majority of the studies focused on dialysis or in-patient pharmacist interventions in CKD patients. This study focused on all types of patients visiting to receive kidney care in nephrology unit were enrolled and observed the effect of pharmacist-mediated educational interventions of KAP levels. Prior to provide pharmacist interventions, patients were receiving routine care from the multidisciplinary healthcare team to manage CKD. Later, pharmacist measured baseline KAP levels of CKD patients, and their prescriptions were reviewed for suitability of medication, indication, dosage, diet, and any lifestyle changes needed among them. Patient suffering from CKD, it is foremost important to understand their disease, laboratory testing and interpretation, appropriate medication use, dietary and lifestyle modifications in a view to achieve an optimal therapeutic outcome. Findings of the current study emphasize the pharmacist role in management of CKD and achieve positive clinical outcomes.

Findings of our study revealed that there was a significant improvement in mean knowledge levels of the patients from first (13.82 ± 3.10) to second (16.50 ± 2.46) follow-up and baseline (12.36 ± 3.18) to second (16.50 ± 2.46) follow-up visits. Similar findings such as improved knowledge levels after pharmacist mediated educational intervention were also found in a study conducted in Nepal.[13] These findings suggest that pharmacist can enhance the knowledge regarding disease, diet, lab tests, and management of disease among CKD patients. To achieve the improvement of knowledge levels of the patients it is required to provide interventions for multiple times than once. This statement further supported by one more finding of our study that adequacy of good knowledge is low at first follow-up, but this was greatly improved on second follow-up visit.

Our study revealed that the mean attitude score of CKD patients was significantly improved from baseline (21.65 ± 4.29) to second follow-up visit (22.80 ± 3.66), however the improvement was not noticed from baseline to first, and first to second follow-up visits. A study conducted in Nepal shown a significant improvement in mean attitude scores of CKD patients before (38.19 ± 3.21) and after intervention (38.78 ± 3.03).[13] In our study, nearly 90% of the CKD patients attained favourable attitude at second follow-up visit which was very high compared to the baseline and first follow-up visit. Our

study findings suggest that it is most important to provide repeated educational interventions to modify the attitude domain of the CKD patients. Though the knowledge levels can improve immediately, attitude domain requires enough time to show an improvement in belief, behaviour, and others. Pharmacist was recognized to improve the patient perception, beliefs, behaviour, and attitudes towards various chronic disorders and its management.[10,14,15,18]

Pharmacist mediated educational intervention was significantly improved mean practice of CKD patients from baseline (5.45 ± 2.12) to first follow-up (6.47 ± 2.03), first follow-up (6.47 ± 2.03) to second follow-up (7.31 ± 1.58), and baseline (5.45 ± 2.12) to second follow-up (7.31 ± 1.58) visits. Similar findings are also observed in a study conducted in Nepal that pharmacist provided education improved practice from baseline (6.69 ± 0.89) to post intervention (6.91 ± 0.77).[13] A study conducted by Thomas et al revealed that pharmacist mediated counselling can improve quality of life in dialysis patients. (Thomas D, Joseph J, Francis B, et al. Effect of patient counseling on quality of life of hemodialysis patients in India. *Pharm Pract* 2009; 7(3): 181–184.) In our study, about 80% of the CKD patients attained appropriate practice at the end of the study. These findings suggest that pharmacist can greatly enhance the appropriate practice towards CKD management, which can improve the outcomes of the patients.

Strengths and limitations

The study was conducted at a single centre in Anantapur district, this can affect the generalizability of the findings to other hospital settings based on the hospital policy on the management of CKD. However, this is the primary study that provide evidence regarding pharmacist involvement in enhancing the KAP of CKD patients. Though the study is interventional in nature, there was no comparator at the all points of data collection and analysis. This can confound the outcome level by patient characteristics, and even time progresses, level of KAP can be altered. The study recommends to incorporate clinical and humanistic outcomes to evaluate the effect of pharmacist interventions in future studies.

Conclusion

The research shows that pharmacist-led educational treatments boost knowledge attitude and practice (KAP) competencies of chronic kidney disease (CKD) patients significantly. These findings demonstrate that organized educational interventions create effective pathways to close knowledge gaps along with empowering patients about disease management to help them change their health behaviors. A large percentage of study individuals displayed poor knowledge (46.17%) about CKD signs and factors that trigger the condition together with dietary limitations at the start of the study. The number of participants demonstrating good knowledge reached 82.81% following two follow-up assessments which proved to be statistically significant ($P < 0.001$). The participants demonstrated a gradual yet positive improvement in their attitude scores because their favorable attitudes rose from 72.96% during the baseline phase up to 89.84% at the second follow-up time point. The rise in positive perceptions shows that educational interventions worked but additional long-term support would be needed to maintain these observations. The practice scores of healthcare providers showed substantial improvement when appropriate CKD management practices increased from 33.16% to 81.77% during this study period ($P < 0.001$). The directed educational efforts deliver excellent results by helping patients with CKD practice self-care practices and follow their medication regimens while adopting beneficial lifestyle changes. A number of ongoing barriers exist including maintaining patient involvement across time together with extended counselling support and regular check-ins for sustaining knowledge maintenance and behavioral adherence. The research field requires investigations into the extended maintenance of these methods alongside their effects on the progression of clinical state and lifestyle quality for patients. The research strengthens the essential function of pharmacists in managing CKD while demonstrating the necessity of established patient education systems for achieving better treatment results and enhanced CKD patient self-care.

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Declarations

Conflict of interest

The authors state they have no known conflicting financial interests or personal relationships that would have seen to affect the work this paper reports.

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