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Knowledge, Attitude and Practice Towards Renal Rehabilitation in Chronic Kidney Disease Among Physiotherapy Students in Tripura

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ABSTRACT

Background: Chronic Kidney Disease (CKD) is a progressive condition leading to reduced functional capacity and poor quality of life. Renal rehabilitation plays an important role in improving outcomes, and physiotherapists are key contributors in its implementation. However, knowledge and clinical preparedness among physiotherapy students remain unclear.

Objective: To assess knowledge, attitude, and practice (KAP) regarding renal rehabilitation in CKD among physiotherapy students in Tripura.

Methodology: A cross-sectional, questionnaire-based study was conducted among 121 physiotherapy students in Tripura using a pre-validated, self-administered online questionnaire distributed through Google Forms. The questionnaire comprised demographic details and 41 questions assessing three domains: knowledge (12 items), attitude (12 Likert-scale statements), and practice (12 items, including 5 scenario-based questions) regarding renal rehabilitation in chronic kidney disease (CKD). Data were collected over three weeks through email and WhatsApp, and only complete responses were included in the final analysis.

Results: Out of 121 students, 54.5% of participants had received formal teaching regarding renal rehabilitation, whereas only 48.8% had direct clinical exposure to patients with CKD and 33.1% were familiar with exercise guidelines for CKD. Only 19.2% of students demonstrated good knowledge regarding renal rehabilitation, while the majority exhibited moderate (43.3%) or poor (37.5%) knowledge levels. Attitude towards renal rehabilitation was predominantly neutral (50.4%), although most participants agreed that physiotherapists should be integrated into dialysis teams and receive structured training in renal rehabilitation. Poor practice was observed in 65% of participants, with limited exposure to exercise assessment, monitoring, and rehabilitation outcome documentation. No significant differences in knowledge, attitude, or practice scores were found across academic years, whereas practice scores showed a significant association with age group [Mean ± SD= 24.80 ± 11.60, F = 5.06, p = 0.008].

Conclusion: Physiotherapy students in Tripura demonstrated moderate knowledge, neutral attitudes, and poor practice regarding renal rehabilitation in chronic kidney disease. The study highlights the need to strengthen academic training and

clinical exposure to bridge the knowledge-practice gap to improve competency in renal rehabilitation among future physiotherapists.

Keywords: Chronic Kidney Disease (CKD), Renal Rehabilitation, Physiotherapy Students

INTRODUCTION

Chronic Kidney Disease (CKD) is a progressive condition characterized by abnormalities in kidney structure and function that lead to a decline in the glomerular filtration rate and proteinuria that persist for more than three months, and have several health implications [1,2]. Due to the increasing prevalence of CKD, it has emerged as a major global public health concern. CKD is relatively common; approximately 1 in 10 people are affected worldwide, around 850 million people are affected with CKD and it is predicted that this number will reach 14.5 million by 2030 [1-3]. Out of them only 5.4 million patients are treated with hemodialysis or kidney transplantation. In upcoming years this problem will possibly come in epidemic proportion [1,3,4]. Common risk factors associated with CKD include congenital or inherited conditions such as Hypertension, Diabetes mellitus, Obesity, Renovascular disease, Glomerulonephritis, Interstitial disease, and Systemic Inflammatory disease [1,3,4]. In most patients with slow progressing CKD, until GFR falls below 30 ml/min/1.73m^2 (Stage3&5) stays asymptomatic [1,3,4]. According to various researchers, CKD has a physiologically wide impact, such as muscle wasting in patients. Depending on severity and duration, patients experience on constant fatigue, weakness, high blood pressure, and altered mental status [1,2]. CKD is associated with several systemic complications. This includes impairment of immune function, which increases susceptibility to infectious disease, development of anaemia, disturbances in electrolyte balance, metabolic acidosis, and endocrine abnormalities that may prolong the half-life of insulin. Additionally, Patients with chronic kidney disease may experience neurological dysfunction, an increased risk of cardiovascular complications, and metabolic bone disorders [1,2]. Apart from the physiological consequences, CKD significantly affects patients' functional capacity and daily activities. Patients diagnosed with CKD may experience reduced aerobic capacity, fatigue, and impaired physical performance compared with healthy individuals [5,6].

In context, renal rehabilitation has gained recognition as an important component of CKD management. Renal Rehabilitation generally includes structured exercise training, lifestyle modification, nutritional counselling, and psychosocial support aimed at improving physical function and health outcomes [7-9]. Evidence from several clinical studies suggests that appropriately prescribed exercise programs can improve cardiovascular fitness, muscle strength and overall quality of life in individuals with CKD [3,10]. Exercise-based interventions have also been associated with reduced fatigue, improved functional independence, and better tolerance to dialysis treatment [10-12].

Physiotherapists therefore play a key role in the multidisciplinary care of CKD patients by designing safe and effective exercise programs tailored to individual patients' needs [13,14]. Despite the increasing evidence supporting the benefits of renal rehabilitation, structured exercise programs remain inadequately implemented in many health care settings, and awareness regarding rehabilitation approaches for patients with CKD is often limited among healthcare professionals and trainees [15-20].

Physiotherapy students represent the future workforce responsible for implementing rehabilitation strategies in clinical practice. Therefore, adequate knowledge, positive attitudes and appropriate clinical practice related to renal rehabilitation are essential

for effective management of patients with CKD [21-23].

However, limited research has examined the level of awareness and perspectives on renal rehabilitation among physiotherapy students, particularly in developing regions. Understanding these aspects is important for identifying educational gaps and promoting the integration of evidence-based rehabilitation strategies into physiotherapy training [24]. Therefore, this study aims to assess the knowledge, attitude, and practice regarding renal rehabilitation in chronic kidney disease among physiotherapy students. Evaluating these factors may provide valuable insights into current educational preparedness and help strengthen rehabilitation-focused approaches in the management of chronic kidney disease (CKD).

MATERIALS & METHODS

Study design:

This study was conducted as a single-center cross-sectional study ai assessing the knowledge, attitude, and practice (KAP) regarding renal rehabilitation in chronic kidney disease (CKD) among physiotherapy students in Tripura. The research was carried out over a period of 2–3 months within an academic institutional setting.

Study setting:

The study was conducted at a physiotherapy college in Tripura, i.e., the Tripura Institute of Paramedical Sciences. Data collection took place in academic settings such as classrooms or clinical training environments, depending on participants' availability and institutional permissions.

Participant/ sample size:

A total of 121 participants were recruited using a convenience sampling technique based on their availability and willingness to participate.

Study population:

The study population will include undergraduate, interns, and postgraduate physiotherapy students currently enrolled in recognized institutions in Tripura.

Inclusion criteria:

- Undergraduate physiotherapy students (BPT), mainly 3rd, 4thyear students, and students who are doing internships, and Postgraduate physiotherapy students (MPT) from a recognized physiotherapy college in Tripura.
- Students who are willing to participate voluntarily in the study.
- Students who are available at the time of data collection and complete the questionnaire.
- Students who have completed at least one clinical posting or clinical exposure.

Exclusion criteria:

- Physiotherapy students studying outside Tripura.
- Incomplete or partially filled questionnaires may affect the reliability of the data.
- Students who have already participated in a similar pilot survey.
- Students who are absent during the data collection period.

Data collection tool:

Data collection was performed using a pre-validated structured questionnaire using Google Form, designed to comprehensively assess the three domains of knowledge, attitude, and practice (KAP). It consisted of a total of 41 questions divided into three sections along with demographic details of the participants, such as age, gender, level of qualification, and basic educational and clinical exposure to renal rehabilitation**.** Section A assessed knowledge regarding renal rehabilitation in chronic kidney disease, Section B evaluated attitudes toward renal rehabilitation, and Section C assessed practice-related aspects among physiotherapy students. The knowledge section consisted of 12 multiple-choice questions evaluating awareness of chronic kidney disease (CKD), its complications, and principles of renal rehabilitation. The

attitude domain included 12 statements measured on a five-point Likert scale, capturing participants' perceptions, beliefs, and willingness to engage in renal rehabilitation practices. The practice section comprised 12 multiple-choice questions along with 5 scenario-based questions, focusing on clinical decision-making, application of rehabilitation protocols, and real-life patient management strategies.

Procedure:

Before the commencement of data collection, permission was obtained from the institutional research committee for ethical approval. Informed consent was obtained from all participants after explaining the purpose and scope of the study. Ethical considerations were strictly followed, ensuring confidentiality, anonymity, and voluntary participation throughout the research process. The questionnaires were distributed electronically via email and WhatsApp. Each message contained a hyperlink that redirected participants to the online questionnaire webpage. Participants completed the questionnaire only after providing informed consent to participate in the study. To improve the response rate, participants were given a period of three weeks to complete and submit the questionnaire. The entire took about 15 min to fill out. In cases where no response was received within the specified timeframe, two reminder messages were sent at one-month intervals. Participants who did not respond after the reminders and incomplete responses were considered excluded from the study.

Before initiating the study, the survey questionnaire was reviewed by a panel of five experts in the field of renal rehabilitation. Their suggestions and recommendations were incorporated to improve the quality and clarity of the questionnaire. Subsequently, the Content Validity Index (CVI) was employed to evaluate the validity of the instrument, as it is a widely accepted method for assessing content validity during questionnaire development. The relevance of each item was assessed using a 5-point Likert scale through Google Forms, where 1 indicated "irrelevant," 2 "slightly relevant," 3 "moderately relevant," and 4 "extremely relevant." For CVI calculation, expert ratings were dichotomized, where scores of 1 and 2 were coded as 0 (not relevant), and scores of 4 and 5 were coded as 1 (relevant). According to Lynn's criteria (1986), excellent content validity is achieved when items demonstrate an Item-Level Content Validity Index (I-CVI) of 1.00 for panels consisting of 3–5 experts and a minimum I-CVI of 0.78 for panels of 6–10 experts. In addition, a Scale-Level Content Validity Index/Average (S-CVI/Ave) value of 0.90 or above is considered acceptable [25]. Based on the feedback obtained from the experts, the final version of the questionnaire was prepared for data collection.

Statistical Analysis

Data were analyzed using IBM SPSS version 26.0.1 (Statistical Package for the Social Sciences). The frequencies, cumulative frequencies, and percentages of responses were created, along with bar and pie charts that summarized the categorical data taken in this study. Additionally, we employed one-way ANOVA to determine whether there was statistical evidence of a significant relationship among the variables.

RESULT

Content Validation

The content validity of the questionnaire was assessed using the Content Validity Index (CVI), as presented in **[Table 1]**. The proportional relevance (PR) scores obtained from the five experts were 0.97, 0.97, 0.95, 0.95, and 0.9, respectively. The Scale-Level Content Validity Index based on Item-Level CVI (S-CVI/Ave based on I-CVI) was 0.95. In addition, the Scale-Level Content Validity Index based on Universal Agreement (S-CVI/UA) was found to be 0.87. These findings indicate that all validity

indices achieved acceptable standards, demonstrated satisfactory content validity. confirming that the questionnaire

Table 1: Response of each question from 5 experts, along with expert agreement, I-CVI, PR, and UA, where I-CVI is item content validity, UA is universal agreement, PR is proportion relevance, S-CVI Ave is score content validity average based on I-CVI, and S-CVI Ave is score content validity average. [Demographic items were excluded from the content validity assessment].

Section	Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert in agreement	I-CVI	UA
A (Knowledge)	Q1	1	1	1	1	1	5	1	1
	Q2	1	1	1	1	1	5	1	1
	Q3	1	1	1	1	1	5	1	1
	Q4	1	1	0	0	1	3	0.6	0
	Q5	1	1	1	1	1	5	1	1
	Q6	1	1	1	1	0	4	0.8	0
	Q7	1	1	1	1	0	4	0.8	0
	Q8	1	1	1	1	1	5	1	1
	Q9	1	1	1	1	1	5	1	1
	Q10	1	1	1	1	1	5	1	1
	Q11	1	1	1	1	1	5	1	1
	Q12	1	1	1	1	1	5	1	1
B (Attitude)	Q13	1	1	1	1	1	5	1	1
	Q14	0	0	0	0	0	0	0	0
	Q15	1	1	1	1	1	5	1	1
	Q16	1	1	1	1	1	5	1	1
	Q17	1	1	1	1	1	5	1	1
	Q18	1	1	1	1	1	5	1	1
	Q19	1	1	1	1	1	5	1	1
	Q20	1	1	1	1	1	5	1	1
	Q21	1	1	1	1	1	5	1	1
	Q22	1	1	1	1	1	5	1	1
	Q23	1	1	1	1	1	5	1	1
	Q24	1	1	1	1	1	5	1	1
C (Practice)	Q25	1	1	1	1	1	5	1	1
	Q26	1	1	1	1	1	5	1	1
	Q27	1	1	1	1	1	5	1	1
	Q28	1	1	1	1	1	5	1	1
	Q29	1	1	1	1	0	4	0.8	0
	Q30	1	1	1	1	1	5	1	1
	Q31	1	1	1	1	1	5	1	1
	Q32	1	1	1	1	1	5	1	1
	Q33	1	1	1	1	1	5	1	1
	Q34	1	1	1	1	1	5	1	1
	Q35	1	1	1	1	1	5	1	1
	Q36	1	1	1	1	1	5	1	1
	Q37	1	1	1	1	1	5	1	1
	Q38	1	1	1	1	1	5	1	1
	Q39	1	1	1	1	1	5	1	1
	Q40	1	1	1	1	1	5	1	1
	Q41	1	1	1	1	1	5	1	1
	PR	0.97	0.97	0.95	0.95	0.9		S-CVI Ave= 0.95	S-CVI/UA= 0.87

Response

A total of 121 questionnaires were distributed among physiotherapy students across different academic levels, including undergraduate students, interns, and postgraduate trainees.

The highest proportion of responses was obtained from BPT final year students (41%), followed by interns (34%), whereas the lowest response was observed among MPT 2nd year students (4%), indicating a varied representation across academic groups **[Figure-1]**.

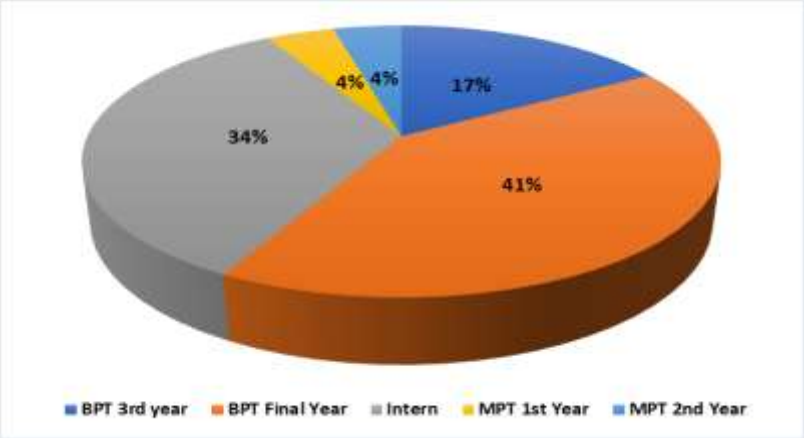

Figure 1: Response rate obtained from different years of undergraduate and postgraduate students

Demographic Characteristics and Academic Profile

The demographic and academic characteristics of the participants are summarized in **[Table 2]**. Out of 121 participants, 66 were female (55%), 55 were male (45%) **[Figure-2]**. The majority of participants belonged to the 22–25 years age group (62%), followed by 18–21 years (33.1%), with only a small proportion representing other age categories **[Figure-3]**.

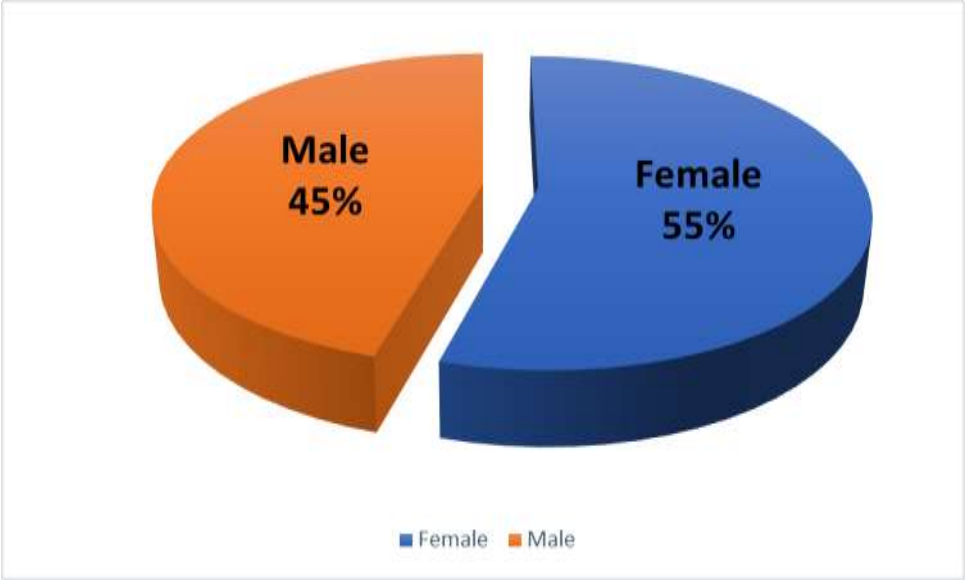

Figure 2: Distribution of Participants based on gender

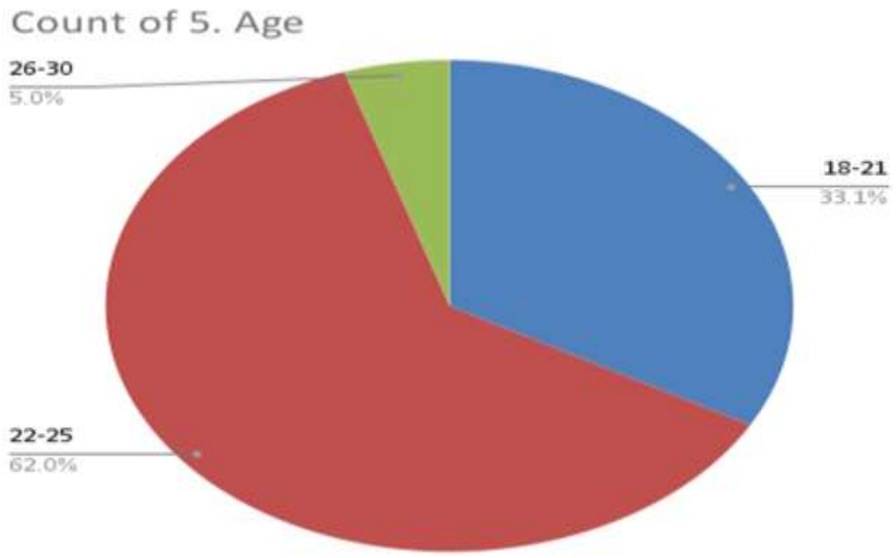

Figure 3: Distribution of Participants based on age

Table 2: Demographic and qualifications of the participants

Characteristics	**n**	**Value**
Age	121	22.71± 2.05
Gender		
Male	66	55%
Female	55	45%
Qualification		
Undergraduate (BPT)	111	92%
BPT 3rd Year	20	17%
BPT final Year	50	41%
Interns	41	34%
Postgraduate (MPT)	10	8%
MPT 1st Year	5	4%
MPT 2nd Year	5	4%
Educational and Clinical Exposure to Renal Rehabilitation		
Formal teaching on renal rehabilitation		
Yes	66	54.5%
No	55	45.5%
Exposure to physiotherapy treatment of CKD patients during clinical posting		
Yes	59	48.8%
No	62	51.2%
Posting in the dialysis unit		
Yes	44	36.4%
No	77	63.6%
Familiarity with CKD exercise guidelines		
Yes	40	33.1%
No	81	66.9%

In terms of academic qualification, undergraduate physiotherapy students constituted the majority (81.8%), while postgraduate students accounted for 18.2% **[Figure 4]**.

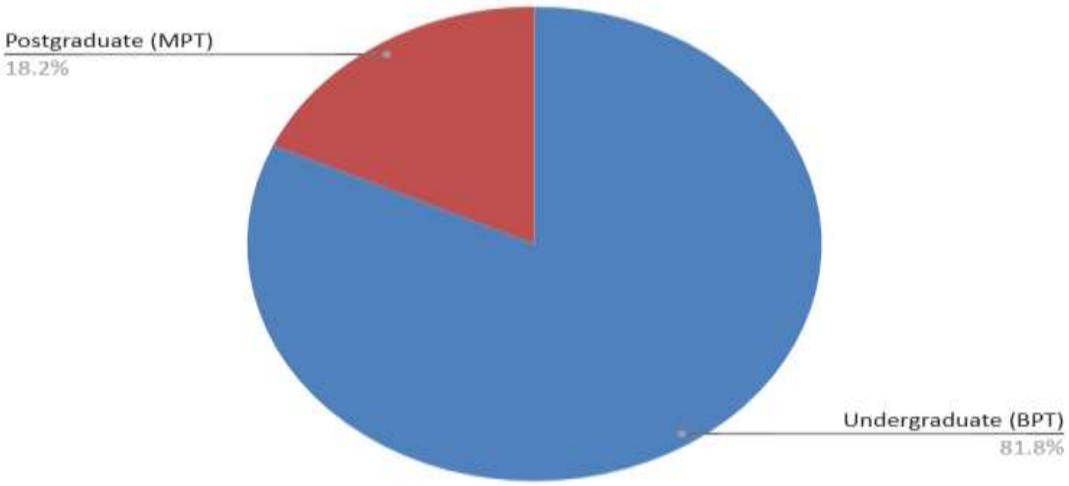

Figure 4: Distribution of Participants based on Academic Level

Regarding clinical exposure, 59 participants (48.8%) reported prior exposure to CKD patients, whereas 62 participants (51.2%) had limited or no exposure. These findings indicate that while most participants possess foundational academic knowledge, their clinical exposure varies considerably—an important factor when evaluating knowledge, attitude, and practice related to renal rehabilitation.

Knowledge

The knowledge of participants regarding renal rehabilitation in chronic kidney disease (CKD) was assessed using a structured questionnaire consisting of 12 multiple-choice questions. Each correct response was awarded one mark, with a maximum possible score of 12.

Participants were categorized into three levels: poor knowledge (score 0–4), moderate knowledge (score 5–8), and good knowledge (score 9–12) to facilitate meaningful interpretation.

CKD was correctly identified as a condition defined by kidney damage lasting for ≥3 months by 27.3% of participants, while 72.7% showed an incomplete understanding of the duration criteria. In terms of disease classification, 37.2% of respondents correctly recognized that CKD is staged based on estimated glomerular filtration rate (eGFR), whereas 62.8% were uncertain about the basis of staging.

Regarding disease severity, 21.5% of participants correctly identified that Stage 5 CKD corresponds to an eGFR of <15 mL/min/1.73 m², while 78.5% demonstrated confusion regarding the correct threshold. The primary cause of mortality in CKD patients was correctly recognized as cardiovascular disease by 27.3% of respondents, whereas 72.7% selected other or incorrect causes.

For exercise prescription, 32.2% of participants correctly selected moderate-intensity aerobic exercise as recommended for stable CKD patients, while 67.8% indicated inappropriate or unclear intensity levels. The most appropriate tool to monitor exercise intensity, the Borg Rating of Perceived Exertion (RPE) scale, was correctly identified by 32.2% of participants, whereas 67.8% were not aware of the standard monitoring method.

Regarding resistance training, 43.8% of respondents correctly recommended a frequency of 2–3 times per week, while 56.2% provided incorrect or inconsistent responses. Knowledge of absolute contraindications for exercise in CKD was correctly identified by 35.5% of participants, whereas 64.5% lacked clarity regarding safety-related restrictions.

In terms of intradialytic exercise, 23.1% of participants recognized its benefits in improving functional capacity and reducing fatigue, while 76.9% were unaware of its therapeutic effects. Common symptoms

experienced by CKD patients, such as fatigue and muscle weakness, were correctly identified by 31.4% of respondents, whereas 68.6% provided incomplete symptom recognition.

Regarding exercise benefits, 30.6% of participants acknowledged improvements in muscle strength, physical function, and quality of life, while 69.4% underestimated the overall benefits of exercise in CKD management. Finally, evidence-based guidelines for renal rehabilitation were correctly identified as being supported by major international nephrology and exercise organizations by 32.6% of participants, whereas 67.4% were unaware of the guideline sources. **[Table 3]** presents the frequency and percentage distribution of responses to the knowledge-based questions regarding renal rehabilitation in chronic kidney disease among physiotherapy students.

Based on the overall knowledge scores, 24 (19.2%) participants demonstrated good knowledge, 52 (43%) participants demonstrated moderate knowledge, and 45 (37.8%) participants demonstrated poor knowledge level regarding renal rehabilitation in chronic kidney disease **[Table 6]**. The majority of participants had moderate knowledge levels. **[Figure 5]** gives a graphical representation of the overall knowledge level of the students. The mean knowledge score of the participants was 5.15 ± 3.81 **[Table 7]**, indicating an overall moderate level of knowledge towards renal rehabilitation in chronic kidney disease.

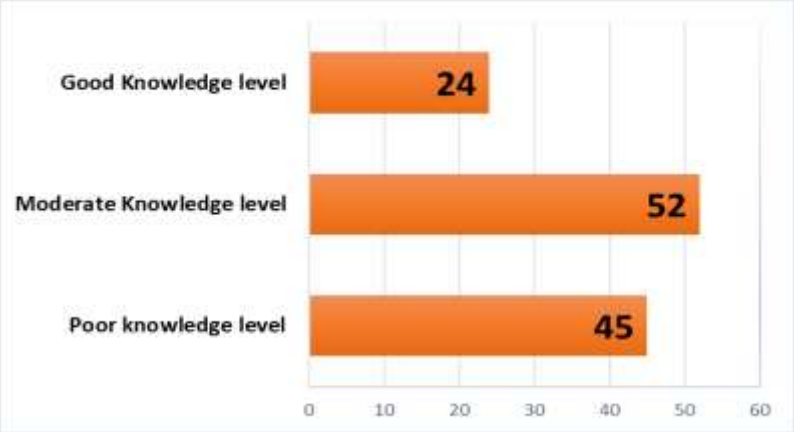

Figure 5: Overall, Knowledge Level

A closer analysis revealed that while participants were generally familiar with basic concepts such as the definition of disease and the role of physiotherapy, inconsistencies were evident in areas involving advanced rehabilitation strategies, exercise prescription, and precautionary guidelines.

Overall, the findings suggest that although a portion of participants demonstrates satisfactory knowledge, the predominance of moderate knowledge indicates an overall moderate level of understanding. This highlights the need for strengthened academic training, improved curriculum integration, and enhanced clinical exposure in renal rehabilitation.

Table 3: Frequency and percentage distribution for knowledge-based question responses (Correct and incorrect).

Sl. No.	Knowledge Questions	Correct n (%)	Incorrect n (%)
1	Chronic Kidney Disease is defined as kidney damage lasting for:	33(27.3%)	88(72.7%)
2	CKD is classified into stages based on:	45(37.2%)	76(62.8%)

3	Stage 5 CKD corresponds to eGFR:	26(21.5%)	95(78.5%)
4	Primary causes of mortality in CKD patients:	33(27.3%)	88(72.7%)
5	Recommended aerobic exercise intensity for stable CKD patients:	38(32.2%)	83(67.8%)
6	Most appropriate tool to monitor exercise intensity:	39(32.2%)	82(67.8%)
7	Resistance training frequency recommendation:	53(43.8%)	68(56.2%)
8	Absolute contraindication for exercise in CKD:	43(35.5%)	78(64.5%)
9	Intradialytic exercise improves:	27(23.1%)	94(76.9%)
10	CKD patients commonly experience:	38(31.4%)	83(68.6%)
11	Exercise benefits in CKD include improvement:	37(30.6%)	84(69.4%)
12	Evidence-based guidelines for renal rehabilitation are mainly supported by:	39(32.6%)	82(67.4%)

Attitude

The attitude section consisted of 12 items assessed using a 5-point Likert scale ranging from strongly agree to strongly disagree. Responses were scored as follows: strongly agree = 5, agree = 4, neutral = 3, disagree = 2, and strongly disagree = 1. The total attitude score ranged from 12 to 60. Based on percentage scores, participants were categorized as having positive attitude (≥80%; score 48–60), neutral attitude (60–79%; score 36–47), and negative attitude (<60%; score <36).

Regarding the initiation of renal rehabilitation in early CKD stages (1–3), 21.3% strongly agreed, 25.6% agreed, 26.4% remained neutral,17.4% disagreed, and 9.3% strongly disagreed. For the inclusion of physiotherapy in dialysis unit teams, 20.7% strongly agreed, 36.4% agreed, 24% were neutral, 13.2% disagreed, and 5.7% strongly disagreed.

In relation to the belief that exercise training reduces hospitalization rates in CKD patients, 16.5% strongly agreed, 23.1% agreed, 33.1% were undecided, 21.5% disagreed, and 5.8% strongly disagreed. Regarding the perception of under-referral of CKD patients to physiotherapy services, 20.7% strongly agreed, 26.4% agreed, 32.2% were neutral, 9.9% disagreed, and 10.8% strongly disagreed.

For the statement that renal rehabilitation is neglected in the undergraduate curriculum, 17.4% strongly agreed, 32.2% agreed, 31.4% expressed neutrality, 11.6% disagreed, and 7.4% strongly disagreed. In terms of multidisciplinary management improving CKD outcomes, 16.5% strongly agreed, 32.2% agreed, 27.3% were neutral, 14.1% disagreed, and 9.9% strongly disagreed.

Regarding confidence in designing exercise programs for CKD patients, 17.4% strongly agreed, 27.3% agreed, 37.2% remained neutral, 9.9% disagreed, and 8.2% strongly disagreed. For the need for structured training in renal rehabilitation during clinical education, 15.7% strongly agreed, 34.7% agreed, 33.1% were neutral, 6.6% disagreed, and 9.9% strongly disagreed.

In relation to exercise improving survival in CKD patients, 19.8% strongly agreed, 27.3% agreed, 26.4% were neutral, 13.2% disagreed, and 13.2% strongly disagreed. Regarding early physiotherapy intervention improving quality of life in CKD patients, 12.4% strongly agreed, 28.1% agreed, 37.2% expressed neutrality, 9.1% disagreed, and 13.2% strongly disagreed.

For the recommendation of regular exercise as part of CKD management, 15.7% strongly agreed, 21.5% agreed, 35.5% were neutral, 12.4% disagreed, and 14.9% strongly disagreed. Finally, regarding interest in specialization in renal rehabilitation, 12.4% strongly agreed, 28.1% agreed, 37.2% remained neutral, 9.1% disagreed, and 13.2% strongly disagreed. **[Table 4]** presents the frequency and percentage distribution of responses to the attitude-based questions regarding renal rehabilitation in chronic kidney disease among physiotherapy students.

The overall analysis of attitude levels revealed that 61 participants (50.41%) demonstrated a neutral attitude, while 36 participants (29.75%) showed a negative attitude, and only 24 participants (19.84%) exhibited a positive attitude among the

subjects **[Table 6]**. **[Figure 6]** gives a graphical representation of the overall knowledge level of the students. The mean attitude score was 39.88 ± 9.76 **[Table 7]**, suggesting an overall neutral attitude among the participants regarding the importance and implementation of renal rehabilitation in chronic kidney disease.

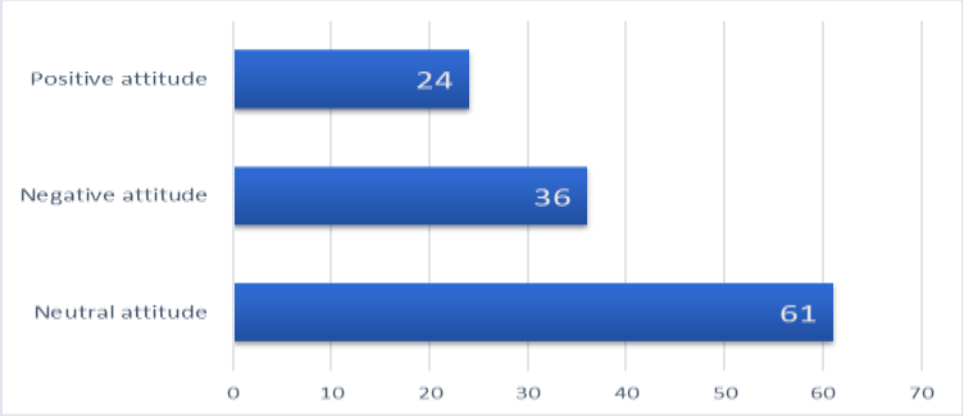

Figure 6: Overall Attitude Level

The predominance of neutral attitudes suggests that many participants were uncertain or moderately aware regarding the topic. Furthermore, the lower percentage of positive attitude may be related to the inadequate level of knowledge observed among the participants in the study.

Table 4: Frequency and percentage distribution for Attitude-based question responses (strongly agree, agree, neutral, disagree, strongly disagree)

Sl. No.	Attitude-based Questions	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
1	Renal rehabilitation should begin in early CKD stages (1-3)	26(21.3%)	31(25.6%)	32(26.4%)	21(17.4%)	11(9.3%)
2	Physiotherapy should be included in dialysis unit teams	25(20.7%)	44(36.4%)	29(24%)	16(13.2%)	7(5.7%)
3	Exercise training reduces hospitalization rates in CKD	20(16.5%)	28(23.1%)	40(33.1%)	26(21.5%)	7(5.8%)
4	CKD patients are under-referred for physiotherapy services	25(20.7%)	32(26.4%)	39(32.2%)	12(9.9%)	13(10.8%)
5	I feel renal rehabilitation is neglected in the undergraduate curriculum	21(17.4%)	39(32.2%)	38(31.4%)	14(11.6%)	9(7.4%)
6	Multidisciplinary approach improves CKD outcomes	20(16.5%)	39(32.2%)	33(27.3%)	17(14.1%)	12(9.9%)
7	I am confident in designing an exercise program for CKD patients	21(17.4%)	33(27.3%)	45(37.2%)	12(9.9%)	10(8.2%)
8	Physiotherapy students should receive structured training in renal rehabilitation during their clinical education	19(15.7%)	42(34.7%)	40(33.1%)	8(6.6%)	12(9.9%)
9	Exercise improves survival in CKD patients	24(19.8%)	33(27.3%)	32(26.4%)	16(13.2%)	16(13.2%)
10	Early physiotherapy intervention can improve the quality of life in CKD patients	15(12.4%)	34(28.1%)	45(37.2%)	11(9.1%)	16(13.2%)
11	Regular exercise should be recommended as a routine part of	19(15.7%)	26(21.5%)	43(35.5%)	15(12.4%)	18(14.9%)

	CKD management					
12	I am interested in specialization in renal rehabilitation	15(12.4%)	34(28.1%)	45(37.2%)	11(9.1%)	16(13.2%)

Practice

The practice of participants regarding renal rehabilitation in chronic kidney disease (CKD) was assessed using a structured questionnaire and categorized into 5-point Likert scale-based responses (never, rarely, sometimes, often, always). The total practice score ranged from 12 to 60. Participants were categorized into good practice (≥80%; score 48–60), fair practice (60–79%; score 36–47), and poor practice (<60%; score <36).

Regarding assessment of exercise tolerance in CKD patients before initiating rehabilitation, 9.9% never performed this assessment, 21.5% rarely, 33.9% sometimes, 19.8% often, and 14.9% always. For screening of contraindications before initiating exercise therapy, 12.4% never screened, 24.8% rarely, 33.1% sometimes, 13.2% often, and 16.5% always followed this practice.

In relation to educating CKD patients about the importance of regular physical activity, 10.7% never provided education, 17.4% rarely, 30.6% sometimes, 24% often, and 17.3% always engaged in patient education. Regarding encouragement of breathing and relaxation exercises, 14.9% never encouraged, 23.1% rarely, 28.1% sometimes, 19.8% often, and 14% always implemented this intervention.

For counselling on lifestyle modifications such as physical activity and stress management, 14% never provided counselling, 22.3% rarely, 35.5% sometimes, 12.4% often, and 15.8% always delivered such guidance. In terms of assessing muscle strength before prescribing resistance training, 13.2% never assessed, 19.8% rarely, 33.9% sometimes, 18.2% often, and 14.9% always performed muscle strength evaluation.

Regarding modification of physiotherapy interventions according to CKD stage, 10.7% never modified, 15.7% rarely, 33.1% sometimes, 25.6% often, and 14.9% always adjusted treatment plans. For adjusting exercise intensity based on patient fatigue levels, 13.2% never adjusted, 17.4% rarely, 33.9% sometimes, 16.5% often, and 19% always considered fatigue during prescription.

In relation to monitoring blood pressure and heart rate during physiotherapy sessions, 13.3% never monitored, 23.1% rarely, 34.6% sometimes, 13.2% often, and 15.8% always performed vital monitoring. Regarding assessment of functional independence prior to rehabilitation planning, 14.9% never assessed, 14.8% rarely, 27.3% sometimes, 24% often, and 19% always evaluated functional status.

For monitoring symptoms such as dizziness, shortness of breath, or chest pain during physiotherapy sessions, 14.8% never monitored, 14.1% rarely, 35.5% sometimes, 14.1% often, and 21.5% always checked for adverse symptoms. Finally, regarding documentation of patient progress during renal rehabilitation, 14.9% never recorded progress, 14.8% rarely, 33.1% sometimes, 19% often, and 18.2% always maintained proper records.

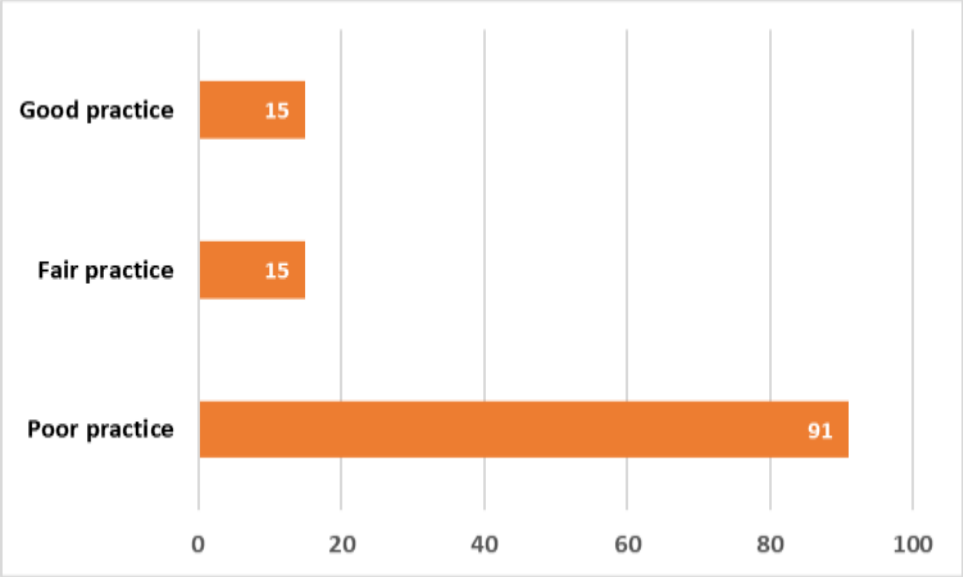

Figure 7: Overall Practice Level

[Table 5] presents the frequency and percentage distribution of responses to the practice-based questions regarding renal rehabilitation in chronic kidney disease among physiotherapy students. The practice-related findings revealed that 79 (65%) of participants demonstrated poor practice in renal rehabilitation for chronic kidney disease. In contrast, only 30 (25%) participants demonstrated fair practice, while another 12 (10%) participants demonstrated good practice **[Table 6]**. The mean practice score was 24.80 ± 11.60 **[Table 7]**, indicating poor practical exposure and implementation related to renal rehabilitation among physiotherapy students. These findings indicate limited practical exposure and inadequate implementation of renal rehabilitation principles among physiotherapy students in Tripura.

Case Scenario-Based Practice

The scenario-based clinical decision-making ability of participants in renal rehabilitation for chronic kidney disease (CKD) was assessed using structured case-based questions.

In the case of a 60-year-old patient with stable stage 3 CKD presenting with fatigue and reduced endurance, 27.3% of participants selected suitable physiotherapy management strategies, whereas 72.7% provided partially correct or suboptimal intervention choices. For a CKD patient undergoing dialysis with muscle weakness, 34.7% demonstrated selection of comprehensive rehabilitation approaches, while 65.3% indicated incomplete or less optimal management options.

Regarding a CKD patient experiencing shortness of breath during activity, 40.5% of respondents chose clinically justified interventions, whereas 59.5% suggested less consistent or inappropriate responses. Before initiating exercise in CKD patients, 33.1% of participants correctly identified essential assessment parameters, while 66.9% showed limited or incomplete pre-exercise evaluation knowledge. **[Figure 8]** illustrates the responses to the overall scenario-based practice questions. In the scenario where a CKD patient develops dizziness during exercise, 28.9% of participants selected correct immediate management actions, whereas 71.1% provided delayed, incomplete, or less suitable responses.

[Figure 9] illustrates the overall mean scores of knowledges, attitude, and practice among the participants towards renal rehabilitation in chronic kidney disease.

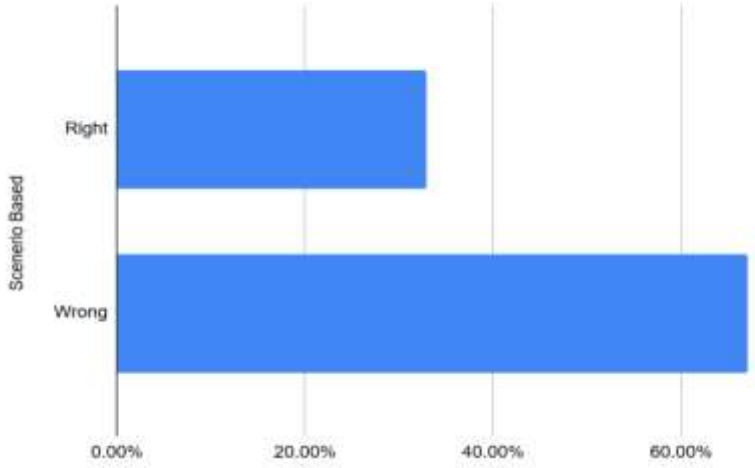

Figure 8: Overall scenario-based practice questions responses

Table 5: Frequency and percentage distribution for practice-based question responses

Sl. No.	Practice-based Questions	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)
1	I assess exercise tolerance in CKD patients before starting rehabilitation	12(9.9%)	26(21.5%)	41(33.9%)	24(19.8%)	18(14.9%)
2	I screen CKD patients for contraindications before initiating exercise therapy	15(12.4%)	30(24.8%)	40(33.1%)	16(13.2%)	20(16.5%)
3	I educate CKD patients about the importance of regular physical activity	13(10.7)	21(17.4%)	37(30.6%)	29(24%)	21(17.3%)
4	I encourage CKD patients to perform breathing and relaxation exercises	18(14.9%)	28(23.1%)	34(28.1%)	24(19.8%)	17(14.1%)
5	I provide counselling about lifestyle changes such as physical activity and Stress management	17(14%)	27(22.3%)	43(35.5%)	15(12.4%)	19(15.8%)
6	I assess muscle strength before prescribing resistance training	16(13.2%)	24(19.8%)	41(33.9%)	22(18.2%)	18(14.9%)
7	I modify physiotherapy interventions based on the patient's stage of CKD	13(10.7%)	19(15.7%)	40(33.1)	31(25.6%)	18(14.9%)
8	I adjust exercise intensity based on the patient's fatigue level	16(13.2%)	21(17.4%)	41(33.9%)	20(16.5%)	23(19%)
9	I monitor blood pressure and heart rate during physiotherapy sessions for CKD patients	16(13.3%)	28(23.1%)	42(34.6%)	16(13.2%)	19(15.8%)
10	I assess the patient's functional independence before planning rehabilitation	18(14.9%)	18(14.8%)	33(27.3%)	29(24%)	23(19%)
11	I check for symptoms such as dizziness, shortness of breath or chest pain during physiotherapy sessions	18(14.8%)	17(14.1%)	43(35.5%)	17(14.1%)	26(21.5%)
12	I record patient progress during renal rehabilitation sessions	18(14.9%)	18(14.8%)	40(33.1%)	23(19%)	22(18.2%)
Case Scenario-Based Practice:			Correct n (%)		Incorrect n (%)	
1	A 60-year-old patient with stable stage 3 CKD reports fatigue and low endurance. Best Physiotherapy intervention?		33(27.3%)		88(72.7%)	

2	CKD patient on dialysis has muscle weakness. Best Physiotherapy management?	42(34.7%)	79(65.3%)
3	CKD patient experiences shortness of breath during activity. Appropriate intervention?	49(40.5%)	72(59.5%)
4	Before starting exercise in a CKD patient, what should the physiotherapist assess?	40(33.1%)	81(66.9%)
5	CKD patient develops dizziness during exercise. Best action?	35(28.9%)	86(71.1%)

Table 6: Overall KAP Category Distribution

Category	Frequency (n)	Percentage (%)
Knowledge:		
Poor knowledge	45	37.5
Moderate knowledge	52	43.3
Good knowledge	24	19.2
Attitude:		
Neutral attitude	61	50.4
Negative attitude	36	29.75
Positive attitude	24	19.84
Practice:		
Poor practice	79	65
Fair practice	30	30
Good practice	12	12

Table 7: Overall Mean Scores of Knowledge, Attitude, and Practice

Domain	Mean Score ± SD	Minimum Score	Maximum Score
Knowledge	4.19 ± 3.81	0	12
Attitude	39.88 ± 9.76	12	60
Practice	24.80 ± 11.60	12	60

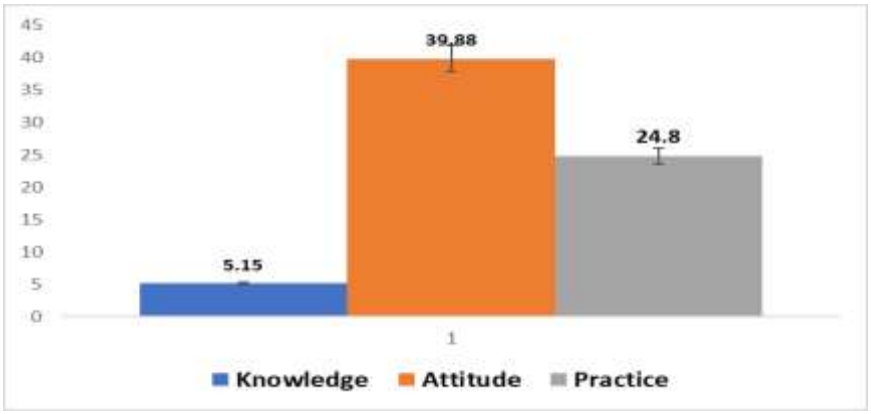

Figure 9: Overall mean scores for knowledge, Attitude, and Practice among the participants.

One-way ANOVA was conducted to assess the association of demographic characteristics with knowledge, attitude, and practice (KAP) scores regarding renal rehabilitation among physiotherapy students **[Table 8]**. With respect to year of study, the mean knowledge score increased progressively from BPT 3rd-year students (4.2 ± 2.3) to MPT 2nd-year students (6.6 ± 3.4). Similarly, attitude scores increased from 35.80 ± 8.50 among BPT 3rd year students to 46.00 ± 10.50 among MPT 2nd year students, while practice scores increased from 23.10 ± 10.90 to 28.20 ± 12.01. As shown in Table 8, no statistically significant differences were observed in knowledge ($F = 1.25$, $p = 0.29$), attitude ($F = 0.43$, $p = 0.78$), or practice ($F = 0.77$, $p = 0.54$) scores across different years of study. Similarly, age was not significantly associated with knowledge ($F = 1.40$, $p = 0.25$) or attitude ($F = 1.76$, $p = 0.17$) scores.

However, One-way ANOVA revealed a statistically significant difference in practice scores across age groups (F = 5.06, p = 0.008), indicating that age was significantly associated with practice regarding renal rehabilitation in this study.

Table 8: Association of different characteristics with knowledge, attitude, and practice

Characteristics/N	Knowledge			Attitude			Practice		
	Mean ± SD	F	P value	Mean ± SD	F	P value	Mean ± SD	F	P value
Year of the study for Undergraduate and Postgraduate students:									
BPT 3rd Year (20)	4.2±2.3	1.25	0.29	35.80±8.50	0.43	0.78	23.10±10.90	0.77	0.54
BPT 4th Year (50)	4.8±2.7			38.20±9.10			24.10±11.20		
Interns (29)	5.8±3.1			42.10±9.60			25.80±11.50		
MPT 1st Year (17)	6.2±3.2			44.20±10.20			27.00±11.80		
MPT 2nd Year (5)	6.6±3.4			46.00±10.50			28.20±12.01		
Total (121)	5.15±3.81			39.88±9.76			24.80±11.60		
Age:									
18-21 years (40)	4.90±3.60	1.40	0.25	38.70±9.20	1.76	0.17	23.50±11.10	5.06	0.008
22-25 years (75)	5.20±3.80			40.30±9.80			25.30±11.70		
26-30 years (6)	5.80±4.00			41.80±10.40			26.80±12.20		
>30 years (0)	-			-			-		
Total (121)	5.15±3.81			39.88±9.76			24.80±11.60		

DISCUSSION

The present study evaluated the knowledge, attitude, and practice regarding renal rehabilitation in chronic kidney disease among physiotherapy students in Tripura. The findings demonstrated an overall moderate level of knowledge, predominantly neutral attitudes, and poor practical exposure towards renal rehabilitation. Although more than half of the participants (54.5%) had received formal teaching regarding renal rehabilitation, less than half had direct clinical exposure (48.8%) to patients with chronic kidney disease, and only one-third (33.1%) were familiar with exercise guidelines for CKD. These findings suggest important gaps in both educational and clinical training related to renal rehabilitation among physiotherapy students.

The present study demonstrated that only 19.3% of participants had good knowledge regarding renal rehabilitation, whereas the majority exhibited moderate or poor knowledge levels. In particular, substantial deficiencies were observed in understanding CKD staging, exercise prescription, intradialytic exercise, and evidence-based guidelines. These findings may be attributed to inadequate curricular emphasis on renal rehabilitation and limited exposure to nephrology settings during undergraduate education.

Similar findings have been reported by Greenwood et al., who highlighted insufficient awareness and implementation of exercise-based renal rehabilitation despite growing evidence supporting its benefits among patients with CKD [15]. Likewise, Delgado and Johansen reported inadequate counseling regarding physical activity among nephrology healthcare professionals [20]. The lack of familiarity with international exercise guidelines observed in the present study is therefore not unexpected and may reflect a broader educational gap in renal rehabilitation training [21–23].

Although the majority of participants demonstrated a neutral attitude towards renal rehabilitation, only a small proportion exhibited a positive attitude. The predominance of neutral responses may indicate uncertainty regarding the role of physiotherapy in CKD management and a lack of confidence in exercise prescription. Interestingly, more than half of the participants agreed that physiotherapists should be integrated into dialysis teams and that structured training in renal rehabilitation is necessary.

These findings are consistent with previous studies indicating that exercise is recognized as an important component of CKD management and renal rehabilitation [17–19,26]. However, healthcare professionals often lack confidence and adequate training to implement rehabilitation programmes effectively [20–22]. The observed neutral attitude may therefore be secondary to insufficient knowledge and limited clinical exposure rather than a lack of interest in renal rehabilitation itself.

The most concerning finding of the present study was the poor level of practice regarding renal rehabilitation, with nearly 51.2% of participants demonstrating inadequate practical exposure. Many participants reported that they only occasionally assessed exercise tolerance, screened for contraindications, monitored vital signs, or documented rehabilitation outcomes. These findings may be explained by the limited opportunities for clinical postings in nephrology and dialysis units, as only 36.4% of participants had exposure to dialysis settings. Similar barriers have been reported in previous literature, where inadequate training, lack of clinical experience, and insufficient interdisciplinary collaboration were identified as major obstacles to implementing renal rehabilitation programmes [17,20,22].

Poor practice despite moderate knowledge further suggests the existence of a knowledge-practice gap, indicating that theoretical understanding alone is insufficient to ensure clinical competence in renal rehabilitation.

Evidence from supervised intradialytic exercise programmes has demonstrated significant improvements in physical function and supports the feasibility of integrating exercise into routine dialysis care, further emphasizing the importance of developing practical competencies among future physiotherapists [27].

Nearly half of the participants had never managed a patient with chronic kidney disease during clinical postings, and approximately two-thirds had never been posted in a dialysis unit. This lack of direct patient exposure may partly explain the deficiencies observed in knowledge, attitude, and practice scores [22,28,29]. Clinical exposure is an essential component of physiotherapy education because experiential learning significantly improves confidence and clinical decision-making skills [21,22]. Therefore, the integration of structured nephrology postings and renal rehabilitation modules into physiotherapy curricula may help bridge this educational gap.

No statistically significant differences were observed in knowledge, attitude, or practice scores across academic years. This finding suggests that progression through the physiotherapy curriculum alone may not necessarily improve competencies related to renal rehabilitation. The absence of a structured renal rehabilitation curriculum across academic years may explain these findings. Interestingly, practice scores differed significantly across age groups. Older students demonstrated slightly better practice scores, possibly due to greater clinical exposure, maturity, and increased opportunities for patient interactions. However, the small number of participants in the higher age groups necessitates cautious interpretation of this finding.

To the best of our knowledge, this is among the first studies from Northeast India to evaluate knowledge, attitude, and practice regarding renal rehabilitation among physiotherapy students. The findings

highlight significant educational and clinical gaps that may influence the future delivery of rehabilitation services to patients with chronic kidney disease. Considering the growing global burden of chronic kidney disease and the expanding evidence supporting exercise-based renal rehabilitation, there is an urgent need to strengthen educational and clinical training strategies in this area of physiotherapy practice [30–32].

Limitations

This study was limited by its cross-sectional design, single-state setting, and reliance on self-reported data, which may affect the generalizability and accuracy of the findings. Additionally, practical skills in renal rehabilitation were not objectively assessed.

Future Recommendations

Renal rehabilitation should be integrated into the physiotherapy curriculum, with increased clinical exposure in nephrology and dialysis units. Future multicenter and longitudinal studies with larger samples are recommended to evaluate the impact of educational interventions on students' competencies.

CONCLUSION

Physiotherapy students in Tripura demonstrated moderate knowledge, neutral attitudes, and poor practice regarding renal rehabilitation in chronic kidney disease. The findings highlight the need for improved educational strategies, structured training, and enhanced clinical exposure to strengthen competencies in renal rehabilitation and improve future patient care. Therefore, it is essential to enhance physiotherapy education by integrating comprehensive theoretical teaching with hands-on clinical training, particularly in specialized settings such as dialysis units and nephrology departments. Emphasis on evidence-based practice and interdisciplinary learning will further improve competency. In conclusion, strengthening both academic and clinical components is crucial to bridge the gap between knowledge and practice, ultimately ensuring better preparedness of future physiotherapists and improved outcomes for patients with chronic kidney disease.

Declaration by Authors

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