DOI: 10.7860/JCDR/2026/80468.23326

Original Article

Physiotherapy Section

Effect of Intradialytic Exercise Program on Physical Function, Depression and Quality of Life in Diabetic Nephropathy Patients: A Pre-post Interventional Study

KASHISH PRABHAKAR SHETTY[1], PURUSOTHAM CHIPPALA[2]

ABSTRACT

Introduction: Diabetic Nephropathy (DN) is a prevalent complication of Diabetes Mellitus (DM) that frequently results in impaired physical functioning, a reduced Quality of Life (QoL) and a decline in psychological well-being. Patients who undergo Haemodialysis (HD) are at a higher risk of experiencing depression, fatigue and functional decline. Although there is potential for exercise therapy to improve outcomes for Chronic Kidney Disease (CKD), limited evidence exists regarding its structured application in DN patients receiving HD.

Aim: To assess the effect of Intradialytic Exercise (IDE) program on the physical function, depression and QoL of DN patients who are undergoing HD.

Materials and Methods: This pre-post interventional study was carried out at Department of Nephrology in Justice KS Hegde Charitable Hospital, Deralakatte, Mangaluru, India. The study was conducted from July 2024 to February 2025 and involved 15 patients with DN who were receiving maintenance HD.Participants underwent an 8-week IDE program (three sessions per week for one hour each). To assess the intervention's effects, outcome measures included the 6-Minute Walk Test (6MWT), 30 -Second Sit-to-Stand test (30STS), handgrip strength, lower limb strength, the Hospital Anxiety and Depression Scale (HADS) and the Kidney Disease Quality of Life-36 (KDQoL-36). Paired sample t-tests were used to evaluate difference between baseline and post intervention scores.

Results: Significant improvements were observed in 6MWT (9.98%), 30 STS (38.06%), handgrip strength (10.62%) and lower limb strength (20.75%) ($p<0.001$). Depression scores on the HADS significantly decreased (24.14%) ($p=0.001$), while the KDQoL-36 scores indicated a marked enhancement (10.46%) in QoL ($p=0.008$).

Conclusion: Intradialytic exercise program significantly improves physical function, reduces signs of depression and enhances the QoL of DN patients receiving HD.

Keywords: Exercise therapy, Haemodialysis, Physical fitness, Renal dialysis

INTRODUCTION

The DM, which usually results in diabetic kidney disease or DN, is a cause for adverse effects and mortality in people with kidney disease as it reduces the kidney's ability to filter waste and excess fluids. DN is characterised by excessive protein loss in urine and decreased renal filtration [1,2]. The presence of DN also elevates the risk of cardiovascular issues, further compromising overall health, accelerating the deterioration of renal function and ultimately leading to kidney failure. Chronic inflammation, oxidative stress and metabolic disturbances are the result of DN, which also impacts the nervous, musculoskeletal and endocrine systems in addition to the cardiovascular system. The prevalence of DN in India is reported to range from 2.2% to 27% as of 2023 [3,4].

Patients with End Stage Renal Disease (ESRD) frequently undergo HD, a time-intensive procedure that, typically lasts between three and five hours and occurs several times each week. A dialyser is used in this treatment to remove waste, excess fluid and toxins from the blood. CKD patients receiving dialysis have a higher chance of mortality and generally participate in less physical activity, which reduces their overall functional ability [5,6]. People receiving maintenance HD, especially those with DN, often experience a decline in QoL and are more prone to depression due to both physical and emotional distress [6].

Physical activity and exercise have been shown to improve cardiovascular endurance, muscular strength and dialysis efficiency in HD patients and also reduces fatigue and depression. Regular IDE enhances overall functional capacity and contributes to better QoL in patients with DN, structured exercise interventions are recommended for patients on dialysis. IDE, performed during HD sessions, enhances sleep quality, reduces fatigue and improves exercise tolerance, potentially leading to better psychological health and overall well-being [7-9]. Although exercise has shown benefits for individuals undergoing HD, few studies have examined its effects on HD patients with DN.

The present study aimed to evaluate the effect of exercise therapeutic program on DN patients undergoing maintenance HD in aspect of physical function, depression and QoL.

To evaluate the effect of IDE program on:

- Physical function using 6MWT, hand grip strength, lower limb strength and sit-to-stand in DN patients
- Depression using HADS in DN patients
- QoL using KDQoL-36 questionnaire

MATERIALS AND METHODS

The present pre-post experimental study was carried out at Department of Nephrology in Justice KS Hegde Charitable Hospital, Deralakatte, Mangaluru, India. The study was conducted from July 2024 to February 2025. Ethical clearance was granted by the NITTE Institutional Ethics Committee (Ref: NIPT/IEC/Min/30/2023-2024) and the trial was prospectively registered with the Clinical Trial Registry of India under CTRI number (CTRI/2024/05/067594). The study design is a single arm pre-post experimental study.

Sample size: A total 15 patients with DN undergoing HD were recruited using convenience sampling. According to a study by

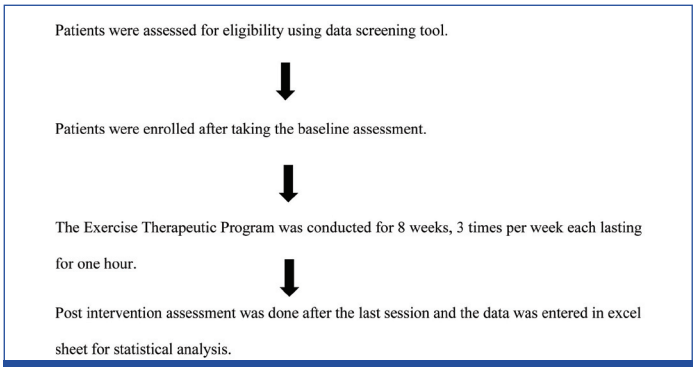
Jamshidpour B et al., the baseline mean 249.53±95.6 metres for two-tailed tests with 90% power and effect size of 1.0, required sample size was 13 [10]. Considering the 10% attrition rate, the required sample size was 15. The software used for sample size determination was G*Power, version 3.1.

Inclusion criteria: The study included participants within the age of 35 to 50 years. Both men and women who spoke English or Kannada were included in the study. Participants having DN with type 2 DM and Target Ultrafiltration rate less than 13 $mL \cdot kg^{-1} \cdot h^{-1}$ and undergoes HD twice or thrice a week. Participants having Body Mass Index (BMI)>26 were eligible for study.

Exclusion criteria: Participants were excluded if they had unstable vital signs, missed previous HD session, were symptomatic or recently hospitalised participants or had poor functioning of the arteriovenous fistula or central venous catheter.

Study Procedure

The exercise therapeutic program was tailored to be feasible during dialysis and was supervised to ensure proper technique, safety and vitals of patient was monitored throughout the session [Table/Fig-1] Demographic information was collected after informed consent was obtained. Baseline data for all outcome measures were recorded. Post-intervention assessments were conducted after completion of the 8-week program.



[Table/Fig-1]: Procedure and Intradialytic Exercise (IDE) program.

Outcome Measures

Primary outcome measure

Physical function:

- A 6 Minute Walk Test (6MWT): Estimated the total distance walked over six minutes in 30-meter corridor [11].
- A 30-second Sit-To-Stand test (30STS): Recorded the number of complete stands from a chair in 30 seconds [12].
- Handgrip strength: Assessed using a handgrip dynamometer on the non cannulated arm [13].
- Lower limb strength: Measured knee extension strength using a handheld dynamometer [Table/Fig-2,3].

Secondary outcome measures

Depression: It was analysed using HADS's Depression Component (HADS-D). English and Kannada questionnaire was used for assessment [14].

Quality of Life (QoL): Evaluation was done using the KDQoL-36 English and Kannada questionnaire was used for assessment [15,16].

STATISTICAL ANALYSIS

Baseline and demographic data were summarised using descriptive statistics including mean, standard deviation and percentage. Comparison of results before and after the intervention was done by paired t-tests. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software 23.0, with a p-value of less than 0.05 regarded as statistically significant.

Exercise	Repetition/ time
Relaxation exercise	Diaphragmatic breathing exercises
Neck range of motion exercises	
• Forward bending exercises	(2 reps X 10 times)
• Rotation exercises	(2 reps X 10 times)
• Shoulder shrugs	(2 reps X 10 times)
Upper limb exercises (For non cannulated arm)	
• Shoulder range of motion exercises	(2 reps X 10 times)
• Elbow flexion and extension exercises	(2 reps X 10 times)
• Wrist exercises	(2 reps X 10 times)
• Hand smiley ball gripping exercise.	(2 reps X 10 times)
Lower limb exercises	
• Knee range of motion exercises.	(2 reps X 10 times)
• Ankle-toe movements	(2 reps X 10 times)
• Straight leg raise	(2 reps X 10 times)

[Table/Fig-2]: Intradialytic Exercise (IDE) program.

[Table/Fig-3]: Upper and lower limb exercises.

RESULTS

The study had 15 participants in all. Participants' mean age was 47.60±3.54 years. According to gender distribution, 5 (33.3%) female and 10 (66.7 %) were male participants. The mean BMI was 27.63±1.17 kg/m² [Table/Fig-4].

Parameters	Mean±SD	Range
Age (years)	47.60±3.54	36-50
Height (cm)	165.80±5.846	150-176
Weight (kg)	75.93±6.408	62-84
BMI (kg/m²)	27.627±1.1726	26.2-29.4
Gender, n	Male: 10	-
	Female: 5	-

[Table/Fig-4]: Baseline characteristics of participants (N=15).

The comparison of pre-post-test was done by paired t-test. The study findings revealed highly significant improvements (p=0.001) in physical function parameters (6MWT, handgrip strength, lower limb strength and STS) and depression levels (HADS-D). Significant progress was also seen in the KDQoL-36 (p=0.008). The overall interpretation indicates that the intervention was effective in improving physical function, reducing depression and improving QoL [Table/Fig-5].

Patients undergoing HD typically have a 6MWT cut-off of less than 300–350 metres, which indicate a decreased functional capacity. Low muscle strength is indicated by handgrip strength levels of less than 27 kg for males and 16 kg for women. Less than 12 repetitions in 30 seconds or more than 15 seconds for five repeats are frequently used as thresholds for lower limb weakness in the STS test. Clinically significant depressive symptoms are indicated by scores of 8 or above on the HADS-D subscale, which is used to assess depression. When assessing QoL using the KDQOL, scores below 50 out of 100 generally indicate a lower QoL when kidney disease is present [Table/Fig-5].

DISCUSSION

The findings of this pre-post experimental study showed that among HD patients with DN, an 8-week IDE program significantly improved physical function, decreased depression and enhanced QoL. These results correspond with findings of research indicating that exercise therapy is beneficial for dialysis patients.

Parameters	Phase	Mean±SD	MD*	SD of difference	Change (%)	t-value	p-value
A. 6MWT*(m)	Pre	374.00±85.92	-37.33	10.33	9.98	-14.00	0.001
	Post	411.33± 82.62					
B. HADS-D*	Pre	11.60±3.16	2.80	1.42	24.14	7.61	0.001
	Post	8.80±2.65					
C.HANDGRIP-L*(kg)	Pre	31.40±6.13	-3.33	0.72	10.62	-17.84	0.001
	Post	34.73±6.03					
D.KDQoL-36*	Pre	47.15±4.44	-4.93	6.19	10.46	-3.09	0.008
	Post	52.09±4.65					
E. Lower limb strength (kg)	Pre	10.60±2.16	-2.20	0.86	20.75	-9.89	0.001
	Post	12.80±1.70					
F. Sit-to-stand (s)	Pre	10.33±2.77	-3.93	0.96	38.06	-15.85	0.001
	Post	14.27±2.22					

[Table/Fig-5]: Effect of exercise therapeutic program in patients with Diabetic Nephropathy (DN): Pre-post comparison.
6MWT: 6-Minute walk test; m: metres; HADS-D: Hospital anxiety and depression scale for depression; Handgrip-L: Handgrip of left upper limb; kg: kilogram; KDQoL-36: Kidney disease quality of life-36; s: second; SD: Standard deviation, MD: Mean difference.
Mean difference (MD) and t-values were calculated as pre-post values. Therefore, negative t-values indicate that post-intervention scores were higher than preintervention scores which indicate improvement in results. This does not represent an inverse relation.

The significant increase in 6MWT distance in the present study indicates improved cardiovascular endurance and mobility (9.98%, p=0.001), which correlate with the results of study done by Hu H et al., (2023) who reported increased 6MWT by 35-42 m and Ferrari F et al., (2023) who showed 6MWT with increase of 37-51 m, which highlights the importance of structured exercise in enhancing mobility [17,18]. The program's combination of resistance and aerobic exercises most likely contributed to cardiorespiratory efficiency and muscle strength. Similarly, the enhanced lower limb strength and sit-to-stand performance corroborate the results of study done by Anding-Rost K et al., (2023) who found an improvement of 3.9 repetitions and Manfredini F et al., (2023) who reported 4.8 repetition increase after six months of intervention, suggesting that resistance training promotes muscular growth, which prevents the muscle atrophy that dialysis patients frequently experience [1,19]. The progressive overload approach in strengthening exercises likely contributed to the observed gains in muscle power and endurance over the timeline of eight weeks.

The marked reduction in depression scores (HADS-D) is in line with the results of study done by Araujo SM et al., (2022) who reported that IDE can alleviate depressive symptoms with 3.1 points decrease in HADS-D after 12 weeks of intervention [20]. This could be attributed to the release of endorphins, reduced stress levels and improved social interactions facilitated by exercising. The psychological benefits of exercise, such as enhanced sense of control and accomplishment, may also play a crucial role.Another study done by Bündchen DC et al., (2021) found that routine inteventions have a favourable impact on mental health by improving self-efficacy and treatment adherence [21].

The significant improvement in the KDQoL-36 scores supports the results of study done by Zhang F et al., (2021) who reported an increase of 7-12 points in physical component score and 3-6 points improvement in mental component score of KDQoL-36 and Rhee SY et al., (2019) also showed improved KDQoL-36 with 15-20% improvement in physical and mental component of KDQoL-36 indicating that structured exercise programs positively impact patients' self-reported QoL [5,13]. Although a study done by Greenwood SA et al., (2021) reported mixed QoL outcomes, with physical function domain improving by eight points their study suggested the incorporation of progressive resistance training [22].

The findings of the present study strongly advocate for integrating structured exercise programs in standard dialysis care .The healthcare providers should consider in implementing individualised exercise programs for haemodialysis patients.The improvements observed in the present study suggest that the intervention enhanced patient independence and participation in daily activities, contributing to better overall QoL.

Limitation(s)

The study has few limitations. The eight week intervention program may not be adequate for long-term effects. The participants adherence for exercise program was not assessed which can affect the reliability of results. Lastly the limited trial time prevents evaluation of intervention's durability and long-term efficacy. Also, the single centre design with a restricted set of outcome measures is one of the limitation.

CONCLUSION(S)

The present study demonstrates that an 8-week IDE program significantly enhances physical function, reduces depression and improves the QoL of patients with DN undergoing HD. These results highlight the potential of exercise as a non pharmacological approach to improve mental health in this population. Improvements in KDQoL-36 scores indicate better health-related QoL with participants reporting greater ease in daily activities and enhanced emotional well-being. These findings emphasise the role of exercises as a valuable adjunct therapy in dialysis care.

Acknowledgement

Authors would like to show gratitude to NITTE Institute of Physiotherapy for providing opportunity to conduct the study. We would like to express our sincere gratitude to the entire medical staff of Department of Nephrology and Head of the Department for giving permission to collect the samples and to the patients who participated in the study. We would also like to thank our statistician Dr. Sucharita and Dr. Uday Venkat Mateti for giving permission to utilise Kannada version of Kidney Disease Quality of life-36 questionnaire.

REFERENCES

[1] Anding-Rost K, von Gersdorff G, von Korn P, Ihorst G, Josef A, Kaufmann M, et al. Exercise during hemodialysis in patients with chronic kidney failure. NEJM Evid. 2023;2(9):EVIDoa2300057. Doi: 10.1056/EVIDoa2300057. Epub 2023 Jun 17. PMID: 38320198.
[2] Parker K. Intradialytic exercise is medicine for haemodialysis patients. Curr Sports Med Rep. 2016;15(4):269-75.
[3] Li RY, Guo L. Exercise in diabetic nephropathy: Protective effects and molecular mechanism. Int J Mol Sci. 2024;25(7):3605.
[4] Selby NM, Taal MW. An updated overview of diabetic nephropathy: Diagnosis, prognosis, treatment goals and latest guidelines. Diabetes Obes Metab. 2020;22(S1):03-15.
[5] Zhang F, Zhou W, Sun Q, Zhai Y, Zhang Y, Su H, et al. Effects of intradialytic resistance exercises on physical performance, nutrient intake, and quality of life among haemodialysis people: A systematic review and meta-analysis. Nurs Open. 2021;8(2):529-38.

[6] Kashyap A, Sharma KN. Diabetic nephropathy in India: Epidemiology, challenges, and future directions. Research Gate. 2023;7(1):46-49.
[7] Nataraj M, Maiya AG, Nagaraju SP, Shastry BA, Shivashankara KN. Effect of exercise on renal function in diabetic nephropathy- A systematic review and meta-analysis. J Taibah Univ Med Sci. 2023;18(3):526-37.
[8] Gerogianni G, Babatsikou F, Polikandrioti M, Grapsa E. Management of anxiety and depression in haemodialysis patients: The role of non-pharmacological methods. Int Urol Nephrol. 2019;51(1):113-18.
[9] Ribeiro R, Coutinho GL, Iuras A, Barbosa AM, Souza JAC, Diniz DP, et al. Effect of resistance exercise intradialytic in renal patients chronic in haemodialysis. Braz J Nephrol. 2013;35(1):13-19.
[10] Jamshidpour B, Bahrpeyma F, Khatami M. The effect of aerobic and resistance exercise training on the health-related quality of life, physical function, and muscle strength among haemodialysis patients with Type 2 diabetes. Journal of Bodywork and Movement Therapies. 2020;24(2):98-103.
[11] Andrade FP, Ribeiro HS, Benvenutti H, deOliveira SG, Thomé FS, Veronese FV, et al. Six-minute walk test maybe are liable predictor of peak oxygen uptake in patients undergoing hemodialysis. Ren Replace Ther. 2023;9(1):4.
[12] Figueiredo PHS, Veloso LRS, Lima MMO, Vieira CFD, Alves FL, Lacerda ACR, et al. The reliability and validity of the 30-seconds sit-to-stand test and its capacity for assessment of the functional status of hemodialysis patients. J Bodyw Mov Ther. 2021;27:157-64.
[13] Rhee SY, Song JK, Hong SC, Choi JW, Jeon HJ, Shin DH, et al. Intradialytic exercise improves physical function and reduces intradialytic hypotension and depression in haemodialysis patients. Korean J Intern Med. 2019;34(3):588-98.
[14] Stern AF. The hospital anxiety and depression scale. Occup Med (Lond). 2014;64(5):393-94.
[15] Mateti UV, Nagappa AN, Attur RP, Nagaraju SP, Mayya SS, Balkrishnan R.Cross-cultural adaptation,validation and reliability of the South Indian (Kannada) version of the kidney disease and Quality of Life (KDQOL-36) instrument. Saudi J Kidney Dis Transpla. 2015;26(6):1246-52.
[16] Hays RD, Kallich JD, Mapes DL, Coons SJ, Carter WB. Development of the kidney disease quality of life (KDQOL) instrument. Qual Life Res.1994;3(5):329-38.
[17] Hu H, Wu C, Yan Y, Ho M, Chau PH, Yuet K, et al. Effects of different exercises on physical function, dialysis adequacy, and health-related quality of life in maintenance haemodialysis patients: A systematic review and network meta-analysis. Am J Nephrol. 2023;54(9-10):379-90.
[18] Ferrari F, Andrade FP, Teixeira MS, Ziegelmann PK, Carvalho G, Bittencourt ESS, et al. Efficacy of six exercise-based interventions for individuals undergoing haemodialysis: A network meta-analysis of randomized clinical trials. Nephrol Dial Transplant. 2023;38(10):2389-406.
[19] Manfredini F, Mallamaci F, D'Arrigo G, Baggetta R, Bolignano D, Torino C, et al. Exercise in patients on dialysis: A multicenter, randomized clinical trial. 2017;28(4):1259-68. Doi: 10.1681/ASN.2016030378.
[20] Araujo SM, Sousa H, Bastos JM, Oliveira A, Miranda A, Gonçalves M, et al. Effects of intradialytic exercise on quality of life, functional capacity, and inflammatory markers in haemodialysis patients: A randomized controlled trial. Clin Exp Nephrol. 2022;26(4):745-53.
[21] Bündchen DC, Alves CF, Lemos TV, Rosa CT, Rech CR. Intradialytic exercise in end-stage renal disease: An umbrella review of systematic reviews and/or meta-analytical studies. Clin Rehabil. 2021;35(11):1511-24.
[22] Greenwood SA, Koufaki P, Macdonald JH, Bulley C, Bhandari S, Burton JO, et al. Exercise program to improve quality of life for patients with end-stage kidney disease receiving haemodialysis: The PEDAL RCT. Health Technol Assess. 2021;25(40):01-52.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, NITTE Institute of Physiotherapy, NITTE (Deemed to be University), Mangaluru, Karnataka, India.
2. Professor, NITTE (Deemed to be University), Nitte Institute of Physiotherapy (NIPT), Mangaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Purusotham Chippala,
Professor, NITTE (Deemed to be University), Nitte Institute of Physiotherapy (NIPT), Deralakatte-575018, Mangaluru, Karnataka, India.
E-mail: chippala_puru@nitte.edu.in

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 09, 2025
- Manual Googling: Jan 01, 2026
- iThenticate Software: Jan 05, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **May 08, 2025**
Date of Peer Review: **Jul 01, 2025**
Date of Acceptance: **Jan 09, 2026**
Date of Publishing: **May 01, 2026**