by routine diagnostics in a patient with acute leukemia. Ann Clin Microbiol Antimicrob 2022;21:49.
10. Malathi CV, Prema K.SJ, Kurien AA. Pathologic spectrum of kidney diseases associated with snake bites. Indian J Nephrol 2025;35:543-6.

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Effectiveness of Intradialytic Aerobic and Resistance Exercise on Functional Capacity and HRQoL in ESKD Patients Undergoing Hemodialysis - A Pre-Post Study

Dear Editor,

Patients with kidney failure on maintenance hemodialysis (HD) have markedly reduced exercise capacity, accelerating physical decline, loss of independence, and fall risk.[1] Intradialytic exercise improves oxygen uptake, muscle strength, cardiovascular performance, and quality of life.[2] This time-efficient, individually tailored regimen is feasible and safely performed under professional supervision.[3]

Literature indicates limited comparative evidence for individualized exercise programs, with no clinical practice recommendations.[4] The absence of standardized guidelines for the type, intensity, and duration of exercise for Indian patients on HD underscores the need for effective intradialytic programs. We evaluated the effect of 8 weeks of combined intradialytic aerobic and resistance exercise in ESKD patients undergoing HD to improve functional capacity and health-related quality of life (HRQoL) by integrating intradialytic exercise into routine care for patients on HD.

All patients dialysed between June 2022 and May 2023, who fulfilled the eligibility criteria and provided signed informed consent, were included. Data confidentiality was maintained throughout in accordance with institutional ethical guidelines. An ethically approved pre-post interventional study was conducted on 27 eligible participants with CKD stage IV & V undergoing HD. Detailed descriptions of all procedures are provided in the Supplementary methodology. Participants received an 8-week supervised, progressive exercise program (aerobic cycle ergometer + resistance training with bands), three sessions/week, 30 minutes each. Outcomes included six minute walk test (6MWT), timed up and go test (TUG), and muscle strength (hand-held dynamometer) [Supplementary Table 1]. Participants (mean age 53.19±11 years, as outlined in the baseline demographics presented in Supplementary Table 2 showed improvement in the 6MWD by 36 m (p = 0.0001), the TUG score (p=0.001), and muscle strength (p<0.05), as assessed using a hand-held dynamometer, as depicted in Table 1. The KDQOL questionnaire, piloted for this ESKD population, assessed HRQoL across disease-specific and physical/mental domains. Some mean differences were noted, but no statistically significant improvement was observed post-intervention [Supplementary Figure 1] despite participants reporting subjective health benefits. Similarly, 8 weeks of exercise did not significantly change blood pressure, likely due to short duration and concomitant antihypertensive therapy. Findings have been presented in Table 1 and Supplementary Figure 2.

This study addressed the evidence-practice gap in intradialytic exercise by supporting its hypothesis of improved functional capacity in ESKD patients following 8 weeks of combined training. In most dialysis centers, patients remain physically inactive during HD. Sedentarism, a modifiable risk factor, is linked to cardiovascular events, fatigue, and mortality.[5] Exercise training in CKD has been studied for over 30 years, showing benefits in cardiovascular fitness, physical function, and quality of life.[5] This study demonstrated that exercising during dialysis, instead of remaining inactive, can substantially counteract muscle deconditioning in this population.

Endurance training has been used for renal rehabilitation for ESKD. In this study, cycle ergometer exercise improved fatigability, reflected by greater 6MWD and lower Borg rating of perceived exertion (RPE), and enhanced functional capacity, while TUG time was reduced,[6] suggesting lower fall risk. Resistance training with thera-bands increased muscle strength during sedentary dialysis hours. The individualized, progressive regimen[4] allowed adaptation, and exercises performed in the first 2 hours of dialysis[1] were safe, with no dropouts or serious adverse events, therefore supporting feasibility. Post hoc analysis of the TUG test showed greater improvement between the 4th and 8th week, indicating that functional gains can be observed within 4 weeks. In a post hoc exploratory analysis of muscle strength, flexor muscles of both upper and lower limbs demonstrated greater improvement and effect sizes across assessments compared to extensors, likely due to preferential recruitment of flexors in the recumbent dialysis position.

Table 1: Effect of intradialytic exercise on outcomes at pre- (baseline), 4th week, and 8th week post-intervention

Variable	Baseline	4th week	8th week	*p*-value	Effect size
6MWD (m)	351.54 ± 52.73	361.19 ± 53.85	387.75 ± 52.21	0.000*	0.91
TUG test (s)	9.21 ± 1.33	8.85 ± 1.13	8.21 ± 0.94	0.001*	0.69
Muscle strength (lbs)					
Shoulder flexors	23.19 ± 2.61	24.12 ± 2.73	24.98 ± 3.13	0.001*	0.64
Shoulder extensors	21.58 ± 2.7	21.98 ± 2.96	22.67 ± 3.09	0.000*	0.30
Elbow flexors	22.12 ± 2.25	23.23 ± 2.40	24.37 ± 2.47	0.001*	0.85
Elbow extensors	20.51 ± 3.10	21.00 ± 2.84	21.85 ± 2.81	0.000*	0.41
Rt. Knee flexors	22.35 ± 3.61	22.94 ± 3.66	23.81 ± 3.84	0.004*	0.66
Lt. Knee flexors	22.27 ± 3.5	22.92 ± 3.69	23.62 ± 3.76	0.000*	0.56
Rt. Knee extensors	23.17 ± 3.07	23.50 ± 3.27	24.23 ± 3.18	0.004*	0.22
Lt. Knee extensors	23.17 ± 3.33	23.58 ± 3.38	24.42 ± 3.69	0.000*	0.36
SBP (mmHg)	144.62 ± 20.95	142.38 ± 17.52	138.96 ± 20.41	0.08	-
DBP (mmHg)	87.23 ± 13.56	85.23 ± 14.21	80.96 ± 10.89	0.252	-

Friedman test, $p<0.05$. 6MWD: Six-minute walk distance, TUG: Time-up-go test, SBP: Systolic blood pressure, DBP: Diastolic blood pressure. *significant *p*-value <0.05.

Figure 1: (a) Participant performing right elbow flexion with thera-band; resistance exercise. (b) Participant performing Intradialytic exercise; aerobic exercise-cycling.

As the study was conducted in a single dialysis unit, only a small sample could be recruited; therefore, inclusion of a control group was not feasible. Longer duration studies with a larger population may see significant changes in HRQoL in patients with ESKD undergoing HD.

To conclude, a progressive, individualized 8-week intradialytic aerobic-resistance program was safe, and it improved functional capacity and muscle strength in patients with ESKD. Ultimately, it aligns with American College of Sports Medicine (10th ed.) guidelines, supporting its inclusion in routine care.

Conflicts of interest: There are no conflicts of interest.

Use of Artificial Intelligence (AI)-Assisted Technology: The authors declare that no generative AI or AI-assisted tools were used in drafting, editing, or preparing this manuscript.

Tasneem R Hazarika[1], Ambika Lama[1], Nikita J Sonowal[1], Dheeraj Khatri[2]

[1]Department of Physiotherapy, Sikkim Manipal College of Physiotherapy, [2]Department of Medicine, Central Referral Hospital, Tadong, Gangtok, India

***Corresponding author:** Tasneem Rahman Hazarika, Department of Physiotherapy, Sikkim Manipal College of Physiotherapy, Tadong, Gangtok, India. E-mail: hazarikatasneem97@gmail.com*

References

1. Bennett PN, Daly RM, Fraser SF, Haines T, Barnard R, Ockerby C, *et al*. The impact of an exercise physiologist coordinated resistance exercise program on the physical function of people receiving hemodialysis: A stepped wedge randomized control study. BMC Nephrol 2013;14:204.
2. Heiwe S, Jacobson SH. Exercise training in adults with CKD: A systematic review and meta-analysis. Am J Kidney Dis 2014;64:383-93.
3. Sheng K, Zhang P, Chen L, Cheng J, Wu C, Chen J. Intradialytic exercise in hemodialysis patients: A systematic review and meta-analysis. Am J Nephrol 2014;40:478-90.
4. Battaglia Y, Baciga F, Bulighin F, Amicone M, Mosconi G, Storari A. Physical activity and exercise in chronic kidney disease: consensus statements from the Physical Exercise Working Group of the Italian Society of Nephrology. 2024;34:1735-65.
5. O'Hare AM, Tawney K, Bacchetti P, Johansen KL. Decreased survival among sedentary patients undergoing dialysis: Results from the dialysis morbidity and mortality study wave 2. Am J Kidney Dis 2003;41:447-54.
6. Bennett PN, Fraser S, Barnard R, Haines T, Ockerby C, Street M, *et al*. Effects of an intradialytic resistance training programme on physical function: A prospective stepped-wedge randomized controlled trial. Nephrol Dial Transplant 2016;31:1302-9.

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