RJNMSR
Review Journal of Neurological & Medical Sciences Review

Volume 4, Issue 5, 2026

EVALUATE THE EFFECT OF INTRADIALYTIC STRETCHING EXERCISE ON MUSCLE CRAMPS AMONG PATIENTS UNDERGOING HAEMODIALYSIS

Arishba Iftikhar[*1], Rabia Sikander[2], Muhammad Sikandar[3], Neha Naveed[4]

[*1]*Demonstrator, Renal and Dialysis Technology, Department of Emerging Health Professional Technology, Allied Health Sciences, Superior University Lahore, Pakistan*
[2,3,4]*Renal and Dialysis Technology, Department of Emerging Health Professional Technology, Allied Health Sciences, Superior University Lahore, Pakistan*

[*1]arishba.iftikhar@superior.edu.pk, [2]drr75218@gmail.com, [3]sikandargazar1234@gmail.com, [4]nehanaveedbutt98@gmail.com

Corresponding Author: *
Arishba Ifthikhar
arishba.iftikhar@superior.edu.pk
DOI: http://doi.org/10.5281/zenodo.20606342

Received	Accepted	Published
26 March 2026	05 May 2026	23 May 2026

ABSTRACT

Background: *Chronic kidney disease is common and many patients in Pakistan depend on regular hemodialysis to stay alive, but muscle cramps during treatment are still a very frustrating problem for them. These cramps tend to affect the lower legs, interfere with dialysis and slowly erode the patient's quality of life despite good dialysis blood markers.*

Objective: *The aim of this research was to compare muscle cramps and health related quality of life changes in the group of patients receiving maintenance hemodialysis training with the use of intradialytic stretching exercises vs. the control group.*

Methods: *In total about four months, a quasi experimental two group pre test post test design was employed in three dialysis units in Lahore. Adult patients on maintenance hemodialysis who reported cramps were recruited by consecutive non probability sampling, and then allocated to a study group (n = 27) and a control group (n = 27). The study group was given guided intradialytic leg and foot stretching for approximately 8-10 minutes a session for three weeks, and the control group was given regular care without stretching. The severity of muscle cramp was scored on a numeric rating scale and the quality of life was rated by the WHOQOL BREF. The analysed data in SPSS 27 at $p < .05$.*

Results: *The mean age was approximately 47 years, most were of average body weight and mean Kt/V was about 1.38. The most common causes of end stage renal disease (ESRD) were diabetes (66.6%) and hypertension (33.4%) and there was a significant relationship between primary cause and cramp severity ($\chi^2 = 23.79$, $p = .022$). Muscle cramps were more likely to happen during dialysis (63 percent) and were focused in the lower limbs, especially the legs (29.6 percent) and calves (27.8 percent). Mean WHOQOL BREF scores decreased from baseline to end point (58.98 to 47.59) and remained low and almost unchanged in the study group (69.67 to 48.22); whereas the control group did not change. Age was negatively correlated with end point scores ($r = -.325$, $p = .016$) and positively correlated*

with weight (r = .312, p = .022) and baseline and end point scores were highly correlated (r = .614, p < .001) indicating that older and lighter patients were particularly susceptible to lower scores.
Conclusion: *Intradialytic muscle cramps were very common and mainly occurred in the lower limbs and correlated with lower and declining quality of life scores among older and lighter patients.*
Keywords: *Haemodialysis, Intradialytic Stretching, Muscle Cramps, End-stage renal disease*

INTRODUCTION

Chronic kidney disease (CKD) is a rapidly growing global health burden, progressing irreversibly toward end-stage renal disease (ESRD), where renal replacement therapy becomes essential for survival. Its increasing prevalence is strongly associated with diabetes, hypertension, and population aging, particularly in low- and middle-income countries where healthcare systems are already overburdened (1). In Pakistan, the situation is more critical due to limited nephrology infrastructure and high disease prevalence, with an estimated 21–24% of the population affected by CKD in various stages (2). Maintenance haemodialysis remains the most widely used treatment for ESRD; however, it is associated with significant physiological stress and a persistent reduction in health-related quality of life, making CKD a major clinical and public health challenge (1,2).

Haemodialysis, although life-sustaining, involves rapid fluid and solute removal over a short period, which frequently leads to intradialytic complications. Among these, muscle cramps are one of the most common and distressing events, affecting approximately 20% to 86% of patients undergoing haemodialysis (4). These cramps typically occur during the latter part of dialysis when ultrafiltration is at its peak, leading to discomfort, anxiety, and sleep disturbance, ultimately reducing treatment adherence and quality of life (3,4). The high frequency and recurrence of this complication highlight the need for effective preventive and non-pharmacological management strategies.

The pathophysiology of intradialytic muscle cramps is complex and multifactorial, involving hemodynamic instability, electrolyte imbalance, and neuromuscular dysfunction. Rapid ultrafiltration may exceed plasma refilling capacity, resulting in intravascular volume depletion and transient tissue hypoperfusion (5). This triggers sympathetic activation and peripheral vasoconstriction, reducing skeletal muscle perfusion and contributing to ischemia (6). Additionally, electrolyte shifts involving sodium, potassium, calcium, and magnesium alter neuromuscular excitability, while dysfunction of spinal reflex pathways further increases motor neuron hyperexcitability, culminating in involuntary muscle contractions (6,7). Uremic myopathy and toxin-induced muscle dysfunction further exacerbate susceptibility to cramps in ESRD patients (8).

Pharmacological management of intradialytic cramps has shown limited and inconsistent effectiveness, and several commonly used agents are associated with safety concerns. Quinine sulfate, once considered the gold standard, has been restricted due to serious adverse effects such as thrombocytopenia, cardiac arrhythmias, and hemolytic uremic syndrome (9). Other interventions, including vitamin E, vitamin C, and gabapentin, have demonstrated variable outcomes and are not consistently effective in complex CKD populations (10). Acute interventions such as saline boluses or hypertonic solutions may provide temporary relief but risk fluid overload, making them unsuitable for long-term management (10). These limitations emphasize the need for safer, cost-effective, and non-pharmacological approaches.

Emerging evidence supports intradialytic stretching exercise as an effective intervention for reducing muscle cramps and improving patient comfort during dialysis. Randomized controlled trials have demonstrated significant reductions in pain and cramp frequency in patients performing intradialytic stretching compared with standard care (11). Such exercises may improve muscle perfusion, reduce ischemic stress, and enhance dialysis adequacy through improved circulation (12). Additionally, intradialytic activity has been shown to improve psychological wellbeing, self-

efficacy, and quality of life among patients undergoing haemodialysis (13,14). However, implementation in Pakistan remains limited due to staffing constraints, lack of rehabilitation training, and patient-related barriers such as low awareness and fatigue (15,16). Addressing these challenges through structured guidelines, institutional support, and policy-level interventions is essential to integrate intradialytic stretching into routine dialysis care (17,18).

Literature Review

Najumusaqib et al. (19) reported that intradialytic complications are highly prevalent in hemodialysis patients, with 41.7% of individuals experiencing at least one acute event during treatment sessions. Muscle cramps were among the most frequently observed complications, alongside hypotension and headache, indicating a consistent pattern of dialysis-related physiological instability. Similarly, Bilal et al. (20) found comparable findings in a Pakistani dialysis population, where muscle cramps were especially common in patients with diabetes undergoing thrice-weekly hemodialysis. These studies collectively highlight that intradialytic cramps are a significant and recurrent clinical issue requiring structured preventive and monitoring strategies.

Bhavani et al. (21) demonstrated that non-pharmacological interventions such as leg stretching and foot massage significantly reduce the severity and frequency of intradialytic muscle cramps compared to standard care. Al Rahbi et al. (22) further supported this evidence through a randomized controlled trial showing that guided intradialytic stretching significantly decreased pain scores, particularly during the later stages of dialysis sessions. Parlak et al. (23) also confirmed that progressive muscle relaxation combined with massage techniques resulted in meaningful reductions in cramp intensity over a short intervention period. Together, these findings strongly support the effectiveness of simple physical therapies in managing dialysis-related muscle cramps.

Ahmed et al. (24) reported that intradialytic stretching exercises in elderly hemodialysis patients led to complete elimination of severe cramps and significant reductions in stress levels, emphasizing the importance of age-specific interventions. Shalaan et al. (25) further demonstrated that nurse-led intradialytic stretching programs reduced the need for emergency interventions such as saline boluses and improved overall patient comfort during dialysis. Sajjadi et al. (28) additionally found that patient education interventions enhanced awareness and adherence to preventive strategies, including stretching exercises, which in turn reduced complication rates. Collectively, these studies emphasize that combining education with structured exercise programs enhances both clinical outcomes and patient experience.

Ahmed et al. (26) highlighted that patient-related factors such as age, comorbidities, and duration of dialysis significantly influence the risk and severity of intradialytic complications. Saleem et al. (27) further emphasized that the early phase of dialysis initiation is particularly high-risk, with patients experiencing more frequent complications and higher mortality rates. Lee et al. (30) demonstrated that inadequate dialysis frequency contributes to fluid overload, which exacerbates muscle cramps and hypotension during treatment. Islam et al. (31) and Saleem et al. (32) also found that poor fluid management and excessive interdialytic weight gain are strongly associated with increased symptom burden and reduced quality of life.

Amin et al. (34) reported that correction of electrolyte imbalances, particularly calcium levels, significantly reduces neuromuscular irritability and decreases the incidence of muscle cramps in hemodialysis patients. Haroon et al. (36) further identified that bone and muscle disorders commonly seen in ESRD patients contribute to chronic pain and increased susceptibility to cramps. The Cochrane review (37) confirmed that stretching exercises remain one of the most effective and safest first-line interventions for reducing lower limb muscle cramps across different patient populations. Overall, the evidence consistently indicates that intradialytic muscle cramps are multifactorial in origin and require a comprehensive approach combining exercise, education, metabolic correction, and

optimized dialysis care to improve patient outcomes.

Materials and Methods

This study utilized a quasi-experimental two-group pre-test and post-test design to evaluate the effect of intradialytic stretching exercises on muscle cramping in haemodialysis patients. The research was conducted over a four-month period in the dialysis units of CMA Hospital, Bahria International Hospital, and Doctor Hospital in Lahore, targeting adult male and female patients undergoing maintenance haemodialysis who reported intradialytic muscle cramps. A total sample size of 54 patients was calculated using a standard formula for estimating a single population mean, with a 95% confidence level, resulting in 27 participants in the intervention group and 27 in the control group. Non-probability consecutive sampling was applied to recruit eligible participants until the required sample size was achieved.

The study population included adult haemodialysis patients with a history of poorly controlled diabetes who had been on dialysis for more than three months and who experienced muscle cramps during treatment sessions. Patients included in the study were required to be conscious, cooperative, and able to provide informed consent. Patients with complex musculoskeletal disorders, recent fractures or surgeries, uncontrolled comorbid conditions, or those unable to safely perform stretching exercises were excluded. In the intervention group, participants were guided through structured intradialytic stretching exercises targeting calf, hamstring, quadriceps, and foot muscles for 8–10 minutes per session across three dialysis sessions, while the control group received standard haemodialysis care without additional exercise intervention.

The primary outcome of the study was the severity of muscle cramps, assessed using the Numeric Rating Scale (NRS), while secondary outcomes included frequency of muscle cramps, patient comfort during dialysis, and overall treatment tolerance. Data were collected using a structured demographic and clinical proforma, an NRS pain assessment tool, and an observation checklist to ensure consistency in recording outcomes. Ethical approval was obtained from the Ethical Review Committee of Superior University Lahore, and all participants provided written informed consent after being fully informed about the study objectives, procedures, potential risks, and benefits. Confidentiality and anonymity were strictly maintained throughout the study, with all data securely coded and accessible only to the research team.

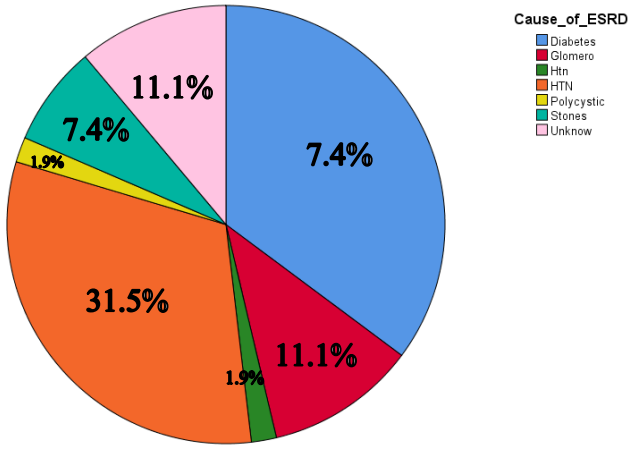
All collected data were analyzed using SPSS version 27.0. Continuous variables such as age, dialysis duration, cramp frequency, and pain scores were expressed as means and standard deviations, while categorical variables such as gender, comorbidities, and exercise adherence were presented as frequencies and percentages. A paired t-test was applied to compare pre- and post-intervention cramp severity and frequency within groups, while Chi-square tests were used to assess associations between categorical variables. Correlation analysis using Pearson or Spearman tests was performed based on data normality to examine relationships between clinical variables and outcomes. A p-value of less than 0.05 was considered statistically significant, and results were presented in tables, figures, and comparative charts to clearly demonstrate the impact of intradialytic stretching exercises on muscle cramping in haemodialysis patients.

Results

Among the 54 haemodialysis patients included in the study, muscle cramps were highly prevalent, occurring most frequently during dialysis sessions (63%), followed by post-dialysis (27.8%) and pre-dialysis (9.3%) episodes. The cramps predominantly affected the lower limbs, with the legs (29.6%) and calves (27.8%) being the most commonly involved sites, while fewer patients reported involvement of the feet, thighs, and hands. In terms of severity, 38.9% of participants experienced moderate cramps, 31.5% severe cramps, and 29.6% mild cramps, indicating a considerable symptom burden during treatment. The primary causes of end-stage renal disease (ESRD) were diabetes (35.2%) and hypertension

(31.5%), followed by glomerulonephritis (11.1%) and unknown causes (11.1%). A statistically significant association was observed between the cause of ESRD and severity of muscle cramps (p = 0.022), suggesting that underlying renal pathology may influence symptom intensity during dialysis.

Causes of ERSD



The descriptive analysis of clinical and demographic variables showed that participants had a mean age of 46.96 ± 9.859 years and a mean weight of 64.13 ± 8.798 kg. Dialysis parameters indicated a mean blood flow rate of 273.07 ml/min and a dialysate flow rate of 548.15 ml/min, reflecting generally stable dialysis settings across participants. The mean dialysis session duration was 3.648 hours, and the mean Kt/V value was 1.3796 ± 0.4974, suggesting adequate dialysis efficiency in most patients. Despite these acceptable clinical parameters, quality of life (WHOQOL-BREF) demonstrated a marked decline from a baseline mean of 58.98 ± 13.706 to an end-point mean of 47.59 ± 8.941, indicating worsening perceived well-being over time.

Comparison between study and control groups revealed notable differences in baseline quality of life scores. The study group initially had a higher mean WHOQOL-BREF score (69.67 ± 8.167) compared to the control group (48.30 ± 8.896), suggesting better initial health status among participants receiving the intervention. However, at the end point, the study group's score declined to 48.22 ± 9.208, closely approximating the control group's final score of 46.96 ± 8.795. Paired samples analysis further confirmed a significant reduction in quality of life within the study group, highlighting a downward trend over the observation period despite intervention exposure.

Correlation analysis demonstrated significant relationships between several variables and quality of life outcomes. Age showed a statistically significant negative correlation with end-point WHOQOL-BREF scores ($r = -0.325$, $p = 0.016$), indicating poorer outcomes among older patients. Weight showed a positive correlation with end-point scores ($r = 0.312$, $p = 0.022$), suggesting slightly better perceived outcomes among heavier individuals. A strong positive correlation was observed between baseline and end-point quality of life scores ($r = 0.614$, $p < 0.001$), indicating that patients with better initial health status tended to maintain relatively higher scores despite overall decline. Kt/V showed no significant association with quality of life outcomes.

Chi-square analysis further revealed a significant association between cause of ESRD and severity of muscle cramps ($\chi^2 = 23.787$, $df = 12$, $p = 0.022$), indicating that underlying disease etiology may influence cramp intensity during dialysis. Overall, the results demonstrate that muscle cramps are a frequent and clinically significant complication of haemodialysis, predominantly affecting lower limb muscles and occurring mainly during treatment sessions. Although dialysis adequacy indicators were generally acceptable, patients experienced a

decline in quality of life over time, with significant associations observed between demographic factors, disease etiology, and symptom burden. These findings underscore the need for targeted interventions, such as intradialytic stretching exercises, to improve symptom control and patient-reported outcomes.

Discussion

The present results show that muscle cramps are a frequent and clinically significant complication among haemodialysis patients, with 63% experiencing cramps during dialysis, 27.8% post-dialysis, and 9.3% pre-dialysis. The predominance of lower limb involvement, particularly legs (29.6%) and calves (27.8%), aligns with recent literature indicating that intradialytic muscle cramps are most commonly localized to distal lower extremities and are strongly associated with fluid shifts and hemodynamic instability during treatment. A 2024 quality-of-life study similarly reported that recurrent muscle cramps in chronic haemodialysis patients were strongly associated with reduced physical functioning and impaired daily activity, reinforcing that cramps are not a minor symptom but a major determinant of patient comfort and treatment tolerance (41).

The current findings further demonstrate that diabetes (35.2%) and hypertension (31.5%) are the leading causes of ESRD, with a statistically significant association between underlying cause of ESRD and severity of muscle cramps (χ^2 = 23.787, p = .022). This suggests that systemic disease burden may influence neuromuscular susceptibility during dialysis, possibly through vascular, metabolic, and inflammatory mechanisms. This interpretation is supported by a 2025 randomized trial from Oman, which highlighted that comorbid conditions and baseline physiological status significantly influence symptom expression during dialysis sessions, particularly in later stages of treatment (11). In this context, the present study contributes to evidence that cramp severity is not purely dialysis-procedure dependent but is also shaped by the underlying renal pathology and comorbidity profile.

The severity distribution of cramps in this study, with 38.9% moderate and 31.5% severe cases, highlights a substantial symptom burden that can directly interfere with dialysis adherence and patient well-being. These findings are consistent with recent interventional studies in which patients typically present with moderate-to-severe cramp intensity before receiving stretching-based interventions, followed by improvement in symptom control. A 2026 systematic review of 11 studies involving 809 participants reported that intradialytic stretching interventions significantly reduce cramp severity and improve patient comfort, supporting its role as a non-pharmacological management strategy in haemodialysis settings (42). However, while the current study confirms high baseline burden, its broader quality-of-life outcomes show a decline over time, suggesting that symptom improvement may not automatically translate into measurable improvements in global quality-of-life indices within short follow-up periods.

The overall WHOQOL-BREF trend, showing a decline from 58.98 to 47.59, indicates worsening perceived quality of life despite intervention exposure. This contrasts with several recent trials reporting improved quality-of-life outcomes following structured intradialytic exercise programs, including stretching and combined physical activity interventions (40). One plausible explanation is baseline imbalance between groups, particularly the higher initial WHOQOL score in the study group (69.67 vs. 48.30), which may have contributed to regression effects and reduced comparability over time. Additionally, correlation findings show expected clinical patterns, including a negative association between age and end-point quality of life (r = –0.325, p = .016) and a positive association with weight (r = 0.312, p = .022), while dialysis adequacy (Kt/V) showed no significant relationship. Overall, these results reinforce that haemodialysis-related cramps and quality of life are multifactorial outcomes, and while intradialytic stretching is supported in literature as beneficial, future studies should incorporate more balanced designs and direct cramp-specific outcome measures to better quantify its true clinical effect.

CONCLUSION

This study concludes that muscle cramps are a frequent and important problem among patients undergoing haemodialysis, occurring mostly during dialysis and mainly in the lower limbs, with many patients reporting moderate to severe intensity. The findings support recent evidence that intradialytic stretching is a practical non pharmacological approach for reducing cramp burden, although the present quality of life results were mixed and did not show a clear overall improvement. Even so, the study adds useful local evidence that better symptom focused care during dialysis is needed.

Based on the findings from future studies, it was concluded that there is a need to use larger size of randomly selected samples, groups with similar baseline and extended follow up to fairly evaluate the true effect of intradialytic stretching. In addition, researchers should look at cramp frequency, how long it takes for the cramps to stop, how bothersome and severe the cramps are, and the amount of time spent in a dialysis session that the patient actually enters, when measuring benefit; as cramps affect quality of life. A structured stretching protocol can be a simple routine intervention in the clinical setting particularly for older dialyzate and patients with repeated lower limb cramps during their dialysis.

First, the sample size was small at 54 participants, which limits generalization to wider haemodialysis populations. Second, the visible results show a major baseline quality of life difference between control and study groups, which makes comparison less clean. Third, the results presented focus more on burden and associations than on a clearly reported pre to post cramp score reduction. Fourth, quality of life may have been influenced by many illness related factors beyond cramps alone, so the intervention effect may have been diluted

REFERENCES

1. Anwar MS, Mahmood A, Saeed H, Raza ZA, Hussian R. Chronic Kidney Disease CKD/END Stage Renal Disease (ESRD) Global and National Perspective. 2026.
2. Im S. Pakistan Renal Registry: Annual Report 2024. Pakistan Journal of Kidney Diseases. 2025;9:3–26.
3. Habas E, Rayani A, Habas A, Farfar K, Habas E, Alarbi K, et al. Intradialytic Hypotension Pathophysiology and Therapy Update: Review and Update. Blood Press. 2025:1–18.
4. Ramos-Daguman KMA, Conde JB, Go HAS, Viscayno VBB, Dungca MLL, Lim MEL. Intradialytic massage for leg cramps among hemodialysis patients: A single-center, randomized crossover trial.
5. Atkinson AJ, Jr. Elucidation of the pathophysiology of intradialytic muscle cramps: pharmacokinetics applied to translational research. Transl Clin Pharmacol. 2019;27(4):119–22.
6. Jancy P, Parimala S. Assess the effect of intradialytic stretching exercises to reduce leg muscle cramps among patients undergoing hemodialysis in selected dialysis unit of Ernakulum District. International Journal of Nephrology and Kidney Failure. 2020;6(3):1–6.
7. Takahashi A. The pathophysiology of leg cramping during dialysis and the use of carnitine in its treatment. Physiol Rep. 2021;9(21):e15114.
8. Kaltsatou A, Sakkas GK, Poulianiti KP, Koutedakis Y, Tepetes K, Christodoulidis G, et al. Uremic myopathy: is oxidative stress implicated in muscle dysfunction in uremia? Front Physiol. 2015;6:102.
9. Samson K. Quinine Risks Limit Muscle Cramp Options, AAN Review Finds. Neurology Today. 2010;10(5):1–5.
10. Mantilla-Manosalva N, Guadarrama S, Bedoya-Muñoz LJ, Giraldo-Moreno S, Cuellar-Valencia L, Iriarte-Aristizábal MF, et al., editors. Pharmacological Treatment for Dialysis-Related Muscle Cramps: A Systematic Review. Seminars in Dialysis; 2024: Wiley Online Library.
11. Rahbi I, Lazarus Rathinasamy E, AlZaabi O, Al-Noumani H. Effectiveness of intradialytic muscle stretching exercise onmuscle cramps among patients

undergoing maintenance hemodialysis in Oman - A randomized controlled trial. Journal of Health Sciences. 2025;15:69–75.
12. Jiang H, Wang Y, Peng J, Wu S, Wu C. The efficacy of different types of intradialytic exercise for patients undergoing hemodialysis: a systematic review and network meta-analysis of randomized controlled trials. BMC Nephrol. 2025;26(1):450.
13. Zelko A, Skoumalova I, Kravcova D, Dankulincova Veselska Z, Rosenberger J, Madarasova Geckova A, et al. Perceptions of healthcare providers on benefits, risks and barriers regarding intradialytic exercise among haemodialysis patients. Int J Qual Stud Health Well-being. 2024;19(1):2287597.
14. Takahashi R, Yabe H, Ishikawa H, Hibino T, Suzumura A, Yamada T. The Impact of Intradialytic Exercise on Activities of Daily Living and Physical Function in Hospitalized Hemodialysis Patients: A Study of Efficacy and Safety. JMA journal. 2025;8(3):834–45.
15. Asghar RS, Saleem J, Javaid U, Zahoor M, Aziz F. Ten-year review of renal transplants in Punjab Province, Pakistan. Eastern Mediterranean Health Journal. 2025;31(3):191–7.
16. Wodskou PM, Reinhardt SM, Andersen MB, Molsted S, Schou LH. Motivation, Barriers, and Suggestions for Intradialytic Exercise-A Qualitative Study among Patients and Nurses. Int J Environ Res Public Health. 2021;18(19).
17. Islam G, Shah GH, Saeed N, Jones JA, Karibayeva I. A Cross-Sectional Multivariable Analysis of the Quality of Hemodialysis Patients' Life in Lahore City, Pakistan. Healthcare (Basel). 2025;13(2).
18. G B, Tamilselvi S, Harini J, Harshini J, Parameshwari R. A study to assess the effectiveness of Intradialytic Stretching Exercises on Leg Muscle Cramp among Hemo Dialysis Patient. CARDIOMETRY. 2022;2:97–102.
19. Najumusaqib M, Khan A, Sohail MW, Ullah Z, Mehmood M, Amin Y. Acute Complications in Hemodialysis: Frequency, Patterns, and Clinical Implications: Acute Complications in Hemodialysis. Pakistan Journal of Health Sciences. 2025:33–7.
20. Bilal MS, Anwar S, Ahmad S, Ahmad S, Iqbal Z, Azhar U. Frequency of Intradialytic Complications among Patients of Maintenance Hemodialysis on Thrice Weekly: Intradialytic Complications: Maintenance Hemodialysis on Thrice Weekly. Pakistan Journal of Health Sciences. 2025:03–7.
21. Bhavani Kiran R, Evangelene G. A Study to Evaluate the Effectivness of Leg Stretching Exercises and Foot Massage in Reducing Intradialytic Leg Muscle Cramp among Patients Undergoing Hemodialysis in a selected Hospital at Kolar District.
22. Al Rahbi I, Lazarus ER, AlZaabi O, Al-Noumani H. Effectiveness of intradialytic muscle stretching exercise onmuscle cramps among patients undergoing maintenance hemodialysis in Oman-A randomized controlled trial. Journal of Health Sciences. 2025;15(2):69–75.
23. Parlak A, Şahin Z. The effect of massage on cramp frequency, cramp severity, and sleep quality of hemodialysis patients: A randomized controlled trial. Hemodialysis International. 2024;28:405–18.
24. Ahmed NS, Abd Allah ES, Ahmed FM. Effect of Intradialytic Stretching Exercises on Elderly Patients' Muscle Cramps and Stress. Cuestiones de Fisioterapia. 2024;53(02):4070–88.
25. Shalaan KF, Mohsen MM, Elabbassy AA. Effect of Implementing Intradialytic Stretching Exercise on Reducing Muscle Cramps for Improving Quality of Life among Hemodialysis Patients. Menoufia Nursing Journal. 2024;9(4):191–215.
26. Ahmad T, Jan MS, Zaidi M, Khan ZA, Sultan S. Spectrum of Intradialytic Complications in End-Stage Renal Disease Patients on Maintenance Hemodialysis. Journal of

Health, Wellness and Community Research. 2025:e743–e.
27. Saleem M, Rehan I, Rana MA, Ahmad A, Asif M, Mehmood F, et al. Early Mortality Rate in Patients Initiating Maintenance Hemodialysis in a Tertiary Care Hospital. Pakistan Journal of Kidney Diseases. 2020;4(03):294–7.
28. Sajjadi SL, Ghafourifard M, Khosroshahi HT. The effect of individualized education on learning needs of patients undergoing hemodialysis: a randomized controlled clinical trial. BMC Nephrol. 2024;25(1):452.
29. Akhtar S, Nasir JA, Usman M, Sarwar A, Majeed R, Billah B. The prevalence of hepatitis C virus in hemodialysis patients in Pakistan: A systematic review and meta-analysis. PLoS One. 2020;15(5):e0232931.
30. Lee S, Pham NM, Montez-Rath ME, Bolanos CG, Bonde SS, Meyer TW, et al. Twice Weekly versus Thrice Weekly Hemodialysis-A Pilot Cross-Over Equivalence Trial. Clin J Am Soc Nephrol. 2024;19(9):1159–68.
31. Islam G, Shah G, Saeed N, Jones J, Karibayeva I. A Cross-Sectional Multivariable Analysis of the Quality of Hemodialysis Patients' Life in Lahore City, Pakistan. Healthcare. 2025;13.
32. Saleem I, Dhrolia M, Qureshi R, Nasir K, Ahmad A. Haemodialysis burden'overweighs the associations of demographic, social and clinical factors on quality of life: A single centre study from Pakistan. J Pak Med Assoc. 2022;72:886–90.
33. Imtiaz S, Alam A. Epidemiology and demography of Chronic Kidney Disease in Pakistan-A review of Pakistani literature. Pakistan Journal of Kidney Diseases. 2023;7(1):2–7.
34. Amin A, Jamil M, Ahmad A, Amjad A, Khaliq S. Assessment of quality of life in patients undergoing hemodialysis in RMI, Peshawar. Pak J Med Health Sci. 2022;16(7):808.
35. Naz S, Nazar M, Khalid W, Malik LA, Tahir A, Rehman MMU. Prevalence of intradialytic muscle cramps and quality of life in haemodialysis patients. Journal of Bahria University Medical and Dental College. 2024;14(01):30–4.
36. Haroon M, Anjum N, Tariq S. EVALUATION OF INCIDENCE OF ADYNAMIC BONE DISEASE IN PATIENTS WITH END STAGE RENAL DISEASE. Biological and Clinical Sciences Research Journal. 2022;2022(1).
37. Hawke F, Sadler SG, Katzberg HD, Pourkazemi F, Chuter V, Burns J. Non-drug therapies for the secondary prevention of lower limb muscle cramps. Cochrane Database Syst Rev. 2021;5(5):Cd008496.
38. Poornzaari M, Roshanzadeh M, Mohammadi S, Taj A, Dehghani K, Parsa S. Effect of Isotonic Exercise on the Frequency of Muscle Cramps in Hemodialysis Patients: A Clinical Trial. Medical - Surgical Nursing Journal. 2019;In Press.
39. AWAN A-U-R, ASLAM MI, AKRAM M, RASHID H. Factors affecting survival and quality of life of patients after haemodialysis treatment. 2018.
40. Dhudum B, Bhore NR. Intradialytic stretching exercises on muscle cramps: a systematic review. J Crit Rev. 2020;7(15):4390–8.
41. Kot G, Wróbel A, Kuna K, Makówka A, Nowicki M. The Effect of Muscle Cramps During Hemodialysis on Quality of Life and Habitual Physical Activity. Medicina (Kaunas). 2024;60(12).
42. Ford E, Stewart K, Garcia E, Sharma M, Whitlock R, Getachew R, et al. Randomized Controlled Trial of the Effect of an Exercise Rehabilitation Program on Symptom Burden in Maintenance Hemodialysis: A Clinical Research Protocol. Canadian Journal of Kidney Health and Disease. 2024;11:20543581241234724.
43. Janse RJ, Hoekstra T, Jager KJ, Zoccali C, Tripepi G, Dekker FW, et al. Conducting correlation analysis: important limitations and pitfalls. Clin Kidney J. 2021;14(11):2332–7.

44. Chen Z, Ma J, Ou H, Pu L. Impact of nursing interventions on hemodialysis patients using the integrated theory of health behavior change. Medicine (Baltimore). 2025;104(2):e41050.

RJNMSR
Review Journal of Neurological & Medical Sciences Review