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Effectiveness of Leg Range of Motion Exercises on Muscle Cramps and Associated Pain among Hemodialysis Patients

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Abstract: ***Muscle cramps are a common and distressing complication of hemodialysis. Leg range of motion (ROM) exercises are a simple, non-pharmacological nursing intervention that may reduce them. This study evaluated the effect of leg ROM exercises on muscle cramps and associated pain among patients undergoing hemodialysis. A quantitative, pre-experimental, one-group pre-test post-test design was used with 50 patients receiving regular hemodialysis at Shalinitai Meghe Hospital and Research Center, Nagpur. Muscle cramps (30-item scale, score 30–120) and pain (10-item scale, score 10–40) were assessed before and after the exercises. Data were analysed using descriptive statistics, paired t-test and chi-square test. The mean muscle cramp score fell from 89.16 ± 4.00 to 60.94 ± 4.43 (mean difference 28.22; t = 29.55; p < 0.001) and the mean pain score from 30.30 ± 2.51 to 19.80 ± 2.65 (mean difference 10.50; t = 21.61; p < 0.001). No participant had severe cramps or severe pain after the exercises. Educational and marital status were associated with post-test cramp severity. Leg ROM exercises were followed by significant reductions in cramps and pain; a controlled study is needed to confirm effectiveness.***

Keywords: Range of Motion Exercises, Hemodialysis, Muscle Cramps, Pain, Nursing Intervention

1. Introduction

Chronic kidney disease (CKD) is a growing global health problem, driven largely by diabetes, hypertension and ageing populations [1,2]. When CKD progresses to end-stage renal disease (ESRD), renal replacement therapy becomes necessary for survival, and hemodialysis is its most widely used form [3,4]. Although life-sustaining, hemodialysis is often accompanied by intradialytic complications, of which muscle cramps, mainly in the legs, are among the most common and distressing [5,6]. Cramps are sudden, painful, involuntary muscle contractions [7]. They disturb comfort, sleep, mobility and quality of life [5] and can force sessions to be shortened, compromising dialysis adequacy. Proposed contributors include rapid ultrafiltration, fluid and electrolyte shifts, hypotension and reduced muscle perfusion [6,7]. Pharmacological options such as muscle relaxants and supplements give incomplete relief and may cause adverse effects in renal impairment, which has increased interest in safe, low-cost, non-pharmacological measures that nurses can deliver [8,9]. Range of motion (ROM) exercises are planned movements of a joint through its available range. They need no special equipment and may improve circulation and reduce muscle stiffness [10,11]. Evidence on leg ROM exercises specifically is limited in Indian dialysis units, where most studies have examined stretching. This study therefore evaluated the effect of leg ROM exercises on muscle cramps and associated pain among hemodialysis patients in a hospital in Nagpur, Maharashtra.

2. Literature Survey

Exercise during or between dialysis sessions is increasingly considered a feasible supportive therapy for hemodialysis patients, although the most suitable type of exercise remains debated [10]. Intradialytic ROM exercise has been examined for its effect on dialysis adequacy and fatigue [11], and ROM exercise has also been tested for muscle strength in critically ill patients [12]. For cramps specifically, studies from India report encouraging results. Among 60 patients in a Western Maharashtra hospital who were taught intradialytic exercises, the mean cramp score fell from 10.3 (SD 2.48) to 1.78 (SD 1.5) [13]. A quasi-experimental study in Erode found that intradialytic leg exercise significantly reduced pain and fatigue and improved quality of life, with no significant association between outcomes and demographic variables [14]. Randomized trials of nurse-led intradialytic stretching have examined cramp burden [15], and a trial in Oman reported significantly less pain in the third hour ($p = 0.012$) and cramping in the fourth hour ($p = 0.004$) of dialysis in the intervention group [16]. Overall, exercise appears to be a promising, low-risk approach, but most studies used stretching protocols, small samples and single sites, which supports the need for local evidence on leg ROM exercises.

3. Problem Definition

The problem addressed was the effectiveness of leg ROM exercises on muscle cramps and associated pain among patients undergoing hemodialysis at Shalinitai Meghe Hospital and Research Center, Wanadongri, Nagpur. The objectives were: (i) to assess the level of muscle cramps and pain before and after leg ROM exercises; (ii) to compare

pre-test and post-test scores; and (iii) to determine the association between post-test cramp severity and selected demographic variables. The null hypothesis (H_0) was that there is no significant difference between pre-test and post-test muscle cramp scores after leg ROM exercises; the research hypothesis (H_1) was that a significant difference exists at $p < 0.05$.

4. Methodology

4.1 Design and setting

A quantitative approach with a pre-experimental, one-group pre-test post-test design was used. The study was conducted in the dialysis unit of Shalinitai Meghe Hospital and Research Center, Wanadongri, Nagpur.

4.2 Sample

Fifty patients undergoing regular hemodialysis were selected by non-probability purposive sampling. Patients were included if they were on regular hemodialysis, had muscle cramps during or after dialysis, were conscious, oriented and able to follow instructions, were physically able to perform lower-limb ROM exercises, and gave informed consent. Patients were excluded if they had severe musculoskeletal disorders, fractures, lower-limb surgery or neurological impairment affecting leg movement; uncontrolled hypertension, severe cardiac problems or another contraindication to exercise; were critically ill or unstable; had already undergone physiotherapy or structured exercise for cramps; or were unwilling or unable to cooperate.

4.3 Tools

The tool had three parts. Part A recorded age, gender, education, occupation, marital status, monthly family income, duration and weekly frequency of hemodialysis, history of muscle cramps and source of information on leg exercises. Part B was a 30-item muscle cramp scale scored on a four-point response format (never to often), giving scores of 30–120, categorised as mild (30–60), moderate (61–90) or severe (91–120). Part C was a 10-item pain scale with scores of 10–40, categorised as mild (10–18), moderate (19–29) or severe (30–40). Content validity was established by a panel of experts in nursing, nephrology, physiotherapy and statistics. Reliability was report Cronbach's alpha or other reliability value.

4.4 Intervention and Data Collection

After ethical clearance, permission from hospital authorities and written informed consent, a pre-test was conducted. Participants then performed leg ROM exercises involving the hip, knee and ankle joints describe protocol: exercises, repetitions, duration per session, number of sessions, timing relative to dialysis, supervision]. A post-test with the same tools followed state interval between pre-test and post-test].

4.5 Data Analysis

Frequency, percentage, mean and standard deviation described the data. The paired t-test compared pre-test and post-test scores, Pearson's correlation examined the relationship between pre-test and post-test cramp scores, and the chi-square test assessed association of post-test cramp severity with demographic variables. A p-value below 0.05 was considered significant.

4.6 Ethical Considerations

Approval was obtained from the institutional ethics committee. Participation was voluntary and confidentiality was maintained.

5. Results and Discussion

5.1 Sample Characteristics

Table 1 shows the characteristics of the 50 participants. The largest age group was 18–30 years (32%), 58% were female, and 32% had primary education while 26% were illiterate. Self-employment was the most common occupation (30%), 38% were married, and 36% had a monthly family income of ₹10,001–20,000. About one-third (32%) had been on hemodialysis for under six months. All participants had a history of muscle cramps, and media was the commonest source of information on leg exercises (36%).

Table 1: Characteristics of participants (N = 50), n (%)

Variable		Categories
Age (years)	18–30	16 (32);
	31–40	13 (26)
	41–50	9 (18)
	>50	12 (24)
Gender	Male	21 (42)
	Female	29 (58)
Education	Illiterate	13 (26)
	Primary	16 (32)
	Secondary	10 (20)
	Graduate	11 (22)
Occupation	Government	14 (28)
	Private	13 (26)
	Self-employed	15 (30)
	Unemployed	8 (16)
Marital status	Married	19 (38)
	Unmarried	18 (36)
	Widow/widower	13 (26)
Monthly income (₹)	<10,000	8 (16)
	10,001–20,000	18 (36)
	20,001–30,000	10 (20)
	>30,000	14 (28)
Duration of dialysis	<6 months	16 (32)
	6 months–1 year	13 (26)
	1–3 years	13 (26);
	>3 years	8 (16)
Dialysis sessions/week	Once	15 (30)
	Twice	7 (14)
	Thrice	13 (26)
	>Thrice	15 (30)
History of cramps	Yes	50 (100)
Source of information	Doctor	12 (24)
	Nurse	12 (24)
	Friends/relatives	8 (16)
	Media	18 (36)

5.2 Cramp and pain severity before and after exercises

Before the exercises, no participant had mild cramps; 62% had moderate and 38% severe cramps (mean score 89.16 ± 4.00, 74.30% of the maximum). Afterwards, 46% had mild and 54% moderate cramps, and none had severe cramps (mean 60.94 ± 4.43, 50.78%). Pain showed the same pattern: 64% had severe pain at pre-test, whereas after the exercises 30% had mild and 70% moderate pain, and none had severe pain (Table 2, Fig. 1).

Table 2: Severity of muscle cramps and pain, n (%)

Level (score range)	Pre-test	Post-test
Muscle cramps		
Mild (30–60)	0 (0)	23 (46)
Moderate (61–90)	31 (62)	27 (54)
Severe (91–120)	19 (38)	0 (0)
Mean ± SD	89.16 ± 4.00	60.94 ± 4.43
Pain		
Mild (10–18)	0 (0)	15 (30)
Moderate (19–29)	18 (36)	35 (70)
Severe (30–40)	32 (64)	0 (0)
Mean ± SD	30.30 ± 2.51	19.80 ± 2.65

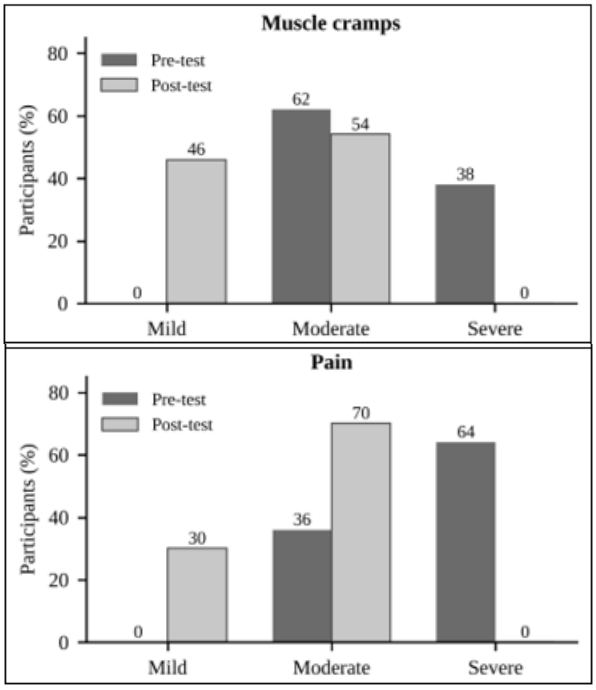


Figure 1: Severity of muscle cramps and pain before and after leg ROM exercises (N = 50)

5.3 Effect of leg ROM exercises

The paired t-test showed a significant reduction in both outcomes (Table 3). Mean cramp scores fell by 28.22 points and mean pain scores by 10.50 points (both $p < 0.001$). The null hypothesis was therefore rejected. Pre-test and post-test cramp scores showed a weak negative correlation ($r = -0.283$, $p = 0.046$); this describes the relationship between baseline and post-test scores and is not itself a measure of the exercise effect.

Table 3: Paired t-test of pre-test and post-test scores (N = 50)

Outcome	Pre-test Mean ± SD	Post-test Mean ± SD	Mean diff.	t (df = 49)	p
Muscle cramps	89.16 ± 4.00	60.94 ± 4.43	28.22	29.55	<0.001
Pain	30.30 ± 2.51	19.80 ± 2.65	10.5	21.61	<0.001

5.4 Association with demographic variables

Post-test cramp severity was grouped as mild or moderate (no participant remained severe). Education ($p = 0.009$) and marital status ($p = 0.001$) were significantly associated with post-test severity; the other variables were not (Table 4). A mild post-test level was seen in 81.8% of graduates against 18.8% of those with primary education, and in 78.9% of married participants against 15.4% of widowed participants.

Table 4: Association of post-test cramp severity with demographic variables (N = 50)

Variable	χ^2	df	p	Result
Age	2.132	3	0.546	NS
Gender	1.81	1	0.179	NS
Education	11.551	3	0.009	Significant
Occupation	2.095	3	0.553	NS
Marital status	14.371	2	0.001	Significant
Monthly income	0.828	3	0.843	NS
Duration of dialysis	1.207	3	0.751	NS
Sessions per week	1.891	3	0.595	NS
Source of information	2.026	3	0.567	NS

NS: not significant ($p \geq 0.05$). Pearson chi-square without continuity correction. Several cells had expected counts below 5.

5.5 Discussion

Before the exercises, all participants had cramps and most had moderate to severe cramps and pain. After the exercises, scores fell significantly and no participant remained in the severe category. The direction of this change agrees with Indian studies of intradialytic exercise that reported significant reductions in cramp or pain scores [13,14] and with the Oman trial, which found less pain and cramping in later dialysis hours [16].

These results should be read with caution. With no control group, the fall in scores cannot be attributed to ROM exercises alone: natural variation in cramps between sessions, regression to the mean, expectation effects and concurrent care could all contribute. Some items of the cramp scale also ask about the perceived benefit of exercises, which may weaken its validity as a baseline measure and favour lower post-test scores.

Education and marital status were associated with post-test severity, whereas the Erode study found no association with demographic variables [14]. Better understanding of instructions and family support in carrying out the exercises may explain such differences, but this is speculative. Nine tests were run without adjustment, subgroups were small, and the finding should be treated as exploratory.

6. Conclusion

Leg ROM exercises were followed by a significant reduction in muscle cramps and associated pain among hemodialysis patients, and no participant had severe cramps or pain afterwards. As a simple, inexpensive, non-pharmacological activity that nurses can teach and supervise, leg ROM exercise is a promising addition to routine dialysis care. Because the design had no control group, these findings indicate association rather than proven effect.

7. Future Scope

The main limitations were the one-group design without a control group, a small sample from one hospital, purposive sampling, short follow-up, self-reported measures and unadjusted multiple testing. Future work should use randomized or controlled designs with larger multicentre samples, follow patients over a longer period, and compare ROM exercises with stretching or physiotherapy. Studies could also record ultrafiltration volume, electrolytes, hydration and comorbidities, and assess quality of life. A structured, nurse-led ROM protocol could then be tested for routine use in dialysis units.

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