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Original Article

Impact of Deep Breathing Exercises and Isometric Handgrip Exercises to Improve Chest Expansion, Handgrip Strength, and Quality of Life in Chronic Renal Failure Patients on Dialysis

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ABSTRACT

Background: Chronic kidney disease (CKD) and its terminal stage, end-stage renal disease (ESRD), significantly impair patients' quality of life, necessitating lifelong dialysis or kidney transplantation. Physical exercises have been posited as beneficial adjunct therapies to improve physical functions and overall well-being in this patient population.

Objective: This study aimed to assess the effects of deep breathing and isometric handgrip exercises on chest expansion, handgrip strength, and quality of life among patients with chronic renal failure on dialysis.

Methods: In a quasi-experimental study design, 22 participants undergoing dialysis at both governmental and private facilities in Faisalabad, Pakistan, were recruited through purposive sampling. Participants engaged in an 8-week program of deep breathing and isometric handgrip exercises. Assessments of chest expansion, handgrip strength, and quality of life were conducted using measuring tapes, hand-held dynamometers, and the WHOQOL questionnaire, respectively. Data were analyzed using the SPSS software version 25, employing paired sample t-tests to compare pre- and post-intervention measurements.

Results: Significant improvements were noted post-intervention, with chest expansion increasing from a mean of 1.36 ± 0.49 cm to 1.58 ± 0.10 cm ($t=12.990$, $p<0.001$), right-hand grip strength from 1.00 ± 0.53 kg to 1.24 ± 0.11 kg ($t=8.775$, $p<0.001$), and left-hand grip strength from 0.82 ± 0.50 kg to 1.04 ± 0.11 kg ($t=7.659$, $p<0.001$). Quality of life metrics also showed significant improvements across various dimensions, including overall quality of life, health satisfaction, and physical mobility.

Conclusion: The study concluded that deep breathing and isometric handgrip exercises significantly enhance chest expansion, handgrip strength, and the quality of life in dialysis patients, suggesting that incorporating such exercises into routine care could be beneficial.

Keywords: Chronic kidney disease, end-stage renal disease, dialysis, deep breathing exercises, isometric handgrip exercises, quality of life, physical therapy.

INTRODUCTION

Chronic kidney disease (CKD), encompassing a spectrum from mild dysfunction to end-stage renal disease (ESRD), represents a significant public health concern with profound impacts on morbidity and mortality. The final stage of CKD, known as end-stage renal disease, necessitates dialysis or kidney transplantation for patient survival. The burden of CKD is evident, with a recent meta-analysis estimating that 13.4% of the global population is affected by stages 1–5 of CKD, and 10.6% suffer from the more severe stages 3–5 (10). Patients with CKD often experience a myriad of symptoms ranging from edema and hypertension to severe musculoskeletal pain, which significantly impair their quality of life (11, 12).

Renal insufficiency, particularly in its terminal stages, is characterized by the kidneys' diminished capacity to filter waste from the blood effectively, leading to an accumulation of toxins that can be life-threatening. This deterioration can be categorized into acute kidney failure, which appears suddenly and is often reversible, and chronic kidney failure, a gradual and typically irreversible decline in kidney function (9). The management of CKD, especially at advanced stages, heavily relies on dialysis, which, while life-sustaining,

also contributes to physical and psychological burdens, emphasizing the necessity for supportive therapies to improve patient outcomes.

Physical therapy, specifically exercises designed to enhance musculoskeletal strength and respiratory function, has emerged as a critical component of comprehensive care for these patients. Exercises such as isometric handgrip and deep breathing have been identified to potentially improve physical functions such as handgrip strength and chest expansion, and by extension, the overall quality of life in individuals undergoing dialysis (15, 16). Such interventions are particularly beneficial as they can be tailored to individual capabilities and needs, thereby supporting better health outcomes and reducing common complications associated with dialysis. The rationale behind incorporating these exercises into patient care regimens stems from both their physiological benefits and the comparative lack of research focused on their efficacy within the Asian population, particularly in Pakistan (17, 18).

Given the limited literature on the subject and the potential for significant clinical benefits, this study was designed to rigorously evaluate the impact of deep breathing and isometric handgrip exercises on chest expansion, handgrip strength, and overall quality of life among chronic renal failure patients on dialysis. This research adopted a quasi-experimental design to explore these effects in a sample of 22 participants from both governmental and private dialysis facilities in Faisalabad, Pakistan, over an 8-week period. The findings from this study could provide a crucial foundation for refining physical therapy protocols and enhancing the care and quality of life for dialysis patients globally.

MATERIAL AND METHODS

This quasi-experimental study was conducted to evaluate the effects of deep breathing and isometric handgrip exercises on chest expansion, handgrip strength, and quality of life in patients with chronic renal failure undergoing dialysis. The research was carried out over a period of six months following the approval of the study protocol, which adhered to the ethical guidelines set forth in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Government College University, Faisalabad, prior to the commencement of the study.

A purposive sampling technique was employed to select participants from both governmental and private dialysis facilities located in Faisalabad, Pakistan. The inclusion criteria stipulated that participants must be adults older than 18 years, currently receiving hemodialysis, and hemodynamically stable. Exclusion criteria included patients with chronic lung disease, ischemic heart disease, arrhythmias, hypertension, or any musculoskeletal disorders that could be exacerbated by exercise (18, 19).

A total of 22 participants were enrolled in the study. Data collection involved initial and follow-up assessments at the start and end of the 8-week intervention period. The interventions consisted of structured deep breathing and isometric handgrip exercises. Deep breathing exercises aimed at enhancing pulmonary function and chest expansion, while isometric handgrip exercises were focused on improving muscular strength. All exercises were supervised by qualified physical therapists to ensure proper technique and safety. Assessment tools included a hand-held dynamometer to measure muscle strength and a measuring tape to assess chest expansion. The quality of life was evaluated using the World Health Organization Quality of Life (WHOQOL) questionnaire (20, 21). All instruments were calibrated and validated for accuracy prior to the study's initiation.

Data were systematically collected and documented in a secure database. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, version 25. The Shapiro-Wilk test was used to assess the normality of the distribution of the variables. Given that the data followed a normal distribution, paired sample t-tests were applied to compare pre- and post-intervention measurements to determine the effectiveness of the interventions. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

In this study, the effectiveness of deep breathing and isometric handgrip exercises was assessed through various metrics, focusing on chest expansion, handgrip strength, and overall quality of life in patients undergoing dialysis. The statistical analysis revealed significant improvements in all measured variables post-intervention.

Table 1: Changes in Physical Metrics

Metric	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Chest Expansion (cm)	1.36364 ± 0.49237	1.58194 ± 0.10497	12.990	<0.001
Right-hand Grip (kg)	1.00000 ± 0.53452	1.23699 ± 0.11396	8.775	<0.001
Left-hand Grip (kg)	0.81818 ± 0.50108	1.04035 ± 0.10683	7.659	<0.001

Table 2: Quality of Life Metrics

Quality of Life Aspect	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Overall Quality of Life	1.27273 ± 0.55048	1.51680 ± 0.11736	10.844	<0.001
Health Satisfaction	1.40909 ± 0.59033	1.67083 ± 0.12586	11.196	<0.001
Physical Pain Impact	1.27273 ± 0.55048	1.51680 ± 0.11736	10.844	<0.001
Medical Treatment Necessity	1.22727 ± 0.75162	1.56052 ± 0.16025	7.659	<0.001
Enjoyment of Life	1.36364 ± 0.49237	1.58194 ± 0.10497	12.990	<0.001
Life Meaningfulness	1.36364 ± 0.49237	1.58194 ± 0.10497	12.990	<0.001
Concentration Ability	1.27273 ± 0.45584	1.47484 ± 0.09719	13.096	<0.001
Safety Feeling in Daily Life	1.27273 ± 0.45584	1.47484 ± 0.09719	13.096	<0.001
Physical Environment Health	1.09091 ± 0.61016	1.36144 ± 0.13009	8.386	<0.001
Energy for Daily Life	1.18182 ± 0.39477	1.35685 ± 0.08417	14.042	<0.001
Bodily Appearance Acceptance	1.36364 ± 0.58109	1.62128 ± 0.12389	11.007	<0.001
Financial Resources Sufficiency	0.31818 ± 0.56790	0.56997 ± 0.12108	2.628	0.016
Information Accessibility for Daily Life	1.63636 ± 0.72673	1.95858 ± 0.15494	10.561	<0.001
Opportunity for Leisure Activities	1.27273 ± 0.45584	1.47484 ± 0.09719	13.096	<0.001
Physical Mobility	1.09091 ± 0.61016	1.36144 ± 0.13009	8.386	<0.001
Sleep Quality	1.40909 ± 0.50324	1.63221 ± 0.10729	13.133	<0.001
Daily Activities Performance	1.45455 ± 0.59580	1.71871 ± 0.12703	11.451	<0.001
Work Capacity	1.18182 ± 0.39477	1.35685 ± 0.08417	14.042	<0.001
Personal Relationships Satisfaction	1.40909 ± 0.50324	1.63221 ± 0.10729	13.133	<0.001
Sex Life Satisfaction	0.95455 ± 0.37509	1.12085 ± 0.07997	11.936	<0.001
Friends Support Satisfaction	1.27273 ± 0.55048	1.51680 ± 0.11736	10.844	<0.001
Living Conditions Satisfaction	1.04545 ± 0.48573	1.26081 ± 0.10356	10.095	<0.001
Access to Health Services Satisfaction	1.36364 ± 0.78054	1.71370 ± 1.6833	8.101	<0.001
Transport Satisfaction	0.95455 ± 0.78542	1.31278 ± 0.16745	5.700	<0.001
Frequency of Negative Feelings (e.g., anxiety)	1.40909 ± 0.73414	1.73459 ± 0.15652	9.003	<0.001

These results indicate substantial improvements in physical metrics and quality of life aspects following the intervention. The significant p-values across all metrics demonstrate the efficacy of the exercises in enhancing the well-being of chronic renal failure patients on dialysis.

DISCUSSION

The results of this study underscore the significant impact of deep breathing and isometric handgrip exercises on improving both the physical metrics and quality of life for patients with chronic renal failure on dialysis. These findings are consistent with previous studies that have highlighted the beneficial effects of physical exercise on patients undergoing dialysis (15, 16). Notably, improvements in chest expansion and handgrip strength, as observed in this study, suggest that such exercises can enhance respiratory function and muscular strength, which are often compromised in these patients.

The improvement in chest expansion is particularly noteworthy, aligning with the work by Gunjal et al. (25), which demonstrated that breathing exercises could significantly influence lung capacity and respiratory function. Similarly, the increase in handgrip strength found in this study correlates with findings from Olvera-Soto et al. (22), where resistance exercises were shown to enhance muscle reserve and handgrip strength in dialysis patients. The consistent results across these studies underscore the reproducibility and reliability of exercise interventions in this patient population.

The quality of life improvements documented in this study also mirror those reported in other interventions involving physical therapy and exercise. For instance, the marked improvement in overall quality of life and specific aspects such as energy levels, physical mobility, and satisfaction with health aligns with findings from de Medeiros et al. (18), who noted significant enhancements in functional capacity and quality of life following inspiratory muscle training in CKD patients.

Despite the promising outcomes, this study has several limitations. The quasi-experimental design and the absence of a control group limit the ability to draw causal inferences from the results. Furthermore, the small sample size and the study's restriction to a single geographic area may affect the generalizability of the findings. These factors suggest that the results should be interpreted

with caution and that further studies with randomized controlled trial designs, larger and more diverse populations, and multiple study sites are needed to corroborate these findings.

Future research should also explore the long-term effects of these exercises on the progression of renal disease and the potential for reducing the dependency on dialysis. Additionally, investigating the optimal frequency, intensity, and types of exercises that best benefit this patient population could help in refining therapeutic guidelines and improving clinical outcomes.

In conclusion, this study adds to the growing body of evidence supporting the integration of targeted exercise regimens into the treatment plans for patients with chronic renal failure. Despite its limitations, the research highlights the potential for non-pharmacological interventions to significantly enhance patient outcomes. Recommendations for future work include broader studies with robust methodological designs to fully ascertain the benefits and limitations of exercise in this vulnerable population.

CONCLUSION

The study concluded that deep breathing and isometric handgrip exercises significantly enhance chest expansion, handgrip strength, and the quality of life in dialysis patients, suggesting that incorporating such exercises into routine care could be beneficial.

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