



A NARRATIVE REVIEW ON THE EFFECTIVENESS OF RESISTANCE EXERCISE ON UREA REDUCTION RATIO (URR) AND KT/V AMONG HAEMODIALYSIS PATIENTS

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ABSTRACT

Resistance exercise has increasingly been recognized for its potential benefits in improving the physiological outcomes of patients undergoing haemodialysis. Two key markers of dialysis adequacy, the Urea Reduction Ratio (URR) and Kt/V, are essential in evaluating treatment effectiveness. This narrative review explores the current evidence regarding the role of resistance exercise in enhancing these markers. Several clinical trials suggest that incorporating resistance training into the dialysis regimen can improve dialysis efficiency, physical performance, and overall patient outcomes. However, more standardized research is necessary to confirm these findings. **Aim:** Present study was aimed to assess the effectiveness of resistance exercises on URR and Kt/v among haemodialysis patients. **Methodology:** The present study is a narrative review of effect on resistance exercise on URR and Kt/v among haemodialysis patients. Literature from 2019 to 2024 was searched using electronic database from PubMed, Google Scholar, ProQuest, SCOPUS Library and ResearchGate. Electronic database search was done to extract the articles related to the theme of research problem and related terms using the keywords - "Resistance Exercise" OR "URR" OR "KT/v" AND "quality of life" AND "Chronic Kidney Disease" AND End Stage Renal failure" AND "randomized controlled trial" AND "kidney failure" OR "Hemodialysis. **Result:** Majority of the studies proved that resistance exercises are effective and reduce URR (Urea Reduction ratio) and KT/v (creatinine clearance) among haemodialysis patients. **Conclusion:** Progressive resistance exercise is very effective and easy to do for haemodialysis patients to reduce maintain the quality of life.

KEYWORDS

Resistance exercise, Haemodialysis, Urea Reduction Ratio, Kt/V, Dialysis adequacy, Physical rehabilitation

INTRODUCTION

Chronic kidney disease (CKD) affects an increasing number of populations and 15% of adults in the United States are estimated to have CKD by the Modification of Diet in Renal Disease (MDRD) estimated glomerular filtration rate (eGFR) criteria. Muscle wasting, abnormalities in muscle function, and effects on exercise performance are common in patients with ESRD. Not only uraemia per se, but also chronic inflammation, metabolic acidosis, oxidative stress, malnutrition, inactivity, androgen deficiency, insulin resistance, haemodialysis procedures, and concurrent illnesses are all related to muscle wasting. A specific form of muscle wasting in patients with ESRD is defined as the Protein-Energy Wasting, or PEW. PEW is characterized by increased muscle protein catabolism relative to protein synthesis. It is also related to metabolic derangements, hormonal abnormalities, and consequent abnormalities in muscle structure in dialysis patients. In addition, muscle wasting is a strong risk factor for mortality in ESRD patients. Therefore, prevention or treatment of PEW is important for the management of ESRD patients. End-stage renal disease (ESRD) patients on maintenance haemodialysis often face multiple health challenges, including muscle wasting, fatigue, and reduced physical functioning. Inadequate dialysis efficiency can further exacerbate these issues. Two commonly used measures to assess dialysis adequacy are the Urea Reduction Ratio (URR) and Kt/V. URR reflects the percentage reduction in blood urea nitrogen (BUN) levels pre- and post-dialysis, while Kt/V represents the fractional urea clearance normalized to the patient's body water volume.

Generally, patients with ESRD have lower physical activities, muscle performance, and quality of life (QOL) than do healthy subjects. Numerous studies have suggested that exercise could improve many indicators of physical functioning, improve self-reported physical functioning, and also improve QOL in ESRD patients.

Exercise is one of the possible preventive manoeuvres to reduce muscle protein loss and maintain muscle function. Recently, many studies have shown the importance of exercise or regular physical activity to prevent muscle wasting in ESRD patients. Therefore, this

review aimed to investigate the beneficial effects of exercise during haemodialysis (intradialytic exercise) and also to introduce various intradialytic exercise programs and their advantages.

Emerging evidence suggests that resistance exercise can have a positive impact not only on musculoskeletal health but also on dialysis adequacy markers. The aim of this review is to analyse the existing literature on the effectiveness of resistance exercise in improving URR and Kt/V among haemodialysis patients.

Global Incidence And Prevalence

Globally, haemodialysis is widely used as a life-saving treatment for patients with end-stage renal disease (ESRD). The incidence and prevalence of dialysis patients vary by country, with high-income nations typically having better infrastructure and higher numbers of dialysis patients. The Global Dialysis Database (GDD). Of these, the vast majority are on haemodialysis. According to National Kidney Foundation estimates, approximately 200,000-300,000 people in India undergo dialysis annually, with about 100,000 new patients starting dialysis each year. The annual incidence rate of chronic kidney disease (CKD) in Delhi NCR is estimated to be about 200-250 new dialysis patients per million population annually. Hypertensive nephropathy accounts for about 25-30% of all ESRD cases in both developed and developing countries. Diabetes is the primary cause of kidney disease in many countries, contributing to over 40% of all ESRD cases globally.

Resistance Exercise:-

It refers to a type of physical activity designed to improve muscle strength and endurance using resistance, and to improve the quality of Life. These exercises are particularly important for people on haemodialysis because they often experience muscle wasting, fatigue, and decreased physical function due to their illness and treatment.

World Health Organization, reported that "physical inactivity is already a major global health risk and prevalent in both industrialized and developing countries, causing approximately 5.2 million deaths. Physical inactivity is the primary cause of most chronic diseases, and it is one of four main risk factors of CKD" (CDC, 2019).

Physical activity is very important in today's world. Exercise keeps the body strong and healthy (National Kidney Foundation 2020). Thus, increasing physical activity is an essential aspect of disease prevention and management in patients with CKD (Kirkman et al., 2014). The "National Institute for Health and Care Excellence" "NICE" recommends guidelines for CKD in adults the following: Encourage people with CKD to take exercise, stop smoking and achieve a healthy weight (Robinson-Cohen et al. 2010). The "American National Kidney Foundation" [ANKF] guidelines include a similar statement encouraging exercise, weight loss, and smoking cessation in CKD. Physical activity enhances various metabolic benefits that may moderate and reduce the long-term risk of kidney dysfunction progression (Heiwe and Jacobson 2019).

The global burden of CKD is increasing, and it is projected to become the 5th most common cause of years of life globally by 2040 (Reese et al., 2020). Haemodialysis transplantation cost about consumes 2–3% budget of the annual healthcare in high-income countries; spending on less than 0.03% of the total population of these countries in low-and middle-income countries, most people with renal failure don't get enough access to life-saving dialysis and kidney transplantation and

The impact of resistance exercise on improving the prognosis of (chronic kidney disease) CKD patients have also received increasing attention. For CKD patients, resistance exercise may be an ideal choice for improving prognosis. Resistance exercise is not necessarily a very intense exercise that can cause harm to the body but can improve metabolic parameters with less energy consumption. Therefore, resistance exercise may be more feasible for CKD patients.

URR – URR (Urea Reduction Ratio) in the context of resistance exercise for hemodialysis patients refers to the percentage reduction in blood urea nitrogen (BUN) levels before and after dialysis, specifically analyzed in patients participating in structured resistance training programs. It is used to assess the impact of exercise on dialysis efficiency.

Kt/V – Kt/V is a quantitative measure of dialysis adequacy, representing the efficiency of urea clearance during hemodialysis. In the context of resistance exercise in hemodialysis patients, Kt/V is used to assess whether exercise enhances dialysis effectiveness by improving blood circulation and urea removal. Resistance training performed *during or between dialysis sessions at moderate intensity 2–3 times per week, 20–45 minutes per session. Expected Impact: Exercise may increase muscle metabolism and blood flow, enhancing urea clearance and improving Kt/V.

Significance Of The Study: -

The significance of study of resistance exercise in haemodialysis patients lies in its potential to address multiple physical, functional, and even biochemical complications commonly experienced by this population.

It Counteracts Muscle Wasting (Sarcopenia): Haemodialysis patients often suffer from muscle loss due to chronic inflammation, inactivity, and protein-energy wasting. Resistance exercise can preserve or rebuild muscle mass and strength, improving mobility and independence.

Improves Dialysis Efficacy (URR and Kt/V): Studies suggest that exercise during dialysis may improve uremic toxin clearance, shown

by better Urea Reduction Ratio (URR) and Kt/V values. It enhances the life span of the patient with fewer complications. .

Research Significance Of Study: -

Fills a Gap in Renal Rehabilitation: While aerobic exercise has been more widely studied, resistance training is still an emerging field in renal care research.

Supports Development of Intradialytic Programs: Studies show safe implementation of exercise during dialysis sessions, making exercise more accessible for patients with limited energy or time.

Contributes To Holistic Care:

It Demonstrates that non-pharmacological interventions like exercise can be effective in improving clinical outcomes in chronic kidney disease (CKD).

AIM: -

To evaluate the effects of resistance exercise on physical function, dialysis adequacy (measured by URR and Kt/V), and overall quality of life among patients undergoing maintenance haemodialysis.

METHODOLOGY: -

The present study is a narrative review of effect on resistance exercise on URR and Kt/v among haemodialysis patients. Literature from 2019 to 2024 was searched using electronic database from PubMed, Google Scholar, Proquest, SCOPUS Library and Researchgate. The study is a Randomized Controlled Trial (RCT) to assess the effectiveness of resistance exercise on patients undergoing haemodialysis.

Electronic database search was done to extract the articles related to the theme of research problem and related terms using the keywords - "Resistance Exercise" OR "URR" OR "Kt/v" AND "quality of life" AND "Chronic Kidney Disease" AND End Stage Renal failure" AND "randomized controlled trial" AND "kidney failure" OR "Hemodialysis

A total of 10 articles were reviewed, that includes cross sectional surveys (incidence and prevalence studies), Randomized controlled trials and prospective randomized clinical trials and conclusion was drawn based on the review of articles findings.

Inclusion Criteria: -

- Research articles related to the prevalence or incidence of Resistance Exercise on URR and Kt/v globally
- Research articles related to the impact of resistance exercise among haemodialysis patients
- Papers that is easily accessible online with full text available
- Studies published online in English literature.
- Research articles published since 2019

Exclusion Criteria: -

- The research studies which are not available in database source
- Meta analysis and systemic reviews
- Research studies published in languages other than English
- Low quality journal publications
- The research study which was published without DOI
- Patient not under treatment of Chronic Kidney Disease or End Stage Renal Disease.

SUPPORTIVE LITERATURE RELATED TO RESISTANCE EXERCISES ON URR & Kt/v: -

AUTHOR/YEAR	TITLE	METHOD	SAMPLING TECHNIQUE /SAMPLE SIZE	RESULTS
Manar F. Mohammed (2019)	Effect of Aerobic Exercises on Functional Capacity in Patients under Haemodialysis	Randomized Control Trial	Simple Random Sampling / 30	The finding of the present study showed de crease of urea level pre and post treatment so improvement of urea reduction ratio (URR) occur.
Mehdi Tayebi et al.,	Isometric Resistance Training and Branched-Chain Amino Acids Supplementation Can Improve Dialysis Adequacy: A Clinical Trial	A Clinical Trial	Simple Random Sampling / 51	After the intervention, the kt/V and URR variables presented a significant difference between the two experimental groups vs the control group (P < 0.001). The group that received BCAA(Branched Chain Amino Acids) and performed isometric resistance exercise indicated the

				most effective improvements in Kt/V (+20%) and URR (+12.5%).
Jianrong Zhao, Qige Qi, Shanshan Xu, and Dongying Shi (2020).	Combined aerobic resistance exercise improves dialysis adequacy and quality of life in patients on maintenance hemodialysis	Prospective, interventionist and open study	Simple Random Sampling / 45	Before intervention, there was no significant difference in general health condition (GH), Kt/V , URR , SF-36 to tal score, and the score of each dimension in the three groups. After the intervention therapy, the Kt/V , URR , GH, vitality (VT), and SF-36 total score markedly improved in the pure aerobic exercise group, while the Kt/V , URR , GH, VT, physical functioning (PF), and SF-36 total score significantly increased in the combined aerobic resistance exercise group.
Katarina D. Sartika, Wayan Sunaka (2022)	Comparison of urea reduction ratio and dialysis efficacy in evaluating haemodialysis adequacy in chronic kidney disease patients in Wangaya Hospital	Cross- sectional Study	Purposive Sampling /58	The mean of URR was 70.74 ± 10.04 , while the mean of Kt/V delivered by machine was 1.27 ± 0.19 . More hemodialysis patients received adequate hemodialysis based on URR parameters compared to Kt/V parameters (84.5% versus 1.7%). There was a significant difference between URR and Kt/V in the evaluation adequacy of hemodialysis ($p=0.000$). In addition, there was a positive correlation between URR and Kt/V in the evaluation adequacy of hemodialysis ($r=0.592$, $p=0.000$).
Ekaterini Vogiatzaki ¹ , Vassiliki Michou ² , et al.,(2022)	The effect of a 6-month intradialytic exercise program on hemodialysis adequacy and body composition: a randomized controlled trial	a Randomized Controlled Trial Study	Simple Random Sampling / 24	A significant increase of both Kt/V (increase by 19%, $p = 0.01$), and URR (increase by 7%, $p = 0.03$) values has been observed in the EX group (exercise group) after the 6-month training program. Similarly, a statistically significant increase in 6MWT distance (from 442 ± 67 m to 481 ± 68 m, $p = 0.02$) in the EX group has also been found, compared to the C group (from 393 ± 59 m to 427 ± 81 m, $p = 0.06$). Neither EX nor C group has shown significant changes in body composition parameters. After training, linear regression analysis revealed a strong positive correlation between Kt/V and 6MWT changes ($r = 0.74$, $p = 0.04$) in the exercise group (EX group).
Afsar et al. (2010)	To establish the effects of resistance and aerobic exercises on blood lipids and inflammation state in HD patients	Randomized controlled trial	Consecutive Sampling /21	Resistance exercises were correlated with hs-CRP levels ($p = 0.005$ and $p = 0.036$) and serum creatinine ($p < 0.0001$ and $p < 0.001$) reduction so that aerobic exercise induced more reduction ($p < 0.001$ between groups). There were no changes in BMI, Kt/V values, serum urea, albumin, hemoglobin and lipid levels ($p > 0.05$).
Freedland et al., 2023 Washington University School of Medicine	Treatment of depression and inadequate self-care in patients with heart failure: One-year outcomes of a randomized controlled trial	Single-blind, parallel groups, randomized controlled trial	Blind type Method / 84	There was no statistically significant difference in weight change ($t=0.80$, $p=0.25$), blood urea nitrogen (BUN) ($t=0.13$, $p=1.52$), or Kt/V ($t=1.62$, $p=0.11$) between the test and control groups
Mahmoud Mohamadizadeh et al. (2024)	The Effectiveness of Physical Activity During Hemodialysis on Dialysis Adequacy in Hemodialysis Patients: A Clinical Trial Study	Randomized controlled trial study	Random Sampling / 84	There was no statistically significant difference in weight change ($t=0.80$, $p=0.25$), blood urea nitrogen (BUN) ($t=0.13$, $p=1.52$), or Kt/V ($t=1.62$, $p=0.11$) between the test and control groups.

Future Scope of the Study

Future Scope: -

Resistance exercise holds significant promise for improving the overall health and quality of life of hemodialysis (HD) patients, but there is still much to explore regarding its full potential. As the field of exercise science for kidney disease progresses, several opportunities exist to refine our understanding and optimize the use of resistance exercise in this unique patient population.

Long-term Impact Studies:

Future research should explore the long-term effects of resistance training on dialysis adequacy, especially over periods longer than 6–12 months, to assess sustained benefits on URR and Kt/V.

Larger, Multi-centre Trials:

Conducting large-scale, multicentre randomized controlled trials will help validate findings across diverse populations and increase the generalizability of the results.

Personalized Exercise Programs:

Developing individualized resistance training protocols based on age, comorbidities, and physical condition may optimize outcomes in dialysis efficiency and patient safety.

Cost-Effectiveness and Quality of Life Evaluation:

Future research could also assess the economic benefits and quality of life improvements associated with resistance training programs in haemodialysis care models.

Exploring Mechanisms:

Investigating the underlying biological mechanisms by which resistance exercise affects solute clearance (e.g., increased blood flow, improved muscle metabolism) could offer new insights into optimizing dialysis).

CONCLUSION

Resistance exercise shows considerable promise as a supportive intervention to improve dialysis adequacy, as indicated by URR and Kt/V, in hemodialysis patients. Beyond improving physical function, it may serve as a non-pharmacologic strategy to enhance treatment efficacy and patient outcomes. With further validation, resistance training could become a routine component of dialysis care.

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