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PHYSICAL TRAINING DURING HAEMODIALYSIS AND OFF-DIALYSIS DAYS IN CHRONIC DIALYSIS PATIENTS: A REVIEW

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ABSTRACT
Chronic kidney disease (CKD) is a significant contributor to the need for dialysis and also elevates the likelihood of developing cardiovascular conditions. It is strongly associated with lifestyle-related illnesses, particularly diabetes mellitus and high blood pressure. Individuals undergoing dialysis often face further health issues such as heart disease, infections, and certain cancers, and unfortunately, their overall prognosis tends to be poor. CKD affects nearly 10% of the global population, and countless people lose their lives each year due to lack of access to affordable care. Despite numerous scientific studies confirming the safety and benefits of physical activity for those with end-stage renal disease (ESRD), many in the medical field still view it as unsuitable, which prevents it from being widely recommended. Additionally, patients' concerns over damaging their vascular access and common experiences of anxiety or depression further discourage them from engaging in physical exercise. In the present study an attempt has been made to review the physical training during haemodialysis and off-dialysis days in chronic dialysis patients. From the discussion of the study, it might be concluded that, supervised physical training should be recommended to the chronic dialysis patients during haemodialysis and off-dialysis days. The endurance and strength training should be encouraged by the nephrologists and physiotherapists to the chronic dialysis patients during their haemodialysis and off-dialysis days.

KEYWORDS: Physical training, Haemodialysis, Chronic dialysis patients, Intradialysis training.

INTRODUCTION
In 2013, the European Renal Best Practice (ERBP) working group issued clinical guidelines emphasizing the importance of incorporating physical activity into the rehabilitation of elderly patients with end-stage renal disease (ESRD).[1] These rehabilitation programs can be conducted either individually or in groups, with both formats benefiting from the supervision of trained professionals. Patients may also engage in individual sessions without supervision, as long as they are properly educated to monitor for signs of overexertion. To reduce the risk of adverse events—particularly cardiovascular complications—telemedicine technologies may be used during training sessions.

Depending on the timing, exercise can take place during haemodialysis treatments—referred to as intradialytic training—or on days when patients are not undergoing dialysis. These various formats allow for flexibility in rehabilitation programs, accommodating different patient preferences and capabilities. A patient's physical and psychological condition, particularly their apprehension about exercise, often influences participation. Many patients report feeling more motivated and emotionally prepared to engage in physical activity on dialysis-free days, which can enhance their willingness to take part.[2] The objectives of the present study were to review the physical training during haemodialysis and off-dialysis days in chronic dialysis patients.

METHODS
A total of 39 references were reviewed which were closely related to physical training and endurance in CKD patients during their haemodialysis and off-dialysis days. These articles were consulted from databases such as PubMed, Google Scholar, and Web of Science. The inclusion criteria were as followed: (1) articles containing the patients with CKD, in which it is

necessary to use renal replacement therapy, including haemodialysis, peritoneal dialysis or organ transplantation, and (2) administered of physical training and endurance.

Endurance Training

Endurance training involves sustained physical activity that engages large muscle groups at an aerobic intensity. Activities like walking, Nordic walking, jogging, and cycling are common examples. Drawing on practices used in cardiac rehabilitation; endurance training was the first form of exercise introduced for people with ESRD.[3] In dialysis patients, this has included marching.[4–7] cycling (including stationary bikes), jogging[7,8], water-based workouts[8–12], and swimming.[9]

The goal of endurance training is to improve the body's aerobic fitness and promote cardiovascular adaptation—both central (heart and lungs) and peripheral (muscles and circulation). The benefits include a notable increase in aerobic capacity, as measured by maximum oxygen uptake (VO_2 max) and peak ventilation (VEmax), as well as improved respiratory rate and heart morphology. Positive changes are also seen in ejection fraction, cardiac output, heart rate response, and blood pressure regulation. Moreover, endurance training helps normalize autonomic heart control.[13,8,14–16]

In terms of peripheral adaptation, it enhances muscle blood supply, shifts muscle fiber composition, and boosts both strength and endurance. However, this form of training does not significantly impact maximal strength measures.[17] Additionally, aerobic exercises may alleviate symptoms of restless leg syndrome (RLS).[18]

Strength (Resistance) Training in Dialysis Patients

The World Health Organization (WHO) recommends that individuals with chronic illnesses engage in strength training at least twice a week, targeting major muscle groups. For haemodialysis patients—who often experience muscle loss, reduced strength and endurance, and poor neuromuscular coordination—this form of exercise is especially crucial.[19]

Strength training involves working against resistance to stimulate adaptation in muscles, tendons, ligaments, and the nervous system. Local adaptations include increased muscle volume, improved vascularity, changes in muscle fiber type, and enhanced muscular strength.[20] These benefits translate into better physical function in ESRD patients, such as improved walking distance, faster walking speed, better balance, and reduced fall risk.[21]

In CKD patients, strength training typically involves lower resistance and longer sets than traditional gym routines. Maximal strength testing is not advised, nor is setting training intensity based on one-repetition maximum tests. Instead, patients should begin with weights or resistance levels that allow at least 20 repetitions comfortably. Over time, more sets can be added. Exercises should target all accessible muscle groups and use a full physiological range of motion.

Progression in resistance training should be gradual, increasing either the load (e.g., weight or band resistance) or the volume (more sets, reps, or exercises). Exercises should stop once a noticeable sense of fatigue is reached—ideally a 5–6 on the Borg scale—with 1–2 reps left in reserve to avoid overexertion. However, since ESRD patients often have elevated cardiovascular risk, it is safer to prioritize moderate loads and controlled pacing over high-intensity, heavy-weight routines. Intense athletic-style workouts are generally discouraged due to a lack of research on their safety in this population.

Currently, no studies have evaluated the exclusive effects of strength training performed only on non-dialysis days. There are concerns about the safety of unsupervised resistance workouts.[13] However, research supports the benefits of combining low-load resistance exercises with aerobic and stretching activities.[8,22,23]

Intradialysis Training – Exercises During Haemodialysis

Intradialysis rehabilitation involves engaging patients in physical activity during their haemodialysis sessions. This approach eliminates the need for additional time dedicated to exercise outside of treatment and helps break the routine of long-term dialysis, all while ensuring that patients are supervised in a controlled medical environment. However, one of the main challenges of intradialysis training is that it must be performed in positions such as lying down, semi-reclined, or seated, which limits the range of movement.

The most suitable time for exercise is typically within the first one to two hours of the dialysis session, or until about 2.5 liters of fluid have been removed through ultrafiltration. Later stages of the session, especially after extensive fluid removal, often result in drops in blood pressure, muscle cramps, or general fatigue—making it unsafe for physical exertion. According to the Renal Association Clinical Practice Guideline on Haemodialysis, exercise should be avoided in the first 30 minutes of dialysis as the body adjusts to the procedure. However, some sources suggest that if the patient remains stable throughout the session, it may be safe to continue exercising during the second half.[24]

The choice of when to exercise should always depend on the individual's condition at various stages of the dialysis process. If the patient is in good spirits and maintains stable cardiovascular function, training later in the session may still be appropriate.

A variety of exercises can be introduced during dialysis, including endurance, strength, or combined strength-endurance routines. Cycle ergometers are commonly used during the main training portion, as they support cardiovascular conditioning. Additional equipment like

resistance bands, light weights, or exercise balls can also be incorporated to enhance engagement. The focus is typically on strengthening the lower limbs and trunk, as upper limb exercises are generally avoided due to the presence of the vascular access used for dialysis—commonly located near the elbow. Movements involving elbow flexion can risk damaging the fistula. In cases where dialysis is conducted via a catheter, upper body movement can interfere with blood flow or trigger machine alarms, particularly during breathing or stretching exercises.

To ensure safety, the following guidelines are recommended for intradialysis exercise

- **Before starting:** Confirm that the patient feels well; check resting blood pressure and heart rate. For diabetic patients, monitor blood glucose levels.
- **During exercise:** Watch for any signs of overexertion or intolerance to physical activity.
- **In hypertensive patients:** Regular blood pressure checks should be performed. If it exceeds 220/105 mmHg, reduce intensity or pause exercise until it normalizes.
- **Use of Borg Scale:** Exercise intensity should be monitored using the Borg scale. Training should not push the patient into high levels of fatigue (no higher than 15 on the Borg scale or 5 on the modified scale).
- **After exercise:** Monitor heart rate and blood pressure until they return to baseline, and observe the patient for at least 20 minutes to watch for late-onset hypotension during the remainder of the session.[24]

According to research by Baker et al.[13], intradialysis training is generally safe and does not increase the risk of cardiovascular events.

Recently, the incorporation of **virtual reality** into intradialysis training has gained attention for its ability to motivate and engage patients. This novel approach adds variety and can significantly boost patient interest and adherence to exercise routines.[25]

Evidence-based benefits of intradialysis training, along with their recommendation grades based on the modified GRADE system,[26] include:

- Enhanced cardiovascular health and physical capacity (**1B**)
- Increased muscle strength (**2C**)
- Fewer hospital admissions (**2C**)
- Better blood pressure regulation (**2C**)
- Improved lipid profile (**2D**)
- Greater dialysis efficiency (**2D**)[13]
- Improved overall quality of life (**2C**)[24]

Exercise Before Haemodialysis

Patients can also engage in physical activity shortly before their dialysis sessions, as long as there are no signs of fluid overload, such as shortness of breath, elevated blood pressure (over 160/100 mmHg), rapid heart rate (over 100 bpm), or swelling in the limbs. These pre-dialysis workouts can be done in group settings at the dialysis centre, making good use of the time patients typically spend waiting for treatment to begin.

Physical Training on Non-Dialysis Days

Engaging in physical activity on days without dialysis can help ESRD (End-Stage Renal Disease) patients meet the recommended levels of exercise.[13,25–28] Unlike during haemodialysis, patients are free to perform a wider variety of movements, as their body is in a more stable state with better water and electrolyte balance. This enables greater flexibility in choosing exercise types and positions, and activities can be done either under supervision (in rehab centres or organized group sessions) or independently at home.

One challenge with unsupervised training is the absence of professional guidance. However, patient education on monitoring their own exercise intensity and response can greatly improve safety. The exercise plan should always consider the individual's health status, preferences, daily responsibilities, financial situation, and social factors.

Walking

Walking is one of the most frequently recommended endurance exercises for dialysis patients.[4–7] Even simple 10-minute walks added to regular physical activity can increase cardiovascular endurance, strengthen leg muscles, lessen fatigue after dialysis, and boost overall quality of life.[5,6] To support consistency, patients are often encouraged to maintain activity diaries. These diaries record session details like duration, distance walked, perceived exertion level, and heart rate (before and after exercise). Ongoing contact with a physiotherapist whether in person or by phone—also helps keep patients motivated and reassured as they gradually increase their activity levels.

Water Exercise and Swimming

Water-based exercises and swimming are especially beneficial for dialysis patients who also suffer from joint conditions such as osteoarthritis.[29] The buoyancy of water reduces stress on joints, allowing muscles to strengthen more comfortably and safely. These exercises support musculoskeletal recovery, enhance kidney filtration, reduce protein loss in urine, improve respiratory function, and even lower mortality risk.[11,12]

Just one 60-minute water exercise session per week has been shown to improve fitness and leg muscle strength.[10] Classes that incorporate music and props—like foam noodles, buoyancy belts, dumbbells, and gloves—make the sessions more enjoyable and engaging, encouraging regular participation. Over time, swimming and aquatic workouts significantly enhance physical health and life satisfaction for haemodialysis patients.[9]

Tai Chi

Tai Chi is a gentle, low-intensity form of exercise characterized by flowing movements, coordinated breathing, and mindful awareness. It's considered safe and particularly beneficial for patients with CKD, as it helps improve physical and psychological well-being. The controlled movements, postural control, and light resistance offered through Tai Chi can counteract conditions such as muscle wasting, bone loss, and poor balance—all common in dialysis patients who also face cardiovascular risks.[30]

An added benefit of Tai Chi is that many routines, especially simplified Yang-style sequences, can be practiced at home using video guides.[31–33] Studies show that Tai Chi improves cardiovascular fitness and overall quality of life in all dimensions.[32–35] When included in a rehabilitation program, it can help patients feel stronger, more in control, and more positive about their health.[34]

Yoga

Yoga offers both physical and mental benefits. By holding various postures (asanas) combined with controlled breathing, yoga promotes muscle strength, flexibility, improved joint mobility, and better lung function. It also reduces oxidative stress and inflammation while supporting mental focus, mood balance, and quality of life.[35,36]

The final relaxation pose, *Savasana*, is used at the end of yoga sessions to encourage deep relaxation and aid psychophysical recovery.[36,37]

Pilates

Pilates is another effective exercise option for dialysis patients. It enhances general health, physical fitness, and emotional well-being. In addition to improving social interaction, Pilates has been shown to strengthen respiratory muscles, improve functional ability, and increase aerobic endurance.[38,39]

CONCLUSION

From the discussion of the study, it might be concluded that, supervised physical training should be recommended to the chronic dialysis patients during haemodialysis and off-dialysis days. The endurance and strength training should be encouraged by the nephrologists and physiotherapists to the chronic dialysis patients during their haemodialysis and off-dialysis days.

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