بازتوانی و ورزش درمانی در بیماران کلیوی

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The Benefits of Exercise

- There is evidence that a physical exercise program, integrated into your total treatment plan, has positive benefits for your general health, including weight loss, improved muscle strength, lower level of cholesterol and blood fats, increased cardiac output and greater physical exercise capacity.

- The psychological benefits of exercise are also important.
- Routine exercise can enhance feelings of self-esteem and create a sense of independence and may help control feelings of depression and anxiety which are sometimes present

- It is widely known that CKD patients are at high risk for premature death as a result of cardiovascular disease due in part to their sedentary behavior.
- By increasing the physical activity levels of individuals with CKD, it is possible to decrease their risk of cardiovascular disease and improve their physical functioning, thus preventing premature death.

- Chronic kidney disease (CKD) is a progressive condition that may negatively affect musculoskeletal health.
- These comorbidities may include malnutrition, osteoporosis, and decreased lean body mass
- Secondary sarcopenia due to CKD may be associated with mobility limitations and elevated fall risk.

- Given the consequences of both low muscle mass and low bone mineral density, appropriate and timely physical therapy is important for fall risk assessment and intervention to minimize the susceptibility to bone fracture

- The disordered binding of the hormonally active metabolite of vitamin D to its nuclear receptor affects the messenger RNA gene transcription, resulting in lower muscle protein synthesis.
- The interaction between vitamin D and serum calcium may also adversely impact muscle function in people with CKD
- Vitamin D deficiency lies at the intersection of osteoporosis and muscle wasting.

- Controlling muscular homeostasis is a complex process dependent on hormonal and immunologic factors, as well as progenitor cell function.
- homeostatic balance may be adversely affected by excess inflammation, metabolic acidosis, malnutrition, and physical inactivity.

- Muscular degradation results from elevated angiotensin II levels, resistance to insulin-like growth factor 1, and increased myostatin levels, which are all potential consequences of CKD.
- the rate of muscular regeneration is limited due to abnormal myogenic regulatory factors, increased myostatin, mitochondrial dysfunction, and of course, decreased physical activity

- It has also been found that type II muscle fiber atrophy is most prevalent in those with CKD who are undergoing dialysis treatment.

- Body composition testing results from a positive screening finding bioelectrical impedance analysis (BIA), has been proposed as a practical alternative to imaging modalities in multiple clinical settings

- that BIA is a lower-cost option and is more readily available in outpatient and community health settings.
- Important limitations exist regarding body composition estimates using BIA for those with altered states of hydration.

- Serial BIA measures before and after hemodialysis may help to guide an interdisciplinary plan of care for people with end-stage renal disease.
- Careful attention to hydration status and food intake, activity levels, time of day, and other confounding factors are also important to note prior to serial BIA measurement sessions.

- Physical activity program is suggested to help in making patients' life quality better.

- The activity is usually conducted mainly twice or three times per week, and the participation time is about 1 hour.

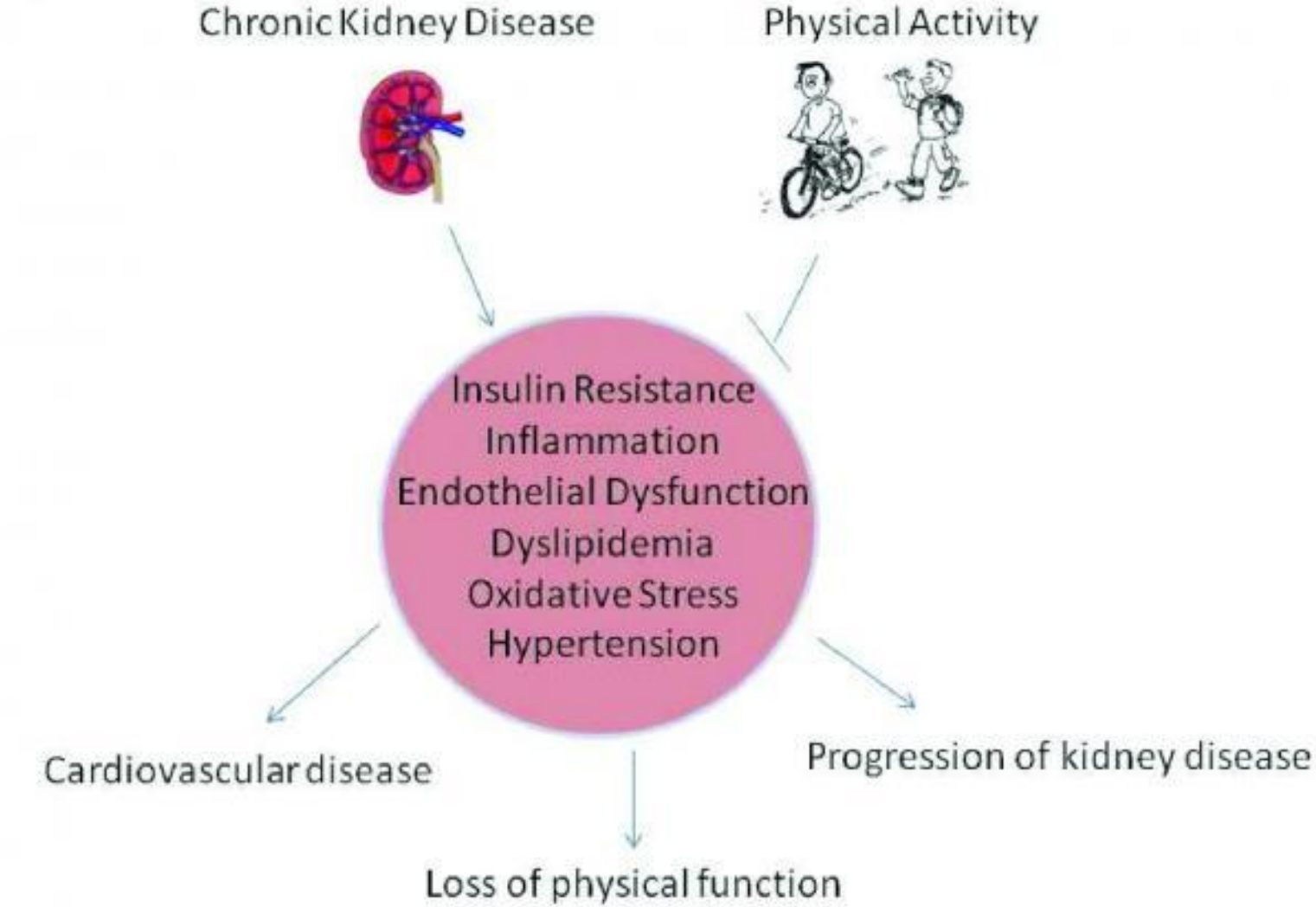
- Although exercise is not routinely advocated in patients with CKD, it delivers a broad range of health benefits and may prevent cardiovascular complications and disease progression in this patient population

- Diabetes, obesity, hypertension, and the presence of kidney dysfunction lead to activation of the renin-angiotensin system, oxidative stress, endothelial dysfunction, elevated asymmetric dimethyl arginine, low-grade inflammation with increased circulating cytokines, and dyslipidemia

- These metabolic disturbances are highly prevalent both in CKD patients and in physically inactive individuals and they augment the risks of microvascular and macro vascular disease.

- Exercise is well recognized as a therapeutic intervention that can improve the physiologic, functional, and psychological deterioration that accrues as a result of a sedentary lifestyle, it is plausible that greater physical activity may temper the metabolic disturbances of CKD and reduce the risks of kidney disease progression and cardiovascular events

Figure 1. Conceptual Model



- Studies that have investigated the effects of resistance training programs in CKD patients have found that muscle endurance programs administered three times per week for 12 weeks cause a significant reduction in levels of inflammation markers (C-reactive protein and IL-6) and a significant increase in muscular strength, dynamic endurance, walking capacity, and functional mobility

Slow the progression of CKD

- In addition to the beneficial effects on risk for CVD, physical function, and psychological well-being, physical activity may slow the progression of CKD.
- One small study of the effect of regular aquatic exercise in patients with moderate chronic renal failure assigned 17 adults with chronic renal failure to low-intensity aerobic exercise in the pool for 12 weeks, twice a week, with sessions lasting for 30 minutes, and matched them to nine control participants who remained sedentary .
- The participants in the exercise group showed significant reduction in serum cystatin-C levels and enhancement of creatinine clearance, whereas no such change was noted in the control group.

- Recent evidence also suggests that greater physical activity is associated with a lower risk of rapid kidney function decline among older adults.
- In this large study of community-based older adults, the two highest physical activity groups had a 28 percent lower risk of rapid kidney function decline, defined by the loss of more than 3 mL/min per 1.73 m2 per year in the GFR (calculated using serum cystatin C), compared with the two lowest physical activity groups, accounting for potential confounding characteristics

- We recommend that physical activity tailored to the individual should be routinely advocated in patients with CKD.

What Types of Exercises Are Best?

- Structured activities include aerobic, strength, and flexibility activities

Aerobic activities include: walking, jogging, stair climbing, swimming, water walking and water aerobics, gardening, dancing, bicycling, and chair exercises.

Other types of aerobic exercises can be performed on machines such as a treadmill, stationary bike, or elliptical trainer

Strength training

- Strength training involves using large muscles of your body to perform activities.
- free weights or dumbbells, resistance bands and tubes, Pilates, and medicine balls aid in strengthening your muscles.

Flexibility

- Flexibility type activities move your joints through their full range of motion and help to lessen your risk of injury when performing physical activities. These include stretching, Yoga, and Tai Ch

How Much Should I Exercise?

- If you have not already been exercising regularly, you will want to start slowly and work up to a pace that you are comfortable with each day
- Ideally, you will want to engage in exercise—aerobic, strengthening, or flexibility activities—5 times per week.

- Begin and end your workout with stretching exercises and follow with either an aerobic activity such as walking or strength training such as lifting handheld weights.
- A combination of these activities using different muscle groups each day such as the upper body 1 day and the lower body another will improve your health over time

How Can I Stay Safe While Exercising?

- The main thing to remember when exercising is to listen to your body.

- Keep in mind that exercising regularly is healthier than not exercising at all.

Stop what you are doing and seek medical help

- Muscle cramps or joint pain
- A Nausea or vomiting
- A Pain in the upper part of your body including your face and jaw
- A Problems seeing, speaking, or trouble swallowing
- A Shortness of breath that is not normal
- A Sudden headache, dizziness, or a feeling of lightheadedness
- A Sudden weakness in your arms or leg

Aerobic
Walking Program

1. Begin by walking at a slow but steady pace for 10 minutes 5 days a week.

2. Once comfortable with the walking 10 minutes daily, then increase to 20 minutes every other day at a brisk pace.

3. At 1 month, increase your time to 30 minutes every other day.

4. Then, after 1 month, walk 30 minutes 5 times a week.

Strength

- Toe Raises:
- 1. Stand straight with your hands on a counter or rail for support. Slowly raise your heels up off the floor and count to two.
- 2. Then lower your heels back down to the floor. Repeat 8 to 12 times.
- Leg Lifts:
- 1. Sit in a chair where your back is straight and your knees are bent and feet are flat on the floor. Lift and straighten your right leg and hold for a few seconds.
- Lower your right leg to the starting position.
- 2. Repeat using your left leg. (8 to 12 times with each leg)

Flexibility

- Stretching exercises will help to lengthen and loosen your muscles and joints. Perform these as a warm-up and cool down part of your overall exercise plan.
- Shoulder Rotations:
- 1. While standing or sitting, move the top of your right shoulder forward in a circular motion for 15 to 30 seconds.
- 2. Repeat with your left shoulder.
- Leg Stretches:
- 1. While lying on your back, bend your
- right leg and keep your left leg straight.
- 2. With both your hands placed behind
- your right leg, pull your thigh toward
- your chest and hold for 15 to
- 30 seconds.

3. Repeat with your left leg •


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Table 1

Summary of studies on physical activity in CKD or ESRD

Setting	Modality, frequency and duration of exercise treatment	Outcomes
End-stage renal disease, intradialytic	Aerobic training • Cycle ergometer (17, 18) 30–45 min, 3–4 times per week for 6–20 weeks	• Increase in peak oxygen consumption • Increase in peak heart rate • Increase in duration of graded exercise stress test • Increase in physical performance
	Strength training • Lower body strength exercise (19, 20)	• Knee extension strength • Increase in self-reported physical functioning
End-stage renal disease, interdialytic/home-based therapy	Aerobic training • Walking (21) • Calisthenics (22, 23) • Cycle ergometer (21) • Swimming (23) 45–60 min, 3–4 times per week for 6–20 weeks	• Increase in maximal aerobic capacity • Decrease in total triglyceride levels • Increase in HDL cholesterol • Decrease in fasting plasma insulin levels • Improvement in glucose disappearance rates • Reduction in coronary risk factors • Increase in self-reported quality of life • Decrease in prevalence of clinical depression
	Strength training • Upper and lower body strength exercise (23) 3–4 times per week, 45 min per session	• Increase in cross-sectional area of muscle fibers • Increased exercise capacity • Increased likelihood of returning to work
Chronic kidney disease, home or training center	Aerobic training • Aquatic exercise (14) 3–4 times per week, 45–60 min per session for 6–20 weeks	• Reduction in cystatin C levels • Reduction in blood pressure • Enhancement of creatinine clearance
	Strength training: • Upper and lower body resistance training (12) 3–4 times per week, 45 min per session	• Reduction in serum C-reactive protein and IL-6 • Increase in type I and type II muscle fiber cross-sectional areas • Decrease in heart rate • Increase in thigh muscular function • Increased muscular strength • Increased dynamic endurance • Increased walking capacity • Increased functional mobility

Exercise on Dialysis

- The hardest part of your program may be finding time to exercise, especially if you are undergoing dialysis

THE TYPICAL HD PATIENT

- This is exacerbated by symptoms such as anemia, fatigue, nausea, hypertension, headaches, edema, shortness of breath, metabolic acidosis, and bone demineralization.
- It is also common for prevalent HD patients to have some level of osteoporosis or renal osteodystrophy

- As the failed kidneys no longer manage the balance of calcium, phosphate, and active vitamin D, there is a high risk of secondary hyperparathyroidism. The risks of spontaneous fractures, postural issues, osteoarthritis, and bone pain increase with each passing year on HD

- Prolonged exposure to HD treatments has a catabolic effect on muscles, and this can greatly impact quality of life, independence, fall risk, and mortality .
- Also compounding this expedited muscle loss are nutritional factors, hormonal changes, low-grade inflammation, metabolic acidosis, neuropathy, inactivity, and complications from multiple comorbidities
- Each HD treatment contributes to a loss of amino acids and increased cytokines

- A typical HD patient spends an average of 11.1 d per year in hospital
- When discharged, it is reported that HD patients have a 37% chance of being readmitted to the hospital within 1 month
- Lengthy hospitalizations induce muscle wasting, which when added to the estimated 4 to 6 wk per year of immobilization for HD treatments, contributes to an even greater decline of physical function in these patients.

- Increasing activity levels is a promising solution to combat muscle wastage and associated decreased physical function in HD patients.
- Exercise training can be delivered as either an extradialytic (outside dialysis treatments) or an intradialytic (during dialysis) option

- Reports have shown that although extradialytic exercise may produce larger benefits in terms of exercise capacity and functional ability, compliance is lower when compared with intradialytic interventions
- Intradialytic exercise, typically done during the first 2 h of HD treatment, is a sensible non pharmacological “medicine” for HD patients.

- The most popular example of intradialytic exercise training involves placing a cycle ergometer in front of the treatment chair, or at the foot of a bed
- Other novel treatments include resistance training ,stretching or yoga

BENEFITS OF INTRADIALYTIC EXERCISE

- More than 30 years of intradialytic exercise research has been completed, including six systematic reviews, which have attempted to synthesize the evidence from randomized controlled trials

BENEFITS OF INTRADIALYTIC EXERCISE

favorable changes in

- $\dot{V}O_{2peak}$
- HR variability
- arterial stiffness
- blood pressure (BP)

BENEFITS OF INTRADIALYTIC EXERCISE

Enhancements to

- muscle size
- strength
- power
- maintenance of activities of daily living in HD patients

BENEFITS OF INTRADIALYTIC EXERCISE

- Intradialytic cycling can increase perfusion to the working leg muscles.
- This moves the trapped urea (and other toxins) from the muscle compartments to the blood stream for removal during HD.
- It has been suggested that 1 h of aerobic exercise could be comparable with an additional 20 min of dialysis time

- Research findings show improvements in fatigue levels (31), depression (27), quality of life ,sleep, restless legs (16), inflammation (1), and hospitalization rates

BARRIERS TO IMPLEMENTATION

- Funding concerns, staff workload, and lack of equipment have been cited as major barriers to implementing intradialytic exercise programs
- Other concerns include nephrologists perceptions about safety (13) and inadequate knowledge on the subject of exercise
- A strong belief in exercise importance was expressed by these patients, with 93% reporting that they would probably do more if their doctor or a health care professional guided them in taking this “medicine

CURRENT RECOMMENDATIONS FOR THE INTRADIALYTIC EXERCISE

- The National Kidney Foundation encourages >30 min of moderate-intensity exercise for HD patients most days of the week if possible
- Currently, there are extradialytic exercise recommendations for chronic kidney disease (CKD) and ESKD patients

CURRENT RECOMMENDATIONS FOR THE INTRADIALYTIC EXERCISE

- The renal unit staff records exercise times, vitals, and notes in the dialysis recording sheet during each treatment.
- All patients new to the HD unit should be assessed for exercise safety
- blood work, medications, cardiac history, bone health, symptoms (angina, shortness of breath, or pain), past surgeries, injuries, hospitalizations, falls history, past/current exercise habits, current living situation, ambulation aids, and ability to do activities of daily living.

Patients should be excluded from exercise (or may require further assessment from a doctor) if they have any of the following:

- Unstable cardiac status (angina, decompensated congestive heart failure, severe arteriovenous stenosis, uncontrolled arrhythmias, etc.)
- Physical limitations that would affect usage of the bike
- Poor blood sugar control
- Active infection or illness
- Poorly functioning CVC or AVF/AVG

Pre exercise criteria before exercise

- Targeted ultrafiltration rate (UFR) <13 mL·h−1·kg−1
- BP <180/100 or >100/50 mm Hg
- Resting HR <100 bpm
- No hospitalization or illness within the last week
- Properly functioning CVC or adequate needling of AVF or AVG
- No abnormal symptoms (cold, flu, headaches, dizziness, nausea, etc.)
- No hemoglobin <90 g·L−1 or 9 g·dL−1
- Blood sugars are controlled (between 7 and 14 mmol or 126 and 252 mg·dL−1)
- Oxygen saturation levels at rest should be above 90% and remain above 88% during exercise without symptoms

- All new participants start with a perceived exertion of “easy” on the Borg Scale of Perceived Exertion.
- During the initial 5- to 10-min bike trial, patients are given an orientation on safety, gradual progression, and proper warm-up/cool down procedures.
- They simply train with shorter durations and progress gradually as they are able to.

- Participants self-progress their exercise duration by 2 to 5 min per session.
- the goal of achieving at least 30 min of exercise during each dialysis session.
- Many patients can continue to increase their duration beyond 30 min. After the “easy” 5-min warm-up, a “moderate” to “somewhat hard” pace is encouraged. A 2- to 5-min cool down at an “easy” pace is essential for adequate redistribution of blood volume and the prevention of a hypotensive event.
- Vitals are measured preexercise, midexercise, and again 2 min postexercise.

- Preexercise, midexercise, and postexercise oxygen saturation
- blood glucose levels are monitored preexercise and postexercise in diabetics.
- Adverse events are rare and are categorized as minor in nature (cramps, mild hypotension, muscle soreness, etc.).
- No serious cardiac events or hospitalizations

- Incorporating resistance and flexibility training into the dialysis unit

- this may not be easy to accomplish if patients have CVC or AVF/AVG issues.

- The Borg scale is highly recommended for monitoring exercise intensity because HD patients commonly take beta-blockers and also may have fluctuations with their day-to-day fluid gains, energy levels, and symptoms.
- If a patient misses their previous HD treatment, no exercise is permitted.
- Missing treatments can cause symptoms of fluid overload such as shortness of breath, edema, and hyperkalemia.

7	very, very light
8	
9	very light
10	
11	fairly light
12	
13	somewhat hard
14	
15	hard
16	
17	very hard
18	
19	very, very hard
20	

Mode	Exercise Plan Outline
Aerobic exercise	• During the first 2 h of dialysis (three times a week) • 55% to 70% of maximum HR or a "moderate" RPE. • Patients are encouraged to progress toward a goal of 30 to 40 min (with a maximum of 180 min). • The most popular mode is with a cycle ergometer placed in front of the chair or at the foot of the bed • Monitor HR, BP, RPE, and symptoms
Resistance training	• Two sessions per week. • One to two sets of 12 to 15 repetitions (or 60% to 70% repetition maximum) • Use Therabands, dumbbells, body weight, weight cuffs, etc. • Resistance training is possible during dialysis and can include the nonfistula arm (or both if the patient has a well-functioning CVC).

Flexibility	• 5 to 7 d·wk^{-1} • Hold stretch to "light tension" for 20 to 30 s • 10-min total body routine
Balance	• Encourage both static and dynamic balance exercises most days of the week in those at risk for falls.


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Exercise and Rehabilitation Needs for Kidney Transplantation

- The overall aims of rehabilitation is to enable people to lead the life that they would wish givenany restriction imposed on their activities by impairments resulting from illness or injury

Exercise and Rehabilitation Needs for Kidney Transplantation

- Impairments and complications such as uremic myopathy in the fifth stage of chronic kidney disease, reduced glucose utilization caused by aerobic glycolysis disorders, protein-energy malnutrition, impaired immune defense mechanisms, increased oxidative stress and neurohormonal disorders have been reported in patients with CKD and post-transplant renal patient

Exercise and Rehabilitation Needs for Kidney Transplantation

- Corticosteroids, used as part of immunosuppressive therapyafter transplant, often result in numerous adverse effects, including weight gain, osteoporosis, and sarcopenia.
- Other impairments include easy fatigability, loss of appetite, swelling around the ankles and lower legs, difficulty in breathing and shortness of breath which could consequently lead to physical inactivity

Exercise and Rehabilitation Needs for Kidney Transplantation

- Physical activity is protective for many of the risk factors that lead to mortality in kidney post-transplant patients

- The role of exercise after kidney transplantation appeared not to have been well emphasized

Exercise and Rehabilitation Needs for Kidney Transplantation

- There is no uniform agreement among transplant professionals about the need for or recommending exercises and on the required exercise prescription after kidney transplantation.
- The promotion of physical activity to enhance Quality of Life(QoL) and reduce mortality rate among kidney transplantpatients is very important

- There is also an urgent need for the development of evidence-based guidelines on rehabilitation protocols to assist rehabilitation and transplant professionals as a routine part of patient management.

- Research suggests that impaired cardiorespiratory fitness and reduced muscle mass are associated with poor outcomes before and after solid-organ transplant surgery (3-5).
- Exercise training appears safe in this population and it is recommended that patients remain physically active while listed for transplantation to minimise any further disease-related deconditioning.

WHAT EXERCISE IS BEST FOR SOLID ORGAN TRANSPLANT CANDIDATES AND RECIPIENTS?

- The most common modes of exercise training that have been used in both solid-organ transplant candidates and recipients include aerobic (endurance), resistance (strength) and flexibility (stretching)
- People that are awaiting or have received a solid-organ transplant are often deconditioned and should begin exercising slowly with gradual progression.

- It is recommended that people aim to achieve 20-60 minutes of aerobic exercise on 3-6 days per week at an intensity that suits the individual's current condition.
- Resistance training should be performed on 2-3 days a week, with 8-10 different exercises, focusing on major muscle groups.
- Additionally, flexibility training can also be incorporated 2-3 times per week for 10 minutes

WHEN CAN ORGAN TRANSPLANT RECIPIENTS START EXERCISING AFTER TRANSPLANTATION?

- It is important to seek medical approval prior to engaging in any exercise following solid-organ transplantation. Transplant recipients have commenced aerobic exercise training in as little as 8 weeks following surgery .
- It is suggested that exercise-induced improvements in health are maximised if patients commence exercise training within the first year after surgery

WHEN CAN ORGAN TRANSPLANT RECIPIENTS START EXERCISING AFTER TRANSPLANTATION

- During exercise, patients with chronic heart failure may experience low blood pressure, which can cause light-headedness, sweating, fainting, distress, anxiety and abnormal heart rhythms

- When performing resistance training, advise patients to maintain normal breathing and avoid holding their breath.The Valsalva maneuver (exhaling against a closed airway) may cause excess pressure in the chest and abdomen