

Exercise Prescription for Patients with Type 2 Diabetes Mellitus

Introduction

Type 2 diabetes mellitus is characterized as a chronic metabolic disorder resulting in hyperglycemia, insulin resistance, and relative insulin deficiency (Olokoba, et al. 2012). The process of developing Type 2 diabetes mellitus is caused by a series of complications known as defective insulin secretion and insulin sensitivity (Galicia-Garcia, et al. 2020). Defective insulin secretion is the process in which adequate insulin secretion is not met after food consumption. This alone can lead to other issues such as increases levels of glucose. As insulin resistance progresses, pancreatic insulin-producing cells produce less insulin and eventually resulting in Type 2 diabetes mellitus.

The second complication, insulin sensitivity, is the process in which insulin-sensitive tissues respond to the release of insulin into the body (Jacobs, 2017). Type 2 diabetes mellitus is also diagnosed when an individual's blood glucose levels exceed the normal range of 126mg/dL or their random blood glucose level exceeds 200mg/dL on two occasions. Exceeding a HbA1c of 6.5% can also pose a danger to individuals with this chronic disease (Smushkin & Vella, 2010).

Approximately 29.1 million individuals in the United States alone have Type 2 diabetes mellitus with a prevalence of this chronic disease being greatest among African Americans and Hispanic Americans (Jacobs, 2017). Initial treatment for these 29.1 million Americans starts with focusing on lifestyle changes like nutritional habits and exercise interventions. Exercise interventions are extremely important in preventing the desensitization of skeletal muscle to insulin released by the pancreas.

Skeletal muscle is essential for glucose uptake so when insulin resistance occurs and skeletal muscle becomes desensitized this process disrupts the uptake of glucose along with the timing of the uptake (Merz & Thurmond, 2021). However, these lifestyle changes do not always help therefore pharmaceutical interventions are needed. An example of a pharmaceutical intervention can be seen using metformin. This drug stimulates the release of insulin by preventing the breakdown of GLP-1, while also inhibiting the release of glucose from the liver. This medication has also been known to improve insulin receptor sensitivity in muscle, liver, and adipocytes (Jacobs, 2017).

Exercise Testing

Six-Minute Walk Test

- It is used to measure activity limitations (Sigal et al. 2002)
- It is also used to measure cardiorespiratory fitness

Borg Scale

- Use of the Borg scale (Rating of Perceived Exertion), with target perceived intensities of "moderate," "somewhat hard," or "hard," is recommended as an alternative to heart rate-based targets based on maximal exercise testing (Sigal et al. 2002)

ECG Stress Test

- Detects chronotropic incompetence as well as exercise-related hypertension and provide more objective information on the individual fitness level (Praet et al. 2007)
- Minimize the risk of a coronary event

Absolute contraindications

- Poor glycemic control, particularly with high and low excursions that place the patient at risk for a severe hyperglycemia, and severe retinopathy that increases the risk of retinal detachment and vitreous hemorrhage during intense exercise (Kosinski et al. 2019)

Relative contraindications

- QT Syndrome, hypertrophic obstructive cardiomyopathy, peripheral neuropathy, a history of recurrent falls, or uncontrolled hypertension (Kosinski et al. 2019).

Exercise Prescription

Parameter/Guideline	Exercise
Aerobic Exercise <ul style="list-style-type: none"> • 50-85% heart rate reserve; 12-16 RPE, at least 30 mins of continuous exercise, rhythmic continuous, emphasize large muscle groups 	<ul style="list-style-type: none"> • Walking • Biking • Swimming • Jogging • Biking
Resistance Training <ul style="list-style-type: none"> • 2-3 days per week, every other day, 30-60 min per session using 8-12 repetitions 2-3 sets, 10-12 large-muscle multijoint, 50-65% 1RM with high reps for one session, 65-80% 1RM with moderate reps for one session, and 80-95% 1RM for one session each week 	<ul style="list-style-type: none"> • Back Squat • Romanian Deadlift • Single-leg squat • Leg press • Hamstring curl • Lat pull-down • Bench press • Dumbbell rows • Shoulder press • Hammer curls • Pull-ups • Paloff press
Flexibility Training <ul style="list-style-type: none"> • Stretch all major muscle groups every other day, 1-2 static stretches per major muscle groups, hold stretches for 10-30 sec each, 20-25 min total duration 	<ul style="list-style-type: none"> • Hamstring stretch • Butterfly stretch • Standing quadriceps stretch • Ankle to knee • Doorway stretch • Runner's lunge • Downward dog • Child's pose • Calf stretch

RPE = rating of perceived exertion; 1RM = 1-repetition maximum
Jacobs (2017).

Special Considerations

Exercise professionals need to be aware of special considerations and contradictions related to Type 2 diabetes mellitus. The list below indicates several considerations when developing an exercise prescription.

- Individuals suffering from Type 2 diabetes mellitus must be medically cleared before starting any vigorous exercise program while also undergoing a medical evaluation, especially if they have any cardiovascular, kidney, nervous, renal, or visual complications (Jacobs, 2017).
- Individuals suffering from Type 2 diabetes mellitus may need to perform a clinical exercise test involving a radionuclide injection because these individuals are prone to silent ischemia. Another condition to keep in mind is Hypoglycemia. This condition is classified as a blood glucose level of <70mg/dL and is particularly common in those affected by Type 2 diabetes mellitus. Untreated hypoglycemia can cause serious issues if left untreated such as diabetic ketoacidosis (Marcovecchio, 2017). Exercise should not occur when exogenous insulin action is peaking (Jacobs, 2017).
- Exercise professionals should monitor glucose before and after exercise sessions. If pre-exercise blood glucose is <100 mg/dl, the client must consume 20 to 30 g of carbohydrates before exercising to prevent complications during the session (Jacobs, 2017).
- If needed during the exercise session, exercise professionals should avoid injecting insulin in exercising limbs (Jacobs, 2017).
- Exercise professionals should also be cautious with exercise sessions that are vigorous because, individuals suffering with Type 2 diabetes mellitus usually have undiagnosed atherosclerosis of the coronary and peripheral arteries (Jacobs, 2017).

The goal and desired outcome of this exercise prescription is to help manage individuals suffering from Type 2 diabetes mellitus through lowering their blood glucose levels and improving insulin sensitivity throughout the body. Aerobic exercise has been shown to enhance glucose delivery to exercising muscle, stimulate translocation of glucose transporter protein to the cells surface, and increase phosphorylation and utilization of glucose intracellularly (Jacobs, 2017). Thus, daily exercise provides an alternative mechanism for blood glucose disposal.

The benefits of sustained exercise are significantly enhanced when coupled with modest weight loss (5-7%) and a low-fat, high-fiber diet (Jacobs, 2017). According to Colberg et al. (2010), even one week of aerobic training can improve whole-body insulin sensitivity in individuals with Type 2 diabetes. Research shows that twice-weekly progressive resistance training for 16 weeks by individuals with Type 2 diabetes may result in a 46.3% increase in insulin action, a 7.1% reduction in fasting blood glucose levels, and a significant loss of visceral fat (Colberg et al. 2010).

Conclusion

Type 2 diabetes mellitus is one of the oldest diseases known to mankind with a prevalence that is increasing steadily all over the world. As a result of this worldwide increase, this disease is becoming an epidemic with the number of affected people expected to increase within the next couple of years due to increase in ageing population (Olokoba, et al. 2012). One way in which health care providers can prevent and manage Type 2 diabetes mellitus is using exercise prescriptions. Through the exercise prescriptions studies have shown that increased physical activity in those affected by Type 2 diabetes mellitus has proven to increase insulin dependent muscle glucose uptake independently (Jacobs, 2017). Exercise has also been shown to improve irisin production. Irisin is an exercise-regulated myokine, which improves glucose tolerance secreted by skeletal muscle and adipose tissue in response to exercise, with an increase in irisin production, the effects of Type 2 diabetes mellitus could potentially be reversed (Olokoba, et al. 2012). According to Jacobs (2017), several recent studies have demonstrated that HbA1c levels improved significantly more in a combined resistance training and aerobic training group compared to resistance training-only and aerobic training-only groups. Studies have also shown that increased physical activity and structured exercise improve insulin-dependent muscle glucose uptake independently of weight loss or a hypoglycemic diet (Jacobs et al. 2017). Overall, exercise prescriptions have been known to improve the health of those suffering from this chronic disease and therefore should be considered by all health care providers.

References

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