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FAQs in Diabetes Endocrinology and Metabolism

M Saifuddin

Foreword
Md Faruque Pathan

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CHAPTER 4

Exercise in Diabetes Mellitus

Q. Define exercise.

Ans. Physical activity that involves planned, structured and repetitive bodily movement performed for the purpose of improving or maintaining physical fitness.

Q. What are the types of exercise?

Ans.

1. **Aerobic exercise:** Exercise that uses primarily aerobic energy-producing systems and involves the repeated and continuous movement of same large muscle groups for extended periods of time ($\geq$10 min at a time). It is a type of exercise that overloads the heart and increases cardiorespiratory fitness. For example, walking, cycling, jogging, swimming.
2. **Anaerobic exercise:** Short, high-intensity exercise supported by energy sources already stored in the muscles that do not require oxygen. For example, sprinting at very fast speed.
3. **Resistance exercise:** Also known as strength training or weight training exercise. Resistance exercise involves the use of muscular strength to work against a resistive load or move a weight. For example, lifting free weights or using weight machines.

Q. What are the benefits of exercise in diabetic patients?

Ans.

- Improved blood glucose, lipid profile and blood pressure control
- Increases peripheral insulin sensitivity
- Weight reduction
- Increases physical work capacity
- Increases sense of well-being and quality of life
- Prevents atherosclerosis and thereby macroangiopathic complications of diabetes mellitus (DM).

Q. What are the benefits of aerobic exercise?

Ans.

- Increases maximal O_2 consumption
- Improves cardiovascular and respiratory function

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- Increases blood supply to muscles and their ability to use O_2
- Lowers systolic and diastolic blood pressure
- Increases HDL cholesterol, decreases LDL cholesterol, increases mean LDL particle diameter (less atherogenic), decreases triglyceride (TG) of blood
- Decreases body fat and helps in weight reduction
- Increases peripheral insulin sensitivity.

Q. What are the benefits of anaerobic and resistance exercises?

Ans.

- Increase muscular strength
- Increase strength of tendons and ligaments
- Potentially improves flexibility (range of motions of joints)
- Decrease body fat and increase lean body mass (muscle mass)
- Improve blood glucose control and increase peripheral insulin sensitivity
- Improve strength, balance and functional ability in older adults.

Q. Discuss about fuel metabolism in aerobic exercise.

Ans.

- Muscle glycogen is the main source of energy during first 5–10 min of exercise
- Blood borne substrates like glucose and nonesterified fatty acid (NEFA) become increasingly important with prolongation of exercise
- If exercise of moderate intensity continues for several hours, the contribution of glucose diminishes and NEFA become the major fuel.

Q. Discuss about fuel metabolism in anaerobic exercise.

Ans.

- Such exercise is fueled by energy generated from breakdown of stored intramuscular ATP and phosphocreatine
- Glycolytic anaerobic energy production leads to blood lactate accumulation.

Q. Discuss about guidelines for exercise in diabetic patients.

Ans.

- Exercise plan should be individualized according to patient's physical status, meal, antidiabetic medication, lifestyle, interest, profession, etc.
- People with diabetes should be advised to perform at least 150 min/week of moderate intensity aerobic physical exercise (50%–70% of maximum heart rate) or 75 min/week of vigorous exercise or equivalent combination of both types with no more than two consecutive days without exercise
- Maximum heart rate = (220 − age) or 200% of basal heart rate or simple when feel palpitation
- In absence of contraindications, people with type 2 diabetes should be encouraged to perform resistance training two to three sessions per week

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- Multiple shorter exercise sessions lasting at least 10 min each in the course of a day are probably as useful as a single longer session of equivalent length and intensity
- An exercise program should include a proper warm-up and cool-down period. A warm up should consist of 5–10 min of aerobic activity (for example, walking) at low-intensity level. It prepares the heart for exercise. After a short warm-up period, muscles should be gently stretched for another 5–10 min for preparing the muscles and preventing muscle injury. A cool down period of 5–10 min should follow main activity session. It gradually brings the heart rate down to pre-exercise level
- Use proper footwear and if appropriate, other protective equipment
- Avoid exercise in extreme heat or cold
- Inspect feet before and after exercise.

Q. What are the contraindications of exercise in diabetic patients?

Ans.

- Unstable coronary artery disease
- Uncontrolled hypertension
- Severe autonomic neuropathy
- Severe peripheral neuropathy
- Foot lesions (weight bearing exercise contraindicated)
- Unstable proliferative retinopathy
- Ketosis/ketonuria
- Any significant acute illness or uncompensated major chronic illnesses.

Q. Discuss caution and advice of diabetic patients during exercise.

Ans.

1. Hypoglycemia in type 1 diabetes:

- Persons with type 1 DM who do not have complications and have good blood glucose control can do all levels of exercise including leisure activities, recreational sports and competitive professional performance. The emphasis must be given on adjusting the therapeutic regimen with the level of exercise, diet and avoiding hypoglycemia
- Avoiding heavy exercise during peak insulin action
- Using nonexercising sites for insulin injection, for example, around umbilicus
- If using multiple daily injections, reduce pre-exercise insulin dosages by 20%–50% or more if necessary. These reductions should be individualized and based on blood glucose monitoring
- Monitor glycemia before, during and after exercise as necessary
- It is recommended to take approximately 15 g carbohydrate before and 15–30 g carbohydrate at every 30–60 min interval during longer exercise sessions (1 g carbohydrate/kg body weight/h of activity)
- Extracarbohydrate should be advised if pre-exercise blood glucose level <5.6 mmol/L.

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2. **Hypoglycemia in type 2 diabetes:**
   - Hypoglycemia is less common during exercise than in type 1 DM and extra carbohydrate is, therefore, usually not necessary
   - Patient taking insulin or sulfonylurea may need to reduce the doses of these medications during days when they exercise. Such adjustments should be guided by glucose monitoring.
3. **Diabetic autonomic neuropathy:** People with diabetic autonomic neuropathy should undergo cardiac investigation before beginning physical activity that is more intense than to which they are accustomed. Autonomic neuropathy increases the risk of exercise induced injury by:
   - Decreased cardiac responsiveness to exercise
   - Postural hypotension
   - Impaired thermoregulation
   - Impaired night vision due to impaired pupillary reaction
   - Unpredictable carbohydrate delivery from gastroparesis predisposing to hypoglycemia
   - Strongly associated with cardiovascular disease.
4. **Diabetic peripheral neuropathy:**
   - Decreased pain sensation in the extremities results in increased risk of skin breakdown, infection and Charcot joint destruction
   - All individuals with peripheral neuropathy should wear proper footwear and examine their feet daily to detect lesions early
   - Non-weight bearing exercise, for example, swimming, cycling, arm exercises are better. However, moderate intensity walking may not lead to increased risk of foot ulcers in patient with peripheral neuropathy
   - Anyone with a foot injury or open sore should be restricted to non-weight bearing activities.
5. **Diabetic retinopathy:** In patient with proliferative diabetic retinopathy or severe nonproliferative diabetic retinopathy, vigorous aerobic or resistance exercise is contraindicated due to increased risk of vitreous hemorrhage or retinal detachment.
6. **Diabetic cardiac patient:**
   - Patient with stable coronary artery disease should perform exercise of moderate intensity
   - Patient with history of or suspected coronary artery disease should be screened by electrocardiogram (ECG) and exercise tolerance test (ETT).
7. **Diabetic nephropathy:**
   - Physical activity acutely increases urinary protein excretion
   - There is no evidence that vigorous exercise increases the rate of progression of diabetic kidney disease
   - There is likely no need for any specific exercise restrictions for people with diabetic kidney disease

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Q. Discuss exercise of diabetic patients in special situations.

Ans.

- **Exercise during pregnancy:** During pregnancy, moderate exercise (e.g., walking at moderate speed for 30 min a day at a time or in divided fashion) is advised. Vigorous exercise or exercise causing pressure in abdomen should be avoided
- **Exercise during sick days:** Diabetic patients are asked to avoid exercise or strenuous physical activity in sick days
- **Exercise during ramadan:**
  - Normal level of physical activity should be maintained
  - Exercise or excessive physical activity during day time should be avoided, particularly at late evening
  - Exercise can be performed 2 h after iftar
  - Tarawih prayer should be considered as a part of daily exercise program.

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- A very useful book for Endocrinology students, as they will get easy and comfortable arrangement of all the endocrine questions.



M Saifuddin MBBS (DMC) FCPS (Medicine) MD (Endocrinology) FACE (USA) FACP (USA) FRSM (UK) is a young eminent Endocrinologist of Bangladesh. He passed MBBS from Dhaka Medical College in 2004, obtained Fellowship in Medicine (FCPS) from Bangladesh College of Physicians and Surgeons in 2012, and passed MD (Endocrinology) from BIRDEM Academy in 2013. Dr Saifuddin got Fellowship (FACE) of American Association of Clinical Endocrinologists (ACCE) in 2017 and also Fellowship (FACP) of American College of Physicians (ACP) in the same year. He is trained on advance endocrinology from Singapore and MAYO Clinic of USA. Dr Saifuddin also got Fellowship training at Harvard Medical School and Massachusetts General Hospital at USA. He is a member of European Association for the Study of Diabetes (EASD), European Society of Endocrinology, American Diabetes Association, and American Thyroid Association.

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ISBN 978-93-5270-617-4