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Sports and diabetes - limitations resulting from the disease in people engaging in sports

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Abstract:
Diabetes mellitus is a chronic condition that significantly impacts various aspects of daily life, including physical activity and sports participation. This article explores the limitations imposed by diabetes on individuals engaged in sports, examining both type 1 and type 2 diabetes. It discusses how the disease affects physical performance, endurance, and recovery, and highlights the need for careful management of blood glucose levels before, during, and after exercise. The potential risks of hypoglycemia and complications like diabetic neuropathy are addressed, alongside strategies for mitigating these risks through personalized exercise regimens, dietary adjustments, and continuous monitoring.
Despite these challenges, the article emphasizes that with proper management and awareness, individuals with diabetes can safely engage in various forms of physical activity, often achieving high levels of performance. The discussion aims to provide athletes, coaches, and healthcare providers with insights into optimizing sports participation for diabetic individuals, promoting both safety and success in athletic endeavors.

Keywords: diabetes mellitus, sport, physical activity, glycemic control, hypoglycemia, insulin, type 1 diabetes, type 2 diabetes.

Introduction:
Diabetes mellitus is a group of metabolic disorders characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The etiology of diabetes mellitus varies depending on its type. There are two main types of diabetes. Type I is caused by an autoimmune response that destroys insulin-producing beta cells in the pancreas, and type II - caused by insulin resistance and eventual insulin deficiency [1] [2].
During physical activity, muscles use more glucose, which lowers its concentration in the blood. Glucose is used as a source of energy for muscle contractions.
It was once believed that people with diabetes should avoid excessive physical activity. This is not true; patients with diabetes can and even should engage in sports. However, physical activity in these individuals is associated with certain limitations and the need for greater glucose control. Individuals with type 2 diabetes should participate in regular physical activity and be motivated to minimize sedentary behavior by incorporating frequent movement breaks throughout the day. When dealing with acute or chronic health issues related to diabetes, adjustments may be needed in their activities to ensure both safety and effectiveness [3].

Beneficial effect of physical activity on the course of diabetes:
Physical activity positively affects tissue sensitivity to insulin, thereby reducing insulin resistance, which is an integral part of type 2 diabetes. During exercise, the working muscles increase their use of glucose, which lowers its level in the blood. Engaging in regular physical activity by patients with type 2 diabetes results in the loss of excess body fat and a reduction in blood glucose levels, allowing for lower doses of oral antidiabetic medications or insulin. In patients with type 1 diabetes, physical activity also reduces the risk of serious diabetes complications, which are common in this group of patients, such as heart, kidney, and eye

diseases. It is worth emphasizing that these effects are most noticeable with regular, preferably daily, physical activity [4] [5] [6].

Diabetic neuropathy:

Diabetic neuropathy is a type of nerve damage that can occur in people with diabetes. This condition most commonly affects the nerves in the legs and feet, but it can also impact other areas, including the digestive system, urinary tract, blood vessels, and heart. Diabetic peripheral neuropathy (DPN) affects up to 50% of those with diabetes, making blood sugar management crucial to preventing or slowing its progression [7] [8].

Research has significantly increased regarding the therapeutic potential of exercise interventions for patients with polyneuropathy. Evidence-based recommendations for DPN now suggest that a combination of endurance and sensorimotor training is most beneficial. Regular exercise offers specific benefits in mitigating the progression and impact of DPN, including promoting nerve regeneration, maintaining nerve fiber integrity, improving nerve function, and slowing the progression of peripheral neuropathy [7] [8].

However, further research is needed to establish clear exercise guidelines, considering individual variations in DPN presentation and other patient factors such as metabolic state and epigenetics [9].

Recommendations for physical exercise in people with diabetes:

According to the latest guidelines from the Polish Diabetes Society (PTD) from 2024, patients with diabetes can engage in any type of physical activity, including those of maximum intensity. For individuals with type 2 diabetes, it is recommended to combine aerobic exercises with resistance training. It is most advisable to target large muscle groups and perform 8-12 repetitions 2-3 times a week [10].

For those wishing to participate in competitive sports, individual solutions are required, developed after consulting with an experienced endocrinologist [10].

For athletes using insulin, it is recommended to use continuous glucose monitoring (CGM) systems. For those on oral medications or other antidiabetic drugs, it is advised to measure glucose 15 minutes before starting physical activity, during the activity, and after completion [10] [11].

Pregnant women with hyperglycemia are recommended to engage in moderate-intensity aerobic exercise for at least 150 minutes per week. Preferred activities include walking, stationary cycling, dancing, water aerobics, stretching exercises, and lifting light weights [10] [12].

Contraindications for practicing sports in people with diabetes:

There are several contraindications to physical exertion in patients with diabetes:

- Proliferative diabetic retinopathy – risk of bleeding into the vitreous body or retinal detachment
- Diabetic kidney disease – due to increased albumin excretion in the urine and proteinuria
- Autonomic neuropathy – risk of orthostatic hypotension
- Risk of myocardial ischemia and macrovascular complications

- Severe hypoglycemia in the last 24 hours
- Hyperglycemia above 250 mg/dL with ketonemia/ketonuria
- Hyperglycemia >300 mg/dL lasting more than 2 hours
- Ketonemia >1.5 mmol/L
- Unawareness of hypoglycemia – a relative contraindication [10].

Management of post-exercise hypoglycemia

The most important and common risk associated with sports participation by patients with diabetes is a sudden drop in blood sugar levels - hypoglycemia. Symptoms include: anxiety, irritability, nervousness, weakness, paleness of the skin, increased sweating, tachycardia, moderate increase in blood pressure, dilated pupils [13].

Every patient with diabetes should be educated and trained in the prevention of hypoglycemia and the appropriate actions to take if it occurs. It is also important to inform those around the patient about their diabetes when engaging in physical activity.

Optimal monitoring of blood glucose levels is crucial for the prevention of acute complications associated with exercise, such as hypoglycemia.

One of the ways in which a patient can prevent a drop in blood glucose levels during exercise is by using special sweet snacks for people with diabetes, which can be a lifesaver in the event of sudden hypoglycemia. It is a good idea for anyone with type 1 diabetes to have one of these easily digestible, high-sugar snacks with them at all times [14] [15].

It is not uncommon for blood glucose levels to decline for up to 48 hours following strenuous or prolonged exercise. During this period, it may be necessary to reduce insulin dosage or increase carbohydrate intake [16].

One should remember that the highest risk of hypoglycemia is associated with the use of insulin and sulfonylureas.

It is necessary to recall that the consumption of alcohol can elevate the probability of sudden post-exercise hypoglycemia. Consequently, individuals with diabetes should refrain from engaging in physical activity following the ingestion of alcohol [14] [16].

Physical activity in children and adolescents with diabetes

It is widely acknowledged that regular physical activity plays a significant role in the management of diabetes mellitus, same in children and adolescents. The evidence suggests that such activity has the capacity to enhance glycemic control, delay the onset of cardiovascular complications and improve overall well-being [17].

Given the impact of physical exertion on fluctuating blood glucose levels, children and adolescents with type 1 diabetes may face challenges in achieving sufficient exercise levels on a daily basis. The issue may be compounded by concerns about the risk of severe hypoglycemia, which can manifest not only during physical activity, but also up to 24 hours after training, due to increased insulin sensitivity [18].

It should be noted that there are a number of additional factors that contribute to the limitations of physical activity in individuals with diabetes. These include the necessity for increased and more frequent monitoring, and the fear of being excluded and feeling stigmatized when participating in sports activities with a chronic disease [17].

It is of the greatest importance that all possible assistance be provided to young people with diabetes who have serious sporting aspirations or who simply wish to learn how to effectively control their blood glucose levels while engaging in activities.
The following section will present the recommended exercise protocols for children and adolescents with diabetes:
- Careful advice and planning for travel, exercise and treatment is essential.
- High glycemic index snacks should always be available at school and an emergency kit should be used in the event of hypoglycemia.
- Caregivers/teachers should be provided with a diabetes care plan, including written advice on how to manage the patient's exercise and sports.
- Healthcare professionals should attend camps for children with diabetes.
- A continuous glucose monitoring (CGM) system can help prevent hypoglycemia during and after exercise.
- To prevent hypoglycemia after a short, high-intensity anaerobic exercise, it is usually best to consume an extra portion of carbohydrate afterwards.
- The patient should be instructed on the percentage by which the insulin dose should be reduced before physical activity.
- To prevent a rise in blood glucose after intense exercise, a low dose of rapid-acting insulin, e.g. 50% of the correction dose, can be given during or immediately after exercise if blood glucose is >268 mg/dl (15 mmol/l).
- If the insulin dose has not been reduced prior to exercise and circulating insulin concentrations are high, 1.0-1.5 g carbohydrate/kg body weight should be consumed for each hour of intense or prolonged exercise.
- If the afternoon or evening exercise was more intense than usual, or if the patient's physical activity is irregular, blood glucose levels should be measured and the nocturnal basal insulin dose (basal flow of the personal insulin pump) should be reduced by 10-20% before going to bed at night.
- High-carbohydrate meals should be consumed shortly after exercise to take advantage of the period of increased insulin sensitivity and to help replenish glycogen stores and reduce the risk of post-exercise hypoglycemia [19].

Conclusions

Engaging in physical activity represents a significant challenge for individuals with diabetes. While it is evident that physical activity is beneficial during leisure time, for those with DM, it is more than that. Indeed, physical activity in diabetes contributes to the effectiveness of the treatment administered. It is important to note that a diagnosis of diabetes does not necessitate the cessation of all physical activity. With proper management and guidance from healthcare professionals, individuals with DM can participate in and benefit from a range of sporting activities [14] [17].
Proper diet management and regular exercise not only help in controlling blood sugar levels but also contribute to improving overall health, reducing body weight, and decreasing the risk of diabetes-related complications [20].

As a result, an increasing number of studies are focusing on creating personalized exercise programs that not only consider the individual needs of patients with diabetes but also maximize the health benefits of physical activity while minimizing the risks associated with the disease.

Disclosure:

Authors' contribution:

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