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Exercise and sport – challenges and benefits for the children and adolescents with type 1 diabetes

Ćwiczenia i sport – wyzwania i korzyści dla dzieci i młodzieży z cukrzycą typu 1

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Regular physical activity is able to replace almost every drug, but all drugs taken together will not replace exercise.

This statement was written in XVI century by Wojciech Oczko (1537–1599) royal doctor of Polish Kings. Despite medical advances over 500 years, this sentence is still relevant today.

In the hundred years since the discovery of insulin, enormous progress has also been made in the pharmacological treatment of type 1 diabetes mellitus (T1DM). In the last decades new formulations of insulin, new methods of insulin delivery, e.g., advanced closed-loop hybrid systems have significantly improved glucose control. However, we must remember that good glycemic control is a key, but not one factor in preventing the development of chronic diabetes complications. Regular physical activity is associated with greater insulin sensitivity, increased fitness, better lipid profile and blood pressure [1]. It extends remission duration in children with new onset diabetes mellitus [2]. It significantly decreases risk of premature cardiovascular morbidity and all-cause mortality. Regular physical activity has not only health but also social benefits for children and adolescents with diabetes mellitus, so it is one of the fundamental parts of diabetes management and should be encouraged [3].

Children and adolescents with T1DM should follow the same recommendations for daily exercise, that are recommended for all youth. Although the beneficial effects of physical activity on health have long been known, with each passing decade, not only the frequency of sports, but also of daily physical activity in youth is decreasing.

In children and adolescents with T1DM approach to physical activity is very differential. Many of them are less physically active than their peers [4]. The reasons of observed much less physical activity in our patients are multifactorial. Some of them are these same like in whole population: lack of time and low motivation, difficult access to facilities, and sometimes issues around body image. However, some barriers are directly specific to diabetes. Exercises can be connected with frequent hypoglycemia and deteriorated glycemic control with high glucose variability. The fear of hypoglycemia in children and in their parents, but also in teachers, coaches also limits the participation not only in sports but sometimes also in physical education lessons, other school activities and recreational exercises [5]. Mostly it is caused by lack of knowledge in the field of physical activity and T1DM.

Exercise presents several important challenges to diabetes management. It requires special management by diabetic therapeutic teams and patients, using algorithms based on an understanding of the exercise physiology. The children with T1DM require thoughtful planning and management of glycemic control before, during and after physical activity. Although the basic aspects of activity management (i.e., insulin dose reduction and additional carbohydrates consumption) are well known, the protocols must be adjusted to the mode of insulin therapy and method of glucose monitoring. The type, amount and intensity of physical activities must also be taken into account. Guidelines for physical activity in diabetes are regularly developed and modified in line with advances in knowledge and the introduction of new technologies and insulins for the treatment of diabetes [3, 6]. Chapter on physical activity in diabetes is also in "Guidelines on the management of patients with diabetes Position of Diabetes Poland" since 2021. The studies and our own experience have shown that each patient has specific physical activity-related needs, so recommendations should be individually tailored.

A particular challenge is to make recommendations for people with T1DM who participate in competitive sport. This task is increasingly faced by pediatric diabetologists because more and more children and adolescents with T1DM participate in sports on a regular basis. In the past, patients with T1DM were advised to avoid sports and high-intensity physical activity, because of glucose fluctuations and risk of hypoglycemia. Now we know that children and adolescent with T1DM can safely participate not only in school physical education but also in sport and competitions. Results of GoalDiab Study performed during two days football tournament involving 189 players with

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T1D showed that such sport events are not only safe, but also encourage children to participate in sport [7]. T1DM is not a contraindication to participation in any sports activities, but sometimes the children and adolescents have some diabetes-relative contraindications to sports. Patients with significantly metabolic unstable diabetes, frequent severe acute diabetic complications and advanced chronic complications of the disease should not participate in sports until diabetes is stabilized.

Sport joints with participation in competitions, matches. Before the best there are national and world championships, and even the Olympics Games. So we have to prepare our patients not only for regular trainings, but also for competitions. During the competition, when emotions are involved, secreted counter-regulatory hormones usually lead to increase of glucose levels. When emotions subside, glucose levels mostly decrease significantly. For these reasons, participating in competitions is even more challenging for athletes with T1DM [8].

Knowledge about physical activity is constantly evolving. Research is also being done in the field of diabetes. Research can be conducted under laboratory conditions according to a strict research protocol, but observational studies in the real world are also very important. Camps and sport events dedicated to children with T1DM are a great opportunity to conduct research improving our knowledge about diabetes managements during physical activity [9]. Continuous glucose monitoring help us to analyze the glucose fluctuation during and after exercise, but monitoring of exercise and its intensity is also a very important issue to better modification of insulin treatment and nutrition during sport. Physical activity can be monitored by accelerometers and heart rate (HR) monitors [10]. Another parameter assessing the intensity of exercise in athletes with T1DM can be the concentration of lactate in the blood as shown in this issue by Flotyńska *et al.* Lactate measurements is one of the most used metrics in the world of training by athletes and coaches worldwide. GoalDiab Study showed that changes in blood lactate levels measured before and after matches indicated the ability of children with T1D to engage in intensive physical activity during the football tournament [11]. Such studies show a very individualized response to exercise and help in better adjustment of exercise protocols.

During camps dedicated to children with T1DM clinicians can gain experience and much better insight into the day-to-day management of diabetes. Children can also learn practically how to manage their diabetes during physical activity. Counselling on nutrition and adjusting insulin to exercise can result in improved glycemic control.

Paraphrasing the statement of Dr. Wojciech Oczko, it can be said: Regular physical activity will greatly enhance the effects of insulin in the diabetes treatment, but the best insulin therapy will not replace exercise.

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