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Physical Activity as important element in prevention and treatment of diabetes. Part II

Szlęzak Michał[(1)]
Medical University of Silesia - Department of Anatomy Katowice, Poland

Paździora Karolina Izabela[(2)]
Medical University of Silesia - Department of Anatomy Katowice, Poland

Mielczarek Adam[(3)]
Medical University of Silesia - Department of Anatomy Katowice, Poland

Otto-Buczkowska Ewa[(4)]
Medical Specialist Centre in Gliwice, Poland

Abstract
Recent years have brought great advances in metabolic control in patients with impaired glucose homeostasis. It has been established that in addition to pharmacotherapy and dietary treatment, physical activity plays a very important role in this control. This activity must be carried out under the control of specialized rehabilitation centers. It concerns all patients, but mainly adolescent and pregnant patients. Rehabilitation activities must be planned and adapted to the type of metabolic disorders, treatment methods and the general health of the patient.
Keywords: *physical activity; prevention; treatment; diabetes; physiotherapy*

I. Introduction

Physical activity program must include age of patient, physical fitness, method of treatment and degree of metabolic control.

Physical exercises has many positive health and psychological benefits, including increase of physical performance, weight control and increased insulin sensitivity. However, it is important that type and intensity of physical exercises must be matched to capabilities and needs of the patient. This makes it necessary for the plan to be varied.

Aim

Pointing out the crucial role of physical activity in the prevention and treatment of diabetes.

Workout program for children diagnosed with diabetes

According to WHO and ISPAD (International Society for Paediatric and Adolescent Diabetes) recommendation training program should consist of 60 minutes sessions preformed daily or at least 2 to 3 training sessions per week. A single training session should consist of warm-up (10min), a main part (40min) and relaxation time (10min). The main part, according to ISPAD should include up to 20 minutes of intensity physical activity. [1]

Children diagnosed with diabetes, should perform a moderate physical activity for at least 60 minutes per day, according to WHO. In addition, according to ISPAD, should spend up to 60 minutes every day on physical activity, including at least 20 minutes of intense physical activity. Children also should reduce sedentary type of lifestyle. The Polish Diabetes Association has concluded that to achieve the best possible results in diabetes control, physical activity should be undertaken each day of the week, or at least 2-3 times a week. For best results, exercise should be done with gentle activities such relaxation and stretching, preceded by 5 or 10 minute warm-up.

It is known that the complications of diabetes related to the circulatory system occurs more often and usually earlier in patients diagnosed with diabetes, than in healthy people. Physical activity reduces this risk by increasing physical performance and effectiveness of the cardiovascular system. Patients diagnosed with diabetes are at risk of developing neuropathy due to excessive blood glucose levels, which in turn create the potential for formation of glycation end products that cause demyelisation of nerve fibres. As mentioned above,

physical activity increase consumption of glucose from the blood, decrease glucose concentrations, and slows the process of neuropathy.

Recently, a proposed activity program for adolescent patients has been presented. [1] In this article, authors compiled the results of the impact in different methods of introducing physical activity in adolescent diabetic patients. In this review, they presented the role of the "mHealth" technologies in the number of glucose measurements taken and the impact of using combined aerobic-resistance training. Using a mobile health technologies increased patient motivation to comply, increased number of blood glucose measurements taken, and patients satisfaction, by supporting rewards. The authors also presented results showing the positive effects of using combine aerobic-resistance training on insulin sensitivity, at similar level as the use of other physical activities. [2]

The introduction of modern methods of diabetes treatment with the possibility of glycemic monitoring in adolescent patients allows for the intensification of physical activity in the process of diabetes therapy. [3].

In discussing the benefits of increased activity in adolescent patients with type 1 diabetes, attention was paid to the usefulness of using continuous glucose monitoring (CGM).[4,5,6,7]

A comprehensive discussion of physical activity implementation programs in adolescent patients with type 1 diabetes was recently presented by American authors. [8] The authors noted that physical activity monitoring is often overlooked in the care of this group of patients. The authors belive that greater use of mobile physical activity monitors and completing a dietary diary would be beneficial. Usefulness of using such a system was tested in a group of 57 adolescent patients. Participants were asked to wear a mobile activity monitor for at least 3 days per week while completing a diet diary. More than half of the children complied with both the activity monitor and food diary recommendations. This indicates that it is possible for children with type 1 diabetes to wear consumer activity monitor and simultaneously record their diet for at least three days per week. This could be very useful in monitoring normal activity in individuals with diabetes in the absence of therapist

Workout program for patients diagnosed with type 2 diabetes

Patients diagnosed with type 2 diabetes are typically older patients, often overweight or obese. These patients usually have variously advanced chronic complications of diabetes or associated conditions. Physical activity reduces the risk of developing second type diabetes due to weight reduction and improved insulin sensitivity. Extensive reviews of the literature that focuses on analyzing the outcomes of exercise use in patients with type 2 diabetes were presented by Chinese authors. [9]

The authors analyzed the effects of aerobic, resistance and combined exercise training on patients with type 2 diabetes. In addition, they compared effects of using different training sessions under therapeutic supervision, as well as without supervision. They observed that controlled activities i.e. aerobic and resistance training significantly reduces HbA1c (glycated hemoglobin) levels compared to the no exercise group. A significantly smaller reduction in HbA1c was observed when the controlled aerobic and resistance exercise group was compared with the combined physical activity group. In contrast, the most pronounced change in HbA1c levels was seen during the combined workouts (aerobic and resistance) compared to those workouts performed separately. Another result of the study was significant changes (decreases) in fasting glucose, total cholesterol, triglycerides, and LDL cholesterol between the supervised aerobic training group and the group without training. The authors also noted that supervised aerobic training group had a significantly better effect on lowering HbA1c levels and body weight, than unsupervised aerobic and resistance training group. This is most likely due to the extra motivation that occurs during the supervised training for patients with type 2 diabetes.

A new article was recently published on the impact of physical activity on cardiovascular disease (CVD) risk. [10]

According to the authors, cardiovascular disease is the most common cause of morbidity and mortality among patients with type 2 diabetes. Physical activity is one of the factors that can reduce this risk. The authors observed that the least amount of cardiovascular complications occurred in the active group (the others were: partially active, inactive).

Similar observations were also reported by other authors. [11] The increased tissue sensitivity to insulin obtained in physical exercise also has a beneficial effect on glycemic control. The authors believe that in type 1 and type 2 diabetes, aerobic training that last form 30 to 60 minutes at moderate intensity should be introduced, with resistance training at least twice a week. With healthy and fit patients, shorter but more intense workouts can also be used.

Recently there have been published new reports on the effects of physical activity on the nervous system. [12] The authors noted that, diabetes contributes to the onset of degenerative processes in the nervous tissue, which results in severe cognitive impairment. Cognitive processes called cognitive function are psychologically the ability of a person to receive, process and use information from the environment. They

determine the basic orientation in the surrounding world, enable the acquisition of knowledge and skills. Physical activity influences the processes of nerve cell formation on the way of brain neuroplasticity and "getting used" to new conditions of organism functioning under the influence of physical activity. The authors of this study applied an intervention to a group of subjects with type 2 diabetes in the form of 40 minutes of walking per week for a period of 12 weeks.After the experiment, it was found that in the walking group, the V02 max index increased, cognitive processes and nonverbal memory values improved. The researchers also noted that simply counting steps could maintain cognitive function at a similar level as walking 3 times a day. Additionally, the authors assumed based on their results that the minimum daily number of steps to improve cognitive function in people with type 2 diabetes should not be less than 8700 steps.

The impact of physical activity on health is perfectly described by Dr Khan's slogan "Run regular, age slower, be neuroplastic". [13]

Currently, more and more attention is paid to the occurrence of cognitive dysfunction in patients with diabetes, which may accelerate the development of these physiologically aging-related mild cognitive impairments (MCI). The Mayo Clinic Group criteria are currently most commonly used to assess the development of cognitive impairment. Because understanding the importance of lifestyle modification is very important in the management of diabetes, individuals with cognitive impairment may not be able to understand the nature of the basic principles of disease management. Of course, in addition to improving nervous system function, the beneficial effects on musculoskeletal function and metabolic processes should not be overlooked.

Another report is devoted to the effect of physical activity on adipose tissue metabolism. [14] Authors presented a study showing that lifestyle modification with particular emphasis on increasing physical activity plays a role in reducing obesity and at the same time decreasing insulin resistance and consequently facilitates prevention of type 2 diabetes development. According to the authors, even a small reduction in body weight of 2.6 kg to 5 kg is associated with a reduction in the incidence of type 2 diabetes. The authors believes that physical activity and exercise training remain the strongest tools for improving cardiovascular fitness. They also believes that according to American Diabetes Association (ADA) recommendations, most adult patients with type 2 diabetes should engage in moderate to vigorous physical activity of 150 minutes or more per week.

Similar observations were recently reported by other authors. [15] They found that in patients with type 2 diabetes, exercise under hypoxic conditions increases skeletal muscle glucose uptake and enhances post-exercise insulin sensitivity. This confirms that regular exercise under short-term hypoxic conditions can improve blood glucose control at a lower load than under normoxic conditions. In addition, physical training under short-term hypoxia may increase weight loss in overweight and obese patients. Activities that can be undertaken under hypoxic conditions include cycling, running on a treadmill with different incline angles, and strength training.

The effect of exercise on weight control has also been addressed in another recent report, which presents an analysis of randomized trials conducted in patients with type 2 diabetes. [16]

Physical activity in pregnancy women

A group requiring special attention in physical activity programming are pregnant women with diabetes or at risk for gestational diabetes. [17,18,19] When evaluating the relationship between pregnancy and diabetes, it is important to determine which type of diabetes we are dealing : pregestational diabetes mellitus (PGDM) or gestational diabetes mellitus (GDM). In pre-pregnancy diabetes it is important to determine the type of diabetes and the type of previous treatment. In women with diabetes, pregnancy should be planned, the pregnant woman should be under the care of a reference specialized diabetes center, and delivery should take place in units with facilities for intensive care of the newborn of a diabetic mother. The treatment of choice in these patients, regardless of the type of diabetes, is intensive insulin therapy using an insulin pump and continuous glycemic measurement. Nowadays, more and more attention is paid to disturbances of glucose homeostasis in pregnant women, which according to current criteria do not allow the diagnosis of diabetes. Since pregnancy is associated with decreased insulin sensitivity, insulin secretion may be insufficient and disturbances of glucose homeostasis may occur, which is defined as gestational diabetes. Early recognition of these disorders allows to reduce the risk of complications. It should be remembered that even a very mild disturbance in maternal glucose homeostasis can lead to fetal [17]

Glucose metabolism disorders in pregnant women are often associated with excessive body weight gain. Two factors play an essential role in the treatment of these conditions - dietary treatment and increased physical activity. This most often reduces insulin resistance and normalizes body weight and facilitates glucose metabolism.

Recently spanish authors presented a publication dedicated to discussing the effects of an exercise program on maternal weight gain and the incidence of gestational diabetes. [20] The authors confirm that exercise during pregnancy can reduce the risk of excessive maternal weight gain and developing gestational diabetes. The authors suggested training 3 times a week for 55-60 min each session (training sessions should starts from 8th weeks of pregnancy).

Physical activity in pregnant women plays a very important role in the treatment of glucose homeostasis disorders. Many authors point out the need to educate women in this regard. [21] According to the authors, insufficient knowledge about the positive effects of physical activity among pregnant women is especially true for women from lower social levels. In recent years, a number of randomized trials have been published, which have highlighted the benefits of physical activity on the course of pregnancy and the health of the baby, based on extensive literature from many countries. The authors believe that it is best to undertake regular physical activity already during the planned pregnancy or at its earliest stage. Phy It is considered that more than 600 MET/minute per week is the recommended minimum of physical activity for adults. [22]Norwegian guidelines recommend that pregnant women engage in moderate-intensity physical activity for at least 150 minutes per week. [23]

Other authors also confirm the importance of physical activity in reducing the risk of gestational diabetes and state that protection against this type of diabetes is greater the more physically active the patients are. [24]

An interesting observation is the highlighting of the importance of LTPA (leisure time physical activity) in reducing the risk of gestational diabetes. [25]According to the authors, such a criterion is 210 min of activity per week. Such planned controlled physical activity has many benefits. One of them is the prevention of overweight and insulin resistance.

As already mentioned it is very important in the prevention of gestational diabetes. [26]

Such physical activity also has a beneficial effect on fetus development. It helps to reduce the risk of macrosomia. [27]

II. Conclusions

Physical activity in the prevention and treatment of disorders in glucose metabolism is currently a recognized method of therapy. Many studies indicate that it should be implemented as early as possible. It concerns both adolescent patients with glucose metabolic disorders on autoimmune background and adult patients. The adult group includes primarily patients whose impaired glucose homeostasis is due to insulin resistance. A very important group are pregnant patients, both those with pre-pregnancy diabetes and those with impaired glucose homeostasis during pregnancy. The causes of these abnormalities can be very diverse. Early initiation of therapy, including increased physical activity, is very important for the prevention of fetal development disorders.

References

[1]. Adolfsson P, Riddell MC, Taplin CE, Davis EA, Fournier PA, Annan F. et al.

[2]. ISPAD Clinical Practice Consensus Guidelines 2018: Exercise in children and adolescents with diabetes. Pediatric Diabetes 2018;19 (suppl 27):205-226. doi. 10.1111/pedi.12755

[3]. Bacus IP, Mahomed H, Murphy AM, Connolly M, Neylon O, O'Gorman C. Play, art, music and exercise therapy impact on children with diabetes. Ir J Med Sci. 2022 Jan 17. doi: 10.1007/s11845-021-02889-5.

[4]. Cafazzo JA. A Digital-First Model of Diabetes Care. Diabetes Technol Ther. 2019;21(S2):S252-S258. doi: 10.1089/dia.2019.0058. PMID: 31169428.

[5]. Muñoz Fabra E, Díez JL, Bondia J, Laguna Sanz AJ. A Comprehensive Review of Continuous Glucose Monitoring Accuracy during Exercise Periods. Sensors (Basel). 2021;21(2):479. doi: 10.3390/s21020479.

[6]. Dovc K, Battelino T. Evolution of Diabetes Technology.Endocrinol Metab Clin North Am. 2020;49(1):1-18. doi: 10.1016/j.ecl.2019.10.009.

[7]. Guidelines on the management of patients with diabetes. Clinical Diabet. 2021;10(1).29

[8]. Malandrucco I, Russo B, Picconi F, Menduni M, Frontoni S. Glycemic Status Assessment by the Latest Glucose Monitoring Technologies. Int J Mol Sci. 2020;21(21):8243. doi: 10.3390/ijms21218243.

[9]. Tauschmann M, Hovorka R. Technology in the management of type 1 diabetes mellitus — current status and future prospects. Nat Rev Endocrinol. 2018; 14(8): 464–475.

[10]. Jaggers JR, McKay T, King KM, Thrasher BJ, Wintergerst KA. Integration of Consumer-Based Activity Monitors into Clinical Practice for Children with Type 1 Diabetes: A Feasibility Study. Int J Environ Res Public Health. 2021;18(20):10611. doi: 10.3390/ijerph182010611.

[11]. Pan B, Ge L, Xun YQ, Chen YJ, Gao CY, Han X. et al Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. Int J Behav Nutr Phys Act. 2018;15(1):72. doi: 10.1186/s12966-018-0703-3.

[12]. Enguita-Germán M, Tamayo I, Galbete A, Librero J, Cambra K, Ibáñez-Beroiz B. Effect of Physical Activity on Cardiovascular Event Risk in a Population-Based Cohort of Patients with Type 2 Diabetes. Int J Environ Res Public Health. 2021;18(23):12370. doi: 10.3390/ijerph182312370.

[13]. Borhade MB, Singh S. Diabetes Mellitus And Exercise. 2021 Sep 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 30252351.

[14]. Leischik R, Schwarz K, Bank P, Brzek A, Dworrak B, Strauss M. et al. Exercise Improves Cognitive Function-A Randomized Trial on the Effects of Physical Activity on Cognition in Type 2 Diabetes Patients. J Pers Med. 2021;11(6):530. doi: 10.3390/jpm11060530.

[15]. Khan F. Run Regular, Age Slower, Be Neuroplastic. Arch Neurosci. 2017;4(2):e39096.

[16]. Carbone S, Del Buono MG, Ozemek C, Lavie CJ. Obesity, risk of diabetes and role of physical activity, exercise training and cardiorespiratory fitness. Prog Cardiovasc Dis. 2019;62(4):327-333. doi: 10.1016/j.pcad.2019.08.004.

[17]. Kim SW, Jung WS, Chung S, Park HY. Exercise intervention under hypoxic condition as a new therapeutic paradigm for type 2 diabetes mellitus: A narrative review. World J Diabetes. 2021;12(4):331-343. doi: 10.4239/wjd.v12.i4.331.

[18]. Zhu X, Zhang F, Chen J, Zhao Y, Ba T, Lin C. et al. The Effects of Supervised Exercise Training on Weight Control and Other Metabolic Outcomes in Patients With Type 2 Diabetes: A Meta-Analysis. Int J Sport Nutr Exerc Metab. 2022: 1-9. doi: 10.1123/ijsnem.2021-0168.
[19]. Lorenc A, Otto-Buczkowska E. Maternal diabetes mellitus – Risk factor for fetus and infant. J Endocrinol Diab. 2018;5(3):1-7. doi: 10.15226/2374-6890/5/3/001107
[20]. Otto-Buczkowska E. [Alterations blood glucose homeostasis during pregnancy — mechanisms, diagnosis and treatment, what's new?] Forum Med Rodz 2017;11(3): 101–106 ISSN 1897–3590
[21]. Otto-Buczkowska E. [Diabetes during pregnancy.] Medycyna po Dyplomie 2021;
[22]. 30(2):45-50. ISSN 1231-1812
[23]. Barakat R, Refoyo I, Coteron J, Franco E. Exercise during pregnancy has a preventative effect on excessive maternal weight gain and gestational diabetes. A randomized controlled trial. Braz J Phys Ther. 2019;23(2):148-155. doi: 10.1016/j.bjpt.2018.11.005.
[24]. Garnweidner-Holme L, Henriksen L, Bjerkan K, Lium J, Lukasse M. Factors associated with the level of physical activity in a multi-ethnic pregnant population - a cross-sectional study at the time of diagnosis with gestational diabetes. BMC Pregnancy Childbirth. 2022;22(1):1. doi: 10.1186/s12884-021-04335-x.
[25]. World Health Organization. Physical Activity and Adults: Recommended Levels of Physical Activity for Adults Aged 18–64 Years. Geneva; 2018.
[26]. Mijatovic-Vukas J, Capling L, Cheng S, Stamatakis E, Louie J, Cheung NW. et al. Associations of Diet and Physical Activity with Risk for Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis. Nutrients. 2018;10(6):698. doi: 10.3390/nu10060698.
[27]. Wang C, Wei Y, Zhang X, Zhang Y, Xu Q, Sun Y. et al. A randomized clinical trial of exercise during pregnancy to prevent gestational diabetes mellitus and improve pregnancy outcome in overweight and obese pregnant women. Am J Obstet Gynecol. 2017;216(4):340-351. doi: 10.1016/j.ajog.2017.01.037.
[28]. Di Mascio D, Magro-Malosso ER, Saccone G, Marhefka GD, Berghella V. Exercise during pregnancy in normal-weight women and risk of preterm birth: a systematic review and meta-analysis of randomized controlled trials. Am J Obstet Gynecol. 2016;215(5):561-571. doi: 10.1016/j.ajog.2016.06.014.
[29]. Barakat R, Perales M, Bacchi M, Coteron J, Refoyo I. A program of exercise throughout pregnancy. Is it safe to mother and newborn? Am J Health Promot. 2014;29(1):2-8. doi: 10.4278/ajhp.130131-QUAN-56.