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Physical Activity and Exercise in Adults with Type 1 Diabetes: Effects and Benefits

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Short commentary

In 1993 a study conducted by Kahn et al.,[1] for the first time described the association between insulin sensitivity and beta-cell function, and nowadays the World health organization reported that more than 9 million people in the USA had type 1 diabetes mellitus (T1D) and its prevalence is expected to triple thirty years from now [2,3]. Because of beta-cell destruction, people with T1D need lifelong insulin replacement therapy that lower the quality of life since is invasive and required at least 4 to 5 times per day. However, this situation can be ameliorated by improvement in glucose tolerance, which several studies associated with Physical Activity (PA) because regular PA practice improves insulin sensitivity in any subject in people with type 1 diabetes (T1D). Engaging in regular PA, defined as any bodily movement produced by skeletal muscle contractions resulting in increased energy expenditure [4], for T1D adults provides both physiological and psychological several benefits. Indeed, PA and, in particular, exercise, defined as planned, structured, and repetitive PA to improve or maintain one's physical fitness [4], improves body composition, endothelial function, and blood lipid profile and reduces the daily insulin requirement, stress and depression [5-9]. For these reasons, the America Diabetes Association (ADA) [10] suggests engaging in at least 150 minutes of moderate to vigorous intensity activities weekly, spread over at least 3 days/week, with no more than 2 consecutive days without activity. Furthermore, adults with T1D should participate in at least 2-3 sessions of resistance training and at least 2-3 times a week of flexibility and balance training.

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While PA and exercise have been long associated with better glycemic control in adults with Type 2 Diabetes Mellitus [11], their effect on glycemic control in adults with T1D are unclear [6,12,13]. Furthermore, despite the clear health benefits of PA and exercise practice, people with T1D may fear or be discouraged to regularly participate in PA or exercise due to a lack of adequate knowledge about exercise management and concern about hypoglycemic episodes [14]. In fact, adults with T1D frequently experience rapid changes in blood glucose levels after engaging in an exercise session because of the loss of glycemia control and the consequent hypoglycemia fear [15,13]. Indeed, it is common for adults with T1D, after engaging in a training, to experience nocturnal hypoglycemia especially if the insulin dosage is inappropriate. One way to contrast these blood glucose level changes is to plan the insulin dosage before the exercise session. Unfortunately, optimizing the insulin dosage is challenging for adults with T1D. In fact, ADA guidelines suggest changes in insulin dosage until 90 minutes prior to the start of exercise depending on the type of exercise. In effect, the type of exercise, along with intensity, volume, frequency and fitness level, greatly influences blood glucose trends. For example, in aerobic activities, the blood glucose level in adults with T1D tend to decrease due to the increased production of the growth hormone stimulated by this type of activity [16]. In anaerobic exercises, instead, due to the increased lactic acid accumulation caused by intense muscular contraction, hepatic production of glucose is increased, and blood glucose tends to rise [17]. Finally, mixed activities, composed of a mix of aerobic and anaerobic actions, may increase blood glucose levels for 1–2 h in recovery [18,19]. **Figure 1** represents a schematic representation of exercise's effects on blood glucose levels and its benefits on health.

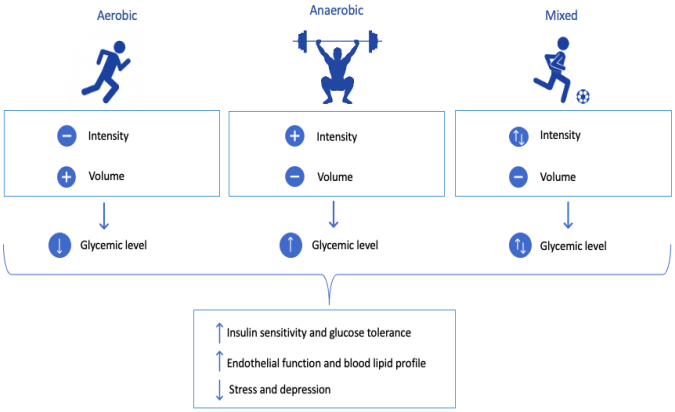

Figure 1: PA and exercise effects on glycemic trends and benefits of training in adults with T1D.

As stated before, also intensity influences greatly blood glucose trends with great changes related to the extent of variations. The gold standard to measure the intensity of training is oxygen consumption, but this measure requires trained personnel and expensive laboratory equipment. Thereby, given their direct relationship with oxygen consumption, easier and less expensive methods were developed, such as the heart rate rest and the rated perceived exertion scale, both valid and reliable methods to assess respectively objective and subjective intensity [20-22].

In conclusion, for these reasons, trainers should know how insulin and blood glucose change during different types of activities and intensities, to preserve people with T1D health during exercise and maximize the benefits. Prior to begin the exercise session, trainers should also have information about people with T1D nutrition or any changes in the usual insulin dosage before the training session and modify their training program according to these adjustments to avoid the risk of hypo- or hyperglycemia during or after the training session. We expect that new studies will lead to greater knowledge about training effects and benefits to help both people with T1D and trainers to achieve the best possible results from exercise programs and PA practice.

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