STUDIA UBB EDUCATIO ARTIS GYMN., LXX, 1, 2025, pp. 47-55
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.70(1).04

Analysis of Diabetic Footballers Blood Sugar Levels

János TÓTH Jr.[1*], Ádám SZÁNTAI-KIS[1]

Article history: Received 2025 January 04; Revised 2025 March 18; Accepted 2025 March 21; Available online 2025.03.30; Available print 2025.05.30

ABSTRACT. Diabetes is one of the fastest growing diseases of our time. (Bakó, 2022) Nowadays 64 million people are diagnosed with diabetes and this number is rising with high tendency. (WHO, 2024) Furthermore lots of people do not know about their diabetes, so this number is not the exact one, it is a lot higher. In Hungary 1,2 million people were diagnosed with diabetes and a bit more of 39.000 people got type one diabetes. (Hungarian Government, 2024) We know about some methods to keep these people healthy and one of them is to do some exercise but also must pay attention to eat healthy and the most important one is the insulin supplement. Luckily, we got some tools like Continuous Glucose Monitoring sensors (CGM), insulin pumps which help us to control diabetes easier. Football has many effects on blood sugar levels. In our research we investigate these. The effects of a training session or a match on the blood sugar levels. Our hypotheses are to watch the differences of training sessions and matches, and the athletes thinking of their performance, in particular their impact of diabetes. From our three hypotheses only one was true, but I have to mention that our population was only ten people, therefore, if we got a chance to examine a bigger population maybe we would have got different results. Because of the rise of this disease in the future we can work with a lot more diabetic athletes in this sport like Nacho Fernandez, former Real Madrid defender (Somfai, 2018). This research can be useful for many coaches and also can help to prepare to work with diabetic players.

Keywords: *football, diabetes, health*

[1] Hungarian University of Sports Science, Football Section, Budapest, Hungary
[*] Corresponding author: toth.janos@tf.hu

INTRODUCTION

Type 1 Diabetes is an irreversible disease, when the immune system mistakenly treats the beta cells in the pancreas which create the insulin as a foreign invader and destroys them. If enough beta cells are destroyed the pancreas cannot make insulin which can cause hyperglycaemia which means high blood sugar level. Insulin is a hormone that helps blood glucose enter your body as cells and then it is used as energy. When your organism has not got enough insulin you have to enter your body outwardly. The most common solution for that is insulin pen injections, but lots of people use insulin pumps. If your diabetes does not manage well you can notice many symptoms just name of few: Urinating often and because of that you can feel very thirsty. Feeling very hungry, even if you ate well. And fatigue these are the most common ones, but these are not total (Vörös and Mészárosné, 2023). Fatigue is a common symptom in diabetes, when the organism has not got enough insulin it is not available to create energy for itself (Øystein et al., 2017).

We must know the three main factors that are key to managing the blood sugar level and the diabetes well. Start with the insulin supplement which is the main factor of the three. As I mentioned before, if the organism can create it we need to gain in another way, outwardly. Nowadays we know lots of different types of insulins like quickly absorbed, slowly absorbed and mixed absorbed. Patients are choosing the most optimal ones for themselves with their diabetologist (Szakszon, Kis, Shenker-Horváth and Martos, 2022). This depends on their lifestyles and routines usually. Insulin is needed when we have a main meal or higher blood sugar level as the optimal one to avoid hyperglycaemia which leads to feeling sick. Insulin pumps are a small wearable medical device which can supply a continuous flow of insulin underneath the skin. In the past they can cause uncomfortable feelings because of their size, but nowadays these are not bigger than a deck of cards. Insulin pumps have many advantages like we can avoid a lot more thrust, if the patients are on the insulin pen injections therapy they have to thrust themselves at least 3-4 times a day.

Continuous Glucose Monitoring sensors can report the blood sugar level in every five minutes. We can synchronise with our smart devices, and we can check how our blood sugar level changes. We can get notifications about when the blood sugar level is rising fast and also when it is falling. Therefore, we can react fast to these changes, and we can keep the blood sugar level in optimal range. Finally, we can also synchronise these sensors with insulin pumps too, so we can change the doses of the insulin when it is needed (Mezővári, Martos, 2023).

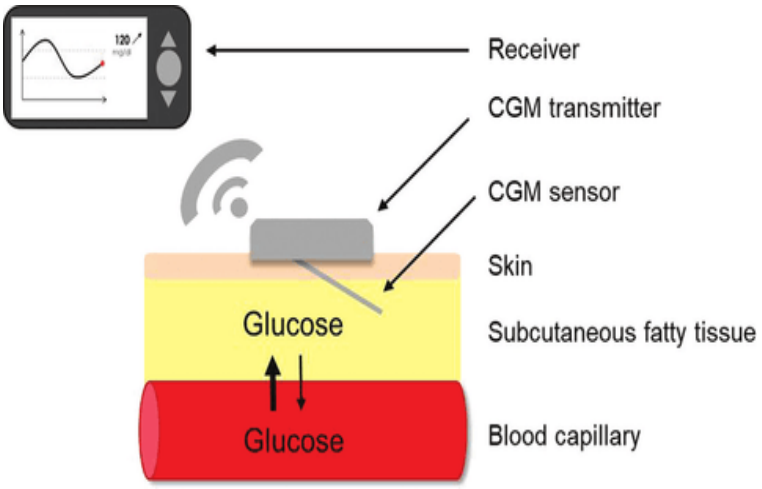

Figure 1. CGM sensor (Randy, 2022)

Secondly, nutrition is really important in the life of athletes, but as a diabetic athlete you have to pay more attention to that. Diabetic athlete's nutrition is almost the same as a normal athlete, but they have to note three main factors of their meals. First, the carbohydrates value of their meal. The daily calorie requirement can be 3000 kcal for an athlete, this can be a huge challenge for a diabetic athlete organism. Suggested to take daily 4-5 meals a day with lower carbohydrate intake to avoid high blood sugar level. Secondly, the time of the meal. This is very important because of the absorption of the carbohydrates. If we eat very close to the training session or the match, we can easily reach a higher blood sugar level than the optimal one, which can influence the performance of the athletes. Finally, the glycaemic index (GI) of the meals and foods. The glycaemic index shows how fast we can absorb the food that we eat (Kusztor, Martos, 2024). When the patient has low blood sugar, he suggests eating high GI foods to raise the flood sugar level. In normal cases they eat normal GI foods to hold their blood sugar level in optimal range. Daily water intake requirement is nearly 2-2,5 litres for a normal person, but for a footballer easily can reach above 3 litres. It also depends on the person's height, weight and of course the daily load intensity (Egy Csepp Figyelem Foundation team, 2022). If a diabetic person dehydrates, their blood is dense which raises their blood sugar level. They have to be hydrated to avoid that (Bibok, 2022).

Finally, physical activity which can improve insulin sensitivity. First of all, the blood sugar level check before starting the activity is mandatory, because if we start the activity with a blood sugar level which is outside of the optimal range, we can easily get hypoglycemia or hypoglycaemia (Beyond Type 1, 2016).

If a diabetic athlete starts activity with blood sugar level which is above 13 mmol/l it can raise their value much higher. The solution is to take bolus insulin before the activity (Szakszon, Kis, Shenker-Horváth, Martos, 2022). This is needed to avoid the following symptoms like feeling thirsty or frequent urination (American Diabetes Association, 2024). On the other hand, if a blood sugar level is below 5 mmol/l the value can be falling down and it can cause hypoglycemia (Matthew et al., 2015). The solution is to take 20-30 grams of high GI carbohydrates before the start of the activity (Suszter, Shenker-Horváth, 2022). We differentiate two types of form of movement. Aerobe and anaerobe activity. The aerobe one can reduce the blood sugar level and the anaerobe do the opposite it is raise the blood sugar level (Szakszon, Kis, Shenker-Horváth, Martos, 2022). Fitness level is an important factor because a small intensity run can be also an anaerobic activity for someone on the other hand someone can sprint for a long time (Sheri, 2023). For a diabetic athlete the mixed form of those movements are the optimal one which is the football too.

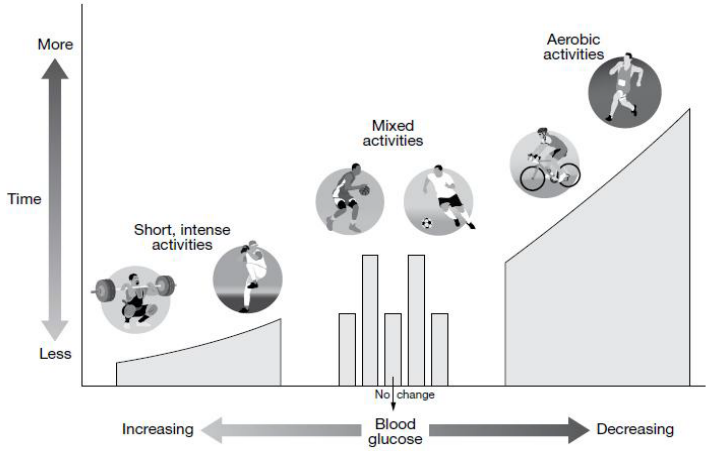

Figure 2. Effects of forms of exercise on blood sugar levels (Sheri, 2020)

HYPOTHESES

In the course of our work, we formulated three hypotheses:

1. We hypothesized that the blood sugar level fluctuated more on the matches than the training sessions.

2. We assumed that blood sugar levels are lower after the training sessions and matches than before in a larger proportion.

3. We assume that the blood sugar level did not influence their playing time on a smaller proportion based on the diabetic player's opinions.

METHOD

First, we made a Google Forms survey which contains an ethical approval from the players and questions about players' routines of their diabetes like are you checking your blood sugar level before/during/after the training session/match? Also, some simple information about them like, how old are you? Or which is your position on the pitch? The players attached their daily CGM reports of their training sessions and matches too. Based on this we can analyse the differences of the blood sugar levels. Our research is really circumscribed, that is the reason for the number of answers. We got 10 answers, which means 20 daily CGM reports, 10 from the training sessions and also 10 from the matches. The average age of our population is 20-22 years old. Most of them are playing in the Hungarian amateur leagues, but one of them is in the Hungarian third division. Firstly, we checked the hypotheses with the Shapiro-Wilk normality test, after that we used Wilcoxon test, paired samples T-test and Chi-square test to decide the validity of hypotheses. For the tests we used the Jamovi programme.

RESULTS

The first hypothesis where we investigate the blood sugar level differences between the training sessions and matches, we assumed that we can find bigger fluctuations on the matches than the training sessions. Only one hormone can reduce the blood sugar level which is the insulin every other one raising the blood sugar level. Football matches can increase the adrenalin level and the stress level too. After the analysis of daily reports of the matches we find 4 times of the 10 when the difference was higher than the training. In our population we have 2 goalkeepers who can influence the result. Goalkeepers easily can get bigger loads at the training sessions than the matches. After the normality test $W(10) = [0.884]$ $p = [0.146]$, we checked the hypothesis with the Wilcoxon test. Because of the result $W = 31$, $p = 0.652$ we have to reject our hypothesis. Nevertheless, this is not evidence totally. In a bigger population we can get other results. The time of the training sessions and matches can influence the research and also we have not got information about the size of the meal from the players.

Paired Samples T-test					
			Statistic	**df**	**p**
Training fluctuation	Match fluctuation	Student's t	-0.139 t	9.00	0.446
		Wilcoxon W	31.0		0.652
Normality test (Shapiro-Wilk)					
				w	**p**
Training fluctuation-		Match fluctuation		0.884	0.146

Figure 3. Results of the first hypothesis

In the second hypothesis, we assumed that the players got big loads of work at the matches and the training sessions, which leads to lower blood sugar levels after the sessions than the start. In this case we also have many factors which can influence the result. Time of the sessions, time of the meals and also their sizes and glycemic indexes and finally the loads of insulins and the intensity of the sessions.

In the case of the training sessions, we found 4 times when the blood sugar level was lower at the end than the start out of 10. As we mentioned before, the training intensity is a key factor and maybe these training sessions were less intense. On the other hand, in the case of matches we find 7 times of the 10 when the blood sugar level was lower than the start. After the normality test *W(9) = [0.942] p = [0.0.17]* we checked the hypothesis with paired samples T-test *(t([9.00]) = -0.563 ([2-tailed]) [-0.178]* we have to reject our hypothesis.

Paired Samples T-Test					
			statistic	**df**	**p**
Before training	**after training**	studen's t	-0.563	9	0.707
Before match	**after match**	studen's t	1.522	9	0.081
Notmality Test (Shapiro-Wilk)					
				w	**p**
Before training-		**after training**		0.942	0.570
Before match-		**after match**		0.807	0.017

Figure 4. Results of the second hypothesis

In our final hypothesis, we assumed that the blood sugar level did not influence the athletes' play times on their matches based on their own opinions. We think diabetes is not a factor which can reduce the player's time on the pitch. The average play time is 88,1 % in our population, but in the survey, we got 5 yes and 5 no answers.

Do you think your blood sugar level has affected your time on the pitch?		
10 Answers		
Yes	5	
No	5	

Figure 5. Results of the Google survey

After the normality test, *W(10) = [0.655] p = [0.01],* we checked our hypothesis with Chi-square test, *Pearson x2 (5, (N=10)=5.20, p = 0.392 2-tailed 0.721)* because of that we accepted our hypothesis. We really think diabetes is not an obstacle to playing football or any other sport on any level. Nacho Fernandez is a role model who played over 300 games at Real Madrid and won many trophies like Champions League and European Championship as a captain.

Independent Samples T-Test				
		statistic	df	p
Play time in %	student's t	02.jan	8	0.335
Assumptions				
Normality Test (Shapiro-Wilk)	W		p	
Play time in %	0.900		0.219	

Figure 6. Normality test of the third hypothesis

Contingency Tables			
Play time in %	2 (yes)	1 (no)	Total
50.0	0	1	1
66.0	0	1	1
75.0	1	0	1
88.1	1	0	1
90.0	0	1	1
100.0	3	2	5
Total	5	5	10

Contingency Tables			
x^2 tests			
	Value	df	p
x2	5.20	5	0.392
N	10		
Nominal			
	Value		
Phi-coefficient	NaN		
Cramer's V	0.721		

Figure 7. Result of the third hypothesis

CONCLUSIONS

In our research we checked 3 hypotheses, but we can accept only one which shows diabetes is not holding back anyone to play football. The other two results are not a totally sure statement because our population was not as big to manage this as evidence. We need more people and a modified survey to reduce our limitations. In the future we are looking to do this research with a bigger population and investigate some other factors too.

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