ISSN 2786-6661
eISSN 2786-667X

UDC: 616.074:612.122:616.379-008.64-084
https://doi.org/10.32345/USMYJ.1(152).2025.123-129

Received: October 23, 2024
Accepted: January 21, 2025

Screening of blood glucose level as a key element of the strategy of prevention and early detection of type 2 diabetes mellitus

Liashko Daria[1], Domanskyi Rostyslav[1], Yanitska Lesya[2], Horkunenko Oksana[2], Yezhel Iryna[3]

[1] student of higher education, Bogomolets National Medical University, Kyiv, Ukraine

[2] PhD, Associate professor, Medical biochemistry and molecular biology department, Bogomolets National Medical University, Kyiv, Ukraine

[3] PhD, Medical biochemistry and molecular biology department, Bogomolets National Medical University, Kyiv, Ukraine

Address for correspondence:

Horkunenko Oksana

E-mail: o.gorkunenko@nmu.ua
+380990955884

Abstract: *the regular screening of glucose level in blood is important for prevention, early detection and treatment of type 2 diabetes mellitus. Timely detection of hyperglycemia, as the main index of impaired glucose metabolism, is a key aspect in prevention of development of long-term diabetic complications, including cardiovascular diseases, peripheral neuropathy, diabetic nephropathy, etc. Awareness of the risks of development of diabetic complications promotes the higher public awareness of the importance of healthy nutrition, regular physical activity, and a healthy lifestyle. The aim of the study was to carry out a blood glucose screening of individuals aged 18-21 years to analyze the impact of the risk factors of type 2 diabetes mellitus on the blood glucose levels, as well as to increase the awareness among higher education students about the importance of regular blood glucose screening for prevention of diabetes and prediabetic states. The level of glucose in capillary blood was determined using a glucometer with individual test strips, the data concerning the risk factors for diabetes taken in the form of a voluntary anonymous survey. According to the level of blood glucose the questionnaire of participants of the study were divided into two groups: group A – normoglycemia (the average blood glucose level is 4.6±0.5 mmol/l), group B – the elevated blood glucose (6.3±0.5 mmol/l). A statistical analysis of the questionnaire results and a quantitative assessment of the impact of risk factors for type 2 diabetes mellitus on the level of glycemia were performed. The homogeneity of gender composition of the groups of individuals with normoglycemia and elevated blood glucose levels was established. It was shown that having breakfast a few hours before the study did not influence the blood glucose levels among the individuals with normoglycemia. It was not possible to assess the effect of having breakfast on the level of glycemia in the group with elevated blood glucose levels due to insufficient sample size. The influence of the risk factors, such as the presence of unhealthy habits (smoking, consumption of energy drinks), heredity (having relatives with diagnosed diabetes mellitus), tendency to consume sweets and lack of regular physical activity, on the blood glucose levels of people of this age category was analyzed. It was shown that for people aged 18-21 years, heredity and lack of regular physical activity can be important risk factors for*

ISSN 2786-6661
eISSN 2786-667X

development of hyperglycemia. Having relatives with diagnosed diabetes mellitus increased the risk of hyperglycemia among the participants by 1.85 times; regular physical activity reduced the risk of hyperglycemia among the participants by 4.5 times.

Key words: Blood Glucose, Diabetes Mellitus, Hyperglycemia, Prediabetic State, Public Health.

Introduction

The regular screening of glucose level in blood is important for prevention, early detection, and treatment of type 2 diabetes mellitus (T2DM). Timely detection of hyperglycemia, as the main index of impaired glucose metabolism, is a key aspect in prevention of T2DM and its long-term complications, such as cardiovascular diseases, peripheral neuropathy, diabetic nephropathy [1]. Understanding the risks of development of diabetic complications contributes to elevated public awareness of the importance of a healthy diet, regular physical activity, and a healthy lifestyle. An effective system of screening and glycemic control can significantly improve the health of the nation, decreasing the risks of development of diabetic complications and reducing the associated economic costs.

Aim

The aim of the study was to carry out the blood glucose screening in order to prevent diabetes mellitus and prediabetes, to increase the awareness among the students of higher education, and to analyze the influence of risk factors of type 2 diabetes mellitus on the level of glycemia in individuals aged 18-21.

Materials and methods

In order to prevent diabetes and prediabetic state, to determine the impact of risk factors of T2DM on the level of glycemia, as well as to increase the awareness of students of higher education regarding the risk factors and methods of diabetes prevention, the glucose screening was conducted at Bogomolets National Medical University on World Diabetes Day in November 2023 among the 1st-3rd year students and lecturers. The value of glycemia was determined using a glucometer and individual test strips in capillary blood, the data on the presence of risk factors of T2DM were collected in the form of the voluntary anonymous survey. 106 people participated in screening of glycemia: 101 of them were aged 18 to 21, the others were older. Statistical analysis of results of the anonymous survey and values of glucose levels was carried out for the age category represented most, the young people aged 18 to 21. For one individual in this category the glucose test appeared to be not valid; at statistical analysis it was not included into the sample. Thus, the sample size was 100 persons.

The participants of screening were asked to fill out the anonymous questionnaire indicating their age and the presence of risk factors of T2DM, in particular:

1. Unhealthy habits (smoking, use of energy drinks);
2. Having relatives with diagnosed diabetes mellitus;
3. Tendency of regular eating sweets;
4. The level of physical activity.

The statistical processing of the data was performed in the Microsoft Office Excel computer software. The values of blood glucose levels were represented as Mean ± SD (standard deviation); the difference between groups was considered as statistically significant at $p<0.05$. The Student's t-test was used to evaluate the reliability of differences between groups. For estimation of the influence of risk factors of T2DM on appearance of hyperglycemia, the questionnaires were subdivided into groups depending on the presence or absence of the risk factor. The risks of appearance of hyperglycemia in the groups exposed (R(+)) and unexposed (R(-)) to the risk factor of T2DM, were calculated by the use of a contingency table. R(+) represents the probability of an outcome (hyperglycemia) in the group exposed to the risk factor; R(-) represents the probability of the outcome (hyperglycemia) in the group unexposed to the risk factor. The relative risk (RR) was calculated as the ratio of probability of hyperglycemia in exposed group to the probability of hyperglycemia in the group

ISSN 2786-6661
eISSN 2786-667X

unexposed to risk factor (RR=R(+)/R(-)), the statistical reliability for RR was estimated as follows [2].

Results

According to results of screening, the elevated level of glucose (≥ 5.8 mmol/l, taking into account the permissible error of the glucometer) was found in 11 people, which makes 11% of the total number of participants. By the results of blood glucose determination, the questionnaires of participants were divided into groups: group A – normoglycemia (< 5.8 mmol/l), group B – elevated blood glucose level (≥ 5.8 mmol/l). According to results of screening, the elevated level of glucose (≥ 5.8 mmol/l, taking into account the permissible error of the glucometer) was found in 11 people, which makes 11% of the total number of participants. By the results of blood glucose determination, the questionnaires of participants were divided into groups: group A – normoglycemia (< 5.8 mmol/l), group B – elevated blood glucose level (≥ 5.8 mmol/l). Both groups had similar gender distribution: group A (normoglycemia) was represented by 20.2% (n=18) men and 79.8% (n=71) women, group B was represented by 18.2% (n=2) men and 81.8% (n=9) women.

In estimation of glycemia, an important criterion is the time interval between getting a meal and blood sampling, so, we assessed the blood glucose level by the subgroups according to the criterion of having breakfast a few hours before glucose screening (Table 1).

The level of glycemia in group A indicates that early breakfast did not influence the average value of blood glucose level (p>0.05). In group B, it was not possible to make a statistical assessment of the influence of breakfast on the level of glycemia due to the insufficient size of the subgroup in which the blood glucose was measured on an empty stomach (n=1). Thus, in further analysis and assessment of influence of risk factors of T2DM on blood glucose level, the division of groups A and B into subgroups was not carried out.

Data are represented as Means ± SD; *p < 0.05 in comparing the groups; #p > 0.05 in comparing the groups.

By the results of the questionnaire, the influence of risk factors of T2DM was analyzed and the frequency of appearance of these factors among the participants of glucose screening was estimated. The presence of risk factors of T2DM among the participants with normoglycemia (Group A) and elevated blood glucose level (Group B) are shown in Table 2.

Discussion

Determination and regular screening of blood glucose level is a key factor in early diagnostics and prevention of diabetes mellitus. Regular glycemic control allows to identify individuals in a prediabetic state and to provide them with timely advice on an individualized strategy of glycemic control in order to prevent development of diabetic complications [3].

Since T2DM develops slowly and is often diagnosed accidentally during routine preventive examinations, the regular control of blood glucose levels is an important preventive factor that allows timely detection of disease and appointment of treatment. In the study «Intermittently scanned continuous glucose monitoring for type 1 diabetes», it has been found that continuous periodic blood glucose screening in individuals with type 1 diabetes mellitus and high glycated hemoglobin allows the more effective control of

Table 1. The average blood glucose level in group A (normoglycemia) and group B (hyperglycemia) 2-3 hours after breakfast and on an empty stomach

Blood glucose level, mmol/L			
Group A (n=89)		Group B (n=11)	
4.6±0.5*		6.3±0.5*	
After breakfast (n=66)	On an empty stomach (n=23)	After breakfast (n=10)	On an empty stomach (n=1)
4.6±0.5#	4.7±0.4#	6.2±0.3	7.6

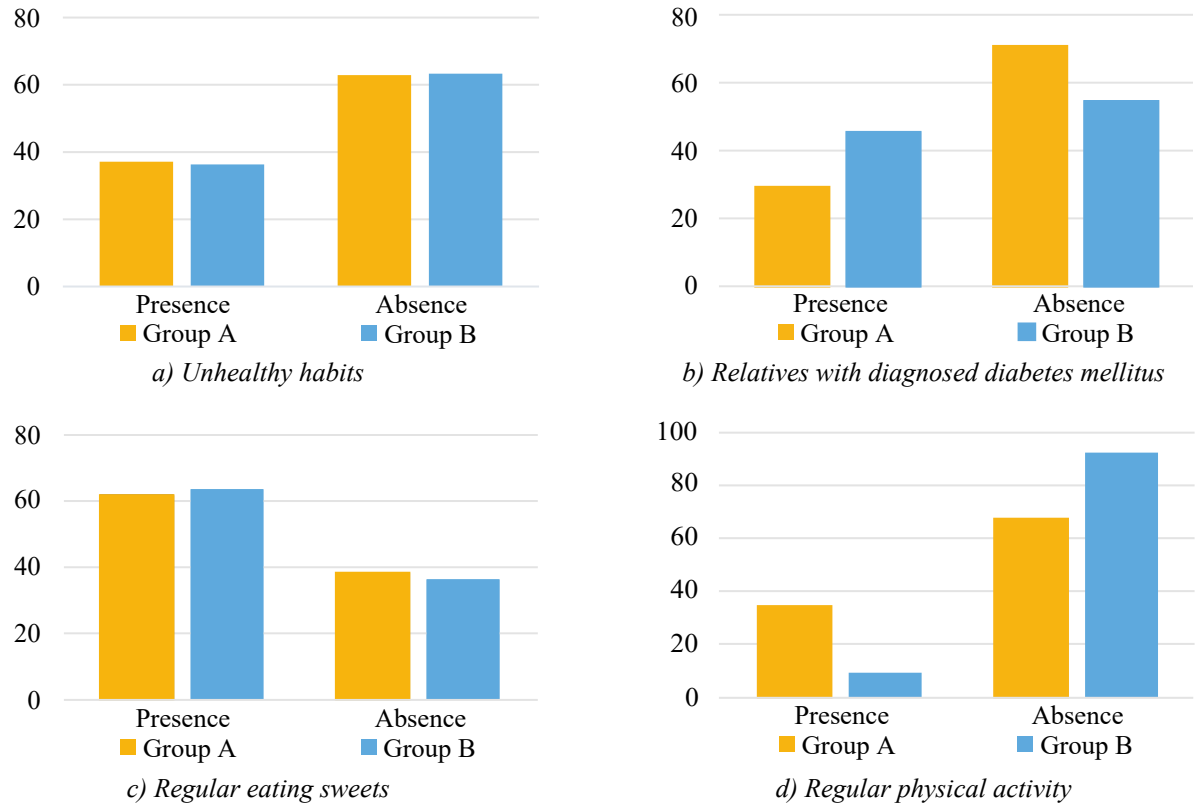
ISSN 2786-6661
eISSN 2786-667X

Table 2. Assessment of the presence of risk factors of T2DM among the participants of glucose screening (n=100)

Risk factor	Group A (n=89)				Group B (n=11)			
	Present		Absent		Present		Absent	
	%	n	%	n	%	n	%	n
Unhealthy habits	37.1	33	62.9	56	36.3	4	63.6	7
Relatives with diagnosed diabetes mellitus	29.2	26	70.7	63	45.4	5	54.5	6
Regular eating sweets	61.7	55	38.2	34	63.6	7	36.3	4
Regular physical activity	33.7	30	66.2	59	9.1	1	90.9	10

blood glucose levels, increases the time within target glucose ranges, and reduces the burden of hypoglycemia [4]. As an alternative method of screening of diabetes and prediabetic states the measuring of glucose level in saliva potentially can be used. As it was shown by the authors [5], it is proportional to the level of glycated hemoglobin and to the level of glucose in blood on an empty stomach. The clinical studies also demonstrate the effectiveness of lifestyle changes and/or pharmacotherapy to prevent the development of diabetes in people with diagnosed prediabetes. Thus, the regular screening for T2DM is a key step in preventing and delaying development of diabetic complications [6].

The trend of growing incidence of T2DM in a large extent is defined by the sedentary lifestyle, excessive body weight, unhealthy diet and obesity [7]. Analysis of the questionnaires of study participants has shown that not all considered risk factors have an impact on the level of glycemia in young people aged 18-21 years. The distribution of the presence of risk factors of T2DM among the individuals of group A (normoglycemia) and group B (elevated blood glucose levels) in percent is shown on Figure 1.



a) Unhealthy habits

b) Relatives with diagnosed diabetes mellitus

c) Regular eating sweets

d) Regular physical activity

Figure 1. Diagrams of distribution of the presence of risk factors of T2DM among the individuals in group A and group B in percent

ISSN 2786-6661
eISSN 2786-667X

Table 3. Assessment of risks of hyperglycemia in participants at presence, R(+), or absence, R(-), of risk factor of T2DM and the values of relative risk (RR)

Risk factors of T2DM	Risk of hyperglycemia, %		Relative risk RR=R(+)/R(-)
	R(+)	R(-)	
Unhealthy habits	10.8	11.1	0.97, p=0.97
Relatives with diagnosed diabetes mellitus	16.1	8.7	1.85, p=0.28
Regular eating sweets	11.3	10.5	1.07, p = 0.91
Regular physical activity	3.2	14.4	0.22, p=0.14

Assessment of the presence of risk factors of T2DM (Table 2) was used to subdivide the questionnaires into groups exposed and unexposed to the risk factors of T2DM.

To assess the impact of considered factors on the level of blood glucose the risk of development of hyperglycemia in individuals with presence R(+) or absence R(-) of risk factors of T2DM was calculated (Table 3). We have also estimated the values of the relative risk (RR) for all the considered factors, which can be easier interpreted. The value of RR>1 indicates that the exposed factor increases the probability of the outcome (appearance of hyperglycemia), RR<1 indicates that the exposed factor decreases the probability of hyperglycemia appearance. The RR=1 shows that the exposed factor does not influence the level of glycemia and there is no difference between groups.

From the data represented in Table 3 we may conclude that the heredity and lack of regular physical activity tend to increase the risk of hyperglycemia in young people aged 18-21 years. The presence of relatives with diagnosed diabetes mellitus increases the risk of hyperglycemia in the sample by 1.85 times: R(+)=16.1%, R(-)=8.7%, RR=1.85. Regular physical activity reduces the risk of hyperglycemia in a sample by 4.5 times: R(+)=3.2%, R(-) = 14.4%, RR=0.22. The other considered factors, such as unhealthy habits and regular eating sweets appeared to be not meaningful, the relative risks are equal to 0.97 and 1.07, respectively. It should be mentioned that despite the RR values for those factors as: having relatives with relatives with diagnosed DM and regular physical activity, for which the RR values notably differ from 1, the p-values appeared to be higher than 0.05. The low statistical reliability in these cases can be associated with the small sample size.

Based on the data of blood glucose screening and questionnaire survey of participants aged 18-21, the following recommendations can be made for further research and prevention measures of diabetes mellitus:

1. Carrying out the measures aimed to increase the public awareness of the importance of maintaining a healthy lifestyle, as well as the regular screening of blood glucose level for prevention and early detection of diabetes.
2. Development and implementation of screening grant programs to identify individuals with elevated risk of development of diabetes based on the measurement of blood glucose level.
3. The study of the influence of risk factors such as heredity, lifestyle, diet, and the level of physical activity on blood glucose levels in people of different age groups. To provide the sufficient level of statistical significance the studies should be performed with the larger groups of participants.
4. Development and validation of more accurate and convenient methods for assessment of blood glucose levels for earlier detection of disorders of glucose homeostasis.

Conclusions

The influence of risk factors of T2DM on the blood glucose level of people aged 18-21 years was analyzed. It was shown that heredity (relatives with diagnosed T2DM) and lack of regular physical activity can be important risk factors for development of hyperglycemia among young people aged 18-21 years.

Financing

This study did not receive any external funding.

ISSN 2786-6661
eISSN 2786-667X

Conflict of interest

The authors have no conflicts of interest to declare.

Consent to Publication

The author has obtained consent to publish the results of the study.

ORCID ID and author contribution

(B, C, D, E) Liashko Daria
(B, C, D, E) Domanskyi Rostyslav1
0000-0002-8116-2022 (A, B, C, D, E, F) Yanitska Lesya
0000-0002-9617-5328 (C, D, E) Horkunenko Oksana
0000-0001-9718-9134 (C, D, E) Yezhel Iryna

A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of article

REFERENCES

1. Tomic D, Shaw JE, Magliano DJ. The burden and risks of emerging complications of diabetes mellitus. Nat Rev Endocrinol. 2022;18(9):525-539. DOI: 10.1038/s41574-022-00690-7
2. Altman DG, Bland JM. How to obtain the P value from a confidence interval. BMJ [Internet]. 2011;343:d2304. DOI: 10.1136/bmj.d2304. Available from: https://www.bmj.com/content/343/bmj.d2304.long
3. Davidson KW, Barry MJ, Mangione CM, Cabana M, Caughey AB, Davis EM, et al. Screening for prediabetes and type 2 diabetes: US preventive services task force recommendation statement. JAMA. 2021;326(8):736-743. DOI: 10.1001/jama.2021.12531
4. Leelarathna L, Evans ML, Neupane S, Rayman G, Lumley S, Cranston I, et al. Intermittently scanned continuous glucose monitoring for type 1 diabetes. N Engl J Med. 2022;387(16):1477-1487. DOI: 10.1056/NEJMoa2205650
5. Choudhry AA, Kumar P, Prasad M, Mohapatra T, Sharma P. Validation of salivary glucose as a screening tool of diabetes mellitus. Rom J Intern Med. 2022;60(3):145-152. DOI: 10.2478/rjim-2022-0005
6. Duan D, Kengne AP, Echouffo-Tcheugui JB. Screening for diabetes and prediabetes. Endocrinol Metab Clin North Am. 2021;50(3):369-385. DOI: 10.1016/j.ecl.2021.05.002
7. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of type 2 diabetes - global burden of disease and forecasted trends. J Epidemiol Glob Health. 2020;10(1):107-111. DOI: 10.2991/jegh.k.191028.001

Скринінг рівня глюкози крові, як ключовий елемент стратегії профілактики та своєчасного виявлення цукрового діабету 2 типу

Ляшко Дар'я[1], Доманський Ростислав[1], Яніцька Леся[2], Горкуненко Оксана[3], Єжель Ірина[4]

[1] здобувач ВО третього року навчання, Національний медичний університет імені О.О. Богомольця, м. Київ, Україна

[2] к.біол.н., доцентка, кафедра медичної біохімії та молекулярної біології, Національний медичний університет імені О.О. Богомольця, м. Київ, Україна

[3] к.хім.н., доцентка, кафедра медичної біохімії та молекулярної біології, Національний медичний університет імені О.О. Богомольця, м. Київ, Україна

[4] к.біол.н., кафедра медичної біохімії та молекулярної біології, Національний медичний університет імені О.О. Богомольця, м. Київ, Україна

Address for correspondence:

Horkunenko Oksana

E-mail: o.gorkunenko@nmu.ua
+380990955884

ISSN 2786-6661
eISSN 2786-667X

Анотація: *регулярний скринінг рівня глюкози крові має важливе значення для профілактики, своєчасного виявлення та лікування цукрового діабету 2 типу. Вчасне виявлення гіперглікемії, як основного показника порушення метаболізму глюкози, є ключовим аспектом у запобіганні розвитку довгострокових ускладнень цукрового діабету, в тому числі захворювань серцево-судинної системи, периферичної нейропатії, діабетичної нефропатії, тощо. Усвідомлення ризиків розвитку ускладнень цукрового діабету сприяє підвищенню рівня обізнаності суспільства щодо важливості здорового харчування, регулярних фізичних навантажень та здорового способу життя. Метою дослідження було проведення скринінгу рівня глюкози в крові осіб вікової категорії 18-21 рік для аналізу впливу факторів ризику розвитку цукрового діабету другого типу на рівень глікемії, а також збільшення обізнаності здобувачів вищої освіти щодо важливості регулярного контролю глікемії для профілактики цукрового діабету та предіабетичних станів. Показник рівня глікемії визначався за допомогою глюкометра та індивідуальних тест-смужок у капілярній крові, збір даних про наявність факторів ризику цукрового діабету проводився у вигляді добровільного анонімного опитування. За результатами глікемії анкети учасників дослідження було поділено на дві групи: група А – нормоглікемія, середній рівень глюкози у крові (4,6±0,5 ммоль/л), група Б – підвищений рівень глюкози у крові (6,3±0,5 ммоль/л). Проведено статистичний аналіз результатів анкетування та кількісна оцінка впливу факторів ризику цукрового діабету другого типу на показники глікемії. Встановлено однорідність гендерного складу груп осіб із нормоглікемією та підвищеним рівнем глюкози у крові. Показано, що наявність сніданку за декілька годин до проведення дослідження не впливає на показники рівня глюкози у крові серед осіб з нормоглікемією. Проведення оцінки впливу сніданку на показник глікемії у групі з підвищеним рівнем глюкози у крові не було можливим через недостатній розмір вибірки. Проаналізовано вплив факторів ризику, таких як наявність шкідливих звичок (паління, вживання енергетичних напоїв), спадковість (наявність родичів з діагностованим цукровим діабетом), схильність до вживання солодощів та відсутність регулярної фізичної активності, на показники рівня глюкози у крові осіб даної вікової категорії. Показано, що для людей віком 18-21 рік важливими ризику розвитку гіперглікемії можуть виступати спадковість та відсутність регулярної фізичної активності. Наявність родичів з діагностованим цукрового діабету збільшувала ризик виявлення гіперглікемії у вибірці у 1,85 рази; регулярна фізична активність зменшувала ризик виявлення гіперглікемії у вибірці в 4,5 рази.*

Ключові слова: гіперглікемія, громадське здоров'я, предіабетичний стан, рівень глюкози крові, цукровий діабет.