Manifestation of risk factors in the development of diabetes mellitus among young people

Gurska Kateryna[1], Karpenko Olena[2], Ostashevska Tetiana[2], Krasiuk Irina[3]

[1] Student Bogomolets National Medical University, Kyiv, Ukraine

[2] PhD, Assosiate Professor of the Department of Propedeutics of Internal Medicine №2, Bogomolets National Medical University, Kyiv, Ukraine

[3] PhD, Assosiate Professor of the Department of therapy, infectious diseases of postgraduate education, Bogomolets National Medical University, Kyiv, Ukraine

Address for correspondence:

Gurska Kateryna

E-mail: katarzynagurski@gmail.com

Abstract: *this study aims to identify lifestyle risk factors for diabetes in 208 young people from 16 different countries, 50,5% of these respondents are predisposed to diabetes mellitus. FINDRISC and Mayo Clinic recommendations were taken into account. The results of the survey are based on the answers of an anonymous survey, which included groups of questions about general data, anthropometric data, nutrition, physical activity, rest mode, bad habits, heredity and anamnesis. The most critical changes were detected in the consumption of fresh fruits and vegetables (55% do not consume enough), as well as activity and rest mode (67% do not perform physical activity regularly, 47.1% of respondents do not spend the required 7-9 hours on sleep). A comparative analysis of respondents of different origins (Ukrainians and Indians) found that among the representatives of India is more elevated body mass index and increased waist circumference. In addition, the proportion of respondents who have ever had a rise in blood glucose is higher among Indians than among Ukrainians (11,4% vs. 6,8%). There are more respondents in Ukraine who do not exercise regularly than in India.*

Key words: diabetes mellitus, hyperglycemia, life style, prediabetic state, risk factors.

Introduction

Diabetes mellitus, according to WHO statistics, is among the top diseases that have the highest mortality rate. Every year, about 1.5 million people die from diabetes and its severe consequences (for example, diabetic foot, nephropathy, diabetic coma).

It is impossible not to pay attention to the fact that in recent years there has been a tendency to "youth" of various diseases, including diabetes. Therefore, the identification of risk factors for the development of this disease should be carried out and corrected, the sooner the better.

The life of each of us, as well as the whole society, has changed dramatically at the turn of 2019 and 2020. COVID-19 has become a lifestyle factor that we cannot ignore. Isolation, limited communication, increased demands of behavior in society (wearing masks, for example), although they are necessary, they also greatly affect the way of life. And the right lifestyle, in turn, is one of the key preventive mea-

sures against the occurrence of many diseases, including diabetes.

Literature review

*A*s mentioned earlier, the COVID-19 pandemic significantly affects people's lifestyle, and hence the development of diabetes. However, the opposite effect also exists. Recent studies have shown that the presence of diabetes in a patient is a risk of a severe form of coronavirus infection (Landstra, C. P., & de Koning, E., 2021; Zhou, Y., Chi, J., Lv, W., & Wang, Y., 2021). As we all know, the coronavirus mortality statistics are getting worse every day, so preventing diabetes should be one of the main activities of the medical community. The WHO suggests that due to the efforts made, the situation with diabetes mellitus will improve significantly by 2025.

As a rule, by the time of diagnosis of type 2 diabetes, about half of patients already have complications of this disease (Lindström, J., & Tuomilehto, J., 2003; Shah, A. D., Langenberg, C. & al., 2015). Therefore, the population should be aware of the risk factors for diabetes mellitus whenever possible (Tuomilehto, J., Schwarz, P., & Lindström, J., 2011).

Finnish researchers were one of the first to develop methods for identifying risk groups for diabetes mellitus (Lindström, J., & Tuomilehto, J., 2003; Saaristo, T., Peltonen & al., 2005). Based on the results of epidemiological simultaneous and prospective studies, they developed the FINDRISC risk scale, which was later taken as a basis and was successfully used by researchers in other countries.

The International Diabetes Federation (IDF) recommends using the FINDRISC questionnaire to identify the risk of this disease, which takes into account the following risk factors: age, overweight, heredity, diet and exercise, medication (Giles, J. T., Danielides, S. & al., 2015; Herder, C., Peltonen, M. & al., 2006; Iwanaga, N., Arima, K., & Terada, K., 2017; Kondratyeva, L., Popkova, T. & Nasonov, E., 2017; Ozen, G., Pedro, S. & al., 2017; Solomon, D. H., Love, T. J., Canning, C., & Schneeweiss, S., 2010).

However, the FINDRISC scale does not cover all risks. According to Mayo Clinic, one of the leading clinics in the world, in addition to the risks listed above, it is also worth considering the presence of elevated cholesterol and / or triglycerides, the presence of bad habits (alcohol, smoking, drugs), stress factors (including sleep and rest), burdened history polycystic ovary syndrome, any autoimmune and/or chronic disease, pancreatic disease, depression, past gestational diabetes, and human origins: although it's unclear why, certain people — including Black, Hispanic, American Indian and Asian American people — are at higher risk (according to the Mayo Clinic data).

At present, the identification of risk factors for diabetes mellitus and their combinations in order to modify or completely eliminate it is the basis for the prevention of diabetes. It was established that lifestyle changes (including normalization of nutrition, physical activity, weight loss) can reduce the risk of type 2 diabetes by 56% (Herder, C., Peltonen, M. & al., 2006; Tuomilehto, J., Schwarz, P., & Lindström, J., 2011). The search for an affordable, economical method for identifying early disorders of carbohydrate metabolism and the formation of risk groups for preventive measures remains relevant.

Aim

Despite the fact that diabetes is considered a disease of older people, the prerequisites for it are formed much earlier. Increasingly, quite young people are either already diagnosed with diabetes or at increased risk of developing it. That is why the first goal of the study is *identification of risk factors for diabetes in young people*.

One of the advantages of our work is that the respondents come from different countries (more on this later), this gives us the opportunity to *compare diabetes risk factors in Ukrainians and Indians*.

Understanding the problem of rejuvenating diabetes, we consider another goal of the study *development of information products that will help educate people about how to prevent the development of diabetes*.

Materials and methods

Our research involved 208 people (Table 1) aged 16 to 35 years (average age of respondents - 21 years). Young people from 16 different countries took part in the survey. Most of all, young people from Ukraine (63.9%), India (21.2%) and Germany (4.8%) took part in the survey.

Number of respondents	208
Average age	21 yo
Sex	Male – 51 (24,5%), female – 157 (75,5%)
Students	190 (91,4%)
Citizenship (together 16 countries)	Ukraine – 133 (63,9%), India – 44 (21,2%), Germany – 10 (4,8%), other – 21 (10,1%)

Table 1. General characteristics of the respondents

We have developed an anonymous questionnaire, where we tried to take into account all the risks of developing diabetes in the daily lifestyle.

Unfortunately, the FINDRISC scale is currently used only for people over 25 years of age, despite the fact that the factors that it reveals are also found in people under 25 years of age. Therefore, we assessed the data of the respondents taking into account FINDRISC, but supplementing it and expanding it. Our survey included several sections:

- general information (sex, age, citizenship, occupation),
- anthropometric data,
- physical activity and rest mode,
- bad habits,
- nutrition,
- heredity and anamnesis.

BMI was calculated by the formula: BMI (kg/m^2) = body weight (kg)/height^2 (m^2). The BMI classification of obesity was used: 18.5–24.9 kg/m^2 - normal body weight, 25–29.9 kg/m^2 - overweight, 30–34.9 kg/m^2 - I degree of obesity, 35-39,9 kg/m^2 - II degree and $\geq$40 kg/m^2 - III degree, BMI $\geq$ 25 kg/m^2 - overweight and obese.

In addition, at the end of the questionnaire, respondents were asked to receive a personalized result based on their questionnaires with our own developed information graphics on diabetes.

In this diagram (Fig. 1), you can see a cartogram that shows the countries from which our survey respondents come (the full list added below).

Results

After analyzing the answers received regarding the lifestyle of the young people examined, we found a number of violations of a healthy lifestyle, and among them - the presence of risk factors for the development of diabetes.

Origin

22.2% of respondents noted that they are natives of those regions, the origin of which adds to the risk of developing diabetes.

Anthropometric data

As represents Fig. 2, only 67.3% of respondents have a normal BMI. 13.5% are underweight, 14.9% are pre-obese, and the remaining 4.3% are of varying degrees of obesity. It is important to understand that not only an increase in BMI, but also its deficiency can have a bad effect on health.

The assessment of waist circumference showed that only 70.2% of young people noted normal waist circumference (up to 80 cm for women and up to 94 cm for men).
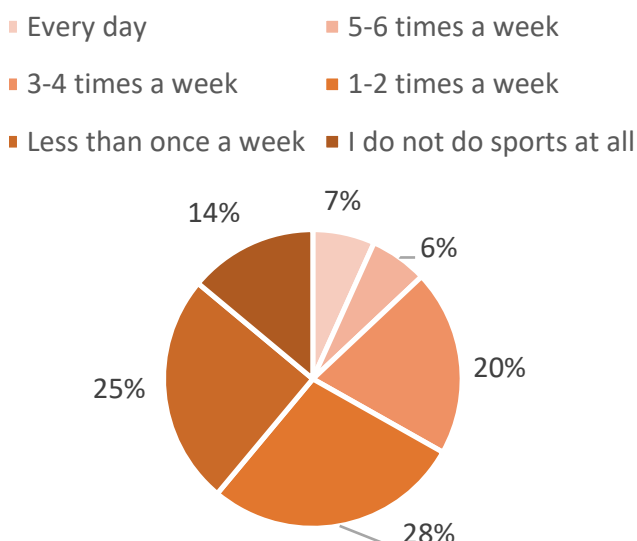
Fig. 1. Visualization of respondents' countries of origin

- Ukraine
- India
- Germany
- Egypt
- Russia
- Pakistan
- Nigeria
- Syria
- Sudan
- Poland
- Peru
- Namibia
- Mexico
- Libya
- Italy
- Iran
- Yemen
- Canada
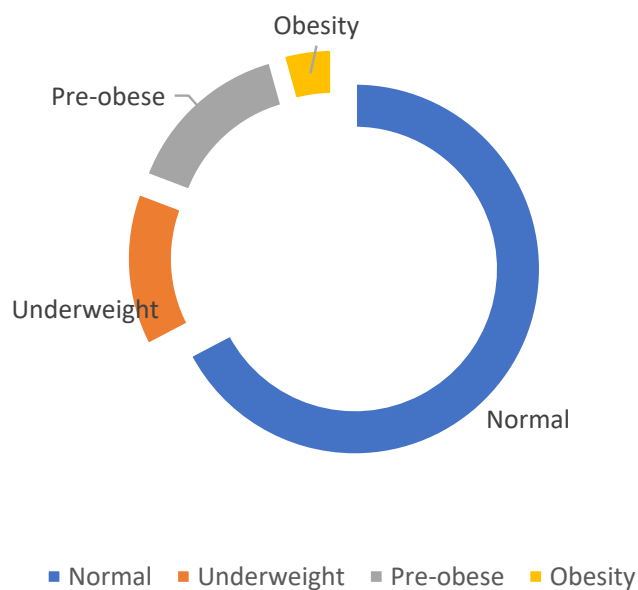
Fig. 2. BMI of interviewed young people

Fig. 3. Distribution of answers to the question "How often do you do sports?"

Physical activity and rest mode

We conducted a comprehensive assessment of respondents' physical activity and rest mode. Unfortunately, the following indicators were found.

Despite the tendency to promote a healthy lifestyle, 38.9% of respondents note that they do not do sports at all or do it less than once a week (Fig. 3), which also cannot be considered regular training.

It should be noted that, only 33.2% of young people do morning exercises, and only 35.1%

walk in the fresh air for at least 30 minutes every day. And respondents mainly give preference to strength training and dancing.

Unfortunately, 44.8% of people noted that their average workout lasts up to 30 minutes, which, of course, cannot be considered a full-fledged exercise.

Most of the responses to the question about bedtime relate to responses after midnight. It should be noted that 47.1% of respondents do not spend the required 7-9 hours on sleep (Fig. 4).

Bad habits

Alarming results were obtained in the analysis of bad habits of the examined people.

Almost a tenth of the respondents (9.1%) smoke regularly, 12.9% of interviewed have answered, that they smoke only sometimes. Among those who smoke regularly, we also asked about the number of cigarettes per day, the results obtained are disappointing: almost a third of them (31.8%) smoke about half a pack of cigarettes per day, and 20.9% smoke more than half a pack daily.

As for alcohol abuse, 11.0% of young people drink alcohol every week or more often. Of course, one cannot but rejoice that as many as a third of the young people surveyed (33.2%) refuse alcohol in general, and the second third (31.3%) drink only on holidays.
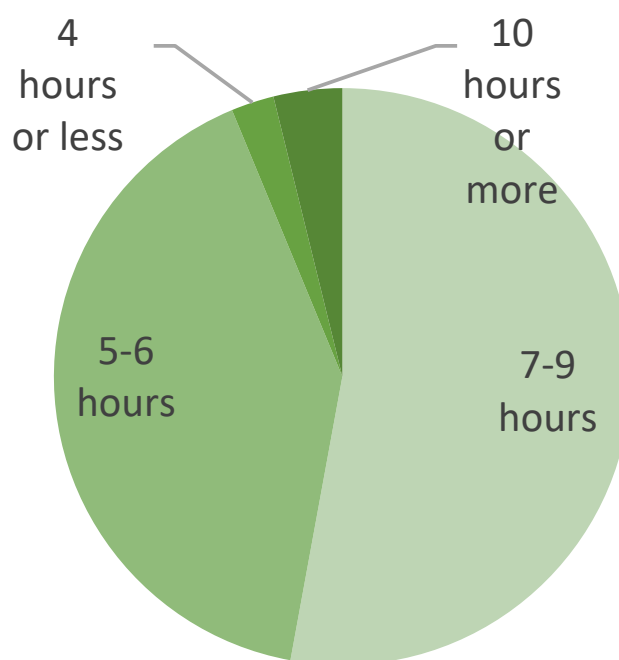
Fig. 4. Durance of respondents` sleep
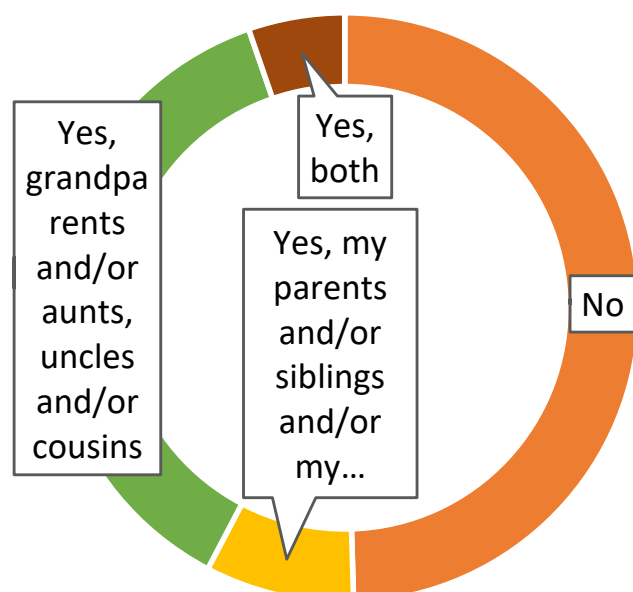
Fig. 5. Distribution of answers to the question "Has somebody in your family been diagnosed with diabetes mellitus?"

Nutrition

With the help of questions about the consumption of fast food, we can estimate the number of people with elevated cholesterol and / or glucose in the blood (since these are laboratory data, it is not possible to estimate them using a questionnaire). Thus, 32.7% of respondents consume fast food every week or more, the same indicator for sweet carbonated drinks is 31.2%.

More than half of young people (54.9%) do not consume the minimum 300-500 fresh vegetables and fruits per day.

Heredity and anamnesis

Being asked "Has somebody in your family been diagnosed with diabetes mellitus?" (Fig. 5) 8.2% of young people note that relatives of the 1st line (parents and/or siblings and/or children) had diabetes mellitus, 37.0% - relatives of the 2nd line (grandparents and/or aunts, uncles and/or cousins), 5.3% - both options. It is worth noting that among the remaining 49.5% of people

who answered that they do not have a family history of diabetes, there may be those who do not know about their family history.

As it was mentioned before, some background diseases can lead to increase of risk of diabetes mellitus. Among 'dangerous' background diseases (Fig. 6) 9.1% of respondents note that they have / had polycystic ovary syndrome, 6.7% - any autoimmune diseases, 18.8% - chronic, 8.7% - any diseases of the pancreas, 12% - depression.

Among the respondents, 8.2% note that they have ever had an increase in blood glucose, and 3.4% are aware of an increased content of cholesterol in the blood. In general, respondents note that their blood pressure is fairly stable.

However, young people are very susceptible to stress, as seen in the answer chart (Fig. 7) for the question "rate your level of stress in everyday life, where 1 is almost no stress, and 5 is the most stressful."

FINDRISC

Despite the fact that the FINDRISC scale is recommended for older people than our respondents, we decided to evaluate the answers on it (Table 2) and compare answers from Ukrainians and Indians:

As can be seen from the Table 2, young people from India have a greater proportion of pre-obese and obese, as well as increased waist circumference, than people from Ukraine.

At the same time, there are more respondents in Ukraine who do not exercise regularly than in India.

Among Indians, more respondents note episodes of hyperglycemia in history than among Ukrainians, and also the proportion of people genetically predisposed to diabetes in India is greater than in Ukraine.

Discussion and conclusions

In accordance with the purpose of the study to identify risk factors for the development of
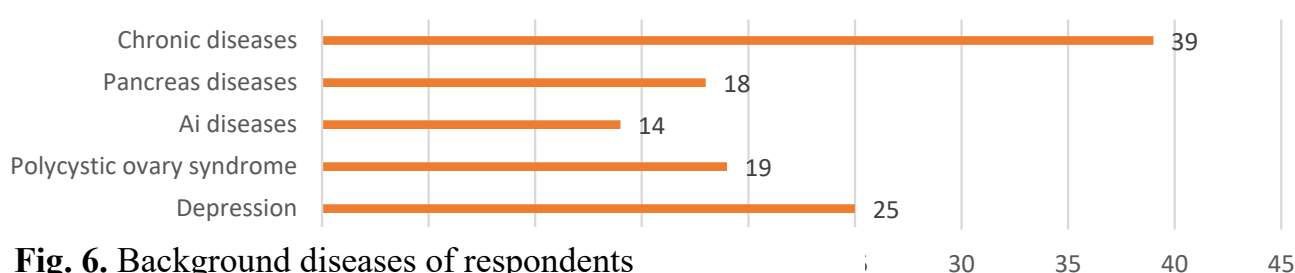
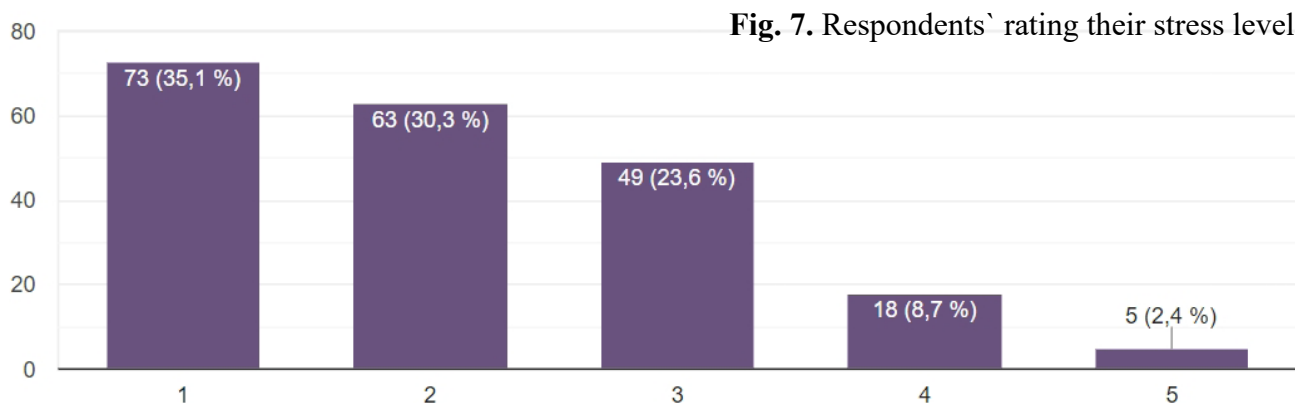**Fig. 6.** Background diseases of respondents

Fig. 7. Respondents` rating their stress level

CRITERION	CATEGORY	NUMBER OF RESPONDENTS		
		ALL (208–100%)	UKRAINE (133-100%)	INDIA (44-100%)
Body mass index	Less than 25 kg/m²	168 (81%)	117 (88%)	33 (75%)
	25-30 kg/m² (+1 point)	31 (15%)	13 (9,8%)	9 (20,5%)
	More than 30 kg/m² (+2 p.)	9 (4%)	3 (2,2%)	2 (4,5%)
Abdominal circumfer-ence	Less than 94 cm (m) / or 80 cm (f)	146 (70%)	104 (78,2%)	27 (61,4%)
	94-102cm(m) or 80-88cm(f) (+3 p.)	57 (27,5%)	27 (20,3%)	16 (36,4%)
	More than previous (+4 p.)	5 (2,5%)	2 (1,5%)	1 (2,2%)
Daily physical activity	Yes	69 (33%)	40 (30,1%)	19 (43,2%)
	No (+2 p.)	139 (67%)	93 (69,9%)	25 (56,8%)
Daily vegetable con-sumption	Yes	94 (45%)	59 (44,4%)	21 (47,7%)
	No (+1 p.)	114 (55%)	74 (55,6%)	23 (52,3%)
Antihypertension medications use	No	202 (97%)	129 (97%)	44 (100%)
	Yes (+2 p.)	6 (3%)	4 (3%)	0 (0%)
Elevated blood glu-cose level ever	No	192 (92%)	124 (93,2%)	39 (88,6%)
	Yes (+5 p.)	16 (8%)	9 (6,8%)	5 (11,4%)
Diabetes family history	No	103 (49,5%)	75 (56,4%)	18 (40,9%)
	Non-1-st degree relative (+3 p.)	77 (37%)	48 (36,1%)	14 (31,8%)
	1-st degree relative (+5 p.)	28 (13,5%)	10 (7,5%)	12 (27,3%)

Table 2. Comparison of diabetes mellitus risk level among Ukrainian and Indian respondents according to the FINDRISC scale

diabetes in young people, the obtained results demonstrate a high frequency of risk factors among lifestyle, heredity, changes in BMI, often a combination of risk factors.

This research found a high frequency of risk factors in young people. 4% of respondents have different stages of obesity, deficiency of BMI is performed by 13,5% of people. Almost a tenth of the respondents (9.1%) smoke regularly. 11.0% of young people drink alcohol every week or more often. 12% of young asked people notice depres-sion in their lives. 8% of respondents whenever had episods of hyperglycemia.

The most critical changes were detected in the consumption of fresh fruits and vegetables (55% do not consume enough), as well as activity and rest mode (67% do not perform physical activity regularly, 47.1% of respondents do not spend the required 7-9 hours on sleep).

It is important to name, that 50,5% of respon-dents are more or less predisposed to diabetes mellitus.

A comparative analysis of respondents of different origins (Ukrainians and Indians) found that among the representatives of India is more elevated body mass index and increased waist circumference. In addition, the proportion of respondents who have ever had a rise in blood glucose is higher among Indians than among Ukrainians (11,4% vs. 6,8%). There are more respondents in Ukraine who do not exercise regularly than in India.

Based on the results of the work, preventive methods and ways of their spreading among young people (infographics, brochures) were developed.

Our study confirms the problem of rejuvenating diabetes. Even at a young age, the majority of respondents have key risk factors for the development of diabetes. Violation of a healthy lifestyle can significantly affect the subsequent quality of life (including the development of diabetes and its complications: diabetic foot, diabetic angiopathy, diabetic coma, etc.).

The results of the work demonstrate the need to activate and popularize preventive measures for diabetes starting from a young age, namely avoiding bad habits (alcohol, smoking), normalizing the diet (eating 300-500 grams of fresh vegetables and fruits daily, avoiding fast food and carbonated drinks), normalizing regime of activity and rest (daily adequate physical activity, sleep 7-9 hours a day), bringing to a normal BMI (18.5-25).

ORCID ID and Authors contribution
0000-0002-5213-5519 (A, B, C, D) Gurska Kateryna

0000-0001-8952-8482 (A, B, F) Karpenko Olena

0000-0001-9878-7304 (B, E) Ostashevska Tetiana

0000-0002-3483-5247 (B, E) Krasiuk Irina

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

Giles, J. T., Danielides, S., Szklo, M., Post, W. S., Blumenthal, R. S., Petri, M., Schreiner, P. J., Budoff, M., Detrano, R., & Bathon, J. M. (2015). Insulin resistance in rheumatoid arthritis: disease-related indicators and associations with the presence and progression of subclinical atherosclerosis. *Arthritis & rheumatology (Hoboken, N.J.), 67*(3), 626–636. https://doi.org/10.1002/art.38986

Herder, C., Peltonen, M., Koenig, W., Kräft, I., Müller-Scholze, S., Martin, S., Lakka, T., Ilanne-Parikka, P., Eriksson, J. G., Hämäläinen, H., Keinänen-Kiukaanniemi, S., Valle, T. T., Uusitupa, M., Lindström, J., Kolb, H., & Tuomilehto, J. (2006). Systemic immune mediators and lifestyle changes in the prevention of type 2 diabetes: results from the Finnish Diabetes Prevention Study. *Diabetes*, 55(8), 2340–2346. https://doi.org/10.2337/db05-1320

Iwanaga, N., Arima, K., & Terada, K. (2017). Risk factors of adverse events during treatment in elderly patients with rheumatoid arthritis: an observational study. *Int J Rheum Dis., 20*(3), 346-352. https://doi.org/10.1111/1756-185X.12348

Kondratyeva, L., Popkova, T. & Nasonov, E. (2017). Type 2 diabetes mellitus risk assessement using FINDRISC in patients with rheumatoid arthritis. *Rheumatology Science and Practice, 55*(5), 504-508. (In Russ.) https://doi.org/10.47360/1995-4484-2020-489-494

Landstra, C. P., & de Koning, E. (2021). COVID-19 and Diabetes: Understanding the Interrelationship and Risks for a Severe Course. *Frontiers in endocrinology, 12*, 649525. https://doi.org/10.3389/fendo.2021.649525

Lindström, J., & Tuomilehto, J. (2003). The diabetes risk score: a practical tool to predict type 2 diabetes risk. *Diabetes care, 26*(3), 725–731. https://doi.org/10.2337/diacare.26.3.725

Ozen, G., Pedro, S., Holmqvist, M. E., Avery, M., Wolfe, F., & Michaud, K. (2017). Risk of diabetes mellitus associated with disease-modifying antirheumatic drugs and statins in rheumatoid arthritis. *Annals of the rheumatic diseases, 76*(5), 848–854. https://doi.org/10.1136/annrheumdis-2016-209954

Saaristo, T., Peltonen, M., Lindström, J., Saarikoski, L., Sundvall, J., Eriksson, J. G., & Tuomilehto, J. (2005). Cross-sectional evaluation of the Finnish Diabetes Risk Score: a tool to identify undetected type 2 diabetes, abnormal glucose tolerance and metabolic syndrome. *Diabetes and Vascular Disease Research, 2*(2), 67–72. https://doi.org/10.3132/DVDR.2005.011

Shah, A. D., Langenberg, C., Rapsomaniki, E., Denaxas, S., Pujades-Rodriguez, M., Gale, C. P., Deanfield, J., Smeeth, L., Timmis, A., & Hemingway, H. (2015). Type 2 diabetes and incidence of cardiovascular diseases: a cohort study in 1·9 million people. *The lancet. Diabetes & endocrinology, 3*(2), 105–113. https://doi.org/10.1016/S2213-8587(14)70219-0

Solomon, D. H., Love, T. J., Canning, C., & Schneeweiss, S. (2010). Risk of diabetes among patients with rheumatoid arthritis, psoriatic arthritis and psoriasis. *Annals of the rheumatic diseases, 69*(12), 2114–2117. https://doi.org/10.1136/ard.2009.125476

Tuomilehto, J., Schwarz, P., & Lindström, J. (2011). Long-term benefits from lifestyle interventions for type 2 diabetes prevention: time to expand the efforts. *Diabetes care, 34* Suppl 2(Suppl 2), S210–S214. https://doi.org/10.2337/dc11-s222

Zhou, Y., Chi, J., Lv, W., & Wang, Y. (2021). Obesity and diabetes as high-risk factors for severe coronavirus disease 2019 (Covid-19). *Diabetes/metabolism research and reviews, 37*(2), e3377. https://doi.org/10.1002/dmrr.3377

Виявлення факторів ризику розвитку цукрового діабету серед людей молодого віку

Гурська Катерина[1], Карпенко Олена[2], Осташевська Тетяна[2] , Красюк Ірина[3]

[1] Студентка НМУ імені О.О. Богомольця, м. Київ, Україна

[2] К.мед.н., доцент кафедри пропедевтики внутрішньої медицини №2, НМУ імені О.О. Богомольця, м. Київ, Україна

[3] К.мед.н., доцент кафедри терапії інфекційних хвороб післядипломної освіти Національного медичного університету імені Богомольця, Київ, Україна

Address for correspondence:

Gurska Kateryna

E-mail: katarzynagurski@gmail.com

Анотація: це дослідження спрямоване на виявлення факторів ризику розвитку діабету у способі життя у 208 молодих людей з 16 різних країн, 50,5% з цих респондентів схильні до цукрового діабету. Було враховано рекомендації FINDRISC та Mayo Clinic. Результати опитування базуються на відповідях анонімного опитування, яке включало групи запитань про загальні дані, антропометричні дані, харчування, фізичну активність, режим відпочинку, шкідливі звички, спадковість та анамнез. Найбільш критичні зміни спостерігаються у споживанні свіжих овочів та фруктів (55% споживають недостатньо), а також режимі активності та відпочинку (67% не займаються спортом регулярно, 47,1% респондентів не витрачають необхідні 7 - 9 годин на сон). Порівняльний аналіз респондентів різного походження (українців та індійців) виявив, що у представників Індії більше підвищений індекс маси тіла та збільшена окружність талії. Крім того, серед індійців частка респондентів, у яких коли-небудь підвищувався рівень глюкози в крові, вища, ніж серед українців (11,4% проти 6,8%). В Україні більше респондентів, які не займаються спортом регулярно, ніж в Індії.

Ключові слова: цукровий діабет, гіперглікемія, спосіб життя, переддіабетичний стан, фактори ризику.