Health, Sports & Rehabilitation Medicine
Vol. 21, no. 3, July-September 2020, 174–178

Is there a link between physical activity, body mass index, Finnish Diabetes Risk Score (FINDRISC) and blood pressure?

Ruxandra Roșescu [1], Roxana Maria Martin-Hadmaș [2], Monica Tarcea [2]
[1] *Emergency Clinical Hospital for Children, Cluj-Napoca, Romania*
[2] *Department of Community Nutrition and Food Safety, "George Emil Palade" University of Medicine, Pharmacy, Science and Technology from Targu-Mures, Romania*

Abstract
Background. Physical activity is one of the essential pillars of a healthy lifestyle and one of the important tools that can significantly improve general health condition. Constant exercise favorably influences 7 out of 10 most common chronic diseases.
Aims. The aim of the study was to analyze the associations between anthropometric data, physical activity, blood pressure and the Finnish Diabetes Risk Score (FINDRISC) in a group of Romanian adults.
Methods. The present research represents a cross-sectional observational pilot study, which includes a group of 95 subjects from Argeș County. The study was conducted between May and June 2019. We calculated the FINDRISC score to estimate the risk of patients to develop diabetes in the next 10 years using 2 different validated questionnaires, focused on lifestyle aspects and nutritional status.
Results. In our study, FINDRISC was significantly associated with waist circumference, waist/hip ratio and body mass index. No correlations were found with subjects' interest for health, physical activity and rest. However, we noticed that patients who spend more time resting weekly have a lower FINDRISC and subjects who rarely exercise have a higher FINDRISC.
Conclusions. There was a link between abdominal circumference, abdomen / hip ratio, BMI and age, blood pressure and FINDRISC score. Our study proves the importance of a healthy lifestyle, BMI and blood pressure for preventing cardiovascular and metabolic diseases such as diabetes.
Key words: Finnish Diabetes Risk Score (FINDRISC), diabetes, physical activity, lifestyle, blood pressure

Introduction

Physical activity is one of the essential pillars of a healthy lifestyle and one of the important tools that can significantly improve general health condition. (1) Constant exercise favorably influences 7 out of 10 most common chronic diseases (2). According to the World Health Organization (3), overweight and obesity are responsible for 5% of global mortality. Furthermore, lack of physical activity is the fourth risk factor for global mortality (approximately 6% of deaths worldwide), followed by high blood pressure (13%), tobacco use (9%) and elevated serum blood glucose (6%) (3).

Globally, it is observed that children, young people, as well as adults are increasingly replacing physical activity with a sedentary lifestyle. Sedentary lifestyle condition is associated with various psychological problems and an increased risk for cardiovascular and metabolic diseases (D'Isanto et al., 2017; Al-Nakeeb et al., 2015; Monteiro et al., 2019).

The benefits that physical activity offers consist of decreasing mortality of any cause, by improving the general physical condition. It also decreases the risk of developing cardiovascular disease, high blood pressure, type 2 diabetes, lipid profile disorders, and the appearance of neoplasms in the genitourinary and digestive systems. Exercise improves bone metabolism, promotes a normal body weight, reduces the risk of anxiety and depression, and improves cognitive function, sleep or quality of life (Wahlich et al., 2020; Meader et al., 2017).

Objectives

The aim of the study was to analyze the associations between anthropometric data, physical activity, blood pressure and the Finnish Diabetes Risk Score (FINDRISC score).

Hypothesis

Our hypothesis was that patients who allocate less time for physical activity have a higher risk of developing

Received: 2020, May 16; *Accepted for publication:* 2020, May 26
Address for correspondence: "George Emil Palade" University of Medicine, Pharmacy, Science and Technology, Tîrgu Mureș, Gheorghe Marinescu Street, no 38, Târgu Mureș, 540142, Romania
E-mail: roxanahadmas@yahoo.com
Corresponding author: Roxana Maria Martin-Hadmaș; roxanahadmas@yahoo.com
https://doi.org/10.26659/pm3.2020.21.3.174

diabetes in the next ten years, higher values of the body mass index and blood pressure, and there is a connection between obesity, sedentarism, diabetes and arterial hypertension.

Methods

Research protocol

All data were collected after obtaining the approval of the Ethics Committee and the consent of each participant in the study.

a) Period and place of the research

Our research was based on a cross-sectional observational pilot study, which included a group of 95 patients from Argeș County, interviewed in the Family Medicine office. The study was conducted between May and June 2019. The data were collected with the approval of the family physician, and with the subjects' consent.

The inclusion criteria were: minimum age 18 years, and no history of chronic diseases. The exclusion criteria were as follows: patients diagnosed with diabetes or other chronic/acute pathologies that may influence physical development.

The data collected included: age, gender, weight, height, abdominal circumference and gluteal circumference. Based on the collected data, the Body Mass Index (BMI) was calculated using the formula weight (kg) / height^2 (m^2). We interpreted the BMI results as follows: under 18.49 - underweight, 18.50 - 24.99 normal weight, 25.00 - 29.99 overweight, over 30 - obesity. We considered normal values for the abdomen / hip ratio < 0.90 for men and < 0.85 for women (1); (4).

Two questionnaires ("Assessment of nutritional status and lifestyle risk factors") of 38 and 25 items related to eating habits and food preferences, coffee consumption, alcohol, smoking, stress level, physical activity, medical history were used to assess the nutritional status and lifestyle. We used the Finnish Diabetes Risk Score (FINDRISC) for estimating the risk of patients to develop diabetes in the next ten years. FINDRISC studies were a random sample based on the National Population Register, from North Karelia, Kuopio, and South-Western Finland in 1987, and another independent sample from the Helsinki-Vanraa region in 1992 (Lindström & Tuomilehto, 2003).

b) Subjects and groups

Our study included 95 adults, 59 (62.11%) women and 36 (37.89%) men, aged between 21 and 78 years. The data from Tables I and II illustrate the relationship between the demographic data of our patients and their BMI, FINDRISC score and blood pressure. The average BMI values were 26.66 ± 4.87.

Table I

Demographic data of the study group.

Indicators	Patients	Gender		Residence	
	N	Female	Male	Urban	Rural
Body mass index					
Underweight	1 (1.05%)	1 (1.69%)	0	1 (1.85%)	0
Normal weight	37 (38.95%)	27 (45.76%)	10 (27.78%)	26 (48.15)	11 (26.83%)
Overweight	37 (38.95%)	20 (33.90%)	17 (47.22%)	20 (37.04%)	17 41.46%)
Obesity	20 (21.05%)	11 (18.64%)	9 (25%)	7 (12.96%)	13 (31.71%)
The FINDRISC risk					
Below	33 (34.73%)	24 (40.68%)	9 (25%)	18 (33.33%)	15 (36.59%)
Slightly high	31 (32.63%)	20 (33.90%)	11 (30.56%)	20 (37.04%)	11 (26.83%)
Moderate	18 (18.95%)	10 (16.95%)	8 (22.22%)	8 (14.81%)	10 (24.39%)
High	13 (13.68%)	5 (8.47%)	8 (22.22%)	8 (14.81%)	5 (12.20%)
Blood pressure					
Optimal	20 (21.05%)	11 (20.37%)	9 (21.95%)	11 (20.37%)	9 (21.95%)
Normal	26 (27.37%)	17 (31.48%)	9 (21.95%)	17 (31.48%)	9 (21.95%)
Highly normal	20 (21.05%)	11 (20.37%)	9 (21.95%)	11 (20.37%)	9 (21.95%)
Hypertension	29 (30.53%)	15 (27.78%)	14 (34.15%)	15 (27.78%)	14 (34.15%)

Table II

Demographic data of the study group.

Indicators	Age (years)					
	≤20	21-30	31-40	41-50	51-60	> 60
Body mass index						
Underweight	0	0	1 (14.29%)	0	0	0
Normal weight	0	3 (75%)	4 (57.14%)	13 (48.15%)	6 (26.09%)	11 (32.35%)
Overweight	0	1 (25%)	1 (14.29%)	13 (48.15%)	12 (52.17%)	10 (29.41%)
Obesity	0	0	1 (14.29%)	1 (3.70%)	5 (21.74%)	13 (38.24%)
The FINDRISC risk						
Below	0	3 (60%)	5 (41.67%)	14 (51.85%)	7 (30.43%)	4 (11.76%)
Slightly high	1 (100%)	2 (40%)	7 (58.33%)	7 (25.93%)	9 (39.13%)	12 (35.29%)
Moderate	0	0	0	6 (22.22%)	4 (17.39%)	8 (23.52%)
High	0	0	0	0	3 (13.04%)	10 (29.41%)
Blood pressure						
Optimal	0	0	4 (57.14%)	7 (25.93%)	6 (26.09%)	3 (8.82%)
Normal	0	4 (100%)	2 (28.57%)	13 (48.15%)	2 (8.70%)	5 (14.71%)
Highly normal	0	0	1 (14.29%)	6 (22.22%)	6 (26.09%)	7 (20.59%)
Hypertension	0	0	0	1 (3.70%)	9 (39.13%)	19 (55.88%)

c) Tests applied

We used two questionnaires to evaluate the nutritional status and lifestyle risk factors. The main questions related to physical activities were: "How much time do you give for weekly rest?", "How much time do you spend resting daily?", "How often do you exercise?", "What kind of exercise do you do?", "Do you perform at least 30 minutes of daily exercise at work/in your spare time/at home?", "Does a change of 2.5 kg in your weight affect your way of life?**".** Regarding the attitude of patients to health, they answered the following questions: "Do you know the caloric value of the common products?", "Have you ever tried to apply preventive measures for hereditary diseases (related to food, physical activity)?"

We calculated the FINDRISC score to estimate the risk of patients to develop diabetes in the next 10 years. We followed the answers to 8 questions: age, BMI, waist circumference, daily physical activity, frequency of daily consumption of vegetables and fruits, use of antihypertensive drugs, personal history of hyperglycemia, history of type 1 and 2 diabetes. Values below 7 indicate a low risk of developing diabetes in the next 10 years, values between 7 and 11 slightly high risk, between 12 - 14 moderate risk, between 15 - 20 high risk and very high risk over 20. The questionnaire was validated in several studies both in the original form and in the simplified formula (Omech et al., 2016; Vandermissen & Godderis, 2015; Makrilakis et al., 2011; Soriguer et al., 2012; Conceicao et al., 2020; Munoz-Gonzalez et al., 2019; Winlker et al., 2013; Grasdalsmoen et al., 2019; Jayawardana et al., 2017a).

d) Statistical processing

For statistical analysis we used GraphPad InStat software (Version 3.06). For quantitative variables (BMI, age, blood pressure, FINDRISC score, anthropometric measurements), we performed descriptive statistics, using the mean and standard deviation for variables with Gaussian distribution (BMI, FINDRISC, age) and the median, minimum and maximum for variables with non-Gaussian distribution (BP, abdominal circumference, abdomen-hip ratio). We applied the Pearson correlation test for parametric data and Spearman for nonparametric data to see if the values of abdominal circumference, abdomen / hip ratio and BMI correlated with age, blood pressure and FINDRISC score. For qualitative variables (patients' responses to the questionnaires) we applied extended contingency tables, and statistical interpretation was performed against the statistical significance threshold p ($p < 0.05$ statistically significant).

Results

The mean FINDRISC score was 8.947 + 5.009. The median systolic blood pressure (SBP) value was 130 mmHg, with a minimum of 90 mmHg and a maximum of 170 mmHg, and the median diastolic blood pressure (DBP) value was 80 mmHg, with a minimum of 55 mmHg and a maximum of 100 mmHg.

We analyzed the interest of the subjects in health, physical activity and rest. There was no statistically significant association between BMI and the daily rest, the exercise frequency, the time spent for physical activity (less or more than 30 minutes per day), the type of physical activity and how a 2.5 kg change in body weight affected the patients ($p > 0.05$). BMI was statistically significantly associated with the weekly rest ($p = 0.0335$). Normal and overweight patients allocate 1-2 days of weekly rest in a higher percentage, and a smaller number of them rarely make time for rest. More than half of obese patients allocate 2 days per week for rest (Fig. 1).

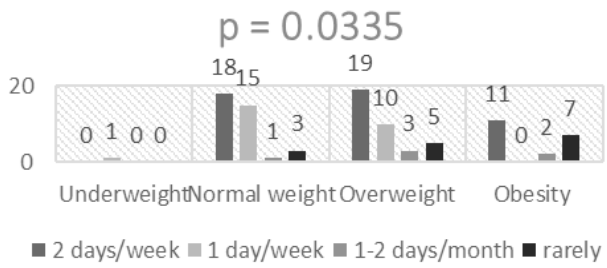

Fig. 1 – The association between Body Mass Index and weekly rest.

We observed a statistically significant association between BMI and patients' response to questions about whether they knew the caloric value of the common products ($p = 0.0030$) and whether they had ever tried to apply methods for preventing hereditary diseases related to food and physical activity ($p = 0.0296$). Most patients answered the two questions negatively, but we found that overweight patients knew the caloric value of common products and tried to apply preventive methods regarding hereditary diseases in a higher percentage than the other groups.

Concerning the link between the interest in health, physical activity, rest and the risk of developing diabetes in the next ten years, we observed that the FINDRISC was not associated with any of the patients' responses ($p > 0.05$). However, we noticed that patients who spent more time resting weekly had a lower FINDRISC and subjects who rarely exercised had a higher FINDRISC. Instead, we observed that BP values were associated with the time given to daily rest ($p = 0.0012$) and weekly rest ($p = 0.0475$). Hypertensive patients allocated more time for both daily and weekly rest, and those with normal BP values allocated time for weekly, but not daily rest. There was no statistically significant association with other variables ($p > 0.05$).

Regarding the anthropometric measures, we compared the values of the abdominal circumference, the abdomen / hip ratio and BMI with age, SBP and DBP values, and FINDRISC score, respectively. We observed that between these variables there were statistically significant positive correlations (Table III).

Discussions

In our study, we did not identify a statistically significant association between BMI values and patients' responses to the daily rest time, frequency and type of exercise, duration of physical activity, and how a 2.5 kg change in body weight affected them. BMI values were associated with the weekly resting time ($p = 0.0335$). Grasdalsmoen

Table III
Correlations between anthropometric measures, age, blood pressure and the FINDRISC score.

Indicators		Waist circumference	Waist/hip ratio	Body mass index
Age	r value	0.3900	0.2716	0.3876
	CI (95%)	0.1987 to 0.5527	0.07407 to 0.4486	0.2018 to 0.5465
	p value	**< 0.0001**	**0.0078**	**0.0001**
SBP	r value	0.5780	0.2106	0.4888
	CI (95%)	0.4210 to 0.7013	0.003346 to 0.4005	0.3131 to 0.6321
	p value	**< 0.0001**	**0.0405**	**< 0.0001**
DBP	r value	0.4659	**0.1752**	**0.3542**
	CI (95%)	0.2862 to 0.6140	0.03339 to 0.3692	0.1585 to 0.5232
	p value	**< 0.0001**	0.0895	**0.0004**
FINDRISC	r value	0.6951	**0.3777**	**0.5804**
	CI (95%)	0.5698 to 0.7888	0.1906 to 0.5383	0.4291 to 0.7001
	p value	**< 0.0001**	**0.0002**	**< 0.0001**

SBP=Systolic blood pressure; DBP= Diastolic blood pressure

et al. (2019) showed in a study conducted on 3 large groups of subjects that there is a causal relationship between physical activity, overweight and obesity (Grasdalsmoen et al., 2019). Similarly, Jayawardana et al. (2017a) showed in a study of 2469 men that an increased level of physical activity was associated with a reduced likelihood of being obese (p = 0.0122) (Jayawardana et al., 2017a). Another study shows similar results, with low levels of physical activity being significantly associated with an increased BMI (p = 0.002) (Karunanayake et al., 2020).

The FINDRISC score was not significantly associated with any of the answers to questions related to physical activity and lifestyle attitudes in our study. However, we observed that patients who devoted more time to weekly rest had a low risk of developing type 2 diabetes. Subjects who rarely exercised had a moderate or high risk of developing diabetes in the next ten years. Clinical studies have demonstrated the importance of lifestyle in the prevention of type 2 diabetes, the measures of changing some unhealthy daily habits having favorable long-term effects (Lindrstom et al., 2010). It has been observed that replacing sedentary behavior with physical activity, even of low intensity, can contribute to improving serum blood glucose levels, reducing the incidence of diabetes, and even improving BP values (Egan, 2017; Hamilton et al., 2014).

In the present research, BP was associated with daily (p = 0.0012) and weekly rest (p = 0.0475). Subjects with optimal and normal blood pressure allocated 1-2 days a week for rest. Hypertensive patients allocated more time for daily and weekly rest. BP was not associated with the other variables studied. However, we noticed that hypertensive patients preferred physical work, while normotensive patients chose walking or running, and only a small number of patients chose both physical activity and other types of exercise.

A considerable number of studies have shown the benefits of exercise on hypertension, reducing both SBP and DBP. Exercise has been shown to be an essential element of lifestyle in primary prevention and hypertension treatment (Hegde et al., 2015). Ahmadi-Abhari et al. (2017) showed that reducing the time spent in front of television or other sedentary leisure activities, as well as increasing the frequency of sports activities can have beneficial effects on the circulatory system, slowing down the aging of blood vessels. Physical inactivity is associated with the risk of developing cardiovascular disease. In a study of 22,476 participants aged 30 to 64 years with no history of cardiovascular disease, Zhang et al. (2020) found a high risk of developing cardiovascular disease in overweight or obese patients compared to those with a BMI <25 kg / m^2.

In this study, there was no statistically significant link between FINDRISC score, blood pressure values and interest in health. However, patients at moderate-high risk of developing diabetes over the next ten years appear to pay more attention to the prevention of genetically predisposed but lifestyle-influenced diseases.

We found in our study that blood pressure values and FINDRISC score correlated positively with anthropometric measurements. In other words, the higher the values of abdominal circumference, abdomen / hip ratio and BMI, the higher the BP values and the higher the risk of developing diabetes in the next ten years. Similar results were shown by the study conducted by Jayawardana et al. (2017b), who found that both SBP and DBP were correlated statistically significantly with age, abdominal circumference and BMI. They did not identify significant correlations between blood pressure values and the intensity of physical activity.

There are several limitations of this study related to the relatively small number of participants and their inequality, being divided into groups according to BMI, FINDRISC score and blood pressure values. However, we mention that this was a pilot study and that we are considering a study on a larger cohort starting from the present research.

Conclusions

1. Normal weight subjects have a lower risk of developing diabetes in the next ten years.
2. Patients with a moderate or high risk of developing diabetes in the next ten years prefer physical work and not sport activities.
3. There is a link between abdominal circumference, abdomen / hip ratio, BMI, age, blood pressure and FINDRISC score. Patients with higher BMI values have a higher risk of developing diabetes in the next ten years.
4. Our study proves the importance of lifestyle, BMI and blood pressure for preventing cardiovascular and metabolic diseases such as diabetes.

Conflicts of interest

There are no conflicts of interest.

References

Ahmadi-Abhari S, Sabia S, Shipley M, Kivimaki M, Singh-Manoux A Tabak A, McEniery C, Wilkinson IB, Brunner EJ. Physical activity, sedentary behavior and long-term changes in aortic stiffness: the Whitewall study. J Am Heart Assoc. 2017;6(8):e005974. doi:10.1161/JAHA.117.005974.

Al-Nakeeb Y, Lyons M, Dodd LJ, Al-Nuaim A. An investigation into the lifestyle, health habits and risk factors of young adults. Int J Environ Res Public Health. 2015;12(4):4380-4394; doi:10.3390/ijerph120404380.

Conceicao ALO, Correa NdC, Ferreira PR, Rego AS, Silva FB, Ferreira de Carvalho STR, da Silva Dias R, Pas BKB, de Carvalho Rocha VC, Bassi-Dibai D. Translation, cross-cultural adaptation and validation of the Finnish Diabetes Risk Score (FINDRISC) for use in Brazilian Portuguese: questionnaire validity study. Sao Paulo Med J. 2020; 138(3):244-252. doi: 10.1590/1516-3180.2019.0524.05032020.

D'Isanto T, Manna A, Altavilla G. Health and physical activity. Sport Sci. 2017;10(1):100-105.

Egan BM. Physical activity and hypertension. Hypertension. 2017;69(3):404-406. doi:10.1161/HYPERTENSIONAHA.116.08508.

Grasdalsmoen M, Eriksen HR, Lønning KJ, Sivertsen B. Physical exercise and body-mass index in young adults: a national survey of Norwegian university students. BMC Public Health. 2019;19(1):1354. doi:10.1186/s12889-019-7650-z.

Hamilton MT, Hamilton DG, Zderic TW. Sedentary behavior as a mediator of type 2 diabetes. Med Sport Sci. 2014;60:11-26. doi:10.1159/000357332.

Hegde SM, Solomon SD. Influence of physical activity on hypertension and cardiac structure and function. Curr Hypertens Rep. 2015;17(10):77. doi:10.1007/s11906-015-0588-3.

Jayawardana NWIA, Jayalath WATA, Madhujith WMT, Ralapanawa U, Jayasekera RS, Alagiyawanna SASB, Bandara AMKR, Kalupahana NS. Lifestyle factors associated with obesity in a cohort of males in the central province of Sri Lanka: a cross-sectional descriptive study. BMC Public Health. 2017a;17(1):27. doi:10.1186/s12889-016-3963-3.

Jayawardana NWIA, Jayalath WATA, Madhujith WMT, Ralapanawa U, Jayasekera RS, Alagiyawanna SASB, Bandara AMKR, Kalupahana NS. Aging and obesity are associated with undiagnosed hypertension in a cohort of males in the Central Province of Sri Lanka: a cross-sectional descriptive study. BMC Cardiovasc Disord. 2017b;17(1):165. doi:10.1186/s12872-017-0600-8.

Karunanayake AL, Senaratne CD, Stathi A. A descriptive cross sectional study comparing barriers and determinants of physical activity of Sri Lankan middle aged and older adults. PloS ONE. 2020;15(5):e0232956. doi: 10.1371/journal.pone.0232956.

Lindström J, Tuomilehto J. The diabetes risk score: a practical tool to predict type 2 diabetes risk. Diabetes Care. 2003;26:725-31. doi: 10.2337/diacare.26.3.725.

Lindrstom J, Absetz P, Hemio K, Peltomaki P, Peltonen M. Reducing the risk of type 2 diabetes with nutrition and physical activity – efficacy and implementation of lifestyle interventions in Finland. Public Health Nutr. 2010;13(6A):993-999. doi:10.1017/S1368980010000960.

Makrilakis K, Liatis S, Grammatikou S, Perrea D, Stathi P, Tsiligros P, Katsilambros N. Validation of the Finnish Diabetes Risk Score (FINDRISC) questionnaire for screening for undiagnosed type 2 diabetes, dysglycaemia and the metabolic syndrome in Greece. Diabetes Metab. 2011;37(2):144-151. doi: 10.1016/j.diabet.2010.09.006.

Meader N, King K, Wright K, Graham HM, Pettucrew M, Power C, White M, Sowden AJ. Multiple risk behavior interventions: meta-analyses of RTCs. Am J Prev Med. 2017;53(1):e19-e30. doi: 10.1016/j.amepre.2017.01.032.

Monteiro D, Machado S, Moutão J, Bento T, Vitorino A, Alves S, Rodrigues F, de Lima JLM, Teixeira D, Murillo-Rodriguez E, Cid L. Physical exercise and sedentary lifestyle: health consequences. Espiral. Cuadernos del Profesorado. 2019;12(25):75-88. doi: 10.25115/ecp.v12i25.2420.

Munoz-Gonzalez MC, Lima-Martinez MM, Nava A, Trerotola G, Paoli M, Cabrera-Rego JO, Gonzalez B, Arciniegas A, Paez J. FINDRISC Modified for Latin America as a screening tool for persons with impaired glucose metabolism in Ciudad Bolivar, Venezuela. Med Princ Pract. 2019;28(4):324-332. doi: 10.1159/000499468.

Omech B, Mwita JC, Tschikuka JG, Tsima B, Nkomazna O, Amone-P'Olak K. Validity of the Finnish Diabetes Risk Score for detecting undiagnosed type 2 diabetes among general medical outpatients in Botswana. J Diabetes Res. 2016;2016:4968350. doi: 10.1155/2016/4968350.

Soriguer F, Valdes S, Tapia MJ, Esteva I, de Adana ESR, Alamaraz MC, Morcillo S, Fuentes EG, Rodriguez F, Rojo-Martinez G. Validation of the FINDRISC (Finnish Diabetes Risk Score) for prediction of the risk of type 2 diabetes in a population of southern Spain, Pizzara Spain. Med Clin (Barc). 2012;138(9):389-390. doi: 10.1016/j.medcli.2011.09.028.

Vandermissen GJM, Godderis L. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) for diabetes screening in occupational health care. Int J Occup Med Environ Health. 2015;28(3):587-591. doi: 10.13075/ijomeh.1896.00407.

Wahlich C, Chaudhry UAR, Fortescue R, Cook DG, Hirani S, Knightly R, Harris T. Effectiveness of adult community-based physical activity interventions with objective physical activity measurements and long-term follow-up: a systematic review and meta-analysis. BMJ Open. 2020;10:e034541. doi:10.1136/bmjopen-2019-034541.

Winlker G, Hidvegi, Vandorfi G, Balogh S, Jermendy G. Prevalance of undiagnosed abnormal glucose tolerance in adult patients cared for by general practitioners in Hungary. Results of a risk-stratified screening based on FINDRISC questionnaire. Med Sci Monit. 2013;19:67-72. doi: 10.12659/msm.883747.

Zhang X, Cash RE, Bower JK, Focht BC, Paskett ED. Physical activity and risk of cardiovascular disease by weight status among U.S adults. PloS One. 2020;15(5):e0232893. doi: 10.1371/journal.pone.0232893.

Websites

(1) National Institutes of Health National Heart, Lung and Blood Institute North American Association for the Study of Obesity. The Practical Guide Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, 2000. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/prctgd_c.pdf. Accessed on 12.08.2020

(2) US Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd ed. Washington, DC: US Department of Health and Human Services, 2018. Available at: https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf#page=43. Accessed on 12.08.2020

(3) World Health Organisation. Global recommandation on physical activity on health, 2010. Available at: https://apps.who.int/iris/bitstream/handle/10665/44399/9789241599979_eng.pdf?sequence=1. Accessed on 12.08.2020

(4) World Health Organisation. Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation, 2008. Available at: https://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf;jsessionid=2CE6A02EA95FA39A940B02EB0342A58F?sequence=1. Accessed on 12.08.2020