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Original Article

Problems of overweight and obesity among students at general secondary educational institutions

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Abstract
Introduction. In many countries around the world, about 63% of deaths are caused by chronic noncommunicable diseases. Obesity is one of the factors in the development of a number of noncommunicable diseases (cardiovascular, diabetes, etc.). It is the most common metabolic disease among people of all ages in all countries. The WHO (the World Health Organization) recognized obesity as a new non-communicable «epidemic» of our time. Despite the fact, that noncommunicable diseases kill adults more frequently, the predisposition to risk factors begins in childhood and its negative consequences accumulate throughout the lifespan. That is why regular monitoring of the prevalence of overweight and obesity among children and adolescents is relevant and appropriate. *Materials and methods.* 340 schoolchildren, including 196 boys aged 8-16 and 144 girls aged 8-15 research took part in the research. Analysis of the prevalence of overweight and obesity among schoolchildren was carried out using anthropometric data (body weight and height) and the calculation of the body mass index, taking into account the standards of the percentiles. *Results and conclusions.* The results of the study during 2017-2020 showed that a higher prevalence of overweight and obesity was observed in boys aged 8-12 years and girls aged 8-11 years. The predominance of overweight and obese people among girls or boys cannot be stated unequivocally, because of a disproportion throughout the years. In 2017 and 2020, a higher percentage of overweight people was observed among boys, in 2018-2019 - among girls. The prevalence of obesity in 2017-2018 was higher among girls, in 2019-2020, respectively, among boys. It was also found that the percentage of obese and overweight schoolchildren during the study period was high. In 2020 there was a significant increase of obese and overweight schoolchildren in comparison with previous years.
Key words: overweight, obesity, schoolchildren, educational institutions.

Introduction

Chronic noncommunicable diseases are the most common cause of high mortality in many countries around the world. Every year, more than 36 million people die of these diseases (63% of all deaths worldwide), among them 14 million people die prematurely, under the age of 70 (WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020). The world's biggest killer is coronary heart disease, responsible for 16% of the world's total deaths. Since 2000, the largest increase in deaths has been for this disease, rising by more than 2 million to 8.9 million deaths in 2019 (WHO. The top 10 causes of death, 2020).

Data from the demographic yearbook «Population of Ukraine 2019» show that diseases of the circulatory system, especially coronary heart disease, have been taking the first place among the causes of mortality in Ukraine for more than 20 years (Population of Ukraine 2019. Demographic Yearbook, 2020).

It is noted in the scientific literature that obesity is one of the main factors in the development of non-communicable diseases such as cardiovascular disease, diabetes (WHO. Obesity and overweight, 2021; Kasimov et al., 2016; Skotnikova et al., 2016; Mohammed et al., 2018; Piche et al., 2020; Shpagina, Bondarenko, 2013). Obesity also worsens the functioning of the whole organism (Poplawska et al., 2019). Many epidemiological studies have shown that overweight and obesity are associated with 44% of cases of type 2 diabetes, and 23% of cases of coronary heart disease (Borodkina, 2016; Diachenko-Bohun et al., 2019).

Over the past two years, in the context of the COVID-19 pandemic, there have been many studies on the effects of obesity on the course of the disease. Obesity is associated with a significant increase in morbidity and mortality from COVID-19, it significantly complicates the course of the disease (Aghili et al., 2021; Cai et al., 2020; Valerio et al., 2020; Kwok et al., 2020; Hajifathalian et al., 2020; Petrilli et al., 2020; Popkin et al., 2020; Wadman, 2020), in addition, obese patients are more likely to develop serious complications from SARS-CoV-2 (Westheim et al., 2021). An inverse correlation was found between age and body mass index. According to this factor, younger people hospitalized with COVID-19 were more likely to be obese (Kass et al., 2020).

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Nowadays, obesity is one of the most serious public health problems and the most common metabolic disease among people of all ages in all countries of the world. The WHO has recognized it as a new non-infectious «epidemic» of our time.

Life expectancy is reduced by an average of 3-5 years for people with a small excess of weight. Life expectancy is reduced to 15 years for people with severe obesity. It was found, that if humanity was able to solve the problem of obesity, life expectancy would increase by 4 years (Hainer, 2009).

The results of a representative cross-sectional study, which was conducted in 2010 in 16 European countries, showed that almost half of the interviewed European adults (47.6%) were overweight or obese (54.5% of men and 40.8% of women). 12.8% of adults (14.0% of men and 11.5% of women) suffered from obesity (Gallus et al., 2015).

In 2016, according to the WHO global estimate, more than 1.9 billion adults over the age of 18 were overweight, more than 650 million among them were obese. According to 2016 data, approximately 39% of adults (39% of men and 40% of women) were overweight, about 13% of the adult population of the planet (11% of men and 15% of women) was obese. From 1975 to 2016, the number of obese people worldwide increased more than 3 times (WHO. Obesity and overweight, 2021). As of 2019, the prevalence of overweight people around the world was following: preschool children (up to 5 years) - 5.9%; school-age children (5-9 years) - 20.6%; adolescents (10-19 years) - 17.3%; adults (18 years and older) - 38.9% (Elflein, 2020).

Despite the fact that adults often die from noncommunicable diseases, the predisposition to risk factors begins in childhood and its negative consequences accumulate throughout the lifespan (WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020). The epidemic of childhood obesity has become global: according to the latest statistics, up to 30% of children and adolescents in the world are overweight or obese (Abaturov, Nikulina, 2020). The state of children and adolescents' health is one of the most acute medical and social problems in Ukraine. Unsatisfactory health in childhood leads to health problems during adolescence and human life. The current medical and demographic situation is characterized by increasing levels of morbidity, prevalence of diseases and disabilities of children and it is becoming extremely important nationwide (Zavada, 2016). According to state statistics, the prevalence of obesity among adolescents (15-17 years) increased by 2.5 times in Ukraine for 10 years (from 2001 to 2010) (Pavlushun et al., 2013). Obesity is 17.2% among diseases of the endocrine system and it occupies the 4th place in the structure of diseases prevalence among children and adolescents (Skyrda et al., 2016).

Prevention of childhood obesity is recognized as one of the main areas of primary prevention of noncommunicable diseases, as childhood obesity is a significant predictor of obesity in adults (Dyachuk et al., 2017). Large-scale epidemiological studies of obesity among children and adolescents have not practically carried out in Ukraine recently. This neglect of the problem has led to the fact that young people often have complications due to the premorbid condition associated with obesity. Despite the fact, that significant progress has been made in studying the epidemiology of food-related diseases, including obesity among children and adolescents in some regions in recent years, according to scientists, the diagnostic process for this type of pathology is ineffective. Thus, the true prevalence of overweight and obesity among children and adolescents in Ukraine remains unknown, as official statistics differs significantly from the results of population-based surveys in Europe and the world. (Ognev, Pomogajbo, 2016).

In view of the above stated facts, regular monitoring of the prevalence of overweight and obesity among children and adolescents in our country is relevant and appropriate.

Materials & Methods

The study was conducted during 2017-2020 on the basis of some institutions of general secondary education in Ukraine. The sample included data of 340 students, including 144 girls and 196 boys. Body mass index (BMI) of boys aged 8-16 years and girls aged 8-15 years was analyzed. In addition, students were divided into two age groups: boys aged 8-12 years and girls aged 8-11 years, boys aged 13-16 years and girls aged 12-15 years.

The research was conducted in accordance with the ethical principles of the 2008 Declaration of Helsinki (WMA Declaration of Helsinki 2008). The research does not violate the rights of schoolchildren and it does not endanger their health. Analysis of the prevalence of overweight and obesity in school-age children was performed using anthropometric data (body weight and height) and the calculation of body mass index. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg / m2). The diagnosis of overweight and obesity was carried out on the basis of the obtained values of Body mass index, age and sex of the child, taking into account the standards of percentiles (WHO. Obesity and overweight, 2021; Pavlushun et al., 2013).

Results

The analysis of the results of the study showed some fluctuations in the percentage of surveyed schoolchildren of general secondary schools with overweight and obesity in the direction of its increase or decrease during 2017-2019 among boys and girls of both age groups, but a significant increase was revealed in all groups in 2020 in comparison with the previous period.

Table 1. Changes in BMI indicators of boys, aged 8-12 years

Indicators		2017	2018	2019	2020
Overweight	%	23,73	19,64	18,96	26,56
	Changes	↓4,09	↓ 0,68	↑ 7,6	
Obesity	%	8,47	8,93	10,34	14,06
	Changes	↑0,46	↑ 1,41	↑ 3,72	

In accordance with table 1, the prevalence of overweight boys aged 8-12 years during 2017-2019 years gradually decreased: in 2018 it decreased to 4.09% compared to 2017, and in 2019 to 0.68% compared to 2018. However, in 2020 this figure increased by 7.6% compared to 2019 and exceeds the percentage of all previous years of the research. The prevalence of boys obesity in this age group has been growing during the investigated years and the highest growth rate was in 2020 - by 3.72% compared to 2019.

Table 2. Changes in BMI indicators of boys, aged 13-16 years

Indicators		2017	2018	2019	2020
Overweight	%	14,70	15,00	13,9	20,11
	Changes	↑ 0,30	↓1,1	↑ 6,21	
Obesity	%	5,88	7,5	6,90	8,16
	Changes	↑ 1,62	↓ 0,6	↑ 1,26	

As it can be seen from table 2, the prevalence of overweight and obesity among boys aged 13-16 years, during 2017-2020 is not characterized by a clear increase or decrease, but it has an oscillating nature. Thus, in 2018, the percentage of overweight and obese boys increased compared to 2017 by 0.30% and 1.62%, respectively. In 2019, the percentage of overweight and obese adolescents decreased compared to 2018 by 1.1% and 0.6%, respectively. In 2020 the prevalence of overweight and obesity increased compared to 2017-2019. In 2020, the rate of overweight boys of this age increased by 6.21% compared to 2019 and the number of obese boys increased by 1.26%.

Table 3. Changes in BMI indicators of girls, aged 8-11 years

Indicators		2017	2018	2019	2020
Overweight	%	21,43	22,72	20,00	22,92
	Changes	↑ 1,29	↓ 2,72	↑ 2,92	
Obesity	%	11,90	11,36	8,89	12,5
	Changes	↓ 0,54	↓ 2,47	↑ 3,61	

According to table 3, an indicator of prevalence of overweight among girls, aged 8-11 years in 2018 increased by 1.29% compared to 2017. In 2019, on the contrary, it decreased by 2.72% compared to 2018, in 2020 this figure increased by 2.92%. Analysis of the prevalence of obesity among girls aged 8-11 years, suggests that this figure gradually decreased during 2018-2019: in 2018 the percentage decrease in the number of obese people was 0.54% compared to 2017, and in 2019, this figure decreased by 2.47% compared to 2018. In 2020, there was an increase in the prevalence of obesity in this group of girls, which amounted to 3.61% compared to 2019 and it exceeded the percentage of all previous years.

Table 4. Changes in BMI indicators of girls, aged 12-15 years

Indicators		2017	2018	2019	2020
Overweight	%	20,00	16,67	15,22	22,73
	Changes	↓ 3,33	↓ 1,45	↑ 7,51	
Obesity	%	8,00	6,25	6,52	9,09
	Changes	↓ 1,75	↑ 0,27	↑ 2,57	

Analysis of the results of the study presented in table 4 showed that the percentage of girls aged 12-15 years with overweight during 2017-2019 gradually decreased: in 2018 by 3.33%, in 2019 by 1.45 %. In 2020, this figure increased by 7.51% compared to 2019. The percentage of girls with obesity of this age group in 2018 decreased by 1.75% compared to 2017, in 2019 it increased by 0.27%. A more significant increase in the prevalence of obesity among girls aged 12-15 years was observed in 2020 and amounted to 2.57% compared to 2019. It should be noted that this figure in 2020 was the highest during all years of the study.

Discussion

An analysis of our studies on the prevalence of overweight and obesity during 2017-2020 in terms of age shows that higher prevalence rates throughout the study period were observed in boys aged 8-12 years and girls aged 8-11 years. The results of our studies on the peak of overweight and obesity in the age group from 8 to 11-12 years of both sexes confirm the conclusions of other researchers (Vitebskaya et al., 2016; Ognev, Pomogajbo, 2016).

Our data suggest that when comparing the prevalence of obesity and overweight among boys and girls, it is impossible to say unequivocally about the predominance of the studied indicators of a certain sex, because there is a disproportion every year. Thus, if in 2017 the highest percentage of overweight was observed among boys aged 8-12 years (23.73%), then in 2018-2019 this figure was highest among girls aged 8-11 years (22,72% and 20.00% respectively). In 2020, the highest percentage of overweight was found again in boys aged 8-12 years (26.56%). In 2017-2018, the prevalence of obesity was highest among girls aged 8-11 years (11.90% and 11.36%, respectively). In 2019-2020 the trend changed, as the percentage of boys aged 8-12 years with obesity was the highest (10.34% and 14.06% respectively). In the scientific literature, when assessing the prevalence of overweight and gender obesity, their predominance among boys is mostly described (Maydannyk, 2013; Ognev, Pomogajbo, 2016; Turlybekova et al., 2016), although in some cases exceptions are noted. (Maydannyk, 2013; Ognev, Pomogajbo, 2016).

Data from our previous studies on the prevalence of overweight and obesity in rural areas during 2019-2020 had a slightly different trend. Thus, among boys aged 8-12 years during 2019-2020, no changes in the studied indicators were observed, and the percentage of girls aged 8-11 years with overweight and obesity increased in 2020 compared to 2019. Among boys aged 13-16 years, there was an increase in the number of overweight and obese people. Among girls aged 12-15 years, a decrease in both indicators was recorded (Shmyhol and Dubenets, 2021).

The reasons for this increase in the prevalence of overweight and obesity among schoolchildren of all ages and both sexes may be the strict quarantine, which lasted from late March to June 2020, when all schoolchildren worked from home, sitting at a computer almost all day, because learning and doing homework turned into a remote format. Schoolchildren were not allowed to go outside, it was forbidden to attend various sports sections, dances, swimming pools, gyms, etc. Such quarantine conditions have led to even greater hypodynamics, and thus to a violation of the balance between energy supply and energy expenditure.

An analysis of the scientific literature indicates that the main cause of overweight and obesity is the energy imbalance between consumed and used calories (Mohammed et al., 2018; Pavlushun et al., 2013), which arises as a result of modern lifestyle. After all, humanity, introducing new technologies (computers, appliances, car-dependent mobility, etc.), deprives us of many types of physical labor, as a result of which we become sedentary, our physical activity is reduced (Poplawska et al., 2019; Kozak, Marushchak, 2013; Mohammed et al., 2018; Ognev, Pomogajbo, 2016). In addition, the factors of modern life that can cause overweight and obesity include malnutrition (Poplawska et al., 2019; Kozak, Marushchak, 2013; Ognev, Pomogajbo, 2016); eating disorders (Ognev, Pomogajbo, 2016); habitual chronic overeating (such as eating habits in the family, frequent snacks while watching TV, the desire to eat something «delicious» after negative emotions or stress, snacking before bed or at midnight) and uncontrolled consumption of soft drinks (Pavlushun et al., 2013) , fast food, sweets; constant psychological stress (Kozak, Marushchak, 2013); reduction of time for active recreation (walks in the fresh air, various moving games, sports) (Kozak, Marushchak, 2013; Pavlushun et al., 2013). The literature states that regular physical activity is important in the prevention and treatment of obesity (Poplawska et al., 2019; Gendeleka et al., 2012).

During the transformation of Ukraine's health care system to European standards, the promotion and formation of a healthy lifestyle and minimization the root causes of these diseases should be at the primary level of health care in the prevention and control of noncommunicable diseases (Ruden et al., 2017).

That is why it is important to unite the efforts of parents, teachers, doctors and society as a whole in promoting a healthy lifestyle among schoolchildren. It is also important to encourage overweight and obese children and adolescents to change their lifestyle.

There are reports in the literature that prevention programs in kindergarten and schools without involving parents failed to fight against the obesity epidemic. (Reinehr, Wabitsch, 2011). Despite the fact that most physicians are aware that overweight and obesity are pressing problems today, only a third of them routinely perform BMI tests during preventive examinations of children and adolescents (Dyachuk et al., 2017). In addition, health technologies should become a priority for general secondary education and ensure that schoolchildren develop healthy lifestyle skills (Schudro, 2014; Maltsev et al., 2011; Smaleye, Scherbina, 2015).

Conclusions

The problem of overweight and obesity is an urgent problem for humanity, due to the significant spread and steady increase in the number of overweight and obese people in the world, as well as the dangerous consequences they have on human health in the near and distant future.

According to the results of our study during 2017-2020, a higher prevalence of overweight and obesity was observed in boys aged 8-12 years and girls aged 8-11 years. Taking into consideration the gender aspect, it should be noted that in the prevalence of overweight and obesity during all years of the study there was a disproportion: in some years a higher percentage of overweight people was among boys (2017 and 2020), in others - among girls (2018-2019). If the prevalence of obesity in 2017-2018 a higher percentage was among girls, in 2019-2020, respectively, among boys.

It was found that the percentage of obese and overweight students during the study period was high, and it is worth noting that it increased significantly in 2020 compared to previous years.

Humanity needs to change radically their attitudes toward their health and therefore their way of life in order to reduce the prevalence of overweight and obesity. Such changes should primarily affect children from their birth, because all these processes start in childhood. That is why, it is important to rethink about the approaches of organizing the educational process of students at all levels of education, to develop practical recommendations for obesity prevention among children and youth and actively implement them by involving parents, teachers, doctors in developing healthy lifestyle skills at the state level. For this, it is necessary to introduce new approaches to the organization of the educational process by increasing the physical activity of students in school (minutes of physical education) and at home (morning gymnastics, moving games); to review the diet and nutrition of students by reducing the caloric content of food and ensuring the possibility of taking meals timely during the day in many countries. When conducting lessons and doing homework, especially with the use of distance learning technologies, it is necessary to comply with the requirements of state sanitary norms and rules of work with a personal computer and other office equipment (breaks every 45 minutes, etc.). Emphasis should be placed on the need to develop general recommendations for the prevention of obesity by involving experts in various fields and taking into account various aspects of life in society. It is also very important to implement them actively in everyday life, monitor their usefulness, and make timely changes, when it is necessary.

Conflicts of interest. The authors declare no conflict of interest.

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