

Anthropometric values, education and occupational situation of parents and the occurrence of overweight and obesity among junior high school students

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Abstract:

Introduction: Overweight and obesity is ever more affecting the youngest children. According to the International Obesity Task Force report, an increase of over 400,000 overweight children is being noted each year. The reason of such exacerbation varies in nature and is strongly correlated with parents' behavior towards their dependents' dietary requirements together with the neglect of encouragement towards physical activity.

Material and Methods: TANITA body composition analyzer has been used to study 200 teenagers in the age of 14 to 16 years old, pupils of one of the secondary schools in the Lower Silesian in Poland. The questionnaire was directed to parents and adolescents regarding physical activity, social and economic status and parents' anthropometric data. The adolescents were additionally subjected to height and body weight measurements.

Results: The results of the study show direct correlation of the higher education of parents (mainly mothers) on the increase of undertaking extracurricular physical activities by overweight or obese girls.

Conclusions: It has been concluded that there is a relationship between the BMI of the examined girls and the BMI of the father. Also, the study proves paramount impact of

mother's education and father's professional status on the physical activity of the examined youth.

Keyword: body composition, oversized body weight teens, BMI, social and living situation, parents' education, the anthropometric values of parents

Introduction

Overweight and obesity is one of the fastest growing diseases of civilization. An issue of the deviated most often increased weight affects people of all ages, ever so often affecting the youngest. Every year in Europe, a group of overweight and obese people is increased by another 400,000 children. The 2004 International Obesity Task Force (IOTF) reports that the issue of overweight in Europe affected 20% of children aged 5 to 17 years, obesity at 5% . Later study of 2014 showed an increase of the phenomenon affecting then every 3rd 11-year-old [1,2]. According to research carried out as part of the European Childhood Obesity Surveillance Initiative (COSI - European Monitoring Project for Child Obesity) as many as 30.7% of Polish 8-year-olds were qualified as overweight [3].

Concluding from the WHO or COIS reports, overweight and obesity is not only an aesthetic problem [3,4]. Too much body fat is conducive to the development of many diseases. It increases cardiovascular risk and lead to the development of such disease as hypertension, reduced bone mass and density, and lead to type II diabetes [5,6,7]. Overweight and obese people are more likely to have asthma and are more susceptible to colon cancer [8,9,10]. Depression is stronger in overweight, especially in women [10,11].

The main reasons for overweight and obesity are little physical activity and poor diet [12,13,14,15,16]. In order for physical activity to have an effective impact on weight control and reduction of body mass is its implementation into once lifestyle on the regular bases. According to WHO, a moderate physical activity of at least 7 times a week for 60 minutes is required to maintain healthy development of children. As it stands currently in schools, according to the guidelines of the Ministry of National Education, only 28-43% of the guidelines are implemented [17,18]. Within research carried out in the health resort "Szczawno-Jedlina" shows that regular physical activity among people with too high body mass is only 17% where among the group with normative body weight is 67% [19].

A multitude of problems associated with the proper selection of a balanced diet makes it difficult to indicate the main cause of the occurrence of excessive body weight. Research indicates, among others, increase in consumed portions, more frequent consumption of fast-foods, reduced consumption of fruit, vegetables and dairy products. Young people also more often eat sweet and savory snacks and drink much more sweet drinks [20].

The aim of the study was to determine the impact of anthropometric values, education and occupational situation of parents on the occurrence of overweight and obesity among adolescents aged 14-15 attending the Junior High School "Discoveries of the Polish Copper in Chocianów".

Material and Methods

200 students were tested from the Middle School Discoverers of Polska Miedź in Chocianów in the province of Lower Silesia, aged 14-15 (average-14.92±0.82 years). The body height of the students tested was on average 165.85±7.82 cm, and the average body weight was 57.36±12.43 kg. Among the respondents there were 100 girls and 100 boys. The subjects were divided into four groups depending on the BMI classification: group I - underweight (BMI ≤ 5th percentile), group II - normative body mass (5 < BMI < 85 centyl), group III - overweight (85 < BMI < 95centyl), group IV - obesity (BMI > 95 percentile). Anthropometric data of the subjects are presented in Table 1.

Table 1. Anthropometric data of children in relation to sex

Female (girls)	Altogether	Underweight	Normative body mass (NBM)	Overweight	Obesity
	n=100	n= 3	n=77	n=14	n=6
Age [mc]	183.3±9.6	181.0±8.2	183.5±9.3	181.64±11.3	186.7±12.1
Height [cm]	162.5±6.7	159.0±5.0	162.3±7.5	165.2±7.8	165.8±4.4
Height centile	54.0±28.3	33.3±15.3	52.8±28.2	65.9±30.5	60.5±30.6
Weight [kg]	53.9±12.5	36.2±5.4	50.6±7.8	65.8±7.3	83.7±13.9
Weight centile	54.8±28.5	3.0±1.7	48.4±23.2	88.1±9.7	97.3±3.9
BMI [kg/m ²]	20.4±3.9	14.3±1.3	19.2±1.9	24.1±1.0	30.4±4.4
BMI percentile	54.2±28.3	2.0±0.0	47.1±22.1	90.0±2.3	97.8±2.4
Male (boys)	n=100	n=6	n=68	n=14	n=12
Age [mc]	183.5±10.9	187.7±8.7	183.5±10.8	184.0±11.8	180.8±11.9
Height [cm]	169.5±8.9	163.7±10.1	169.9±9.1	166.8±7.1	171.1±5.8
Height centile	55.9±29.5	29.0±24.8	59.1±28.9	49.4±21.5	66.7±28.3
Weight [kg]	61.0±12.4	44.4±11.5	57.4±8.6	66.6±6.4	84.5±10.0
Weight centile	62.5±26.8	15.8±23.1	57.3±21.7	83.7±8.6	96.5±3.7
BMI [kg/m ²]	21.1±3.5	16.4±2.8	19.8±1.8	23.9±1.1	28.8±2.5
BMI percentile	61.6±26.8	15.17±28.8	53.9±20.7	88.7±2.7	97.9±2.2

In the study, the height and weight were determined and an original questionnaire was conducted among students and their parents regarding physical activity.

Body height measurement was performed using an anthropometer and body mass using the TANITA SC -240 body composition analyzer. The BMI center was determined using the BMI Calculator developed as part of the OLAF 2007-2010 program [21,22].

The original survey on physical activity was divided into three parts. The first part, addressed parents, considering anthropometric data of parents such as age, body mass and body height. In the second part, questions regarding the material and living situation in which the respondents were brought up were included. The third part was addressed to the youth, and the questions contained in it considered the level of their physical activity: the frequency, type and subjective assessment of it.

Among the respondents, it was observed that the amount of physical activity indicated by the WHO is realized by only 9% of respondents. Most often, teenagers exercise on average 4-5 times a week (15-42% of respondents depending on the group). Physically overweight girls

take the least amount of physical activity (37% - 3x a week), most often underweight boys 20% -7x a week. Regardless of sex and the occurrence of body mass abnormalities, the respondents most often undertake physical activity together with their peers (55%), approx. 15% individually.

Joint normal body weight of a Father, Mother and Teenager was found only in 8% of girls and 7.6% of boys, and overweight in less than 1% of girls and 3.3% of boys. Joint obesity of a father, mother and adolescent occurred in 1% of girls and 2.2% of boys. The incidence of body weight abnormalities in parents of adolescents examined is presented in Table 2.

Table 2. Percentage of parents with weight irregularities in the study group

	Girls		Boys	
	Mother [%]	Father [%]	Mother [%]	Father [%]
Underweight	3	0	3	0
Normative body mass (NBM)	60	32	57	23
Overweight	28	38	28	55
Obesity	9	30	12	22

The results were subjected to statistical analysis using the Statistica 13 package. Descriptive statistics were used to describe the groups - mean and standard deviation. For comparison of large groups (comparison between genders), parametric statistics for independent groups were applied (Student's T test). To determine the significance between groups with different BMI, nonparametric statistics for independent groups, among others Kruskal-Wallis test, were used. The relationship between anthropometric values of the examined teenagers and the medico-social data of parents was determined by Spearman's rank correlations. The level of statistical significance was $p < 0.05$.

Results

The research shows that the parents of girls and boys do not differ in terms of age and body structure. The only statistically significant difference was found in the case of boys' mothers' age- which was greater. The results are shown in Table 3.

Table 3. Anthropometric data of parents of examined children (mean ± SD)

		Girls (średnia ±SD)	Boys (średnia ±SD)
Father	Age [years]	44.1±5.6	45.7±6.7
	Weight [kg]	87.1±12.9	84.4±10.6
	Height [cm]	177.3±6.5	175.9±5.3
	BMI [kg/m ²]	27.5±5.0	26.9±4.5
Mohter	Age [years]	40.6±5.9*	42.9±6.0*
	Weight [kg]	65.1±11.9	66.7±12.4
	Height [cm]	163.2±6.3	163.3±6.1
	BMI [kg/m ²]	24.3±4.1	24.8±4.1

* - the result is statistically significant

Dominant level of parents education was vocational, which amounted to 48% of fathers and 34% of mothers, average respectively 18% and 23%, higher -8% and 14%, and basic - 6% and 10%. The level of parents' education was comparable in both sexes. Assessing the age, height, body mass, BMI and education of fathers of the examined girls, there were statistically significant differences only between the group of normative body weight and obesity in terms of father's body height ($p=0.0117$ - fathers in the group with normative body mass) and father's education ($p=0.0137$, lower education in the group with obesity). In the case of anthropometric and social assessment of mothers, statistical significance was found between underweight and obese mothers ($p=0.0427$, in the underweight group – the youngest), between groups with underweight and normative body mass in the case of education ($p=0.0198$, higher education in the underweight group) and between underweight and overweight groups in the case of a economical situation ($p=0.0371$ – in the underweight group, the least-paid full-time job). Based on the tests carried out, it was found that the parents of underweight boys are different from the normative body weight in terms of father's education ($p=0.0095$) and mother ($p=0.0432$ – the highest education of parents in the underweight boys), mother's BMI ($p=0.039$ – the lowest in the group underweight), while from overweight and obesity groups in terms of the father's professional situation ($p=0.0495$, $p=0.0486$ respectively, in the underweight group the most fathers declare the status of the unemployed).

A positive, low, but statistically significant correlation was observed between girls' BMI and body mass and BMI of fathers (the higher the BMI of girls, the higher the body weight and the higher BMI of the father). However, a negative correlation was observed in the case of a father's professional situation and the BMI of girls (the higher the BMI, the more often the father does not take up full-time employment). There were no significant correlations between the boys 'weight and height index and their parents' anthropometric and social data. Correlation results are presented in Table 4.

Table 4. Comparison of the correlation of girls and boys with their parents' anthropometric and social data.

		BMI classification Girls	BMI classification Boys
Father	Age [years]	0.007728	0.005537
	Weight [kg]	*0.276971	0.057493
	Height [cm]	-0.088097	-0.078294
	BMI [kg/m ²]	*0.345188	0.069461
	Education	0.045954	0.092530
	Professional situation	*-0.263585	0.046198
Mother	Age [years]	0.119614	0.047836
	Weight [kg]	0.186558	0.135919
	Height [cm]	0.148006	0.074453
	BMI [kg/m ²]	0.174411	0.137433
	Education	-0.051583	0.108086
	Professional situation	0.083356	-0.149980

* - correlation effect statistically significant

The results showed a significant relationship between the occurrence of overweight in the father and the impact on his son's physical extracurricular activity (-0.5734). The mother's low BMI influences the time spent on out-of-school physical activity of her sons (-0.3951). Mothers of overweight boys are more likely to play sports for the child according to his interest (0.5365). BMI of the mother is directly proportional to the assessment of physical activity of boys with normative body mass (0.3736). No statistically significant correlation was observed between the weight and height ratio and taking physical activity by the examined girls.

Examining the relationship between parents' educational background and job situation and after out-of-school activities, only correlations between the education of both parents and taking physical activity outside the school in the group of obese girls (M $p=0.8123$, F - $p=0.6451$) were observed, in this group the occupational situation of the mother significantly influences the extracurricular activities ($p=0.8018$). Mother's education also influences physical activity outside of school ($p=0.9143$) and a positive attitude towards physical education ($p=0.6251$) in the group of overweight girls with normative body weight. In the group of girls it was found that the lower their father's education girls spend more time on out-of-school activities ($p=0.5899$).

In the boys' group, only the correlation between the mother's professional situation and the attitude to physical education classes in the overweight group was observed ($p=0.5164$).

A correlation was also observed between mother's education and the weight of their children. Mothers with lower education more often encourage their daughters to engage in physical activity. This relationship can be seen in the group of overweight girls (-0.6944) and obesity (-0.6773). Their sons with normative body mass (-0.3508) are also more often motivated to engage in physical activity.

No connection was noticed between the time spent in front of the computer screen and TV screen and the body mass of the youth. There was also no relation between the occupational situation and the presence of accessories to perform physical activity (possession of bicycles, roller skates, team-playing balls). No results were obtained in regard to the parents' financial situation, therefore, this issue was not mentioned in the research. There were no correlations between the self-awareness of the child's own body weight, assessment of the physical activity and education, or BMI of parents.

Discussion

The problem of over-normative body weight is very complex. Many researchers are trying to determine the risk factors for overweight and obesity, seeking answers in both the biological realm - genetic determinants and social influences. Research and other authors indicate that there is a dependence of the parents' body structure and the body structure of their children [23, 24]. Perez-Pastor et al. show a stronger relationship between parents and offsprings of the same sex (father - son, mother - daughter) [25]. However, it has not been confirmed in the conducted studies. Among the examined youth, less than half of the girls were qualified to the same group of body mass abnormalities as her mother, while in the boys' group, father - son, dependence appeared in every third teenager. Researchers suggest that the relationship between the excessive body mass of parents and offspring does not seem to have a genetic basis. Similar conclusions can be drawn on the basis of the tests carried out, in which only 8% of the respondents in each sex were qualified to normative body weight as well as parents, where in the case of overweight children percentage in girls did not exceed 1% and in boys 3.5%. The results of our work showed a relationship between the parent's BMI and the BMI of the opposite sex. Almost 40% of girls had a similar BMI to the father, while the mother - boy - related to 46% of the respondents. The excessive weight of the father's body is linked to the overstated weight of the daughter's body. The difference between the results of Perez-Pastor and those described may result from the age of the studied offspring - the Perez-Pastor syndrome covered the family of children aged 5-8, while this research included 14-15-year-old adolescents. The results would confirm the lack of genetic background as indicated by Perez-Pastor et al. At the same time, it draws attention to the possibility of occurrence of dependence between the occurrence of overweight and the lifestyle of the subjects [25].

The dynamic development of overweight and obesity among young people is a significant problem in our society. The 2004 International Obesity Task Force report shows a sharp increase in the number of overweight and obese children in Poland over the last 20 years compared to children from other European countries, such as the Czech Republic, France or Germany. The confirmation of this dynamics are further researched by the WHO in 2014 and 2017 and by the Mother and Child Institute (COIS) in 2017 [1,2,3]. In 1995, the percentage of children with excessive body mass was around 8% and currently exceeds 20% and depends largely on the place of residence of the examined children [26, 27, 28]. According to the research carried out as part of the OLAF - OLA 2007-2010 project and local authorities researches, the percentage of children and adolescents with over-normative body weight is smaller compared to rural centers. At the same time, the studies highlighted the difference in access to organized non-school physical activity [21,26]. Among the surveyed youth, everyone lives in one municipality relatively rich in sports infrastructure, thanks to large production plants investments in the development of the region. Despite equal opportunities, young people use sports infrastructure differently. One of the many reasons for the increasing number of the obese children is the environment in which they live. Hence, this paper examines the influence of some factors from the immediate environment of the child, which may influence the occurrence of overweight. According to the conducted research, the parents' education has a quite significant impact on undertaking extracurricular physical

activity, especially in the group of girls with obesity and the mother's failure to take up paid work. The lack of significant influence of parents on taking out extracurricular physical activity by teenagers may result from the age of the respondents. The vast majority of them take physical activity with their peers, only less than 10% actively spend time with their parents. Parents' education may be related to the possibility and necessity of undertaking paid work. As observed in the conducted research, the more often the mother did not undertake paid work (was unemployed, worked less than part-time jobs, worked zero hours contracts), more often the overweight son and daughter with obesity undertook extracurricular physical activity.

The results of our research indicate a significant impact of parents' education on the physical activity of their children. This is particularly evident among girls who are overweight and obese, whose parents with higher education more often send their daughters to additional physical activities. This may indicate that these parents are more aware of the abnormal weight of their child and more often send them to classes with additional physical activities. Studies Witany and Szpak also indicated a significant impact of education on the physical activity of their children. Young people who had parents with higher education more often practiced and better assessed their physical activity compared to adolescents of parents with basic education [25, 29].

Our research shows that mothers with higher education are less likely to encourage their children with overweight and obesity to physical activity. This may be due to the fact that the children of these parents have a better attitude towards physical education classes, which does not have to be encouraged. At the same time, it can be assumed that parents with higher education are more aware of the need to implement physical activity at a younger age. A larger percentage of mothers with the lowest education encouraging overweight and overweight daughters to elevated physical activity indicates a rather late response of parents to the nutritional problems of the child.

Obtained results concerning the occupational and material situation of parents and physical activity of their children are difficult to interpret due to parents' avoidance of answers (especially by unemployed people) to questions related to their income.

In order to obtain further data on the impact of the parents' professional situation on the physical activity and the weight of their children, it is worth adding questions to the questionnaire regarding the time parents have at their disposal with the children.

Despite the wide knowledge about the causes of overweight and obesity, the number of people with this ailment is constantly increasing, ever so more often affecting the youngest children. Therefore, it is worth considering the introduction of local prevention programs aimed at increasing awareness of the problem and emphasizing its importance. Programs should be targeted both in terms of promoting physical activity as well as a balanced and healthy diet. As it results from the conducted research, especially in the field of mobilizing the child to undertake physical activity, these programs should include not only young people, but also the child of early school age together with their parents. Evidence of the importance of such health prevention programs are evident in emerging public initiative programs directed to parents and children regarding the principles of proper nutrition.

Conclusions

1. The occurrence of overweight and obesity in the studied group of girls is approximate to the average level for the population of Polish youth (20%) and in boys elevated (26%)
2. In adolescent age, teenagers are more likely to take extracurricular physical activity with peers in disorganized form than indicated by parents.
3. In the study group, there was a relationship between the BMI of the examined girls and the BMI of the father.

4. The mother's and her father's professional background have the greatest impact on the physical activity of the examined youth.

References:

1. International Obesity Task Force (IOTF). Childhood Report IOSO Newsletter. 2004; 6.
2. World Health Organization (WHO). Report: Obesity and inequalities. Practical aspects of counteracting inequities related to overweight and obesity. WHO. 2014.
3. Dzielska A, Jodkowska M, Mazur J, Radiukiewicz K, Stalmach M, Zawadzka D. Overweight and obesity in Polish 8-year-olds in the light of biological, behavioral and social conditions: Report on international research WHO Childhood Obesity Surveillance Initiative (COSI). Fijałkowska A, Oblacińska A, Stalmach M (edd). Instytut Matki i Dziecka, Warszawa 2017.
4. Uzogara SG. Obesity Epidemic, Medical and Quality of Life Consequences: A Review. *International Journal of Public Health Research*. 2017;5(1):1-12.
5. Cameron AJ, Zimmet PZ, Dunstan DW, Dalton M, Shaw JE, Welborn TA, Owen N, Salmon J, Jolley D. Overweight and obesity in Australia: the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Med J Aust* 2003;178(9):427-432. doi: 10.5694/j.1326-5377.2003.tb05283.x
6. Henrykowska G, Nykiel P, Buczyński J, Dziedziczak-Buczyńska M, Buczyński A. Influence of overweight and obesity on incidence of hypertension in 1st-3rd-form students in primary schools. *Hygeia Public Health*. 2014;49(4):833-837.
7. Kim HY, Jung HW, Hong H, Kim JH, Shin CH, Yang SW, Lee YA. The Role of Overweight and Obesity on Bone Health in Korean Adolescents with a Focus on Lean and Fat Mass. *J Korean Med Sci*. 2017;32(10):1633-1641. doi: 10.3346/jkms.2017.32.10.1633.
8. Bryl W, Hoffmann K, Miczke A, Pupek-Musialik D. Obesity of children and adolescents – epidemiology, consequences and prevention. *Guide for GPs*. 2006;9(9):91-95.
9. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: a meta-analysis of prospective epidemiologic studies. *Am J Respir Crit Care Med*. 2007;175(7):661-666.
10. Przybylska D, Kurowska M, Przybylski P. Obesity and overweight in the adolescent population.. *Hygeia Public Health*. 2012;47(1):28-35.
11. Needham BL, Crosnoe R. Overweight status and depressive symptoms during adolescence. *J Adolesc Health*. 2005;36(1):48-55.
12. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc*. 2000;32(5):963-975.
13. Ussher MH, Owen CG, Cook DG, Whincup PH. The relationship between physical activity, sedentary behaviour and psychological wellbeing among adolescents. *Soc Psychiatry Psychiatr Epidemiol*. 2007;42(10):851-856.
14. Jędrzejewski G, Rutkowski T, Angelus K, Sobiech KA, Chwałczyńska A. Physical fitness of boys in early school age in the prevention of overweight and obesity [in:] Bogusz M., Wojcieszak M., Rachwał P (eds): *Poszerzamy horyzonty*. [in Polish] Monografia , Słupsk : Mateusz Weiland Network Solutions, 2017; 6: 99-109
15. Olszewska A, Jackowiak A, Chwałczyńska A, Sobiech KA. Physical activity as the main factor affecting body composition of the visually impaired. *Physiotherapy Quarterly*. 2018;25(1):23-28. doi:10.1515/physio-2017-0002.
16. Rutkowski T, Jędrzejewski G, Angelus K, Sobiech KA, Chwałczyńska A. Physical fitness and body composition of girls in early school age [in:] Bogusz M., Wojcieszak M., Rachwał P (eds): *Poszerzamy horyzonty*. [in Polish] Monografia , Słupsk : Mateusz Weiland Network Solutions, 2017; 6: 110-119

17. Global Recommendations on Physical Activity for Health. Geneva: World Health Organization; 2010.
18. Rozporządzenie Ministra Edukacji Narodowej z dnia 28 marca 2017 r. w sprawie ramowych planów nauczania dla publicznych szkół. Dz.U. 2017 poz. 703.
19. Chwałczyńska A, Foryś K. Styl życia a zaburzenia odżywiania dzieci i młodzieży uczestniczących w turnusie rehabilitacyjnym w „Uzdrowisku Szczawno-Jedlina” SA. EOIZPM. 2012;8(3):73-79.
20. Szanecka E, Małecka-Tendera E. Changing nutritional patterns and children's obesity. EOIZPM 2006;2(3):102-107.
21. Kułaga Z., Litwin M., Tkaczyk M., Palczewska I., Zajączkowska M., Zwolińska D, Krynicki T, Wasilewska A, Moczulska A, Morawic – Knysk A, Barwicka K, Gajda A, Gurzkowska B, Napieralska E, Pan H. Polish 2010 growth references for school-aged children and adolescents. Eur J Pediatr, 2011; 170 (5): 599 – 609; doi: [10.1007/s00431-010-1329-x](https://doi.org/10.1007/s00431-010-1329-x)
22. Różdżyńska-Świątkowska A, Kułaga Z, Grajda A, Gurzkowska B, Gózdź M, Wojtyło M, Świąder A, Litwin M oraz grupa badaczy OLAF i OLA. Height, weight and body mass index references for growth and nutritional status assessment in children and adolescents 3-18 year of age. [in Polish] Standardy Med Ped, 2013, 1: 11-21.
23. Lazzeri G, Pammolli A, Pilato V, Giacchi MV. Relationship between 8/9-yr-old school children BMI, parents' BMI and educational level: a cross sectional survey. Nutr J. 2011;10:76. doi: 10.1186/1475-2891-10-76.
24. Lamerz A, Kuepper-Nybelen J, Wehle C, Bruning N, Trost-Brinkhues G, Brenner H, Hebebrand J, Herpertz-Dahlmann B. Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany. Int J Obes (Lond). 2005;29(4):373-380.
25. Perez-Pastor EM, Metcalf BS, Hosking J, Jeffery AN, Voss LD, Wilkin TJ. Assortative weight gain in mother-daughter and father-son pairs: an emerging source of childhood obesity. Longitudinal study of trios (EarlyBird 43). Int J Obes (Lond). 2009;33(7):727-735. doi: 10.1038/ijo.2009.76.
26. Chwałczyńska A, Rutkowski T, Jędrzejewski G, Wójtowicz D, Sobiech KA. The comparison of the body composition of children at the early school age from urban and rural area in southwestern Poland., BioMed Res Int, 2018; Article ID 9694615; 9 s.; DOI: 10.1155/2018/969461
27. Mazur J, Woynarowska B, Małkowska-Szcutnik A, Kołoto H, Tabak I, Kowalewska A, Dzielska A. HBSC 2010 research results. Technical report. Mazur J, Małkowska-Szcutnik A (red). Instytut Matki i Dziecka, Warszawa 2011.
28. Mazur J (edd) Health and health behaviour of school children in Poland in the light of sociodemographic determinants, HBSC 2014 research results, Instytut Matki i Dziecka, Warszawa 2015.
29. Witana K, Szpak A. Socio-economic determinants of physical activity of the Białystok high school students. Probl Hig Epidemiol. 2009;90(1):42-46.