Nutrición Hospitalaria

Nutr Hosp. 2015;32(6):2559-2569
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original/*Obesidad*

Influence of socio-economic and demographic factors, feeding and physical activity on nutritional status of 8-15-year-old Bulgarian children and adolescents: preliminary results

Silviya Mladenova[1] and Emiliya Andreenko[2]

[1]Department of Natural-Mathematical and Economical Sciences, Plovdiv University "Paisii Hilendarski", Smolyan. [2]Department of Human Anatomy and Physiology, Faculty of Biology, Plovdiv University "Paisii Hilendarski" Plovdiv, Bulgaria.

Abstract

Objective: **to study of impact of some socio-economic and demographic factors, feeding and physical activity on the prevalence of overweight, obesity and underweight among Bulgarian children and adolescents.**

Material and methods: **the sample of this research included 881 children and adolescents from both sexes, aged from 8 to 15 years, that were measured transversally in the period 2012- 2014 in eight government school in Smolyan region, Bulgaria. Of each child the height and weight were measured and body mass index (BMI) were calculated. The evaluation of nutritional status was made using the IOTF cut-off points of BMI for children and adolescents. By the questionnaire the information about educational level of parents, number of children in the family, place of residence, nutrition and feeding habits and physical activity of children and adolescents were collected. The data were analyzed by software Statistica 10.0.**

Results: **there is a significant positive relation between the factor "overeating" and the BMI values for both sexes and a negative relation between the factor "meals frequency" and BMI for boys ($p<0.05$). The significantly higher values of BMI are observed among overeating children in comparison to their peers, who are eating normal or smaller food quantities ($p<0.05$).The obesity is occur significantly most frequency among children, who eat one-two time per day, compared to those who are having three and more meals per day ($p<0.05$).**

Conclusion: **the preliminary results of our research show that the main determinants of the overweight, obesity and underweight among the studied Bulgarian children and adolescents, are the factors, related to feeding and eating behavior, and in particular "the overeating" for both sexes and the"dally meal frequency" for boys.**

Correspondence: Silviya Mladenova, PhD
Plovdiv University "Paisii Hilendarski"- Branch Smolyan
32 Dicho Petrov Str.
4700 Smolyan, Bulgaria.
E-mail: silvia_mladenova@mail.bg

Recibido: 10-IX-2015.
Aceptado: 11-X-2015.

INFLUENCIA DE LOS FACTORES SOCIO-ECONÓMICOS Y DEMOGRÁFICOS, LA ALIMENTACIÓN Y LA ACTIVIDAD FÍSICA EN LA PREVALENCIA DEL SOBREPESO, LA OBESIDAD Y LA INSUFICIENCIA PONDERAL ENTRE LOS 8 A 15 AÑOS DE EDAD, LOS NIÑOS Y ADOLESCENTES BÚLGAROS: RESULTADOS PRELIMINARES

Resumen

Objetivo: **estudiar el papel de algunos factores socioeconómicos y demográficos, la alimentación y la actividad física en la prevalencia del sobrepeso, la obesidad y la insuficiencia ponderal entre los niños y adolescentes búlgaros.**

Material y métodos: **en la muestra de esta investigación se incluyeron 881 niños y adolescentes de ambos sexos, con edades comprendidas entre 8 y 15 años, que se midieron de forma transversal en el período 2012 - 2014 en las ocho escuelas del gobierno en la región de Smolyan, Bulgaria. De cada niño se midieron la altura y el peso, y se calculó el índice de masa corporal (IMC). La evaluación del estado nutricional se realizó utilizando los puntos de corte del IMC internacional para niños y adolescentes. Mediante el cuestionario se recogió información sobre el nivel educativo de los padres, el número de hijos en la familia, lugar de residencia, nutrición y hábitos de alimentación y actividad física de los niños y adolescentes. Los datos fueron analizados por el software Statistica 10.0.**

Resultados: **existe una relación positiva significativa entre el factor "comer en exceso" y los valores de IMC para ambos sexos, y una relación negativa entre el factor de "frecuencia de comidas" y el IMC para los varones ($p<0,05$). Los valores significativamente más altos de IMC se observan entre los niños que comen en exceso en comparación con sus pares, que comen cantidades normales o pequeñas de alimentos ($p<0,05$). La obesidad es significativamente más frecuente entre los niños, que comen una o dos veces al día, en comparación con aquellos que tienen tres o más comidas al día ($p<0,05$).**

Conclusión: **los resultados preliminares de nuestra investigación muestran que los principales determinantes del sobrepeso, la obesidad y la insuficiencia ponderal entre los niños y adolescentes búlgaros estudiados son los factores relacionados con la alimentación y la conducta alimentaria, en particular "el comer en exceso" para ambos sexos y la "frecuencia de las comidas" para los niños.**

The lack of distinctive influence of the factors like level of education of the parents, place of residence - city or village, daily eating regimen and physical activity over BMI and nutritional status of investigated Bulgarian children and adolescents.

(*Nutr Hosp*. 2015;32:2559-2569)

DOI:10.3305/nh.2015.32.6.9883

Key words: *Socio-economic and demographic factors. Diet. Physical activity. BMI. Overweight. Obesity. Bulgarian children and adolescents.*

Falta la influencia distintiva de factores como el nivel de educación de los padres; el lugar de residencia, ciudad o pueblo; el régimen de alimentación diaria y la actividad física sobre el IMC y el estado nutricional de los niños y adolescentes búlgaros investigados.

(*Nutr Hosp*. 2015;32:2559-2569)

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Palabras clave: *Factores socioeconómicos y demográficos. Dieta. Actividad física. Sobrepeso. Obesidad. Niños y adolescentes búlgaros.*

Abbreviations

WHO: World Health Organization.
IOTF: International Obesity Task Force .
NS: Nutritional status.
BMI: Body mass index.

Introduction

Obesity is a problem with global significance and it affects both adults and children in developed and developing countries as well.The obesity epidemic is gaining alarming size[1-6].

According to data, presented by World Health Organization, Bulgaria is one of the top place among the Europe countries listed by prevalence of overweight and obesity in both- adults and children[7]. This problem is increasing the risk for the child health because it is related to many and serious cardiac, metabolic and other issues in adulthood[8-9].

The obesity is a problem with multifactor etiology. It is related to the influence of various genetic, socio-economic, demographic, cultural, religious, ethnical, territorial and other factors, with differences in physical activity, nutrition, as well as with differences in the life-style and quality of life of the people[6, 9-22].

But the socio-economic, demographic and various other factors, do not directly affect the development of obesity. They are indirect modifiers which, to various extends, are related to the direct action of factors, like eating, health status etc. Additional role in this complex of factors is played by the psycho-emotional factors and physical activities[13].

For this reason the question about the assessment of the impact of various endogenous and exogenous factor over the nutritional status of the adolescents has important scientific and practical role in the understanding of the possible impact of predictor factors over the health status of the children and adolescents.

For this reason, the present research has significant importance for good understanding on eason for prevalence of deviations of normal weight among Bulgarian children and adolescents. Its purpose is to study the role of some socio-economic and demographic factors, feeding and physical activity on the prevalence of overweight, obesity and underweight among Bulgarian adolescents in one of the most critical periods of their growing and development and in a period of continuous political and economic changes.

Material and methods

Sample

The subjects of this study are 881 adolescents, aged from 8 to 15 years, of which 441 boys and 444 girls. The study is transversal and was carried out in the period 2012- 2014 at eight public schools in Smolyan region, Bulgaria.

Ethics

The study was made with the official approval of Regional Inspectorate of Education, Bulgaria's Ministry of Education and Science and of Ethical Committee on Plovdiv University-Branch Smolyan. Also the wrriten informed consent of the parents or guardians of each child included in the research group was obtained, in accordance with the ethical principles for medical research involving human subjects in the Helsinki Declaration of World Medical Association[24].

Study Design and Methods

The anthropometric data of height and weight were measured using the Martin-Saller method[25], by means of original anthropometric instruments (GPM Anthropologishe Instrumente). The height was is measured with original anthropometer "GPM", with an accuracy of 1 mm, and the weight with the help of an electronic balance "Tanita BC 453" with a precision of 0.05 kg. On the basis of the weight and height the body mass index (BMI) was calculated by the formula: Weight(kg)/Height(m^2).

The distribution of the examined children into categories of nutritional status assessed through the BMI (underweight, normal weight, overweight and obesity) was made using the recommendations of the Inter-

national Obesity Task Force (IOTF) for BMI cut-off points of children and adolescents developed by Cole et al.[26-27].

By the questionnaire to parents and children the information about social-economical status (SES), place of residence, nutrition and feeding habits and physical activity of adolescents were collected. Among different factors, mother's and father's level of education, number of children in the family, place of residence – urban or rural, daily meal frequency, daily eating regimen for time, overeating (quantity of consumed food) and physical activity were analysed.

In accordance with the education level of mother and father, two groups of adolescents have been differentiated: secondary/primary education (eight to twelve years of schooling) and higher (university) education (sixteen-seventeen years of schooling). The children whose parents have "primary education" and "secondary education" into one group have been collected: "secondary/primary education", because of the parent's with primary education were a small number. As to the factor "number of children in the family" two groups have been formed: one child and two and more children in the family. In accordance with the demographic factor "place of residence" two groups have been formed –urban place (town) and rural place (village). As regards to the nutrition and feeding habits the three factors were analysed as well: -in accordance with the factor "daily frequency of meal" groups of adolescents were classified: one or two meals, three meals and four and more meals of the day; as to the factor "daily eating regime for time" the two groups were formed - regular regime and irregular/without regimen; as regards to the factor "overfeeding" two groups of adolescents were formed- non overfeeding and overfeeding. In accordance with the factor "physical activity/sports", the adolescents were classified into two groups: physical active/sporting (two and more time per week), inactive/sedentary (from time to time or never sporting).

Statistics

The collected data were analysed by statistical software packages STATISTICA 10.0. Mean and standard deviation for each of the anthropometric measurements were calculated.

The frequency distribution and crosstabulation of children into BMI categories and factor's level were made. The statistical processing of the data included also standartization (Z-score) of the individual data for each age- and sex group of BMI.

The relationship between predictors (factor's level) and BMI (dependent variable) was evaluated by the linear regression analyze. The significance differences between groups, formed by different level of factors were evaluated through Tukey- HSD test (for unequal or equal N) by ANOVA, on significance level (p) ≤ 0.05. The Chi-square test (χ^2) was used to determine the differences in percentage distribution of adolescents with different nutritional status in accordance with different level of factors, on significance level (p) ≤ 0.05.

Results

Table I present the average standardized values (Z-score) of the body mass index (BMI) of the studied boys, according to the levels of the studied factors. As it can be seen in the table, the standard average values of the body mass index (BMI) are above the average values for the gender and age for boys, whose mother's and father's have university education (0.101±1.51 for the sons of mothers with university education, 0.262 ± 1.97 for the sons of fathers with university education). The results are parallel for the BMI values with only one son's (0.112 ± 1.68). Also, the city boys have higher average values of the BMI just above the average values for their gender and age (0.094 ± 1.55), contrary to their peers living in villages. But the difference between the group of boys, formed based on the level of factors, like parents' level of education, number of children per family and place of residence are not significant do not have statistical value ($p > 0.05$).

Regarding the BMI values for the group of boys, formed by various factors, related to nutrition, the results show that the BMI values are above the average values for sex and age for boys who eat one-two times per day (0.251±1.59), compared to those who eat three or more times per day, bt the differences between the group are insignificant ($p > 0.05$).

The boys that are systematically overfeeding, i.e. are taking larger food quantities, are having significantly higher BMI values, as of the standard average BMI values for sex and age (0.575 ±1.12), compared to boys that are not overfeeding and take normal food quantities (-0.183±1.57). The differences have statistical significance ($p < 0.05$).

In relation to the factor physical activities, the values of BMI in active and sporting boys are very similar or equal to values of boys, whose are not practicing any sports and have sendentary lifestyle ($p>0.05$).

The standard average values of the BMI are above the average values for age for girls (Table II), whose mothers and father's are with secondary/primary education, but are below average for daughters, whose fathers have university education ($p>0.05$). BMI for single daughters are with values above the average (0.124±1.68) for age, compared to values for girls, coming from families with two or more children, which are above the average ($p>0.05$).

The girls living in villages are distinguished from their city peers with lower standard BMI values (-0.243±0.72).

The BMI values for sex and age for the group of girls, formed based on the factor "daily meal frequen-

Table I
Mean values of BMI (Z- score) in 8-15-year-old boys according to different level of factors

Factor's level	*N*	*BMI (Z-score±SD)*	*p-level*
Socio-economical factors			
Mother's level education			
Secondary/primary education	175	0.055±1.46	
University education	143	0.101±1.51	0.77
Father's level education			
Secondary/primary education	235	0.032±1.30	
University education	74	0.262±1.97	0.35
Number of children in family			
One child	105	0.112±1.68	
Two and more children	204	0.061±1.38	0.80
Demographic factors			
Place of residence			
Urban (Town)	278	0.094±1.55	
Rural (Village	29	-0.121±0.80	0.44
Diet factors			
Daily meal frequency			
One-two meals	137	0.251±1.59	
Three meals	142	-0.093±1.48	0.14
Four and more meals	33	0.013±0.81	
Daily eating time regime			
Regular regime	106	0.125±1.58	
Without regime	209	0.002±1.41	0.60
Quantity of consumed food			
Non overeating	211	-0.183±1.57	
Overeating	105	0.575±1.12	0.000*
Physical activity			
Active /Sporting	159	0.077±1.84	
Inactive /Sedentary	152	0.082±1.00	0.97

Note: N-number. BMI- body mass index. Z-score-standardized values of BMI for each sex and age.
Mean- average value. SD-standard deviation. p- level of significance *p < 0.05; **p < 0.001

cy" are very similar (p>0.05). But the girls, as well as the boys with significantly higher than average BMI values (p<0.05) are only those, who are frequently or systematically overeating (0.333±0.99), compared to their peers, who are taking normal food quantities and are not overeating (-0.234±0.86).

The differences in BMI values bewteen physical active and inactive and no sporting girls were not shown.

Tables III and IV present the percentage distribution of the groups of boys and girls, formed on the base of studied factors, per categories, according to their nutritional status.

The results for the boys (Table III) shows that the overweight is most common among sons of mother's and fother's with secondary/ primary e ducation, and more rarely among those boys whose both parents have higher education. The obesity is most commonly seen among the sons of father's with higher education, compared to boys, whose father's are with lower level of education. On the other side the undreweight is observed more often in the sons of mother's with secondary or primary education (p > 0.05).

The overweight is most commonly seen among single sons, while obesity has equal distribution among

Table II
Mean values of BMI (Z- score) in 8-15-year-old girls according to different level of factors

Factor's level	*N*	*BMI (Z-score±SD)*	*ANOVA p-level*
Socio-economical factors			
Mother's level education			
Secondary/primary education	208	-0.007±0.97	
University education	143	-0.061±0.93	0.54
Father's level education			
Secondary/primary education	262	0.012±1.00	
University education	81	-0.138±0.83	0.32
Number of children in family			
One child	113	0.124±1.11	
Two and more children	234	-0.101±0.86	0.07
Demographic factors			
Place of residence			
Urban (Town)	308	-0.015±0.96	
Rural (Village	32	-0.243±0.72	0.19
Diet factors			
Daily meal frequency			
One-two meals	147	-0.077±0.95	
Three meals	154	0.028±0.96	0.62
Four and more meals	50	0.000±0.93	
Daily eating time regime			
Regular regime	107	-0.101±0.91	
Without regime	224	0.019±0.97	0.35
Quantity of consumed food			
Non overeating	220	-0.234±0.86	
Overeating	134	0.333±0.99	0.000**
Physical activity			
Active /Sporting	161	-0051±0.87	
Inactive /Sedentary	189	0.003±1.02	0.64

Note: N-number. BMI- body mass index. Z-score-standardized values of BMI for each sex and age.
Mean- average value. SD-standard deviation. p- level of significance *$p < 0.05$; **$p < 0.001$

single sons and those who are coming from families with two and more children ($p > 0.05$).

The overweight is more often occur among boys living in villages, while obesity is more frequently present among the city boys. Also, boys with underweight more frequent to be seen in the cities, rather than in the villages ($p > 0.05$).

According to the nutritional fa ctor daily meal frequency, the results showed that most commonly the overweight (25.55%) and obesity (8.76%) are observed among boys who are feeding only once-twice-a-day, i.e. not quite regularly, while the underweight is most rarely observed among boys who have four and more frequently meals per day. With this factor, the difference of frequency of presence of underweight, overweight and obesity among groups of boys, formed based on the daily meal frequency, have statistical significance ($p < 0.05$).

Also, the obesity and underweight is insignificantly more frequently seen with boys, who haven't daily feeding regimen, and the overweight is seen more commonly with those who are following regular regimen, based on time ($p > 0.05$).

Table III

Prevalence (%) of 8-15-year- old boys from different categories nutritional status according to level of factors

Factor's level	*N*	*Under-weight (%)*	*Normal weight (%)*	*Overweight (%)*	*Obese (%)*	*Chi-square*	*p-value*
Socio-economical factors							
Mother's level education							
Secondary/primary education	174	9.77	63.22	19.54	7.47	0.75	0.86
University education	143	7.69	67.13	17.48	7.69		
Father's level education							
Secondary/primary education	234	7.69	65.81	20.09	6.41	1.18	0.75
University education	73	8.22	65.75	16.44	9.59		
Number of children in family							
One child	104	8.65	63.46	20.19	7.69		
Two and more children	203	9.36	65.02	18.72	6.90	0.20	0.97
Demographic factors							
Place of residence							
Urban (Town)	278	8.99	64.03	18.71	8.27	2.87	0.41
Rural (Village)	29	6.90	72.41	20.69	0.00		
Diet factors							
Daily meal frequency							
One-two meals	137	9.49	56.20	25.55	8.76		
Three meals	142	9.86	71.83	11.97	6.34	12.73	0.04*
Four and more meals	33	3.03	72.73	21.21	3.03		
Daily eating time regime							
Regular regime	105	6.67	68.57	20.00	4.76		
Without regime	208	10.10	63.84	18.27	7.69	2.12	0.54
Quantity of consumed food							
Non overeating	211	11.48	77.51	8.61	2.39		
Overeating	105	3.77	40.57	38.68	16.98	73.89	0.00**
Physical activity							
Active /Sporting	157	10.83	65.61	16.56	7.01		
Inactive /Sedentary	152	6.58	63.82	20.71	7.89	2.78	0.42

Note: p- level of significance *$p < 0.05$; **$p < 0.001$

However, overweight and obesity are significantly more commonly present with boys who are regularly overeating, compared to those who are taking normal food quantities and do not overeat. Among them, the underweight is more commonly seen. The difference in the percentage ratio among groups of boys with different nutritional status, formed according to that factor have statistical significance ($p < 0.05$).

Most commonly, the overweight is present within the group of the boys who are inactive and no practicing sport, compared to the group of boys who are active and regularly sporting, where the underweight is more frequently seen ($p > 0.05$).

The results, showing the percentage distribution of girls with different nutritional status (Table IV), according to the different factor's level are relatively similar to those for the boys but some different tendencies are also observed.

With the increase of the level of education of the parent's , the percentage of girls with obesity and underweight drops down, while obesity is most commonly seen among daughters of mother's with secondary education and of father's with higher education. But tnis differences is insignifficance ($p > 0.05$).

The overweight and obesity are most commonly present among single daughters, compared to girls,

Table IV
Prevalence (%) of 8-15-year-old girls from different categories nutritional status according to level of factors

Factor's level	*N*	*Under weight (%)*	*Normal weight (%)*	*Overweight (%)*	*Obese (%)*	*Chi-square*	*p-value*
Socio-economical factors							
Mother's level education							
Secondary/primary education	248	12.50	65.87	17.31	4.33	2.36	0.50
University education	142	9.15	73.24	14.79	2.82		
Father's level education							
Secondary/primary education	262	12.98	66.41	16.03	4.58	3.96	0.26
University education	80	7.50	72.50	18.75	1.25		
Number of children in family							
One child	113	12.39	60.18	20.35	7.08		
Two and more children	233	10.73	73.39	13.73	2.15	9.13	0.02*
Demographic factors							
Place of residence							
Urban (Town)	308	11.04	68.83	16.56	3.57		
Rural (Village)	32	15.63	71.88	12.50	0.00	2.00	0.57
Diet factors							
Daily meal frequency							
One-two meals	147	10.88	72.11	13.61	3.40		
Three meals	154	11.69	64.94	19.48	3.90	2.33	0.88
Four and more meals	50	10.00	70.00	16.00	4.00		
Daily eating time regime							
Regular regime	107	11.21	71.03	14.95	2.80		
Without regime	244	11.07	67.62	17.21	4.10	0.69	0.87
Quantity of consumed food							
Non overeating	220	14.55	72.27	11.36	1.82		
Overeating	134	5.22	63.43	24.63	6.72	21.89	0.00**
Physical activity							
Active /Sporting	160	10.00	71.25	16.88	1.88		
Inactive /Sedentary	107	12.71	67.20	15.34	5.29	3.41	0.33

Note:p- level of significance *p < 0.05; **p < 0.001

coming from families with two and more children, and the underweight is observed most rarely among girls coming from large families.This differences on percentage distribution between girls are significant ($p < 0.05$).

For the girls, as well as for the boys, the overweight, with its two categories, is most commonly present among adolescents living in the cities, compared to those, living in the villages. Among girls from villages no occur obesity, but often occur underweight ($p > 0.05$).

The overweight is present most rarely among girls who are eating once-twice times per day and the underweight among those who are eating more than three times per day. But the obesity is with almost even distribution among girls from the three groups and is within the range of 3.40% - 4.00 %. Also, the overweight and obesity are most commonly present with girls who are not following any daily feeding regimen, based on time.

Overeating i.e. the quantity of taken food with the girls, as with the boys, is a factor who is playing significant role for their nutritional status. The overweight and obesity are significant most commonly present with overeating girls and the underweight among girls who are not overeating. The percentage difference

between the groups of girls with different nutritional status are statistically significant (p<0.05).

Physical activity and sports also influenced the nutritional status and respectively, the body structure of the young girls. The overweight is seen in equal percent among girls who are not active and those practicing any sport, while the obesity often occur among girls whose no practicing sports (p < 0.05).

Table V presents the results of the linear regression analysis of the research of the impact of the complex of socio-economic factors, demographic factors, feeding and physical activity over the Body Mass Index (BMI), respectively, over the nutritional status of the studied children and adolescents.

The preliminary results of the research show that the factor „overeating" is having the strongest and most significant impact over the values of body mass index (Table V). It is followed by the „daily meal frequency", but this factor has significant impact mainly on the male representatives.

The level of parents' education, number of children in the family, place of residence, daily feeding regimen, based on time and physical activity do not have significant influence over the nutritional status of the modern generation children and adolescents in the researched region in Bulgaria.

Discussion

The present research presents data, related to the impact of the complex of socio-economic factors, de-

Table V
Multiple regression analysis of socio-economic,demographic, diet factors and physical activity and BMI

		BOYS		
Summary statistics for dependent variable BMI N=281	Multiple R=0.433		F(8.272)=7.88	
	Multiple R^2=0.188		**p<0.00000**	
	Adjusted R^2 =0.164		St.Error of estimate:3.55	
Factors	Beta	St.Err. of Beta	t	p-value
Mother's level of education	0,037	0,062	0,598	0,550
Father's level of education	0,033	0,060	0,546	0,585
Number of children in family	0,044	0,055	0,800	0,424
Residence	0,102	0,055	1,835	0,068
Number of meals of the day	-0,139*	0,056	-2,484	0,014*
Daily eating time regime	0,044	0,057	0,773	0,440
Overeating	0,406**	0,056	7,235	0,000**
Sports	0,001	0,056	0,017	0,987
		GIRLS		
Summary statistics for dependent variable BMI N=312	Multiple R=0.350		F(8.303)=5.32	
	Multiple R^2=0.123		p<0.00000	
	Adjusted R^2 =0.100		St.Error of estimate:2.92	
Factors	Beta	St.Err. of Beta	t	p-value
Mother's level of education	-0,002	0,063	-0,031	0,976
Father's level of education	-0,043	0,062	-0,696	0,487
Number of children in family	-0,098	0,054	-1,807	0,072
Residence	-0,027	0,055	-0,492	0,623
Number of meals of the day	0,017	0,055	0,304	0,761
Daily eating time regime	0,060	0,057	1,056	0,292
Overeating	0,304**	0,055	5,567	0,000**
Sports	0,072	0,055	1,321	0,187

Note: Multiple R-coefficient of multiple regression. Multiple R^2-coefficient of multiple correlation (determination). Adjusted R^2 –adjusted coefficient of multiple correlation. F– criteria of Fisher. p-level of significance. Beta - regression coefficient. St. Err. of Beta –Standard Error of regression coefficient. t-coefficient of significance of regression coefficient. p- level of significance of regression coefficient. marked * p<0.05. ** p<0.0001

mographic factors, feeding and physical activity over the nutritional status of children and adolescents in Bulgaria for first time.

In our research, for the evaluation of nutritional status we use the IOTF cut-off points for BMI for children and adolescents, developed by Cole et al[26-27].

According to the accumulated data, BMI with higher than average values for the given age, is observed among sons of mothers and fathers with higher education and among single sons. The comparison of the current our data with the results of previous similar researches prepared by us[28] show that there is no significant modifications of the BMI values for the boys. For the groups of boys, formed based on the parents' level of education and number of children in family, these values are almost unmodified for the period between the two researches (first research - 1999-2003 and second research - 2012-2014). The only exception is the BMI with higher values for modern boys whose fathers have higher level of education. The girls of parents with high level of education are characterized with lower BMI values. Also, the BMI for single sons and daughters is with higher values, compared to the BMI for children coming from families with two or more children. Similar, different in direction and level, impacts of various socio-economic and other factor over the BMI values of growing-ups from Moscow are reported in earlier studies of E.Godina[13].

Also, data of BMI values among adolescents of aged 15-18 years from Serbia, a group formed based on the level of education of both parents and monthly income are reported by Rakić et al.[29].

According to the results of the current research there is difference in the BMI value for both sexes between urban and rural children. The our results supported the data of other researchers, for the higher values for height, weight, fat mass and many other body features i.e BMI of the urban, compared with their rural coevals[20, 30-31].

The differences between BMI values related with daily meal frequency also need to be mentioned. For boys who eat twice-a-day, the BMI has higher values, compared to boys who are eating more frequently. The above collected data for boys, that are not observed among girls, support the results of other researchers about the daily meal frequency impact over BMI[32-34].

According to our results, the only significant differences in BMI for both sexes are observed between children, who are eating normal food quantities and are not overeating and those who are systematically overeating. These results confirm the undeniable relation between the quantity of eaten food and body weight, respectively the BMI.

Regarding to the results from our previous study for the prevalence of overweight, general and central obesity among the same 8-15 –year- old Bulgarian children[6], and independently of any factors, the 9.2 % of them are underweight, 17.9% are overweight, and 5.6% are obese. The distribution according to sex showed that 8 % of the boys are underweight, 18.8% are overweight and 7.6 % are obese. As for the girls, the results showed that 10.4 % are underweight, 17.0 % are overweight and 3.7 % are obese.

The results also show the contrary tendency in both sexes connected to the educational level of parents. The obesity is more frequency occur among daughters whose parents are with secondary or lower education, while more obese boys occur among sons whose fathers are with university education.

Our results for boys confirm the data of Rakić et al.[29] for significantly more frequent distribution of obesity among girls, whose parents are with secondary or lower level of education, compared to those, coming from families, where both parents are with higher education. The similar data are reported by Lazerri et al.[19].

Another tendency is observed, with boys from our research - the more frequent spread of obesity is seen with higher level of education of the father. These data for boys are in unison with earlier data, presented by some authors, according to whom obesity in developing counties is more commonly seen among children coming from families with high socio-economic status[10,12,15, 22]. Contrary data, showing lower chance for obesity among children with fathers with higher education, are reported by Farajian et al.[20].

Also, overweight and obesity are more commonly seen among single sons and daughters studied by us and this tendency is more significant and prominent among girls, compared to boys ($p<0.05$). The interpretation of that result requires more detailed and deep future analysis.

Overweight is more commonly seen among rural boys and urban girls, studied by us, but obesity is spread only among urban children. Data for more frequent observations of children with obesity in the cities compared to villages is reported by other researchers as well[10,31] . Different data are reported by Farajian et al.[20]. Among the Greek children studied by them, overweight is a little bit more frequently observed among children from smaller towns, suburbs and villages, compared to their peers coming from big urbanized areas.

The feeding frequency is a factor that has important significance in the evaluation of the nutritional status. The overweight and obesity, according to our data, is most commonly observed among boys, who are having one or two meals per day. With girls, the spread of obesity is not dependent on the meals frequency, its spread is equal among the three studied groups. Our results confirm earlier data of Mota et al.[33] for authentically higher frequency of overweight and obesity cases with number of meals frequency lower than three times per day.

Obesity is more frequently observed with girls with lower physical activity, while with the boys, such differences are not observed. But in contrast, overweight is more commonly observed among them. Such sex differences most probably, are due to the fact that boys, usually, are more physically active in all age groups and the girls are characterized with lower level of physical activity. It is also known that the lower physical

activity and the consumption of high-calories foods increase the risk for obesity and overweight.

For relationship between obesity and physical activity reported Patrick et al.[35]. Their study examined a variety of dietary and physical activity variables in relation toweight status and found that only vigorous physical activity was associated with weight for adolescent boys and girls.

Underweight is most commonly observed with children, whose both parents have secondary or lower level of education, among boys, coming from families with single-child and among girls, coming from families with two or more children, among urban boys and rural girls.

Underweight is also commonly observed with boys, following daily feeding regimen, among boys eating normal or smaller food quantities and also among boys who are non- practicing sports.

In generally, underweight among investigated children and adolescents from Smolyan region, Bulgaria is more frequently observed among girls, rather than among boys, among whom, obesity is most commonly observed, independently of the social stratification or other factors.

The above data are confirming our previous data[6], as well the data of Gontarev and Kalac[34] about more frequent spread of underweight among Macedonian girls, in comparison with the boys.

According to the results of the linear regression analysis, the main determinants of the overweight, obesity and underweight among the studied growing-ups are the factors, related to feeding, and in particular, eating of bigger food quantities (overeating) for both sexes, as well as the meals frequency with the boys. The regression coefficient of the factor „meal frequency" is negative, which means that the reduction of the meals frequency is related to increase of the values and the risk of overweight and obesity. Similar results are also reported by Mota et al.[33].

The results of the regression analysis also show, that the determination coefficient R^2 for boys has values of 0.188, and for girls 0.123 (Table V). This means that the values of R^2 provide explanation only for about 19% of the dependency between the BMI and the studied factors from boys and about 12% for girls. But no matter it is weaker, the studied liner regression dependency has significance ($p<0.0000$) and it shows that there is a liner dependency between the factors of „

The our results, to the current preliminary stage of the research, show lack of distinctive influence of the factors parents level of education, place of residence, city-village, daily feeding regimen and sports over the nutritional status of the studied individuals.

Conclusion

The preliminary results of the current research show that main determinants of the overweight, obesity and underweight among the studied Bulgarian children and adolescents from Smolyan region, are the factors, related to feeding and eating behavior, and in particular „the overeating" for both sexes and the „dally meal frequency" for boys.

There is a significant positive relation between the factor „overeating" and the BMI values for both sexes and a significant negative relation between the factor „meals frequency" and BMI for boys. The only significantly higher values of BMI are observed among overeating children in comparison to their peers, who are eating normal or smaller food quantities.

Considerably more frequently, obesity and overweight are spread among overeating boys and girls, who are having one- two meals per day as well as among single daughters. The obesity is occur significantly most frequency among children, who eat one to two time per day and also among boys and girls, who don't overeat.

Underweight is considerably more frequently observed among boys who are having more than four meals per day and among boys and girls whose eating behavior is related to lack of overeating and eating of smaller or normal food quantities.

The current preliminary results of our research show lack of distinctive influence of the factors like level of education of the parents, place of residence - city or village, daily eating regimen, based on time and physical activity over BMI and nutritional status of Bulgarian children and adolescents, aged 8-15 years, from Smolyan region.

Recomendation

It is a necessary to take adequate measures for prevention of underweight, overweight and obesity among adolescents, as of the responsible Government Institutions, also of the Schools and parents of the children for the greater promotion of healthy lifestyles, healthy nutrition and physical activity among children and adolescents. The children and adolescents with deviations from normal body nutritional status are need of systematic monitoring for the prevention of the health and personal problems in the later life.

Conflicts of interest statement

The authors declare no conflict of interest related to this manuscript.

Acknowledgements

The researchers would like to extend thanks to the Scientific Researches Fund at Plovdiv University "Paisii Hilendarski", Bulgaria for supporting this Research Grant N° SR15 FS 017.

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