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RELATIONSHIPS BETWEEN SOMATIC INDICES, ENERGY INTAKE AND PHYSICAL ACTIVITY OF CHILDREN FROM EASTERN POLAND

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The aim of the present study was to determine the relationships between BMI, energy intake and physical activity in boys and girls aged 10 to 15 years, coming from small towns in Eastern Poland. The research involved 628 children.

In approximately 12% of the children examined the BMI was ≤ 10 ptc (slim children); and 3% of the children were characterised by growth inhibition, which may indicate a serious disease or dietary (energy) deficiency. Insufficient energy intake was also confirmed by even very low mean values of physical activity index in children with BMI <10 ptc, *i.e.* 1.14 in boys and 1.21 in girls. Furthermore, the results obtained indicate that the declared energy intake does not always correspond with its actual level, so in order to obtain reliable results not only the interview data, but also the BMI of a given individual should be taken into account.

INTRODUCTION

Epidemiologic observations made in the developed countries indicate increasing obesity rates in children and adolescents. This phenomenon has not been linked to excessive energy intake, but substantially reduced physical activity of children and young people, resulting from rapid technological development and a growing amount of time spent in front of the TV or computer screen [Charzewski, 1997; Dietz & Gortmarker, 1985; Goran *et al.*, 1999; Parižkowa, 1996; Prentice & Jebb, 1995]. In countries undergoing system transformations, *e.g.* Poland, physical activity reduction in children and young people may be also caused by dietary energy deficiency [Bar-Or *et al.*, 1998; Gronowska-Senger, 2002; Meeks Gardner & Grantham-Mc Gregor, 1994; Spurr, 1990]. The economic recession observed in recent years, accompanied by a high unemployment rate, which has been growing since 2001, and reduced living standards resulted in increasing poverty, especially in north-eastern and eastern Poland. It has been estimated, on the basis of available data, that the living standards of approximately 40% of the Poles are well below the so-called "poverty line" [Gronowska-Senger, 2002].

These facts made us launch studies aimed at determining the relationships between BMI, energy intake and physical activity in boys and girls aged 10 to 15 years, living in small towns in eastern Poland, where the unemployment rate amounts to 20%.

MATERIAL AND METHODS

Population examined. The research involved 628 primary and secondary school pupils aged 10 to 15 years, including 326 boys and 302 girls, who submitted their written consents to participate in the study. Boys and girls were divided into age groups (50 children each). The study was approved by a local ethics committee.

Anthropometry. The somatic indices were determined on the basis of measurements of body height, body mass, and skinfold thickness in three sites (triceps, scapula and abdomen). Body height was measured exact to 0.1 cm with an anthropometer (Siber Henger, Switzerland), and body mass – exact to 0.1 kg with a CAS electronic balance (Inter Commerce, Poland). Skin-fold thickness was measured exact to ±0.1 mm on the right side of body with a Harpenden skinfold calliper (Siber Henger, Switzerland). All the measurements were performed by a trained professional. They provided a basis for calculating BMI (body mass/body height^2; kg·m^{-2}) and the fatty tissue content of the body, as described by Parižkowa [1961].

Taking into account their BMI and age, the children were classified into percentile ranges, on the basis of "Somatic development indices in children and adolescents from the city of Warsaw" [Palczewska & Niedźwiecka, 2001]. The nutritional status of the population examined was determined according to the WHO criteria [1995]. The following "cut off" points were accepted: normal range – BMI between 25 and 75 ptc; slimness – BMI≤10 ptc; overweight – BMI≥90 ptc; obesity – BMI≥90 ptc, triceps and subscapular skinfold thickness ≥90 ptc; and growth inhibition – height in age group < 3 ptc.

The results obtained for particular percentile ranges and age groups were combined, and the number of children in percentile ranges is given in Tables 1 and 2.

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Nutrition. The mode of nutrition was determined by means of a 24-hour dietary recall interview conducted three times [Thompson & Byers, 1994], on two schooldays and on a Sunday, by professional dietary interviewers. Food rations were determined using the "Album of food products and dishes with a different portion size" [Szczygłowa *et al.*, 1991]. The data obtained provided a basis for calculating average daily energy intake and the percentages of protein, fats and carbohydrates in energy supply with daily rations. The analysis was performed using a computer program based on Polish dietary tables [Kunachowicz *et al.*, 1998].

Physical activity. Total energy expenditure (TEE) was assessed with the method of Bouchard *et al.* [1983]. The method consists in recording, at 15-min intervals, all activities performed on three consecutive days. These data were gathered together with the dietary history. Energy expenditures corresponding to particular activities were summed up, and total energy expenditure was expressed in kcal/24 h.

The basal metabolic rate (BMR) of the respondents, expressed in kcal/24h, was determined on the basis of body mass measurements, according to WHO guidelines [Jeszka, 1998]. The data collected allowed calculation of the physical activity index (PAI), dividing TEE by BMR [Bratteby *et al.*, 1998].

The significance of differences between variables in particular percentile ranges for boys and girls was verified by a one-factor analysis of variance and the Newman-Keuls test at a significance level $p \leq 0.05$.

RESULTS

Table 1 shows that about 51% of the children were characterised by a normal mass to height ratio (BMI between 25 and 75 ptc). 49 boys and 25 girls were classified into the range BMI≤10ptc (slimness), which constituted 11.7% of the population examined (Tables 1 and 2). Anthropometric measurements indicated growth inhibition (Table 2) in 9

TABLE 1. Number of children in particular percentile ranges (clusters) distinguished on the basis of BMI (Percentages of the respondents are given in brackets).

Respondents	BMI – Percentile ranges (clusters)					
	≤3*	3–10	10–25	25–75	75–90	≥90
Boys (n=326)	17 (5.2)	32 (9.8)	48 (14.7)	170 (52.1)	35 (10.7)	24 (7.4)
Girls (n=302)	9 (3.0)	16 (5.3)	44 (14.6)	149 (49.3)	51 (16.9)	33 (10.9)
Total (n=628)	26 (4.1)	48 (7.6)	92 (14.6)	319 (50.8)	86 (13.7)	57 (9.1)

* numbers in columns denote the total number of respondents within a percentile range (cluster) in particular age groups

TABLE 2. Nutritional status of the children determined on the basis of the criteria formulated by Palczewska & Niedźwiecka [2001] and WHO [1995]. (Percentages of the respondents are given in brackets).

Respondents	Growth inhibition (height <3 ptc)	Slimness (BMI<10 ptc)	Overweight (BMI≥90 ptc)	Obesity BMI≥90 ptc triceps ≥90 ptc shoulder ≥90 ptc
Boys (n=326)	10 (3.1)*	49 (15)	24 (7.4)	21 (6.4)
Girls (n=302)	9 (3.0)	25 (8.3)	33 (11)	19 (6.3)
Total (n=628)	19 (3.0)	74 (11.7)	57 (9.1)	40 (6.4)

* numbers in columns denote the total number of respondents within a percentile range (cluster) in particular age groups

TABLE 3. Selected anthropometric indices in the boys (n=326) in particular percentile ranges (clusters) of BMI (mean ±SD.)

Variable	BMI – percentile ranges (clusters)					
	≤ 3	3–10	10–25	25–75	75–90	≥90
	n=17	n=32	n=48	n=170	n=35	n=24
Body mass (kg)	34.9±6.5^{A*}	36.3±7.1^{AB}	41.5±7.5^{C}	47.0±10.2^{D}	56.4±8.0^{E}	66.2±11.3^{F}
Body height (cm)	155.2±11.2	152.4±10.6	158.0±10.7	158.4±12.6	160.4±9.1	159.2±8.1
Triceps skinfold thickness (mm)	8.0±2.1^{A}	8.3±2.3^{AB}	8.3±1.8^{AC}	10.2±3.1^{D}	16.7±4.7^{E}	24.6±7.7^{F}
Subscapular skinfold thickness (mm)	5.3±0.7^{A}	5.9±2.2^{AB}	6.3±2.2^{ABC}	7.7±2.9^{D}	12.5±4.2^{E}	24.7±8.1^{F}
Abdominal skinfold thickness (mm)	6.3±1.9^{A}	6.6±3.2^{AB}	7.5±4.4^{ABC}	10.6±5.9^{D}	25.8±9.4^{E}	33.3±11.3^{F}
BMI ($kg \cdot m^{-2}$)	14.4±0.8^{A}	15.5±1.0^{B}	16.4±0.9^{C}	18.5±1.5^{D}	21.8±1.1^{E}	25.9±2.8^{F}
Lean body mass (kg)	29.8±5.9^{A}	30.8±6.1^{AB}	34.9±6.7^{AC}	38.5±8.8^{D}	42.6±6.7^{E}	45.7±7.9^{EF}
Lean body mass (%)	85.3±2.7^{A}	84.4±2.7^{AB}	84.1±2.6^{ABC}	81.7±3.7^{D}	75.5±3.6^{E}	69.2±4.5^{F}
Fat content (kg)	5.1±1.1^{A}	5.7±1.3^{AB}	6.6±1.4^{ABC}	8.5±2.4^{D}	13.7±2. 5^{E}	20.5±4.8^{F}
Fat content (%)	14.7±2.7^{A}	15.6±2.7^{AB}	15.9±2.6^{ABC}	18.3±3.7^{D}	24.5±3.6^{E}	30.8±4.5^{F}

* means followed by different letters differ significantly at $p \leq 0.05$

girls and 10 boys (3% of the population). Overweight children accounted for approx. 9% of the population examined, including 6% of obese children (Table 2).

The characteristics of anthropometric parameters in particular percentile ranges are given in Tables 3 and 4. They show that the lowest values of the variables analysed were recorded in the group of children in the cluster ≤3 ptc. In the successive percentile ranges, these values were increasing, except body height which demonstrated no significant changes, still in the three successive ranges, *i.e.* ≤3 ptc,

TABLE 4. Selected anthropometric indices in the girls (n=302) in particular percentile ranges (clusters) of BMI (mean±SD).

Variable	BMI – percentile ranges (clusters)					
	≤3	3–10	10–25	25–75	75–90	≥90
	n=9	n=16	n=44	n=149	n=51	n=33
Body mass (kg)	30.5±6.4^{A*}	37.6±7.3^{B}	39.7±7.0^{BC}	44.4±7.7^{D}	54.9±8.8^{E}	67.1±11.8^{F}
Body height (cm)	148.6±10.3	153.7±10.8	155.1±9.5	155.0±8.4	159.6±7.7	159.4±6.3
Triceps skinfold thickness (mm)	7.8±1.8^{A}	8.4±1.5^{AB}	8.8±1.8^{ABC}	11.0±2.9^{D}	13.9±4.2^{E}	19.6±4.9^{F}
Subscapular skinfold thickness (mm)	6.1±1.3^{A}	7.4±1.4^{AB}	7.5±2.1^{ABC}	10.0±3.0^{D}	14.9±5.3^{E}	24.6±7.1^{F}
Abdominal skinfold thickness (mm)	7.1±2.6^{A}	10.8±3.9^{AB}	9.6±3.1^{ABC}	13.9±5.1^{D}	20.7±7.0^{E}	30.6±7.3^{F}
BMI (kgm^{-2})	13.6±1.3^{A}	15.7±1.1^{B}	16.3±1.1^{BC}	18.3±1.5^{D}	21.3±1.4^{E}	26.8±3.5^{F}
Lean body mass (kg)	24.4±5.1^{A}	29.6±5.6^{AB}	31.2±5.2^{BC}	34.0±5.3^{D}	40.4±5.7^{E}	46.7±7.6^{F}
Lean body mass (%)	80.3±1.4^{A}	79.0±1.3^{AB}	78.8±1.7^{ABC}	76.7±2.3^{D}	73.8±2.5^{E}	69.7±2.3^{F}
Fat content (kg)	6.0±1.4^{A}	7.9±1.8^{AB}	8.5±2.0^{BC}	10.5±2.6^{D}	14.5±3.4^{E}	20.5±4.6^{F}
Fat content (%)	19.6±1.4^{A}	21.0±1.3^{AB}	21.2±1.7^{ABC}	23.3±2.3^{D}	26.2±2.5^{E}	30.3±2.3^{F}

* means followed by different letters differ significantly at p≤0.05

TABLE 5. Energy balance and physical activity of the children in particular percentile ranges (clusters) of BMI (mean±SD).

Variable	BMI – percentile ranges (clusters)					
	≤3	3–10	10–25	25–75	75–90	≥90
Boys	n=17	n=32	n=48	n=170	n=35	n=24
Energy intake (kcal·d^{-1})	2564±257^{A*}	2553±416^{AB}	2511±414^{ABC}	2477±444^{ABCD}	2235±515^{E}	2217±442^{EF}
Total energy expenditure (kcal·d^{-1})	1398±239^{A}	1482±327^{AB}	1700±420^{AC}	1924±499^{D}	2255±387^{E}	2654±538^{F}
Energy intake/total energy expenditure (energy balance)	1.89±0,40^{A}	1.78±0.39^{AB}	1.55±0.41^{C}	1.34±0.33^{D}	1.01±0.26^{E}	0.87±0.23^{EF}
Basal metabolic rate, according to WHO (kcal·d^{-1})	1275±114^{A}	1300±125^{AB}	1391±133^{C}	1490±181^{D}	1656±141^{E}	1829±200^{F}
Physical activity index (2/4)	1.09±0,12^{A}	1.14±0.17^{B}	1.21±0.21^{C}	1.28±0.20^{D}	1.36±0.16^{E}	1.45±0.17^{F}
Girls	n=9	n=16	n=44	n=149	n=51	n=33
Energy intake (kcal·d^{-1})	2246±315^{A}	2154±406^{AB}	2103±392^{ABC}	2082±356^{ABCD}	1924±423^{E}	1840±358^{AF}
Total energy expenditure (kcal·d^{-1})	1237±304^{A}	1450±262^{AB}	1616±381^{BC}	1751±350^{D}	2107±353^{E}	2509±637^{F}
Energy intake/total energy expenditure (energy balance)	1.82±0,51^{A}	1.55±0.50^{AB}	1.36±0.35^{BC}	1.23±0.34^{D}	0.91±0.26^{E}	0.76±0.24^{F}
Basal metabolic rate, according to WHO (kcal·d^{-1})	1100±86^{A}	1195±98^{B}	1224±93^{BC}	1287±103^{D}	1428±118^{E}	1591±158^{F}
Physical activity index (2/4)	1.11±0.20^{A}	1.21±0.15^{B}	1.31±0.25^{C}	1.36±0.19^{D}	1.47±0.17^{E}	1.57±0.31^{F}

* means followed by different letters differ significantly at p ≤0.05

TABLE 6. Percentages of energy-supplying dietary proteins, fats and carbohydrates in particular ranges (clusters) of BMI (mean±SD).

Variable	BMI – percentile ranges (clusters)					
	≤3	3–10	10–25	25–75	75–90	≥90
Boys	(n=17)	(n=32)	(n=48)	(n=170)	(n=35)	(n=24)
% energy from proteins	11.9±2.1	12.4±2.2	12.8±2.3	12.8±2.3	12.3±2.5	12.6±1.6
% energy from fats	31.1±6.1	30.3±5.7	32.2±5.0	32.2±6.5	31.4±6.0	34.2±7.3
% energy from carbohydrates	56.6±5.7	56.8±6.5	54.4±4.9	54.8±7.0	55.8±5.9	52.8±6.8
Girls	(n=9)	(n=16)	(n=44)	(n=149)	(n=51)	(n=33)
% energy from proteins	11.9±2.2	12.6±1.7	12.2±1.9	12.1±2.1	11.8±1.9	12.5±2.1
% energy from fats	31.1±6.4	30.2±5.3	31.7±5.3	30.4±5.6	32.2±5.3	31.3±5.6
% energy from carbohydrates	56.4±7.4	56.7±4.9	55.6±5.3	57.0±5.9	55.5±5.6	55.7±6.4

3–10 ptc, and 10–25 ptc, in both groups, considerable differences (p≤0.05) concerned only body mass and BMI. In the other percentile ranges in both groups these differences were more distinct and statistically significant (p≤0.05).

The data included in Table 5 indicate that the energy intake to total energy expenditure ratio (energy balance) was the highest in the cluster ≤3 ptc (boys: 1.89±0.40; girls: 1.82±0.51). In the successive percentile ranges this ratio was decreasing significantly (p≤0.05), reaching 0.87±0.23 and 0.76±0.24 for boys and girls, respectively, in the group ≥90. The physical activity index was the lowest in the group ≤3 ptc in both sexes (boys: 1.09; girls: 1.11). This index was increasing significantly (p≤0.05) in the successive ranges, to reach 1.45±0.17 for boys and 1.57±031 for girls in the cluster ≥90.

In the case of boys, the amount of energy supplied by dietary carbohydrates was slightly decreasing in the successive clusters (Table 6). Its decrease, with a constant percentage of energy supplied by proteins, resulted in a higher intake of energy supplied by fats. No such tendencies were observed in the group of girls (Table 6).

DISCUSSION

The frequency of overweight and obesity prevalence in children in Poland, and risk factors related to them, have been the object of numerous studies [Muchacka *et al.*, 1995; Oblacińska *et al.*, 1997; Kozieł & Kołodziej, 1999; Nordyńska-Sobczak *et al.*, 1999; Mazur *et al.*, 2001]. However, the problem of excessive slimness seems equally important from the social and health protection perspective, especially that poverty areas are still expanding in our country [Gronowska-Senger, 2002].

The research results show that slim children constituted 12% of the population examined (Tables 1 and 2). According to the WHO criteria [1995], 9 girls and 10 boys (3% of the population) were characterised by growth inhibition, which may indicate a serious disease or dietary (energy) deficiency. Overweight and obese children accounted for 9% of the population (Tables 1 and 2), and this result was lower than that obtained in other regions of Poland [Oblacińska *et al.*, 1997; Kozieł & Kołodziej, 1999; Nordyńska-Sobczak *et al.*, 1999; Mazur *et al.*, 2001]. The results concerning measurements of somatic indices correspond with those reported by Skład [2000], showing significant diversification in height, body mass and other somatic indices in children of this region, compared with those coming from urbanized areas of Poland. It seems that these differences have become even more visible due to the economic crisis observed in Poland for the past few years.

It is also worth noting that despite considerable differences in somatic characteristics between clusters (Tables 3 and 4), the energy intake was significantly higher in the group ≤3 ptc, showing lower values of these indices than in the other clusters (Table 5). A comparison of mean energy intake and mean energy expenditure (Table 5) indicates positive energy balance in the boys and girls in the clusters ≤75 ptc, and negative or neutral in the clusters ≥90 ptc. Nutritional analyses prove that the declared energy intake does not always correspond with its actual level, and depends on nutritional status, self-perception and self-evaluation [Johnson-Down *et al.*, 1997; Mc Gloin *et al.*, 2002; Ortega *et al.*, 1996; Wądłowska *et al.*, 2002]. According to Ortega and *et al.* [1996], very slim persons trying to put on weight declare energy intake about 10% above measured energy expenditure, whereas those with a higher BMI trying to lose weight declare energy intake about 16% below its measured expenditure. This suggests that energy intake is usually underestimated by obese and overweight respondents, and overestimated by the slim ones. This regularity was confirmed in the present study, as higher energy intake was declared by slim children (cluster ≤10 ptc) and lower – by children characterised by different obesity levels (range ≥90 ptc). A very low physical activity index in the boys and girls in the first two clusters (boys: 1.14; girls: 1.21), compared with the other children, can be associated with the response of their bodies to insufficient energy intake, because organism normally displays a tendency towards energy balance maintenance. When dietary energy becomes a limiting factor, the first spontaneous response of the organism is physical activity reduction, in order to save energy for growth and other biological needs [Bar-Or *et al.*, 1998]. Different analyses show that prolonged physical inactivity caused by decreased energy intake can have a negative effect on the interactions between the child and his social environment, leading to disturbances in his mental and physical development [Bar-Or *et al.*, 1998; Malina, 1984; Torun, 1990]. Moreover, the results of a report by FAO/WHO/UNU [1985] indicate that if physical activity does not exceed 1.27 for a longer period of time, a person cannot enjoy good health. The results obtained indicate a low physical activity of the children in the cluster ≤10 ptc, which could result from insufficient energy intake. The study was conducted in a backward area, where the living standards are low, and most of the children examined are expected to work hard both at home and on the farm. It may happen that an increased physical activity is not accompanied by a higher energy intake. This may be one of the reasons for low body mass and height of the boys and girls in the group ≤10 ptc (Tables 3 and 4). The data obtained show also (Table 6) that in the range ≥90, with some obese boys, the mean diet composition was characterised by a higher percentage of fats and a lower percentage of carbohydrates, compared with the cluster ≤3. These data confirm the relationships between the kind of diet and body mass [Miller *et al.*, 1990]. No such tendencies were observed in the group of girls (Table 6).

CONCLUSIONS

1. In the population analysed, slim children constituted 12%, and children characterised by growth inhibition – 3%, which indicates that there is an urgent need to conduct more detailed medical studies on the health state and physical development of children and adolescents in this region of Poland.
2. Prolonged periods of low and very low physical activity in the children examined could negatively affect their physical development.
3. In order to obtain reliable results on energy intake, not only the interview data, but also the BMI of a given individual should be taken into account.

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REFERENCES

1. Bar-Or O., Foreyt J., Bouchard C., Brownell K.D., Dietz W. H., Ravussin E., Salbe A. D., Schwenger S., St. Jeor S., Torun S., Physical activity, genetic, and nutritional considerations in childhood weight management. Med. Sci. Sport Exerc., 1998, 30, 2–10.
2. Bouchard C., Tremblay A., Leblanc C., Lortie G., Savard R., Thériault G., A method to assess energy expenditure in children and adults. Am. J. Clin. Nutr., 1983, 37, 461–467.
3. Bratteby L.–E., Sandhagen B., Fan H., Enghardt H., Samuelson G., Total energy expenditure and physical activity as assessed by the doubly labeled water method in Swedish adolescents in whom energy intake was underestimated by 7-d diet records. Am. J. Clin. Nutr., 1998, 67, 905–911.
4. Charzewski J., Sports activity of Poles. 1997, RCMSKFiS, Warszawa, p. 130 (in Polish).
5. Dietz W.H., Gortmarker S.L., Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. Pediatrics, 1985, 75, 807–812.
6. FAO/WHO/UNU. Energy and protein requirements. World Health Organ. Tech. Rep. Ser., 1985, 724.
7. Goran M.J., Reynolds K.D., Lindquist C.H., Role of physical activity in the prevention of obesity in children. Int. J. Obes., 1999, 23, (Suppl. 3), S18–S33.
8. Gronowska-Senger A., Today's nutritional problems of population in Poland. Żyw. Człow. Met., 2002, 29 (Suppl), 27–34 (in Polish; English abstract).
9. Jeszka J., Energy. Energetic demands of a body. 1998, *in*: Human Nutrition. Bases of Nutrition Science (eds. J. Gawęcki, L. Hryniewiecki). PWN, Warszawa, pp. 114–128 (in Polish).
10. Johnson-Down L., O'Loughlin J., Koski K.G., Gray--Donald K., High prevalence of obesity in low income and multiethnic schoolchildren: A diet and physical activity assessment. J. Nutr., 1997, 127, 2310–2315.
11. Kozieł S., Kołodziej H., BMI and fractions of relatively obese boys and girls aged 13–15. Ped. Pol., 1999, 74, 991–997 (in Polish; English abstract).
12. Kunachowicz H., Nadolna J., Przygoda B., Iwanow K., Tables of nutritive values of food products. 1998, IŻŻ, Warszawa, Nr 85, p. 694 (in Polish).
13. Malina R.M., Physical activity and motor development performance in populations nutritionally at risk. 1984, *in*: Energy Intake and Activity (eds. E. Pollitt, P. Amante). New York: Liss, p. 285–302.
14. Mazur A., Małecka-Tendera E., Lewin–Kowalik J., Overweight and obesity in school children of the Podkarpackie Province. Ped. Pol., 2001, 76, 743–748 (in Polish; English abstract).
15. Mc Gloin A.F., Livingstone M.B.E., Greene L.C.,Webb S.E., Gibson J.M.A., Jebb S.A., Cole T.J., Coward W.A., Wright A., Prentice A.M., Energy and fat intake in obese and lean children at varying risk of obesity. Int. J. Obes., 2002, 26, 200–207.
16. Meeks Gardner J.M., Grantham-Mc Gregor S.M., Physical activity, undernutrition and child development. Proc. Nutr. Soc., 1994, 53, 241–248.
17. Miller W.C., Lindeman A.K., Wallace J., Niederprumen M., Diet composition, energy intake, and exercise in relation to body fat in men and women. Am. J. Clin. Nutr., 1990, 52, 426–430.
18. Muchacka M., Małecka-Tendera E., Koehler B., Occurrence of atherosclerosis risk factors in Silesian school children. Ped. Pol., 1995, 70, 130–138 (in Polish, English abstract).
19. Nordyńska-Sobczak M., Małecka-Tendera E., Klimek K., Lewin-Kowalik J., Obesity risk factors in adolescent children. Ped. Pol., 1999, 74, 791–798 (in Polish; English abstract).
20. Oblacińska A., Wrocławska M., Woynarowska B., Frequency of overweight and obesity in the school – age population in Poland and health care for pupils with these disorders. Ped. Pol., 1997, 72, 241–245 (in Polish; English abstract).
21. Ortega R.M., Requejo A.M., Quintas E., Sánchez--Quiles B., Lopez-Sabaler A.M., Andres' P., Estimated energy balance in female university students: differences with respect to body mass index and concern about body weight. Int. J. Obes., 1996, 20, 1127–1129.
22. Palczewska I., Niedźwiecka Z., Somatic development indices in children and adolescents from the city of Warsaw. Med. Wiek. Rozw., 2001, 5, 2, (Supl.), 120 (in Polish).
23. Parižkowa J., Nutrition, physical activity and health in early life. 1996, CRE Press: Boca Raton, Florida, p. 320.
24. Parižkowa J., Total body fat and skinfold thickness in children. Metabolism, 1961, 10, 794–807.
25. Prentice A.M., Jebb S.A., Obesity in Britain: gluttony or sloth? Br. Med. J., 1995, 311, 437–439.
26. Skład M. (ed.), Selected indices of biological development of girls and boys from rural areas of Podlasie, IWFiS, Biała Podlaska, p. 336 (in Polish).
27. Spurr G.B., Physical activity and energy expenditure in undernutrition. Prog. Food Nutr. Sci, 1990, 14, 139–192.
28. Szczygłowa H., Szczepańska A., Ners A., Nowicka L., Album of food products and dishes with a different portion size. 1991, IŻŻ, Warszawa (in Polish).
29. Thompson F.E., Byers T., Dietary assessment resource manual. J. Nutr., Suppl., 1994, 124, 2245–2317.
30. Torun B., Short- and long- term effects of low and restricted energy intakes on the activity of infants and children. 1990, *in*: Activity, Energy Expenditure and Energy Requirements of Infants and Children. (eds. B. Schurch, N.S. Scrimshaw). Lausanne: JDECG, pp. 335–359.
31. Wądołowska L., Cichon R., Słowińska M.A., A comparative study into nutritive value of dietary rations and energy balance of young people at different nutrition levels. Żyw. Człow. Met., 2002, 29, (Suppl), 150–154 (in Polish).
32. WHO Technical Report Series 854, Physical status: The use and interpretation of anthropometry. Geneva, 1995.

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ZWIĄZKI POMIĘDZY CECHAMI SOMATYCZNYMI, SPOŻYCIEM ENERGII I AKTYWNOŚCIĄ FIZYCZNĄ DZIECI ZE WSCHODNICH REGIONÓW POLSKI

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Celem pracy było zbadanie zależności pomiędzy wartością BMI, spożyciem energii i aktywnością fizyczną dzieci w wieku 10–15 lat pochodzących z niewielkich miast leżących na wschodzie Polski. Badaniami objęto 326 chłopców i 302 dziewczęta. Wielkość cech somatycznych oceniono na podstawie pomiarów wysokości i masy ciała oraz grubości fałdów skórno-tłuszczowych (na mięśniu trójgłowym ramienia, pod łopatką, na brzuchu), zaś spożycie energii metodą trzykrotnego wywiadu o spożyciu z ostatnich 24 godzin poprzedzających badania. W oparciu o pomiary masy ciała oraz równania podane przez WHO oznaczono podstawową przemianę materii (PPM) badanych. Zebrane dane posłużyły do wyliczenia wskaźnika aktywności fizycznej (WAF) dzieląc całkowity wydatek energetyczny wyliczony metodą Boucharda i wsp. przez PPM. Na podstawie BMI, uwzględniając kategorie wiekowe, wyodrębniono grupy dzieci o podobnych cechach somatycznych. Stan odżywienia dzieci określono stosując kryteria zaproponowane przez Instytut Matki i Dziecka i WHO.

Spośród przebadanych dzieci 12% zakwalifikowano do przedziału BMI≤10ptc (dzieci szczupłe), a 3% charakteryzowało się zahamowaniem wzrostu, co może wskazywać, że w przeszłości dzieci te przeszły poważną chorobę lub wystąpiły u nich niedobory żywieniowe (energetyczne). Na niewystarczające spożycie energii w stosunku do zapotrzebowania wskazuje również bardzo niska średnia wartość WAF badanych dzieci zaobserwowana w przedziale ≤10 ptc (WAF=1,14 – chłopcy i 1,21 – dziewczęta). Z przeprowadzonych badań wynika również, że zadeklarowane spożycie energii nie zawsze było zgodne ze stanem faktycznym i ażeby uzyskać dokładniejszą wiedzę o spożyciu energii obok wywiadu należy brać pod uwagę także wartości BMI badanego osobnika.