

# ANTHROPOMETRIC ASSESSMENT OF THE NUTRITIONAL STATUS OF CHILDREN AND ADOLESCENTS RESIDING IN SELECTED POLISH ORPHANAGES BASED ON THEIR ENERGY INTAKE AND PHYSICAL ACTIVITY LEVEL

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## ABSTRACT

**Background.** Actions to the prevention of overweight and obesity should be first addressed to the youngest population and their parents, guardians as well as teachers. The major objectives of prevention and treatment of overweight and obesity programme should be focused on modification of nutritional habits and promotion of physical activity.

**Objective.** The aim of this study was to evaluate the nutritional status, intake of energy and macronutrients as well as the physical activity of students from orphanages in Krakow.

**Material and methods.** Study was performed in 5 orphanages located in Krakow (Poland), which were under control of Social Welfare Centre in Krakow. The study involved 153 students, 67 girls and 86 boys, aged from 7 to 20 years. Nutritional status was assessed by anthropometric measurements. The protein and total fat content in diets was measured by chemical analyses and carbohydrates were calculated by difference. Physical activity level of children and adolescents was assessed by questionnaire.

**Results.** Over 80% of boys and about 90% of girls had a normal body mass. Students have spent their free time on additional physical activity from 1h 34 min/day to 5 h 12 min/day. They also have spent their free time on sedentary activities on average 4 h/day. Daily diets of students did not meet recommendations for energy, carbohydrates and fats. Intake of protein was too high and exceeded the estimated average requirement even over three times.

**Conclusions.** Despite the insufficient intake of fat and carbohydrates, students generally showed a proper BMI value. This suggests that excess intake of protein was used for maturation process and was additional source of energy. Reported additional physical activity was satisfactory.

**Key words:** *students of orphanages, nutritional status, nutrients intake, physical activity*

## STRESZCZENIE

**Wprowadzenie.** Działania dotyczące zapobiegania nadwadze i otyłości powinny być kierowane głównie do dzieci, ich rodziców, opiekunów prawnych, a także do nauczycieli. Powinny one koncentrować się głównie na monitorowaniu i korygowaniu nawyków żywieniowych oraz promowaniu aktywności fizycznej.

**Cel.** Celem pracy była ocena stanu odżywienia, spożycia energii i makroskładników, a także aktywności fizycznej dzieci domów dziecka w Krakowie.

**Material i metody.** Badania przeprowadzono w 5 domach dziecka, będących pod nadzorem Miejskiego Ośrodka Pomocy Społecznej. W badaniach wzięło udział 153 wychowanków, w tym 67 dziewczęta i 86 chłopców, w wieku od lat 7 do 20 lat. Stan odżywienia dzieci oceniano przy pomocy pomiarów antropometrycznych. W całodziennych racjach pokarmowych dzieci i młodzieży oznaczono, metodami chemicznymi, zawartość białka i tłuszczu. Ilość węglowodanów obliczono z różnicy. Poziom aktywności fizycznej u dzieci i młodzieży oceniono przy pomocy kwestionariusza.

**Wyniki.** Ponad 80% chłopców i ~90% dziewcząt miało prawidłową masę ciała. Czas poświęcony na dodatkową aktywność fizyczną, przez wychowanków krakowskich domów dziecka, wahał się w granicach od 1h 34 min./dobę do 5 h 12 min./dobę, czyli w pełni pokrywał zalecaną ilość, wynoszącą 1 h/dobę. Zajęcia sedenteryjne trwały średnio 4 h/dobę.

W sposobie żywienia badanej młodzieży występowały błędy, polegające na niepełnym pokryciu zapotrzebowania na energię, węglowodany, tłuszcze oraz błonnik pokarmowy. Równocześnie stwierdzono nadmierne ilości białka w racjach, przekraczające wartości zalecane nawet ponad 3-krotnie.

**Wnioski.** Pomimo niedostatecznej ilości energii, tłuszczów i węglowodanów w racjach pokarmowych wychowanków domów dziecka, wartości wskaźnika BMI były na ogół prawidłowe. Sugeruje to, że nadmierne spożycie białka było wykorzystane do procesów wzrostu i rozwoju oraz jako dodatkowe źródło energii. Czas przeznaczony na dodatkową aktywność fizyczną przekraczał zalecany czas.

**Słowa kluczowe:** *wychowankowie domów dziecka, stan odżywienia, sposób żywienia, aktywność fizyczna*

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## INTRODUCTION

Obesity has become a major public health problem around the world in the twenty-first century. Statistical data shows the worrying trends, not only because that the percentage of obese people constantly grow, but also because a lot of children in early stage of development become obese. Statistical data have shown that more than 22 million of children under five years old are obese around the world. It has been also reported that obesity affected 5 to 10% of children under 10 years of age [9, 25].

Prevention of obesity should be primary addressed to the population below 18 years of age and their parents as well as teachers. The major objectives of prevention and treatment of overweight and obesity programme should be focused on modification of eating habits and increased physical activity. Properly developed prevention of obesity can bring benefits to the society, primarily by reducing costs on health care related to the treatment of diet-related diseases, as well as the economic impact of disability and premature mortality. Prevention of obesity and underweight of children and adolescents should become a priority of health policy in all countries around the world [25, 29].

Orphanages are responsible not only for the child's physical and psychological development, but also for adequate living conditions. In these institutions nutritional education should be important part of teaching programme. Due to the fact that children and adolescents are the group most vulnerable to the effects of poor nutrition, it is reasonable to undertake studies concerning the assessment of nutritional status, nutritional habits and the physical activity of children and youth from orphanages.

Monitoring and analysis of parameters of physical development is an essential factor of the assessment of growing of children. Weight losses, inhibition of body weight gain, or improper weight gain are often the first symptoms of disorder or health problems. Evaluation of nutritional status of children is an important tool in assessment of proper growth and requirements for nutrients [24, 25, 29].

The aim of this research was to evaluate the nutritional status of residents of orphanages, located in Krakow as well as assessment of selected elements of

lifestyle, which included energy, macronutrients intake and physical activity.

## MATERIALS AND METHODS

Study was performed in 2008 in 5 orphanages located in Krakow (Poland), which were under control of Social Welfare Centre in Krakow. The study involved 67 girls and 86 boys, aged from 7 to 20 years (Table 1). The study included seven measurements commonly used in the assessment of nutritional status: height, weight, arm and chest circumference, as well as the thickness of three skin folds (triceps above, under the shoulder and the iliac crest).

Weight was measured by a trained person using a Digital Scale (Radwag Radom, Poland). Weight was measured in kilograms with an accuracy of 100 g. Height was measured using a stadiometer with a vertical backboard and moveable headboard with an accuracy of 1 mm. On the basis of measurements of weight and height, body mass index (BMI) was calculated.

The thickness of skinfolds was measured with *Harpender* skinfold caliper (measuring pressure: 10 gms/mm<sup>2</sup> constant over range) with an accuracy of 0.1 mm. The sum of three skinfolds thickness was used to estimate total and subcutaneous body fat content [26]. Assessment of nutritional status was performed in relation to the age, using the growth charts prepared by the University of Physical Education in Krakow [5]. In this study the value of the parameters, between 10 and 90 percentile were considered as the proper, while values below 10 and above 90 percentile were used for indicating respectively underweight, overweight and obesity.

Questionnaire evaluating the physical activity of the children and adolescents was performed anonymously, through face to face interviews. The survey was related to the frequency and type of physical activity undertaken by children and adolescents. Based on these results, the average time spent to perform regular daily activities, other physical activity (handball, volleyball, tennis, cycling, etc.) [h/person/day], and the time spent on passive activities (watching TV, computer, homework) [h/person/day] was calculated. Results were compared to the daily physical activity recommendations, prepared by the World Health Organization. The European

Table 1. Characteristics of children and adolescents from orphanages

Orphanages	Male [n]	Female [n]	Age [years]		Weight [kg]	
			range	$\bar{x}$	range	$\bar{x}$
I	8	15	7-13	11.0	13-43	25.3
II	-	30	11-18	15.0	55-61	59.3
III	26	14	8-20	15.0	20-79	48.7
IV	12	8	14-20	16.6	42-72	52.0
V	40	-	13-20	16.7	35-96	55.4

Union and its Member Countries recommend at least 60 minutes daily physical activity of moderate intensity for children and youth in school age. This activity should be carried out in the forms of developmentally appropriate, enjoyable and involving different exercises, with an emphasis on the development of motor skills [6].

Assessment of nutritional pattern was completed based on chemical analysis of daily diets of children and youth. Daily diets were collected in four seasons of 2008. Homogenized and freeze-dried daily diets were used for the determination of protein, with using *Kjeldahl* method and total fat content with *Soxhlet* method [7]. Total carbohydrates were calculated by the difference between dry mass of daily diets and sum of total fat, protein and ash content. The energy content of daily diets was calculated based on the level of digestible carbohydrates, fat and protein, using Atwater factors i.e. 4 kcal, 9 kcal, 4 kcal/1 g respectively.

In order to assess the meeting of recommendations for macronutrients and energy obtained results were compared with Polish recommendations [12]. For protein the EAR (estimated average requirement) value was used. To assess the intake of fat with daily diets the level of 30% of recommended value for provide

energy, from this nutrient, was used. Carbohydrates intake was compared to recommended range of intake in the prevention of chronic disease (55-75% of total energy) – i.e. 137-187 grams of carbohydrate/1000 kcal. For energy intake the recommended value for children with moderate physical activity was used.

## RESULTS

Most of students from orphanages had correct body mass. Excessive body weight, indicating a presence of overweight or obesity, was found in 6% of boys and 6% girls. Too low body mass, indicating the thinness or underweight, was measured in 14% of boys and 5% of girls (Table 2).

Proper BMI value was characterized in 86% of boys and in 92% girls. The thickness of the sum of three skin folds was proper in 83% and 85% respectively. More frequently the underweight than overweight and obesity were observed based on BMI value as well as on the sum of three skin folds in assessed group of children and adolescents (Table 2).

The important finding of this study is that more frequently extremely low content of fat was measured

Table 2. Percentage of children and adolescents in the results of anthropometric measurements

Measurements	Unit	Male					Female				
		EL	VL	Standard	VH	EH	EL	VL	Standard	VH	EH
Weight	kg	13	0	81	2	4	5	0	90	0	5
Height	cm	15	0	83	2	0	5	2	90	0	3
BMI	kg/m <sup>2</sup>	6	2	86	0	2	0	0	92	0	8
Arm circumference	cm	4	2	84	4	6	2	0	95	0	3
Chest circumference	cm	4	0	81	10	5	0	0	90	2	8
The thickness of skinfolds above triceps	mm	2	2	90	0	6	0	0	92	0	8
The thickness of skinfolds under the shoulder	mm	6	0	86	0	8	7	0	88	0	5
The thickness of skinfolds under the iliac crest	mm	6	4	90	0	0	10	0	87	0	3
The sum of three skinfolds thickness	mm	9	2	83	2	4	10	0	85	0	5

EL- extremely low value, VL- very low value, S- standard, VH- very high (overweight), EH- extremely high (obesity).

Table 3. Time used for sedentary and additional physical activity by children and adolescents

Gender	Sedentary activities [min (h)/person/day]							Additional physical activity [min (h)/person/day]	
	Watching TV		Playing computer games		Doing homework		Total	range	$\bar{x}$
	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	$\bar{x}$		
Female	34-253	113 (1.9)	27-164	77 (1.3)	21-83	39 (0.6)	230 (3.8)	52-207	119 (2.0)
Male	21-328	125 (2.1)	6-204	71 (1.2)	13-18	50 (0.8)	246 (4.1)	58-456	220 (3.7)

Table 4. The most common forms of additional physical activity undertaken by children and adolescents

Physical activity	Female		Male	
	n	[%]	n	[%]
cycling	28	70.0	41	67.2
skating	27	67.5	15	24.6
dancing	27	67.5	7	11.5
bowling	9	22.5	4	6.6
playing tennis	1	2.5	4	6.6
playing soccer	23	57.5	53	86.9
playing volleyball	28	70.0	15	24.6
playing basketball	24	60.0	21	34.4
playing handball	0	0.0	4	6.6
mountaineering	0	0.0	5	8.2
table tennis	21	52.5	30	49.2
rowing	0	0.0	3	4.9
canoeing	0	0.0	1	1.6
playing golf	1	2.5	0	0.0
running on a treadmill	14	35.0	11	18.0
sprint	7	17.5	11	18.0
long-distance running	2	5.0	9	14.8
baseball game	3	7.5	2	3.3
jumping rope	17	42.5	5	8.2
hiking	23	57.5	29	47.5
walking	38	95.0	38	62.3
swimming	15	37.5	25	41.0
gym	3	7.5	16	26.2

than high content of it in students. It may suggest that students had higher content of muscle mass. What is more, results of the questionnaire concerning to evaluation of physical activity of assessed children and adolescents indicate, that students have chosen active forms of spending free time instead of passive ones (Table 3). It is probably the reason of lower content of fat in assessed population. Residents of orphanages have also spent their time after school on sedentary activities (~4 h/day), mostly watching TV (~2 h/day). More than an hour a day they have played on computer or they have used the Internet. An average of 45 min. was necessary for homework. Boys, compared to girls, almost twice

longer, but less than 4 hours per day, spent their free time on additional physical activity. Among the boys dominated the following forms of physical activity: playing soccer (87%), cycling (67%) or walking (62%). Less popular were: table tennis (49%), hiking (48%) and swimming (41%). Girls, when chosen active form of spending free time they usually preferred: walking (95%), cycling (70%), rolls (68%) and dancing (68%). The most commonly practiced by the girls team games were: volleyball (70%), basketball (60%) and soccer (58%) (Table 4).

Results concerning assessment of intake basic nutrients with daily diets have shown that average intake of energy, fat and carbohydrate met of about 80% recommended values. The intake of protein with daily diets exceeded EAR value and ranged from 115 - 362% (average 214.2%). It has been also found that the intake of basic nutrients was varied, coefficient variation (CV) ranged from 22.2% to 27.1%. (Table 5).

## DISCUSSION

### *Body mass, height, BMI, thickness of skinfolds*

Results obtained in this study indicate that the majority of students (~81% boys and ~90% girls) were characterized by normal weight, height and BMI value. A significant deficiency in body weight was measured in 13% of boys and 5% of girls, and overweight or obesity in 6% of population. These results were confirmed by measurements of thickness of skinfolds (Table 2). Once again, these studies confirm the usefulness of BMI (assessed based on growth charts) to the initial assessment of the degree of obesity in children and the general condition of percentage of fat in development age. Similar findings were published by *Ozimek* and co-workers [22].

In available literature there is a few information concerning nutritional status of children from orphanages [30]. Results obtained in this study are similar to data published by other authors, which assessed nutritional status of children and/or adolescents from other places of residence.

Table 5. Intake of energy and basic nutrients by children and adolescents

		Energy [kcal/person/day]	Total proteins [g/person/day]	Total fats [g/person/day]	Digestible carbohydrates [g/person/day]
Intake	range	1455.9-3141.9	52.2-121.1	40.6-113.1	198.7-443.0
	$\bar{x} \pm SD$	2161.9 $\pm$ 486.7	87.2 $\pm$ 19.5	68.7 $\pm$ 18.6	307.3 $\pm$ 74.4
	CV	22.5	22.4	27.1	24.2
Meeting of requirements [%]		84.0	214.2	80.3	62.1- 84.9

$\bar{x}$  - mean, SD - standard deviation, CV- coefficient variation [%]



In Polish survey conducted by the Department of School Medicine Institute of Mother and Child in 1995 (2 mln of children and adolescents were assessed), repeated in 2005 (adolescents aged 13-15 years), it was shown that similar percentage of adolescents was obese, more frequently in girls than in boys. Additionally it was found that higher percentage of girls (compared to our studies) and similar percentage of boys were overweight [14]. Results obtained in our study are confirmed also by data published by *Malecka-Tender* et al. [17]. *Chabros* et al. [4] reported that the percentage of girls with overweight, obesity as well as with weight deficiency was higher.

Our data did not correspond with results published by other authors. A study in primary schools in Milan showed that the lowest percentage of children's with proper BMI, as well as higher percentage with overweight and obesity [2]. Other research showed that the excessive thinness, overweight and obesity was found in higher percentage of students of primary and secondary schools [3, 11, 15].

Too high or too low intake of nutrients with daily diets by children and adolescents may cost serious health problem in future. It can predispose to develop of overweight in the future and consequently, lead to health complications such as endocrine complications, hyperlipidemia, insulin resistance, hypertension and liver steatosis. Overweight and obesity in children also have negative psychosocial effects [25, 29].

In this study we have found that the correct value of the thickness of skinfolds was measured in ~ 90% of the participants both genders (in relation to a wide range of standards, between 10 and 90 percentiles). We also reported the strong correlation between the thickness of skinfold and gender. The average thicknesses of various skinfolds were higher in girls than in boys. What is more, boys had more often proper content of fat compared to girls.

Skin-fold thickness in girls from 8 years of age has a tendency to spread, and in boys - especially on hands - to decrease. In boys two years before the maturation the thickness of subcutaneous fat increases. During the intensive growth of boys the percentage of fat usually does not change or decreases [28]. This was also observed in this study. Among younger children, up to 10 years of age, a higher percentage of boys than girls (40% and 9% respectively), had a higher content of fat, providing the occurrence of overweight. In older age groups, girls had a higher content of subcutaneous adipose tissue, providing the overweight or obesity, compared to boys. *Mleczko* et al. [19] reported the long term changes in growth of students of the Academy of Physical Education in Krakow between the years 1972 and 2008. These authors showed that the percentage of fat, expressed as the sum of skinfolds under the shoulder,

on the arm and iliac crest, increased within 36 years. These authors suggest that these changes are the typical for intergenerational change, but sharply marked. A similar trends has been reported by *Chrzanowska* et al. [5], *Mialkowska* and *Pietraszewska* [18] and by *Radochońska* and *Perenc* [23]. Last authors found that between first (1978/79) and third (2003/04) period of studies (25 years) thickens of skinfolds of boys, aged 3-18, increased almost double. In the case of girls the thickness of the skinfolds increased by about 8 mm. On the other hand girls had lower content of fat and the percentage of them with deficiency in body mass and very low content of fat was increased [23]. *Langnase* et al. [16] showed the highest fat content (calculated from measurements of skinfolds) in children from families with lower incomes.

#### *Physical activity level*

The natural need for being active is the largest in childhood, and decreases with age. Physical activity is an important factor in prevention of chronic non-communicable diseases. Lack of exercise causes abnormal metabolic processes; it has also a negative impact on the mental health. Physical activity not only stimulates the development of children and adolescents, but also slows the aging process and relieves the symptoms of involution individual's in mature [22]. In our study we found that children and adolescents from orphanages spent their free time watching TV, playing on computer and doing homework about four hours per day. Boys, compared to girls, almost two time longer had spent their time on additional physical activity. It was about 4 hours per day. According to the guidelines of the World Health Organization and the European Union it is recommended at least an hour per day, moderate intensity physical activity for children and adolescents [6]. Results obtained in our study are not similar to data published by other authors. *Jegier* et al. [13] showed that 26% to 50% of adolescents had insufficient amount of physical activity. It has been well reported that boys, regardless of age, are more physically active than girls [1, 32]. It was also confirmed in our studies. More than 50% of adolescents have spent their free time usually watching TV 1-2 h/day. Watching TV during weekends and for 3-4 h/day, declared 31% of adolescents [27]. *Ouwens* et al. [21] reported that 24% pre-adolescent children watched TV less than 30 min./day, 33% watched TV between 30 min. and one hour, 26% between one and two hours and 17% watched TV more than 2 h/day. TV-watching was positively associated with snacking, external eating and emotional eating, but it was not associated with BMI. International survey on health behavior of school children showed that ~40% respondents watched TV 2-3 h/day, both on school days and weekend [10].

### Intake of energy and basic nutrients

Assessment of nutritional pattern of children and adolescent of orphanages located in Krakow showed many mistakes related to the amount of energy and nutrients intake. Improper composition of daily diets were also found in orphanages located in Poznań [30]. Poorly balanced diet can result in fluctuations in blood glucose levels, lowering the concentration, reduction of mental and physical activity, and thus may have an impact on the effectiveness of studying. In addition, irregularities in food consumption can cause changes in metabolic rate. It causes higher conversion of energy from consumed food in fat [8]. Although proteins are important during the growth of children but on the other hand their metabolites may affect the liver and kidneys function. Long-term excessive protein intake in future can cause development of metabolic disorders e.g. high level of homocysteine, it increased risk of the atherosclerotic process and decreased absorption of calcium [12]. In addition, it has been reported that excided intake of proteins with daily diets by children and adolescents is correlated with a higher BMI [31].

## CONCLUSIONS

Although the majority of assessed children from Polish orphanages had proper body weight and satisfactory additional physical activity level, eating habits should be changed. These changes should apply to increase the participation of total carbohydrates and fat as well as to decrease of total protein in the diets.

These irregularities indicate the necessity of intervention and monitoring of energy and nutrition intake by children from other orphanages.

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### Conflict of interest

*Authors declare no conflict of interest.*

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