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ORIGINAL ARTICLE

Influence of urbanization level and Gross Domestic Product on the prevalence of adolescent obesity in Poland

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Abstract

Introduction. Obesity is considered as a major disease of twenty-first century civilization. Its occurrence in Poland and worldwide has been increasing steadily for many years. Several factors play an important role in the development of overweight and obesity. In addition to the genetic factors and those associated with diseases of the endocrine system and nervous system, the rapidly growing number of obese people is due to improper nutrition.

Objectives. In this paper, authors attempt to justify the prevalence of obesity in Poland among the population of adolescent and young adults aged 15 – 29 years of age, depending on the urbanization level and Gross Domestic Product (GDP) *per capita* of voivodeships.

Methods. Voivodeships, as an entity of regional autonomy, were divided into two groups according to urbanization level and GDP *per capita*. From the total population of each voivodeship population, groups of overweight and obese people aged 15–29 were selected. The population group aged 15–29 was divided into male and female subgroups. Each subgroup was compared in the different voivodeships, depending on the urbanization level and GDP *per capita*.

Results. The study shows that there is a strong linear relationship between the prevalence of obesity and GDP *per capita* of each examined region. During the study, the correlation between the level of prevalence of obesity and urbanization level produced a negative result.

Conclusion. The high level of regional economic development in the economic transformation states has a significant impact on the increase in the percentage of people with overweight and obesity in the population aged 15–29. Gender and place of residence (urban or rural areas) did not show significant correlation with the occurrence of overweight and obesity in the study group of the population.

Key words

Adolescent obesity, urbanization level, GDP *per capita*

INTRODUCTION

Control over the quantity of consumed food is held by hunger and satiation centres located in the central nervous system – in hypothalamus, limbic system, rhinocephalon and cerebral cortex. The main structure of that system is the arcuate nucleus, involving both neurons producing activating neurotransmitters (neuropeptide Y, agouti protein), and appetite inhibiting neurotransmitters (antiorexygenic substances: proopiomelanocorin, cocaine and amphetamine transcripts). Nutritional centres receive information in chemical form from energetic substrates (glucose, free fatty acids, amino acids) and from neurotransmitters (gamma-aminobutyric acid – GABA, acetylocholine, adrenalin, dopamine, serotonin, endorphins). Stimuli continuously reach regulation centres that affect glucose usage, insulin release, thermogenesis and food consumption. The most pronounced effect on appetite are exerted by the following neurotransmitters:

- activating: noradrenalin (increased appetite for carbohydrates);
- inhibiting: serotonin (reduced appetite for carbohydrates) and dopamine (inhibiting consumption of fat) [1].

Most commonly diagnosed in the population of children and adults (over 90% of cases) is simple obesity (idiopathic, primary, monosymptomatic), a condition that is not accompanied by other pathologies, but a result of disturbance of a balance between quantity of energy supplied with food, and energy used by the organism. This type of obesity is often genetically conditioned – other members of a family present excessive body weight, being most probably a result of a low rate of basic metabolism. Environmental factors play an important role in development of simple obesity: eating is sometimes a way of escape from stress (divorce of parents, unfortunate events in the family, sexual abuse, school failures); physical activity is highly limited and the family presents incorrect eating habits. Children in families where other members have excessive body weight and adolescents during pubescence are especially predisposed to the development of primary obesity.

Juvenile obesity is a result of reduced growing rate associated with lower demand for energy. A child's appetite

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is rather good, leading to accumulation of fatty tissue that will become a source of energy for significant metabolic expenditures during pubescence.

Secondary obesity (pathological obesity) is a result of diseases of the hormonal system, nervous system, genetic defects, or is a result of a long-term pharmacotherapy [2]. Secondary obesity may be caused by:

- diseases of the endocrine system: Cushing's syndrome, hypothyroidism, hypoparathyroidism, growth hormone deficiency, hyperinsulinism, pubescence, climacterium and pregnancy-related disorders;
- diseases of the nervous system: cerebral palsy (may be associated also with cachexy), spinal muscular atrophy, tumours of the central nervous system, condition post-meningitis and encephalitis, condition post-injuries of the central nervous system;
- genetic and chromosomal syndromes: Down syndrome, Turner syndrome, Klinefelter syndrome, rare genetic syndromes, storage diseases;
- long-term pharmacotherapy: steroids, antiepileptics, psychotropes and sedatives.

Pathogenetic division includes also a regulative obesity in which – under the influence of various factors – mental, hormonal, economic – the normal mechanism of hunger and satiety becomes disturbed leading to disturbance in eating habits.

In metabolic obesity, the basic cause for hypertrophy of adipose tissue is a congenital or acquired disorder in the metabolism of carbohydrates or lipids [3].

Depending on the distribution of subcutaneous tissue, the following types of obesity are discriminated:

- androidal (abdominal, visceral, 'apple-like') characteristic for males. Fat accumulates mostly in the abdomen. In that type, the risk of accompanying metabolic disorders, arterial hypertension, diabetes and circulatory disorders is particularly high. It is a result of the fact that fatty tissue present in the abdomen is more susceptible to the action of hormones causing increase in the fat level in blood, compared to fat accumulated elsewhere;
- gynoidal (buttock-thigh, 'pear-like'), occurring mostly in females. Fatty tissue is localised mostly in the hips, buttocks and thighs.

Types of androidal and gynoidal obesity are different from the metabolic point of view. In the case of the abdominal type, a metabolic syndrome develops (insulin resistance syndrome) characterised by hyperinsulinaemia, hyperuricaemia and high blood fibrinogen level, and also an unfavourable composition of plasma lipids (increased level of triglycerides, LDL cholesterol, with reduced level of the HDL fraction). Therefore, patients belonging to that group present hypertension, type II diabetes and various types of atherosclerosis: coronary disease, strokes, limb ischaemia, increased risk of thrombo-embolic events, more often than the group with gynoidal type of obesity. The tendency for accumulation of fat in the abdomen is strongly generically dependent, and develops mostly during adulthood [1].

Causes of secondary obesity, associated with diseases of the nervous system, hormonal system, medication and chromosomal and genetic disorders have been presented before (types of obesity). The most common cause of obesity is a positive energy balance being a result of excessive energy consumption in relation to energy used on the basic metabolism, movement and thermogenesis.

Strongly marketed products ready for consumption, with low nutritional value but high caloric load, are a basis of nutrition in many families in highly industrialised countries. Children receive candy bars, snacks, chips, cookies and cola drinks as a lunch for school, instead of fruit and mineral water. They are often given some money to buy lunch themselves, it is therefore no wonder that they buy what they like most – highly caloric food. Adolescents often eat at fast-foods outlets. High-energy food sold there contains a significant quantity of saturated fat and trans isomers, combined with low dietary fibre, trace elements and antioxidants. The reason for the high incidence of obesity in children from poor regions is sought in an improperly balanced diet rich in carbohydrates and fats, and in irregular meals. Children and adolescents living in poor families also have a limited access to sport facilities, which leads to low physical activity and improper lifestyle, with most of the time spent in front of the TV or a computer, with fatty snacks at hand.

Long-acting negative psycho-emotional factors, such as: emotional problems, improper family relations (divorces, separations), sexual abuse, unfortunate events, stressful lifestyle under constant mental stress, e.g. high expectations in school and in family, are compensated by the pleasure of eating. At the same time, they may disrupt the function of the hypothalamic and cortical centres of hunger and satiety, leading to constant stuffing.

The foetal life period is highly important for the shaping of a child's body weight after birth and later on. Study results indicate that the mother's overweight and excessive energy supply during the prenatal period favour infantile obesity [4], thus increasing the risk of metabolic syndrome, associated with damage to pancreatic islet system, formation of insulin-resistance, changes in vascular reactivity and arterial hypertension. It is also believed that the early introduction of artificial feeding favours increase in body weight in infants, which is supposed to be a result of increased protein consumption, in comparison to breast-fed infants, although literature data are not consistent in that respect [5].

Clinical observations indicating more the common occurrence of obesity in children of overweight parents have become a basis for genetic search for a gene of obesity. It is known that correct body weight is conditioned by numerous genes, and obesity may be a result of a disorder of the function of body weight-controlling genes by effect on proper thermogenesis, accumulation and metabolism of fat, maintenance of appropriate count of adipose cells, etc.

Realisation of a genetically conditioned tendency to obesity depends on environment. If food is easily available and physical exercise limited, the expression of genes responsible for body weight gain leads to obesity. The effect of environment is probably the strongest during childhood, when eating habits are shaped, usually to the standard presented by parents [2].

Nowadays, several genes have been isolated that may contribute to obesity. They are responsible for synthesis of proteins participating in metabolism of fat, hormones, neuropeptides and appetite-controlling cytokines. The best known is the *ob* gene located on the 7th chromosome. Its product is a protein – leptin – produced by fatty tissue. With blood, the protein reaches the hypothalamus, where it binds to the receptor causing inhibition of synthesis and release of neuropeptide Y, that increases appetite and reduces

thermogenesis. Leptin increases the sense of satiety, reduces appetite, intensifies thermogenesis by intensification of energy consumption and reduces blood insulin and glucose level [6]. As in obese patients the blood level of leptin is usually higher than in individuals with regular body weight, it is believed (though not proven) that some substances antagonistic to leptin exist, causing leptin-resistance.

Study results indicate a serious fluctuations of expression of the *ob* gene during hunger and return to normal nutrition. During starvation (e.g. in patients with anorexia nervosa) the level of leptin drops beyond the limit of detectability, and increases to very high values during increased calory supply, which may cause trouble with achieving a regular body weight in the face of reduced appetite and increased energy usage. On the contrary – in obese people who use caloric restrictions – the blood level of leptin drops; thus increasing appetite, reducing thermogenesis and use of energy, which may render difficult the maintenance of hard-regained reduced body weight [7].

Hereditary factors play an important role in shaping of the psycho-physical structure. Genetically-conditioned tendency for excessive body weight may be a result of a significantly increased susceptibility to environmental stimuli favouring body weight gain.

Consequences of obesity and its therapy. The following consequences of obesity may be present:

pulmonological: bronchial asthma (more severe course compared to slim children), reduced tolerance to exercise, sleep apnoea;

- orthopaedic: flat feet, knee valgity, postural defects;
- endocrine: premature pubescence, type II diabetes, hypogonadism, polycystic ovary syndrome.
  Diabetes is a result of insulin-resistance developing as a result of long-term postprandial hyperglycaemia. The condition leads to reduction in number of insulin receptors or a change in their structure. Compared to slim people, obese patients are at 10-fold higher risk of diabetes. In 1992, only 4% of newly diagnosed diabetes in children was of type II, and only two years later the ratio increased 4-fold; moreover, it was noticed that over 90% of affected children had a BMI over 90 percentile characteristic for the age [8]; gGastroenterological: fatty degeneration of the liver, cholelithiasis.
- Circulatory: hypertension, strokes and arterial atheromatosis during adulthood;
- abnormal blood lipid profile: ↑LDL CHOL, ↑ TAG, ↓HDL CHOL;
- emotional disorders and psycho-social consequences.

Obese children are discriminated by peers, they have a low self-estimation, sometimes they present symptoms of depression, and the depression becomes more strongly expressed with increasing BMI [9]. Those disorders favour the development of anorexia nervosa and bulimia.

According to recommendations issued by experts, therapy should be provided for children with obesity diagnosed on the basis of BMI exceeding 95 centile. Effective therapy that does not involve pharmacotherapy in the case of children (efficacy and safety of appetite-inhibiting drugs have not been studied in children) should be provided by a team of specialists, including a paediatrician, endocrinologist, dietician, psychologist and a physical therapist.

The basic principles of therapeutic conduct in the case of simple obesity are as follows:

- major caloric restrictions should not be used in the case of children under the age of 7 years, and diet should be constructed on an individual basis and should cover demand on all nutrients, ensuring proper growth and development of a child;
- improper eating habits should be modified: share of vegetables and fruit (bananas, grapes and candied fruit are high caloric food), fish, groats and wholemeal bread should be increased with reduction of non-saturated fat of animal origin; drinks with high content of sugar should be eliminated, and fast-foods should be avoided or consumed only sporadically;
- care should be taken that the child eats at regular hours and avoids between-meal snacks, especially sweets, chips and other high-caloric products;
- more physical exercise (bicycle riding, playing ball, dancing, swimming at least half an hour a day) and less time in front of a TV and computer;
- the child should be engaged in the therapy and self-control in form of a diary recording quantity and caloric value of consumed meals.

Body weight loss should be gradual but systematic, and achieved effects should be maintained in subsequent years.

The scope of the overweight and obesity problem is increasing daily. Although the scope of this big problem is representative of rich industrial countries, whose population have easy access to inexhaustible quantities of relatively cheap, tasty and energy-rich food, it is also present in poor countries with predominantly very greasy and poor quality food. North America has the highest obesity rate in the world – almost a third of the US population has a BMI of 30.00 kg/m^2. The incidence of obesity is also increasing rapidly in many European countries, in spite of all the efforts by public health authorities. Even in Japan, a country where obesity is still not an appreciable problem, about 16% of the population have elevated BMI, which indicates a growing problem [10, 11]. The global problem has become vast, more obvious and more expressed, together with the growing concern for the reasons responsible for this increasing public health problem. There are significant variations in the prevalence of overweight people between different countries. Differences complicate comparison of data in the time period in which data were collected in different countries. At least one billion people worldwide are overweight or obese (BMI ≥ 25.00 kg/m^2), and 300 million people worldwide are now overweight (BMI ≥ 30.00 kg/m^2) [12].

Although the initial obesity had the highest percentage in the developed countries, particularly in the USA, developing countries are rooted in the time to solve the problem of malnutrition. In the moment when underdeveloped countries become richer, there occurred migration from rural to urban environment and the increasing of intake of energy-rich food, with accompanying decrease in physical activity observed. As the obesity associated with a number of chronic diseases, the increasing prevalence of overweight carries potentially serious implications for the health of the population and costs in the health systems of these countries.

The last decade in Poland has highlighted the transformation of adverse trends in the health care situation, including a slowing the growth of life expectancy, a high ratio premature

mortality, which may be the result of the rising epidemic of overweight and obesity and insufficient physical activity of the population [13]. The prevalence of overweight and obesity in Poland, unfortunately is increasing rapidly. On the basis of anthropometric measurements conducted in 2000 as part of the project 'Studies of individual food intake and nutritional status of households' carried out by the Institute of Food and Nutrition, in collaboration with the Central Statistical Office, excess body weight was observed in 56.7% of adult males (obesity 15.7%) and in 48.6% of females (19.9% obese). It was also shown that there was an increased incidence of obesity with age [14]. Overweight was also found in 19.9% of boys (4% obese) and in 14.5% of girls (at 3.5% obese) [15].

MATERIALS AND METHOD

To show the regional distribution of the prevalence of obesity in the adolescent population across Poland, a voivodeship as an entity of regional autonomy was used. Voivodeships were divided in two groups according to urbanization level. The definition of urban and rural areas, however, has changed over time. The criteria for the identification and allocation of areas and regions, according to the OECD classification, were determined based on the degree of urbanization. They include 2 levels of territorial analysis: local and regional. The local level included a basic administrative unit, classified as urban or rural according to the following criteria:

- a rural area is an area where the population density is 150 persons per km^2;
- an urban area is an area where the population density is 150 persons per km^2 or more;
- At the regional level (NUTS 3), functional or administrative units are classified according to the percentage of the population living in the area, for rural areas (according to the criteria of the local level), distinguished by three types of regions:
  - predominantly rural (PR), if more than 50% of the population live in areas classified as rural local criteria level local;
  - intermediate (IN): if the percentage of people living in local areas classified as rural is 15–50%;
  - predominantly urban (PU): if less than 15% of its local residents live in areas classified as rural.

For the purpose of the presented study, the voivodeships with more than 50% of inhabitants living in urban settlements (urbanization index >0.50) were defined as predominantly urban voivodeships, while regions with less than 50% of inhabitants living in urban settlements (urbanization index <0.50) were defined as predominantly rural voivodeships.

Voivodeships were also divided into two groups according to the GDP *per capita*. The quartile method was used as criteria for the division of regions.

The definition of youth is not in any of the international conventions to which Poland is a party. This concept includes a person defined differently for a transitional period between the end of childhood and attaining full biological and social maturity. Both of these limits are imprecise, but widely consider a young person to be aged 15–24. However, depending on the age ranges of data sources, these are presented inconsistently, which directly results from the methodology of the study carried out by the Central Statistical Office, the methodology of international research on health behaviour of school children, as well as the methodology of data collection and research by scientific institutes. Therefore, in order to harmonize the age group, the study assumed a broader age group, representing adolescent and young adults aged 15–29 years.

General demographic data and characteristic of investigated overweight and obese population in 2009 is shown in Table 1.

For validation studies, comparative tests were also conducted on the frequency dependence of the prevalence of obesity and overweight in particular groups (females and males) in the total population aged 15–29 years in different

Table 1. General demographic data and characteristic of investigated overweight and obese population in voivodeships

Voivodeship	No of inhabitants [thousands]	Urban population [thousands]	Female population [thousands]			Male population [thousands]		
			Age 15–29	Over weight	Obesity	Age 15–29	Over weight	Obesity
Dolnośląskie	2877.8	2016.8	241.4	41.5	7.2	223.0	71.0	11.7
Kujawsko-pomorskie	2069.5	1252.9	174.2	22.5	4.0	165.1	55.4	13.0
Lubelskie	2151.9	1002.6	195.3	13.8	2.3	177.3	47.0	7.3
Lubuskie	1011.0	641.7	88.2	9.8	4.0	75.9	26.4	4.3
Łódzkie	2534.4	1621.9	217.4	17.3	4.4	199.4	62.0	11.3
Małopolskie	3310.1	1627.8	275.1	34.5	6.5	259.4	72.7	8.9
Mazowieckie	5242.9	3385.8	472.9	44.0	22.8	497.0	173.7	23.0
Opolskie	1028.6	537.5	77.9	8.3	1.8	62.9	13.7	5.5
Podkarpackie	2103.5	870.0	200.0	17.5	3.4	191.0	54.5	9.2
Podlaskie	1188.3	717.8	108.0	8.9	0.5	99.7	33.9	2.3
Pomorskie	2240.3	1477.7	191.8	21.7	8.6	179.3	58.2	8.7
Śląskie	4635.9	3613.7	386.2	44.1	8.2	376.9	90.1	29.6
Świętokrzyskie	1266.0	570.3	98.8	15.1	2.7	86.3	21.5	3.1
Warmińsko-mazurskie	1427.2	852.7	153.2	17.6	3.3	146.3	45.5	8.0
Wielkopolskie	3419.4	1910.7	333.3	31.9	14.2	333.4	101.2	22.7
Zachodniopomorskie	1693.1	1164.5	170.6	15.5	10.0	154.8	38.1	5.3

Source: GUS, *Rocznik Statystyczny* 2010: male and female population figures [16]

regions of the index of urbanization and GDP *per capita*. The prevalence of obesity in the population aged 15–29 years was determined as the ratio of the sum of overweight and obese people to the total number of the population aged 15–29 years.

The Urbanization Index was calculated by dividing the number of people living in urban area by the total number of inhabitants in the voivodeship.

The obesity indicator determining the percentage of overweight and obese people and the Urbanization Index in the individual regions were determined and presented (Tab. 2).

Table 2. Prevalence of overweight and obesity in population aged 15–29 years, GDP *per capita* and Urbanization Index by voivodeships (2009)

Voivodeship	Female	Male	GDP *per capita* [zł]	Urbanization Index
Dolnośląskie	20.17%	37.09%	38 427	0.701
Kujawsko pomorskie	15.21%	41.43%	29 866	0.605
Lubelskie	8.24%	30.63%	23 679	0.466
Lubuskie	15.65%	40.45%	30 108	0.635
Łódzkie	9.98%	36.76%	32 204	0.640
Małopolskie	14.90%	31.46%	30 251	0.492
Mazowieckie	14.13%	39.58%	56 378	0.646
Opolskie	12.97%	30.52%	28 811	0.523
Podkarpackie	10.45%	33.35%	24 157	0.414
Podlaskie	8.70%	36.31%	25 983	0.604
Pomorskie	15.80%	37.31%	34 296	0.660
Śląskie	13.54%	31.76%	37 800	0.780
Świętokrzyskie	18.02%	28.51%	27 357	0.450
Warmińsko mazurskie	13.64%	36.57%	26 029	0.597
Wielkopolskie	13.83%	37.16%	37 462	0.559
Zachodniopomorskie	14.95%	28.04%	30 978	0.688

Source: GDP *per capita* [17]. Prevalence of female and male obesity and Urbanization Index; – author's own calculations using figures from Table 1

Statistical analysis. Data are presented as mean ± standard deviation (SD). Parametric statistics, t-test, and Pearson correlation were used to analyse the differences in scores between different groups in voivodeships (urban vs. rural and richer vs. poorer), and to test the relationship between the number of overweight and obese female and male population. The level of statistical significance was set at $P<0.05$. Data were analysed with STATISTICA software (Stat-Soft Inc., Tulsa, OK, USA).

RESULTS

There were no significant differences in the number of overweight and obese male and female population in urban and rural regions, and between predominantly urban and predominantly rural regions (Tab. 3).

Table 3. Characteristics of overweight and obese population in urban and rural regions (No. of overweight and obese population mean±SD)

Subgroup of population	urban regions	rural regions	P	t (df=16)
Female	31.0±17.59	23.59±9.99	0.291146	3.74481E-12
Male	12.12±8.23	56.05±20.63	0.336649	7.31545E-06

In terms of rich and poor voivodeships, an opposite phenomenon was observed. Tests showed that there was a strong correlation between the numbers of people with overweight and obese weighted by GDP *per capita*. This relationship occured among both males and females (Tab. 4).

Table 4. Characteristics of overweight and obese population in richer and poorer regions (Number of overweight and obese population mean±SD).

Subgroup of population	richer regions	poorer regions	P	t (df=16)
Female	41.55±14.16	16.94±5.45	0.86606	3.41042E-11
Male	98.52±44.64	43.83±17.35	0.87238	3.32455E-11

The above studies refer only to the number of obese and overweight people occurring in the various provinces. The dependency of percentage of overweight and obese people in the total population of the Urbanization Index and GDP *per capita* is presented in Tables 5 and 6.

Table 5. Characteristic of overweight and obese population in urban and rural regions (percentage of overweight and obese people in total population mean+SD)

Subgroup of population	urban regions	rural regions	P	t (df=16)
Female	12.87±2.21	12.90±3.80	0.291146	3.74481E-12
Male	36.39±3.47	30.98±1.74	0.334825	1.89193E-08

Table 6. Characteristic of overweight and obese population in richer and poorer regions (percentage of overweight and obese people in total population mean+SD).

Subgroup of population	richer regions	poorer regions	P	t (df=16)
Female	14.66±2.64	12.86±3.26	0.337412	3.45571E-11
Male	34.89±3.70	34.72±4.45	0.375601	3.456E-11

There were no significant differences in the percentage of overweight and obese population in the total population of males and females in urban and rural regions between predominantly urban and predominantly rural voivodeships (Tab. 5) and the percentage of overweight and obese population males and females in richer and poorer regions (Tab. 6).

The higher percentage of males than females (overweight and obese), regardless of the level of urbanization and GDP *per capita,* is noticeable.

DISCUSSION

The presented study shows that in Poland, as in other countries around the world and in Europe, the problem of overweight and obesity in the population is a serious one. The location and prevalence of overweight and obese adolescents in Poland is shown by Figure 1. The occurrence of this phenomenon is presented by dividing the country into two groups using the criterion of quartiles.

In the population of females and males, aged 15–29 years, the problem of overweight and obesity, to a greater extent, affects males more than females. The high level of SD in the male population living in areas with high a GDP *per capita* (98.52±44.64), indicates the heterogeneity of the studied areas.

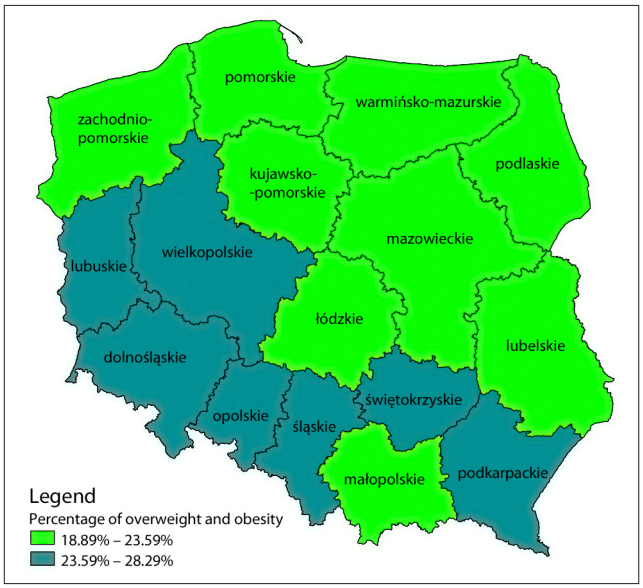

Figure 1. Regional distribution of prevalence of obesity in adolescent population across Poland

This may mean that the group of rich areas are located in both urban and rural areas (e.g. Wielkopolskie) with complex of internal urbanization structure. The results of the quantitative prevalence of obesity and overweight among men in rural areas could be indirect evidence of this. In these areas, SD is also a significant value in relation to the average (56.05±20.63). The bigger number of obese females only occured in urban areas (31.0±17.59); however. their share in the total population of women living in areas with a high index of urbanization is equal 12.87 ±2.21, and is not significantly different from the same index for females living in rural areas (12.90 ±3.80). High rates of both quantitative and structural indexes are representative for the female population living in rich areas. The presented study confirms previous results by other authors studying the problem of obesity and overweight [18, 19]. In Poland, as in other countries, the prevalence of obesity and overweight is closely correlated with the economic development of the region, as measured by the GDP *per capita*. The tests performed showed a significant correlation between the number of obese people (males and females) and the region's wealth as measured by the GDP *per capita*.

Obesity and low physical activity raises specific health and economic consequences. The most important chronic diseases resulting from faulty nutrition in developed countries include: cardiovascular disease, cancer, obesity, type 2 diabetes, dyslipidaemia, osteoporosis and gastrointestinal disease. Faulty nutrition, in addition to low physical activity, induces the development of obesity, diabetes, dyslipidemia and hypertension [20]. These diseases in turn cause atherosclerosis, clinically manifested as coronary heart disease or stroke. A particularly unfavourable role is played by abdominal obesity, which is itself a risk factor for type 2 diabetes, dyslipidemia and hypertension.

The association of obesity with these diseases is called metabolic syndrome. It is found in over 25% of people in Poland and is a very strong risk factor for cardiovascular disease. Cardiovascular diseases are currently the biggest health problem in Poland and are the cause of 46% of all deaths. Cancer causes 25% of all deaths [21].

It is expected that if the situation on the prevalence of overweight and obesity does not improve, in many countries it will result in a reduction in the average duration of life; for example, in the UK, the middle of this century, the average life expectancy may be reduced by 5.3 years [22]. Serious consequences can result in overweight and obesity among children and adolescents. They may be the cause of various disorders of psychological development, leading to depression and eating disorders, and the result may be worse academic performance. Obesity may also cause disorders of sexual maturation. Among the complications of obesity occurring in children should be include type 2 diabetes. Hypertension, gallstones, gastroesophageal reflux disease, and asthma. Obesity in children has a significant risk of continuation of obesity in later life.

CONCLUSIONS

Analysis of the presented results shows that the prevalence of obesity in Poland among the overweight and obesity population is not related to their place of residence – urban or rural. At the same time, the study shows a strong relationship between the incidence of overweight and obesity in the population and economic growth measured by the GDP *per capita*. Gender has no significant role in overweight or obesity.

The occurrence of a significant percentage of obese people in rich regions suggests that a high level of wealth is used for their own existential needs, but has no effect on improving the quality of nutrition which may be the cause of overweight and obesity in the society. This situation may indicate a low level of awareness of the consequences of irrational use of own resources. It therefore seems advisable to carry out studies of obesity through the prism of the socio-economic development indictors of regions, taking into account other data, such as the level of education, access to health services and prevention activity. Such studies could answer the question whether obesity in Poland is a result of faster economic growth and slower growth in public awareness, which is so characteristic of the economic transformation of countries, or the society consciously resorting to irrational choices. Appropriate international comparative studies would also be advisable.

There is an urgent need for the health education of children and adolescents, because almost one third of the young population with excessive body weigh demonstrate signs of metabolic syndrome [23]. Both parents and physicians should educate their children and patients about the necessity for a balanced diet, avoiding situations favouring body weight gain, and promoting an active lifestyle.

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