

## RESEARCH STUDIES

### Childhood obesity – a major problem of public health

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#### Abstract

**Background:** The rate of childhood overweight and obesity is increasing in all countries. Overweight in children represents a very dangerous tendency because for long term it may cause serious health problems such as cardiovascular diseases, type 2 diabetes, hypertension, various forms of cancer and other major chronic diseases, which are generating premature mortality and long-term morbidity.

**Material and methods:** It has been carried out a secondary study, a narrative review of scientific bibliographical sources dedicated to the problem of obesity in children. The analysis is based on 50 literary sources of foreign authors (USA, Great Britain, Romania, Russia, the Netherlands, Slovenia, Croatia, France, Germany and Italy) and international organizations, published in the period 2000-2014.

**Results:** Globally, it is estimated that 170 million children under 18 years old are overweight. About 60% of obese children become obese adults. In the Republic of Moldova the statistical records on overweight and obesity among children are incomplete. Many studies show that obesity in children is characteristic for school age, being registered a rate of 10-30%. In order to determine if the excess of adipose tissue can cause health problems it is necessary to calculate the BMI 2-20 years/age/sex according to nomograms CDC 2000 and perform additional investigations: abdominal, tricipital and subscapular skinfold measurement, abdominal circumference, hip circumference, relation between abdomen and hip circumference, determination of adipose tissue percentage by advanced methods, evaluation of nutrition, physical activities and family background. Obesity in children is a risk factor for cardiovascular diseases, hypertension, type 2 diabetes, sleep apnea syndrome, depressions, some forms of cancer, behavioral problems at school and low self-esteem. The performed studies show that the obesity occurred in childhood leads to the decrease of life expectancy due to the complications it determines.

**Conclusions:** Overweight children face multiple health problems, social and psychological problems. The problem of obesity has a major contribution to the global burden of chronic diseases, with serious social and psychological implications. Thus, research on overweight and obesity in children, with a stress on prevention, has a high priority.

**Key words:** overweight, obesity, children, health condition, determinants

#### Introduction

Childhood obesity is a major public health problem worldwide, increasing in all countries [3, 16, 39]. According to the European Commission data for 2014, over 22 million children in the European Union are considered overweight or obese, and this number is increasing each year by 400,000 [16]. The problem of obesity has a major contribution to the global burden of chronic diseases, with serious social and psychological implications, which are practically affecting all ages and socioeconomic groups [39]. Overweight in children represents a very dangerous tendency because for long term it may cause serious health problems such as cardiovascular diseases, type 2 diabetes, hypertension, various forms of cancer and other major chronic diseases [10, 21, 40, 48, 50]. These diseases cause premature mortality and long-term morbidity as well [19]. Additionally, overweight and obesity in children are associated with significant reductions of life quality and a greater risk of social isolation [45].

#### Material and methods

It has been carried out a secondary study, a narrative review of scientific bibliographical sources dedicated to the

problem of obesity in children. The analysis is based on 50 literary sources of foreign authors (USA, Great Britain, Romania, Russia, the Netherlands, Slovenia, Croatia, France, Germany and Italy) and international organizations, published in the period 2000-2014. The analyzed sources were classified into the following sections: background, definition of overweight and obesity in children, evaluation methods of overweight and obesity in children, etiology and determinants, health condition of overweight children, economic impact, and preventive measures against obesity in children. It was applied the qualitative method by comparing the same phenomenon in different countries.

#### Results and discussion

##### Epidemiology of obesity in children at international level

Obesity is the most common nutritional disorder of children in many countries, representing a major public health problem in many parts of the world [3, 16, 39]. Currently there is an epidemical and increasing tendency of the frequency of obesity and overweight in children, which have spread worldwide affecting about 20-25% of children and 45-50% of adolescents [16].

Globally, it is estimated that 170 million children under 18 years old are overweight [35]. According to WHO (year 2013) 43 million children under five years old are overweight. Over 60% of obese children become obese adults [16, 17].

The prevalence of obesity and overweight in children is increasing alarmingly in North America, Europe, and recently in Australia, China, South America and North Africa as well. The prevalence varies considerably between different regions and countries, from 5% in Africa and several parts of Asia, to more than 20% in Europe and 30% in America and in several countries in the Middle East [4].

The problem of obesity in children is global and it is spreading increasingly in the developing countries [11, 39]. For example, the prevalence of obesity in children aged 5-12 years old in Thailand has increased from 12.2% to 15.6% in just two years, in Mexico the percentage of overweight and obese children is 41.8%, in Brazil – 22.1%, in India – 22.0% and in Argentina – 19.3%. Sedentary lifestyle and fast change of food practices have resulted in increase of prevalence of obesity in children aged 5-19 years old in developing countries [11].

Obesity in children in Europe has tripled in the last 20 years (European Commission 2007) [7]. In most countries from the Western Europe the obesity has a frequency of 10-25%, in Eastern European countries and Mediterranean countries the frequency is much higher, reaching 40% in female sex. In the Northern European countries, the prevalence of overweight in children is 10-20%, while in the South Europe it reaches 20-35%, the prevalence being in ongoing increase.

According to the European Commission data for year 2014, over 22 million children in the European Union are considered overweight or obese, and this number is increasing each year by 400 000 [16].

Great Britain, Slovenia and the Netherlands are countries in which there have been registered alarming rates of overweight and obesity among children, Great Britain being in the top of the EU countries that are facing this problem [3].

A study performed in Romania on a lot of 7904 children from I-XII grades, coming from 20 schools from Cluj-Napoca, in 2008 showed a prevalence of overweight of 12.8% and a prevalence of obesity of 8.2%. The highest prevalence has been registered in the age group of 6-10 years old for both overweight (15.9%) and obesity (13.3%), and the lowest one in the adolescents (7.6% for overweight and 3.8% for obesity) [46]. Another study performed in Craiova in 2011 established a prevalence of overweight in children of 8.8% (21.2% in preschool children and 7.1% in school children) and a prevalence of obesity of 13.7% (24.2% in preschool children and 12.2% in school children) [4]. According to data provided by the Society of Endocrinology from Romania for 2013, 40% of children are overweight.

In the Republic of Moldova, statistical records on overweight and obesity among children are incomplete. There were considered some particularities that facilitate the occurrence of overweight in the population through Multiple

Indicator Cluster Survey (MICS 2012); Study on physical development in children (COSI) from 2013. But it is also known about the alarming situation of overweight and obesity in adults. The data included in the National Strategy of Public Health for the years 2014-2020 show that in the Republic of Moldova about 50% of adults are overweight or obese [12]. In the National Strategy for prevention and control of non-communicable diseases for the years 2012-2020 it is noted that 73.1% of overweight and obese people suffer from hypertension, and 71.6% of them suffer from coronary heart diseases [13]. STEPS 2013 study regarding the evaluation of risk factors for non-communicable diseases in the Republic of Moldova has determined that 56% of the adult population is overweight [36].

#### Definition of overweight and obesity in children

Obesity is a chronic disorder of nutrition condition characterized by increase of body weight due to the pathogenic adipose tissue, being a consequence of an accumulation of energy, resulted from an imbalance between intake and output of energy [1, 33].

The manifestation of obesity in children has certain tendencies depending on the age and gender of the child [4]. Obesity is common in infancy, especially in the first 6 months, followed by a transient decrease in weight at the age of 4-6 years (adiposity rebound) [21]. This age is considered a critical period with increased risk for obesity in childhood that may persist in the adult (Winickoff et al., 2003). In the period of adiposity rebound changes in the organs and tissues may occur (Fitzgibbon et al., 2002). Children who become overweight during this period are more likely to become obese adults. Obese children up to 3 years old with normal weight parents are exception, having a low risk for obesity in childhood. The probability of the child in becoming obese increases by 4-5 times if this child has obese parents (Summerbell et. al, 2002, Dietz, 2003 Daniels et al., 2005).

It was found out that the increase of prevalence of overweight in boys occurs within prepubertal age and in girls during puberty. Many studies show that obesity in children is common for school age, being registered a rate of 10-30% [21].

Another particularity of the occurrence of obesity in children is a higher prevalence among girls, and this tendency increases with the age. 10.7% boys manifest more frequently a light degree of obesity [67].

Philip R. Nader [33] highlighted some age groups with increased risk of obesity in children aged: 2-4 years, 7-9 years and 12-13 years. If at the age up to 54 months, the BMI value was of 75-85 percentiles, then the child is 6 times more likely to be overweight at the age of 12 years; if at the age of up to 9 years, the BMI value was of 75-85 percentiles, then the child has a chance of 40-50% to be overweight at the age of 12 years.

Krebs F. Nancy et al. [21] investigated the probability of becoming overweight or obese in adult age depending on the age at which overweight and gender occurred. In girls with BMI > 85 percentiles at the age of 3-4 years the probability of becoming obese adult is up to 20%, at the age 5-17 years – 20-

40%. In boys this probability is up to 20% if BMI > 85 percentiles between 3-16 years, 20-40% – at the age of 17 years.

#### **Methods of evaluation of overweight and obesity in children**

In children with the age past 2 years the obesity is defined by increased BMI (body mass index) values related to sex and age. The child is obese if  $BMI \geq \text{percentile } 95 (+ 2DS)/\text{sex}/\text{age}$ , is overweight if  $\text{percentile } 85 \leq BMI < \text{percentile } 95/\text{sex}/\text{age}$ , has normal weight if  $\text{percentile } 5 \leq BMI < \text{percentile } 85/\text{sex}/\text{age}$ , is underweight if  $BMI < \text{percentile } 5/\text{sex}/\text{age}$  [4, 21].

For evaluating nutrition condition in children aged past 2 years, CDC and AAP recommend the use of BMI 2-20 years/age/sex charts (CDC 2000) [2, 30].

BMI is not a direct indicator of adipose tissue mass because it does not distinguish the adipose tissue from muscle mass, bones and vital organs. A child may have an increased BMI/age/sex, but to determine if the excess of adipose tissue can cause health problems some additional investigations are necessary: abdominal, tricipital and subscapular skinfold measurement, abdominal circumference, hip circumference, relation between abdomen and hip circumference, determination of adipose tissue percentage by advanced methods (Dual-energy X-ray absorptiometry (DEXA), bioelectric impedance, etc.), evaluation of nutrition, physical activities, family background [23, 43, 50].

Measurement of the thickness of (abdominal, tricipital, subscapular) skinfolds is performed using the caliper and it is an indicator that distinguishes the adipose tissue mass from the muscle mass when a high BMI is established. Expert Committee of 2007 does not recommend the routine use of the measurement of tricipital skinfold for evaluating the obesity in children [21].

Measurement of abdominal and hip circumference is an indirect indicator regarding visceral adiposity. These indicators are commonly used to assess the risk of comorbidities (diabetes type 2, hypertension, hyperlipidemia, hypertriglyceridemia, metabolic syndrome, coronary artery disease) [2].

An important indicator is the ratio between abdominal and hip circumference, which is used in adolescent and adult for evaluating the cardiovascular risk. If this ratio exceeds the value 1 and abdominal circumference  $\geq 102$  cm in boys, if the ratio between waist and hip circumference  $\geq 0.85$  and abdominal circumference  $\geq 88$  cm in girls, then there is a high cardiovascular risk (Cole et al. 2000) [5].

There are advanced methods for the determination of total adiposity, such as abdominal ultrasonography, Dual-energy X-ray absorptiometry (DEXA), bioelectric impedance, densitometry, computed tomography, magnetic resonance imaging are used on a low scale and, especially, for the research purposes, because they have a high cost, poor availability and require a high level of training for users in order to ensure adequate reliability [4].

#### **Determinants of obesity in children**

The etiology of obesity is complex. The interaction of several factors, including genetic, metabolic, behavioral and environmental ones, has increased overweight and obesity

in children. [1, 8, 28, 50]. The speed of obesity spreading suggests that behavioral and environmental factors, rather than biological factors, have directly contributed to the epidemic [64].

According to the Report of the “First Meeting of the Ad Hoc Working Group on Science and Evidence for Ending Childhood Obesity” (18-20 of June, 2014, Geneva), infant obesity is determined by interactions between biological, behavioral and social factors [38].

Biological factors include maternal malnutrition (unbalanced nutrition, including both underfeeding and overfeeding), obesity, and stress before and during pregnancy and maternal glycemia. Another factor resides in infant feeding, including short duration of breastfeeding (< 6 months); inadequate complementary foods, parents' great care that determines an overconsumption for child [8, 38, 39, 50].

Behavioral risk factors overlap with behavioral and biological factors and include sedentary behavior, sleep duration, fewer opportunities for sport, giving priority to transport, wide interest for broad entertainment provided by TV and computer. Behavioral factors related to food include frequent meals, consumption of foods high in calories, increased consumption of acidulous juices, concentrated sweets, fast foods, consumption of foods with a high degree of processing out of meal times, low consumption of fruits and vegetables, consumption of big portions, some bad eating habits (skipping breakfast, taking dinner in late hours and big portions, diet breach) [10, 28, 37, 38, 49].

Social factors include socio-economic issues, changes in work forms, nutritional education in the family, availability and affordability of healthy food [38, 43].

Excessive food intake and decreased physical activity are the main exogenetic factors that have a role in generating the obesity in children [1, 8, 11, 21, 48].

In a study conducted in Craiova in 2011 it was found out that overweight and obese children compared with normal weight ones, eat sweets daily (55.6%, respectively 42.3%, vs. 11%), acidulous drinks (38.8%, respectively, 38.2% vs. 8.2%), fast foods (31.8%, respectively 34%, vs. 8.3%). The results of the investigation on physical activity showed that 62.9% of overweight children and 64.5% of obese children do not perform physical activities in their free time [4].

Environmental factors that have an important role in the occurrence of overweight in children are family, kindergarten, school and community [21, 42, 43, 47]. Eating habits of their parents influence children's preferences and vice versa. Family behavior is influenced by socio-economical and cultural factors. Children are also influenced by advertising, starting with the school age they become more independent; they buy the desired food by themselves. Another major factor is the kindergarten and school, where the formation of a lifestyle and healthy eating habits takes place. Social environment (community) also may influence the children's behavior by reducing the sedentary life by increasing the accessibility to physical activities [3, 4].

### Health condition of overweight and obese children

Overweight children face multiple health problems, social and psychological problems [8, 39, 48]. In particular, child and adolescent obesity is a risk factor for cardiovascular disease, hypertension, type 2 diabetes, sleep apnea syndrome, depression, some forms of cancer, behavioral problems at school and low self-esteem [8, 10, 21, 40, 41, 48, 50]. These diseases cause premature mortality and long-term morbidity as well [59]. The results of studies show that the obesity occurred in childhood leads to the decrease of life expectancy due to complications it determines (OMS 2011) [31]. Additionally, overweight and obesity in children are associated with significant reductions of life quality and a greater risk of social isolation [45].

Topical issue of the problem is determined by the presence of multiple evidences proving an important relation between overweight and cardiovascular diseases. It has been outlined a linear relationship between the increase of BMI and weight of children with BP values past 90 percentiles: 3.45% – in underweight subjects, 14, 22% – in the normal weight subjects, 36.75% – in overweight subjects and 50% – in the obese subjects ( $p < 0.001$ ) [40].

Children with overweight have an increased risk of developing metabolic syndrome, which subsequently develops in type 2 diabetes and predisposes to cardiovascular diseases [32]. At least three indicators of risk are typical for obesity, such as hyperlipidemia, presented by high triglycerides, low density lipoproteins, high LDL, high density lipoprotein, low HDL; increased cholesterol level; glucosemia; insulinemia; hypertension [8].

Zimmet P. et al. [32] found out that in children aged 6-10 years old with BMI  $\geq 90$  percentiles, metabolic syndrome can be diagnosed, but additional investigation should be conducted if there is a family history of metabolic syndrome, type 2 diabetes, dyslipidemia, cardiovascular diseases, hypertension and/or obesity. At the age of 10-16 years and BMI  $\geq 90$  percentile, metabolic syndrome is established if triglyceride level  $\geq 1.7$  mmol/L ( $\geq 150$  mg/dL), HDL  $< 1.03$  mmol/L ( $< 40$  mg/dL), systolic blood pressure  $\geq 130$ /diastolic blood pressure  $\geq 85$  mm Hg, glucose  $\geq 5.6$  mmol/L (100 mg/dL).

Overweight causes overload of osteoarticular apparatus. Orthopedic disorders suffered by children with obesity include: Genu valgum, flat foot, edema of legs in orthostatism (upright position), joint pain, knee arthritis, aseptic necrosis of the femoral head, hyperlordosis [4, 19, 21].

Obesity in children increases the risk of gastrointestinal diseases, including hepatic steatosis, bile calculus, gastroesophageal reflux [8, 37]. There was detected an increased incidence of fatty liver disease in children in parallel with the increase of obesity incidence in childhood. Thus, the incidence of hepatic disease is assessed at 3% in the general pediatric population and 53% in obese pediatric population.

Obesity has become a major challenge for male and female infertility. Obese girls often face polycystic ovarian syndrome, early menarche, irregular menstrual cycles, unovulation caused by infertility [22, 24].

Obstructive sleep apnea is 4-6 times more common in obese children, being manifested by hypertension, left ventricular remodelling, daytime sleepiness, anxiety and inactivity. Obesity significantly increases the risk of developing asthma [8, 21].

Obesity is associated with some types of cancer, such as colorectal, ovarian, endometrial, cervical, breast and prostate cancer [19].

### Economic impact

The results of the studies conducted by the WHO in the European Region showed that the direct costs caused by obesity involve 2-4% from GDP [9]. But there are also indirect costs that are caused by low labor productivity (absence from work for health reasons or premature mortality). Assessments of such losses in England indicate that these costs could be two times higher than the direct costs [14].

According to data from world statistics, presently there are 1 585 768 510 overweight persons, 528589 504 obese persons, and for the treatment of diseases related with obesity in the USA \$ 341907 570 are spent [18].

In the USA it has been estimated that the total costs for health services due to obesity will increase to 861-957 billion USD by 2030, totaling 16-18% from GDP [28].

Calculations performed by the United States show that in comparison with persons of normal weight (BMI 20.0-24.9 kg / m<sup>2</sup>), obese persons (BMI over 30 kg / m<sup>2</sup>) consume annually by 36% more health services and overweight persons (BMI of 25.0-29.9 kg / m<sup>2</sup>) – by 10% more. The high costs associated with obesity and unhealthy lifestyle show that the savings could result from health promotion and prevention, at least for short term. Persons who adopt a healthier lifestyle will gain health and will add years to their lives generally [48].

### Preventive measures against overweight and obesity in children

National programs for prevention of obesity, particularly in children, treatment of comorbidities, reduction of mortality caused by overweight represent an international priority of public health [3, 44].

Children are victims of an intense advertising marketing for products very rich in fat, sugar and salt. WHO considers this alarming phenomenon is directly related with TV advertising for products that negatively form the food style of the children. [16]

The European Union is actively engaged in the fight against obesity in children. In order to intervene in this field, the European Commission has the Strategy for Europe concerning the issues related to nutrition, overweight and obesity, and two implementation tools, respectively “High level group on nutrition and physical activity” and “EU Platform for diet, physical activity and health”. Members of the High Level Group pledged to do more to tackle the alarming tendency related with the increase of obesity among children through an Action Plan on infant obesity (2013) [17].

In order to reduce this risk factor, WHO proposes a series of measures, by inviting the countries to eliminate in-

dustrial fatty acids from foods, promote the display of nutrition information on the labels, reduce the percentage of sugar and salt in foods and sugar in soft drinks or reduce the portion sizes. The action plan also recommends the increase of "financial affordability and consumption of fruits and vegetables" [34].

The tough fight the European authorities must lead is the fight against fast food products, ready-to-eat or frozen food, whose content of sugar, salt and fat is usually very high. Among the solutions currently explored, the scientists analyze a bio-technological process, based on enzymology and fermentation, which would reduce, for example, the presence of sugar in apple juice. Other scientific approaches point to the use of high hydrostatic pressure or a new type of homogenizer in order to improve the distribution of salt and fat in food products; the target is to reduce their presence by up to 30 percent. According to experts, the food can be juicy and tasty without too much salt, sugar or additives, if the processing technologies provide a better distribution of different ingredients [6].

Many EU countries (Great Britain, Slovenia, the Netherlands, Croatia, France, Germany and Italy) have developed and implemented certain strategies and actions in the field of healthy food and physical activity. These countries have concentrated their efforts on creating partnerships between education and health sectors in order to promote health in education institutions [3, 7].

Scottish Ministry of Health and Ministry of Education have joined their forces to create multi-sectoral partnerships aimed at involving schools, families, communities for the facilitation of access to adequate and safe food presented attractively, and also for understanding the role of a healthy nutrition and a healthy lifestyle. The most important actions that were implemented include: provision of free breakfast for children from primary school; stimulation of healthy food marketing within a pilot program conducted at three schools of secondary education; supply of water dispensers, highlighting the benefits of water drinking; stimulation of fruit consumption by placing fruit kiosks in schools; free swimming courses during the holidays; sports programs at the class level by encouraging the participation of the pupils and teachers [3].

In Slovenia a partnership between the Ministry of Health and Ministry of Education and Sport has been created in order to promote health. A special place has the national program on nutrition in schools, which requires all schools to give pupils at least one meal a day [26].

In the Netherlands one of the main national programs is called SchoolGruiten and stands for "fruits and vegetables in school". Within this program the children are acquainted with information on fruits and vegetables through various fun games. Teachers together with the pupils eat fruits and vegetables for two days a week in the classroom. This program has been already proven to be effective. A large study involving the participation of 300 primary schools with a total of about 75 000 children and 7 000 teachers involved in seven different cities, shows that children from Gruitschools

really eat more vegetables: from 1.1 portions per day to 1.6 portions per day [27].

Waters E. et al. in review Cochrane "Interventions for preventing obesity in children" have examined the characteristics of programs and strategies in this field [47]. The meta-analysis has included 37 studies (27 946 children) and showed that programs were effective in reducing the overweight and obesity in children. In particular, there were highlighted the most effective actions and strategies: amendments to educational program, which includes the introduction of topics on healthy food, physical activity and body image; increase of the number of hours of physical activity and the development of fundamental movement skills during the week at school; improvement of the nutritional quality of food supplied in schools; introduction of cultural and environmental practices that will encourage children to eat healthy foods and be active every day; training of teachers and medical staff in school in respect with health promotion strategies; involvement of parents in encouraging children to be more active, eat healthy food and spend less time in front of small screens (various brochures, guides, homework).

Generally, namely family and school have a profound influence on the young generation and form the behavior concerning healthy food and physical activity of children and adolescents [31, 43, 50].

## Conclusions

1. Childhood obesity is a major public health problem due to the epidemically increased tendency of the frequency of overweight in children that has reached to affect about 20-25% of children and 45-50% of adolescents worldwide.

2. Infant obesity is determined by interactions between biological, behavioral and social factors. Excessive food intake and decreased physical activity are the main exogenetic factors that have a role in generating the obesity in children.

3. Topical issue of the problem is determined by the presence of multiple evidences proving an important relation between overweight and cardiovascular diseases, type 2 diabetes, hypertension, some forms of cancer, hepatic steatosis, infertility and other major chronic diseases that cause premature mortality and long-term morbidity.

4. Epidemiologic and economic impact of obesity is high and the authorities' actions should be directed to its prevention by developing and implementing strategies and actions in the field of healthy food and physical activity for children. In the fight against obesity in children, many countries have focused their efforts on creating multi-sectoral partnerships aimed at involving schools, families, communities for the facilitation of access to adequate and safe food presented attractively, and also for understanding the role of a healthy nutrition and a healthy lifestyle.

## References

1. Dumitrescu Adriana Oana Particularități etiopatogenice în obezitate. 2008, Pitesti. *AMT*. 2008;II(4):124-127.
2. Barlow Sarah E. Expert Committee Recommendations Regarding the

- Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. *Pediatrics*. 2007;120:S164-S192.
3. Domnariu Carmen. Strategii privind alimentația sănătoasă și activitatea fizică la copii și adolescenți în unele țări europene. *Sănătate publică și management (Sibiu)*. 2010;2:2-8.
  4. Coșoveanu Carmen Simona. Obezitatea primară la copil - aspecte etiopatogenice, clinice și profilactice: rezumat la teza de doctor în medicină. Craiova, 2011.
  5. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320:1240-1243.
  6. CE propune noi metode în lupta împotriva obezității, 2013. ec.europa.eu
  7. European Commission Health and Consumer Protection Directorate General, Nutrition and Obesity Prevention, 2006.
  8. Freemark Michael. Pediatric Obesity Etiology, Pathogenesis, and Treatment. 1st Edition, 2010;XV. ISBN 978-1-60327-873-7.
  9. Fry J, Finley W. The prevalence and costs of obesity in the EU. Proceedings of the Nutrition Society, 2005.
  10. Gail Busby, Seif Mourad W. Obesity in adolescent. The Cochrane Library. *Obesity*. 2013;53-65.
  11. Gupta N, Goel K, Shah P, Misra A. Childhood obesity in developing countries: epidemiology, determinants and prevention. *Endocrinol Rev*. 2012;33:48-70.
  12. Hotărîre Nr.1032 din 20.12.2013 cu privire la aprobarea Strategiei naționale de sănătate publică pentru anii 2014-2020.
  13. Hotărîre Nr.82 din 12.04.2012 pentru aprobarea Strategiei naționale de prevenire și control al bolilor netransmisibile pe anii 2012-2020.
  14. House of Commons Health Committee. Obesity: third report of Session 2003-04. Volume I, report together with formal minutes. London: The Stationery Office, 2004.
  15. <http://www.agerpres.ro/media/index.php/international/item/198750-OMS-lanseaza-o-ofensiva-impotriva-obeziitatii.html>
  16. Tackling Childhood Obesity in Europe through Prevention and Partnership, 22nd April, Brussels, 2014. <http://www.publicpolicyexchange.co.uk/events/ED22-PPE2.php>
  17. WHO Media centre, Obesity and overweight. Fact sheet N°311, March 2013. <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>
  18. <http://www.worldometers.info/ro/>
  19. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *Int J Obes*. 2011;35:891-898. citat Scopus (127).
  20. Baker JL, Olsen LW, Sorensen TIA. Childhood body mass index and risk of coronary heart disease in adulthood. *N Engl J Med*. 2007;357:2329-2337. citat Scopus (558).
  21. Krebs F, Nacy, Himes H, John, Jacobson Dawn, Nicklas A, Theresa. Assessment of Child and Adolescent. *Overweight and Obesity Pediatrics*. 2007;120(Suppl. 4):S193-S228.
  22. Hamilton Mark, Maheshwari Abha. Obesity and assisted reproduction. *Obesity*. 2013;127-132.
  23. Mei Z, Grummer-Strawn LM, Pietrobelli A, et al. Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *Am J Clin Nutr*. 2002;978-985.
  24. Yii MF, Lim CED, Luo X, et al. Polycystic ovary syndrome in adolescence. *Endocrinol Gynecol*. 2009;25(10):634-639.
  25. Mihalache Georgeta. Aspecte clinico-hemodinamice și biochimice la pacienții cu hipertensiune arterială în asociere cu obezitatea și influența agonistului receptorilor imidazolinici i1- moxonidinei. Chișinău, 2010.
  26. Ministry of Health, Republic of Slovenia: National Health Enhancing Physical Activity programme from 2007 to 2012. 2007.
  27. Ministry of Health, Welfare and Sport, Netherlands: Opting for a healthy life, Public Health policy in the Netherlands, 2006.
  28. Moreno L, Pigeot A, Wolfgang A. Epidemiology of Obesity in Children and Adolescents. Prevalence and Etiology, Springer Series on Epidemiology and Public Health. 1st Edition, 2011;2. access: <http://www.springer.com>.
  29. Timnea Olivia Carmen. Obezitatea la copii versus acizii grași Omega-3. *Medica Academica*. 2012.
  30. Organizația Mondială a Sănătății. Baza de date la nivel mondial privind indicele de masa corporală. <[http://apps.who.int/bmi/index.jsp?introPage=intro\\_3.html/](http://apps.who.int/bmi/index.jsp?introPage=intro_3.html/)>, 2012.
  31. Organizația Mondială a Sănătății. Strategia globală privind alimentația, activitatea fizică și sănătatea, 2012. <http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/>
  32. Zimmet P, Alberti KG, Kaufman F, et al. The metabolic syndrome in childhood and adolescents - a consensus report FIL. *Diabet Pediatr*. 2007;8:299. citat Scopus (386).
  33. Nader Philip R, O'Brien Marion, Houts Renate, et al. Identifying risk for obesity in early childhood. *Pediatrics*. 2006;118(3):e594-e601.
  34. Roux Philippe. Măsurile UE privind combaterea obezității și promovarea unui stil de viață mai sănătos. [http://ec.europa.eu/health/newsletter/114/focus\\_newsletter\\_ro.htm](http://ec.europa.eu/health/newsletter/114/focus_newsletter_ro.htm)
  35. Population-based approaches to childhood obesity prevention. World Health Organization, 2012.
  36. Prevalența factorilor de risc pentru bolile cronice netransmisibile în Republica Moldova. STEPS, 2013.
  37. Protocol de diagnostic și tratament în obezitate la copil. Prof. Dr. Alfred Ruscescu, Institutul pentru Ocrotirea Mamei și Copilului. București, 2011.
  38. Report of the First Meeting of the Ad hoc Working Group on Science and Evidence for Ending Childhood Obesity, 18 – 20 iunie 2014, Geneva.
  39. Haththotuwa Rohana N, Wijeyaratne Chandrika N, Senarath Upul. Worldwide epidemic of obesity. The Cochrane Library. *Obesity*. 2013;3-11.
  40. Rudi M, Pirțu L. Obezitatea la copii ca factor de risc al hipertensiunii arteriale cu debut în copilărie. *Buletin de perinatologie*. 2008;40(4):45-49.
  41. Sinha A, Kling SA. Review of adolescent obesity: prevalence, etiology and treatment. *Obes Surg*. 2009;19:113-120.
  42. Strategy on nutrition, overweight and obesity-related health issues, may 2007. [http://ec.europa.eu/health/nutrition\\_physical\\_activity/policy/strategy\\_en.htm](http://ec.europa.eu/health/nutrition_physical_activity/policy/strategy_en.htm)
  43. Summerbell CD, Waters E, Edmunds LD, et al. Interventions for preventing obesity in children. The Cochrane Database of Systematic Reviews 2005; Suppl 3, No. CD001871.
  44. Kelly T, Yang W, Chen CS, et al. Global burden of obesity in 2005 and projections to 2030. *Int J Obes*. 2008;32:1431-1437.
  45. Tsiros MD. Health-related quality of life in obese children and adolescents. *International Journal of Obesity*. 2009;33:387-400.
  46. Văleanu C, Tătar S, Nanulescu M, et al. Prevalence of obesity and overweight among school children in Cluj Napoca. *Acta Endocrinologica*. 2009;V(2):213-219.
  47. Waters E, de Silva-Sanigorski A, Burford BJ, et al. Interventions for preventing obesity in children (Review). *The Cochrane Library*. 2011;12.
  48. World Health Organization, Regional Office for Europe: The challenge of obesity in the WHO European Region and the strategies for response. 2007;16.
  49. Аверьянов АП. Ожирение у детей и подростков: клинико-метаболические особенности, лечение, прогноз и профилактика осложнений. Саратов, 2009.
  50. Красноперова ОИ. Гендерные и возрастные особенности ожирения у детей и подростков Пермского Края и факторы риска прогрессирования заболевания: Автореф. дисс. на соискание ученой степени канд. мед. наук. Пермь, 2013.