

# Prevalence and possible complications of pediatric obesity in Romania: a review of recent literature

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## ABSTRACT

**Introduction.** Excess weight has been recognized as a global health issue for many years. It is an established risk factor for several chronic conditions, notably cardiovascular disease and diabetes, and is increasingly present in the pediatric population. The purpose of this paper is to review the existent local data regarding pediatric excess weight (including obesity) and its impact.

**Method.** A review of existent literature from the year 2000 and onwards was performed. Only material referring to a Romanian cohort (or subgroup) was included.

**Results.** Of the initial 455 identified records, 62 full text papers in English and Romanian were considered relevant to the topic and analyzed. A mean prevalence of excess weight of 31.6% (WHO), 18.35% (CDC) and 21.37% (IOTF) with obesity rates of 11.4% (WHO), 7.2% (CDC) and 7.69% (IOTF) was calculated. Several factors that could promote excess weight have been identified in Romanian cohorts and are presented. Possible complications are in line with previous published data and mainly involve the cardiovascular system and metabolic effects. Psychological obesity-associated issues have also been reported.

**Discussion.** To our knowledge, there has not been a local study to assess the prevalence of pediatric excess weight at a country level. The available prevalence data is in line with both previous reports of Romanian data and international figures. There does not appear to be an increase in rates over time in the last few years.

Systematic country-level attempts to tackle the excess weight problem are few, however smaller range community-based intervention programs have been reported, with modest results.

**Conclusions.** A worrying proportion of children are overweight or obese in Romania and this may lead to a variety of physical and psychological issues for the child. Conditions such as arterial hypertension and dyslipidemia, typically encountered in adults, are being noted with increased frequency in the pediatric population and their full impact on quality of life and life expectancy is difficult to grasp. Sustained, community-based interventions could possibly achieve a slow reduction in the rates of pediatric excess weight.

**Keywords:** pediatric obesity, child obesity, obesity prevalence, excess weight, Romanian cohort, obesity complications

## INTRODUCTION

Overweight and obesity are roughly defined as "abnormal or excessive fat accumulation that presents a risk to health" [1]. This has been recognized as a global health issue for many years, with a prevalence that doubled or even tripled in certain countries from the WHO European region since the 1980s [2]. It is an established risk factor for several chronic conditions, notably cardiovascular disease and diabetes.

Excess weight affects the population as a whole, regardless of age or gender. The issue has been grow-

ing in significance in the pediatric population as well, with rates of obesity as high as 18.5% of children aged 2-19 years in the United States (13.9% among 2- to 5-year-old children, 18.4% among 6- to 11-year-old children, and 20.6% among 12- to 19-year-old children) according to the CDC (Centers for Disease Control and Prevention) [3]. According to the Global Health Observatory (GHO) data in 2016, around 18% of children and adolescents aged 5-19 years were overweight or obese worldwide [4].

Moving from the global picture to a local one, the importance of excess weight in Romania has not gone

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unnoticed, with various reports, campaigns and proposed plans of action having been published [2,5-7].

The purpose of this paper is to review the existent local data regarding pediatric excess weight (including obesity) and its impact.

To note, a person's weight can be assessed in several ways, including abdominal circumference and body fat percentage (which in turn may also be determined using various methods). Although body fat percentage is considered to be the more accurate way of determining adiposity [8], the body mass index (BMI), which does not quantify body fat directly, has been established as a simple and effective clinical screening tool [9-11]. Its ease of use has made it the preferred method of assessment in most clinical trials. The BMI is a person's weight in kilograms divided by the square of height in meters. While standard normal values are accepted for adults, for the pediatric population the BMI is both age and gender-specific and underweight, overweight and obesity are defined either using percentiles (CDC [12], Table 1), standard deviations (WHO [13], Table 2) or international cut off points for body mass index (International Obesity Task Force, IOTF [14,15]; for cut-offs please refer to relevant articles cited here).

**TABLE 1.** BMI-for-age weight status categories and the corresponding percentiles according to the CDC

Weight Status Category	Percentile Range
Underweight	Less than the 5 <sup>th</sup> percentile
Normal or Healthy Weight	5 <sup>th</sup> percentile to less than the 85 <sup>th</sup> percentile
Overweight	85 <sup>th</sup> to less than the 95 <sup>th</sup> percentile
Obese	Equal to or greater than the 95 <sup>th</sup> percentile

**TABLE 2.** WHO Growth Standards for children. SD – standard deviation(s)

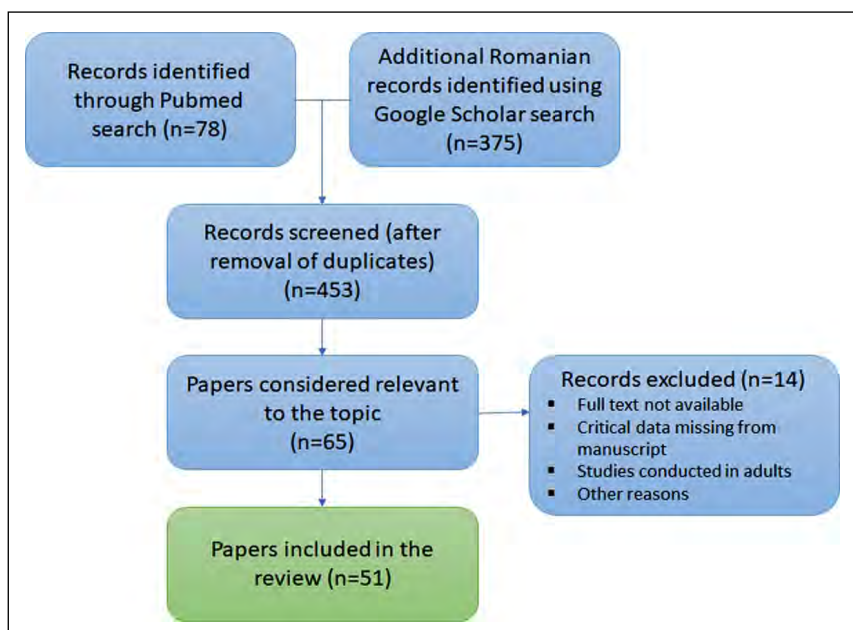
	Children under 5 years of age	Children aged between 5 and 19 years
Overweight	>+2SD	>+1SD (equivalent to BMI 25 kg/m <sup>2</sup> at 19 years)
Obesity	>+3SD	>+2SD (equivalent to BMI 30 kg/m <sup>2</sup> at 19 years)
Thinness	<-2SD	<-2SD

## METHOD

A review of existent literature from the year 2000 and onwards was performed. Articles written in English were searched for in PubMed. In addition, a Google Scholar search was performed for relevant Romanian literature not included in the PubMed Search. Only material referring to a Romanian cohort (or subgroup) was included. This search strategy yielded 453 articles, 65 of which were selected as relevant to the topic. Of these, full text was not available for 3 articles, leaving 62 papers for review. Given the paucity of data, some of the remaining articles were still mentioned as reference, provided the abstract was believed to contain significant information. A further 11 papers were later excluded for various reasons (supplementary Figure 1).

## RESULTS

19 papers were found to include data regarding prevalence. Papers that reported percentages of excess weight children derived from the total number of hospitalized children over a certain period were excluded, as it was felt they may not accurately reflect the situation in the general setting. Of the remaining



**FIGURE 1.** Papers included in the review

**TABLE 3.** Prevalence of excess weight (EW), overweight (OW) and obesity (Ob) as reported by various studies fully or partially performed in Romania. Values presented in orange have been calculated (see text). The IOTF cut-offs employed are the original BMJ 2000 cut-offs [14].

Reference	Period of assessment	Area (county)	Cohort (no)	Age group (years)	Data collection	Urban population (%)	Male gender in cohort (%)	Excess weight* (%)	Overweight (%)	Obese (%)	Prevalence EW boys	Prevalence EW girls	Prevalence OW boys	Prevalence OW girls	Prevalence Ob boys	Prevalence Ob girls
17	NS	SV	223	14-18	M	33.33%	25.11%	9.41% (CDC)	7% (CDC)	2% (CDC)	12.50% (CDC)	8.38% (CDC)	8.92% (CDC)	6.58% (CDC)	3.57% (CDC)	1.79% (CDC)
18	2004	NS	1826	2-4	M	NS	NS	x	x	x	8.4% (WHO) 12.7% (IOTF)	6.4% (WHO) 11.7% (IOTF)	5.7% (WHO) 7.8% (IOTF)	4.2% (WHO) 6.9% (IOTF)	2.1% (WHO) 4.9% (IOTF)	2.2% (WHO) 4.8% (IOTF)
19	2006-2008	B, IF	4866	3-17	M	44.94%	49.5%	16.46% (CDC)	10.1% (CDC)	6.40% (CDC)	x	x	x	x	x	x
20	2007	DB	3761	6-18	M	NS	45.49%	11.4% (CDC)	8% (CDC)	3.47% (CDC)	13.68% (CDC)	9.60% (CDC)	9.64% (CDC)	6.78% (CDC)	4.03% (CDC)	2.82% (CDC)
21	2008	CJ	7904	6-19	M	NS	NS	21.13% (CDC)	12.84% (CDC)	8.29% (CDC)	x	x	x	x	x	x
22	2008-2012	IS, NT	3444	6-10	M	100%	49.70%	23.7% (IOTF)	16.60% (IOTF)	7.10% (IOTF)	24.60% (IOTF)	22.70% (IOTF)	16.80% (IOTF)	16.30% (IOTF)	7.80% (IOTF)	6.30% (IOTF)
23	2009-2010	NS	3780	11-15	Q	NS	49.47%	14% (IOTF)	x	x	19% (IOTF)	9% (IOTF)	x	x	x	x
24	2010	NS	1003	6-11	Q	NS	NS	31.40% (IOTF)	21.10% (IOTF)	10.30% (IOTF)	x	x	x	x	x	x
25,26	2010-2011	TM	3626	7-18	M	72.3%	43.13%	25.80% (CDC) 25.34% (IOTF)	14% (CDC) 18.17% (IOTF)	11.80% (CDC) 7.17% (IOTF)	30.80% (CDC) 29.65% (IOTF)	22% (CDC) 21.73% (IOTF)	15.20% (CDC) 20.65% (IOTF)	13% (CDC) 16.29% (IOTF)	15.60% (CDC) 9% (IOTF)	9% (CDC) 5.77% (IOTF)
27	2010-2011	GL	3103	7-18	M	100%	NS	18.9% (CDC)	10.53% (CDC)	8.44% (CDC)	x	x	x	x	x	x
28	2011	B	866	6-18	M	100%	46.76%	31.6% (WHO) 25.2% (CDC) 24.6% (IOTF)	20.2% (WHO) 15.2% (CDC) 18.4% (IOTF)	11.4% (WHO) 10% (CDC) 6.2% (IOTF)	36.2% (WHO) 30% (CDC) 29.1% (IOTF)	27.6% (WHO) 21% (CDC) 20.7% (IOTF)	21.9% (WHO) 17.5% (CDC) 21.1% (IOTF)	18.7% (WHO) 13.2% (CDC) 16.2% (IOTF)	14.3% (WHO) 12.5% (CDC) 8% (IOTF)	8.9% (WHO) 7.8% (CDC) 4.5% (IOTF)
29	2011-2012	NS	1646	14-17	Q	NS	NS	9.20% (IOTF)	x	x	x	x	x	x	x	x

Legend: NS, not specified; M, measured. Q, questionnaire. \* Excess weight = overweight plus obese

**TABLE 4.** Calculated mean prevalence according to the WHO, CDC and IOTF standards, based on prevalence data recorded in Table 3. EW, excess weight. OW, overweight. Ob, obese

	EW (%)	OW (%)	Ob (%)	Prevalence EW boys	Prevalence EW girls	Prevalence OW boys	Prevalence OW girls	Prevalence Ob boys	Prevalence Ob girls
<b>WHO</b>	31.6%	20.2%	11.4%	26.5%	17%	13.8%	11.45%	8.2%	5.55%
<b>CDC</b>	18.35%	11.09%	7.2%	21.74%	15.24%	12.81%	9.89%	8.92%	5.35%
<b>IOTF</b>	21.37%	18.56%	7.69%	23.01%	17.16%	16.58%	13.92%	7.42%	5.34%
<b>Mean</b>	<b>23.77%</b>	<b>16.61%</b>	<b>8.76%</b>	<b>23.75%</b>	<b>16.46%</b>	<b>14.39%</b>	<b>11.75%</b>	<b>8.18%</b>	<b>5.41%</b>

papers, we were unable to locate critical information in 2 instances, and another paper was a review and did not provide original data. The latest available round of the WHO Childhood Obesity Surveillance Initiative (COSI) initiative [16] was also not included in the analysis, as this only targeted specific age groups (7, 8 and 9-year-old children in Romania) and we were unable to locate general prevalence data in the report.

The remaining data concerning the prevalence of excess weight in Romania as reported in various studies is summarized in Table 3, in chronological order. 36,048 children were included. The derived mean values by various methods are recorded in Table 4.

Some of the percentages and numbers, although not included in the original papers, could be derived from the data presented in the articles; most though could not be calculated accurately, as the percentages reported had most likely been rounded up. Given the fact that we did not have access to the actual data presented in the published literature, the bolded (calculated) values should be interpreted with caution, as they may be inexact.

As showed in Table 3, data collection included direct measurement of height and weight in most cases, with only 3 papers relying on questionnaires. There is considerable variability in the standard used to define excess weight, although, recognizing the various available classifications [12–14], some papers reported data using more than one standard.

Several articles have provided insights into possible factors that could promote excess weight or obesity in the Romanian population (Table 5). Rarely, genetic factors causing monogenic or syndromic obesity may be identified and should be taken into consideration in children under the age of 2 that exhibit severe obesity [30]. Certain maternal factors and characteristics at birth have been link to excess weight later in life. There is still controversy regarding some, such as low birth weight, which has been shown to be both a protective and an aggravating factor [31–33]. And, of course, several modern lifestyle factors have a significant effect on weight, electronic media use being more and more studied and becoming increasingly important.

Several factors have been shown to have a somewhat protective effect. These include breastfeeding in the first 6 months of life (exclusive or not) [33], parental educational level and the child's school performance (children with better grades are more likely to have normal weight) [29].

Excess weight has been proven to worsen or even cause many conditions and is a well-recognized risk factor for cardiovascular disease. An overview can be found in a recent review [44]. Some of the possible complications of excess weight that have been identified in Romanian pediatric cohorts are summarized in Table 6.

## DISCUSSION

To our knowledge, there has not been a single, local study to assess the prevalence of excess weight at a country level. The only recent available data with adequate, country-wide sampling comes from the WHO COSI initiative, which reports prevalence data according to specific age groups and gender and will be discussed briefly below. The few local studies that are available give some insight into the situation in only 9 counties out of 41. To this, data from studies performed abroad that included a Romanian cohort was included, but the exact geographical area of data collection is unclear in most cases [18,23,24,29]. Based on the information reviewed here, the prevalence of excess weight is in line with previous published data, namely 23.77% of children aged 2-19 have excess weight, 16.6% being overweight and 8.7% being obese (mean values based on WHO, CDC and IOTF derived prevalences, Table 4). The overall numbers are also similar to prevalence data found in a review by Chiriță-Emandi et al. [61] (28.3% / 23% / 23.2% (WHO / IOTF / CDC)), which included studies performed during 2006-2015 as well as some unpublished data.

To note, the numbers reported here were driven up by the results obtained using the WHO classification provided in a single study by Barbu et al. [28]. The overall data obtained by means of both the CDC and

**TABLE 5.** Factors that may promote excess weight or obesity in the Romanian population. Legend: BMI, body-mass index; MUAC, middle upper arm circumference; TST, tricipital skin-fold thickness; SNP, single nucleotide polymorphism; CNVs, copy number variants; VOUS, variants of unknown significance; UPD, uniparental disomy; T2DM, type 2 diabetes mellitus

Group	Factor	Details	Reference
Genetic	CC allele carriers of the Interleukin-6 (IL-6) 572 gene	BMI, MUAC, TST and serum albumin levels correlated with CC allele carriers of IL-6 572 gene in children with obesity	[34]
	FTO rs 9939609 SNP	AA genotype carriers have a 2.02 times higher risk for obesity compared with AT+TT genotype carriers	[35]
	Leptin Gene Polymorphisms 223 A/G and 1019 G/A	Obesity is more frequent in children with LEPR 223 AG+GG and LEPR 1019 GA+AA genotypes	[36]
	Pathogenic copy number variants (CNVs) in patients with obesity and developmental/intellectual disability	33% of study group presented CNVs with a higher degree of pathogenicity (pathogenic CNVs in 66.7%, VOUS in 16.7% and UPD in 16.7% of patients)	[37]
Maternal factors	Maternal smoking during pregnancy	An association between maternal smoking and overweight was seen in all participant countries except Romania	[38]
	Hyperglycemia of the mother in maternal T2DM	The child's risk of developing T2DM and obesity is higher than the genetically transmitted susceptibility	[39]
	Maternal obesity and gestational weight gain		[40]
Characteristics at birth	Birthweight	Both high [32,33] and low birthweight [31] could be involved	[31-33]
	Prematurity	Preterm babies have higher odds of being obese	[31,33]
Lifestyle	Decreased sleep time		[41]
	Diet	Imbalanced diet and excess calorie intake	[32,42]
	Internet and electronic media use	Use of electronic media > 2 h per day (if physically inactive) [23], heavier internet use (> 2 h per day), heavier social networking sites use and internet addictive behaviors [29]	[23,29]
Others	Disorders in hypothalamic-pituitary-adrenal (HPA) axis caused by chronic stress	Repeated stimulation of the reward pathways through highly palatable food leads to overeating because of neurobiological adaptations	[43]

**TABLE 6.** Possible complications of excess weight identified in Romanian cohorts. LV, left ventricle. Legend: HCM, hypertrophic cardiomyopathy; IL, interleukin; ICS, inhaled corticosteroids; NAFLD, non-alcoholic fatty liver disease; T2DM, type 2 diabetes mellitus; SIBO, small intestinal bacterial overgrowth

Group	Factor	Details	Reference
Cardiovascular	Arterial hypertension	12-24% of overweight or obese children were found to have arterial hypertension in various cohorts	[19,26,45,46]
	LV hypertrophy / HCM	Study performed on 188 children (all of whom were overweight or obese). Rates of 32% (LV hypertrophy) and 12% (HCM) were reported	[46]
	Dyslipidemia	Increased total cholesterol, LDL, triglycerides, low HDL or combinations	[45,47,48]
	Elevated plasma homocysteine level	Observed in hypertensive subjects in particular.	[49]
Endocrine and metabolic	Metabolic syndrome	Rates of 21-55% of study groups	[27,50]
	Hyperinsulinism	47.76% of study group, all of whom were obese	[48]
	Insulin resistance		[48]
	Impaired basal glycemia		[45]
	Elevated inflammatory adipokines	Increased leptin, IL-6 and IL-8 and decreased adiponectin	[51]
	Changes in thyroid parameters	Elevated TSH, FT3/FT4 levels and increased prevalence of thyroid nodules	[52]
Respiratory	Asthma	Obesity correlates with more severe or even difficult asthma (persistent asthma symptoms and/or frequent moderate/severe asthma exacerbations despite regular intake of ICSs (beclomethasone or equivalent) > 800 µg/day for at least 3 months in one study)	[53,54]
Digestive	Non-alcoholic fatty liver disease (NAFLD)	Metabolic syndrome or family history of T2DM seems to increase the risk for NAFLD	[55,56]
	Chronic functional constipation		[57]
	Small intestinal bacterial overgrowth (SIBO)	SIBO was found in 37.6% of overweight group. Obese children with SIBO have an increased risk for developing NAFLD.	[58]
Other	Psychological issues		[45,59]
	Lower limb deficiency	Genu varum or genu valgum. The prevalence of genu varum was also significantly higher in underweight children	[60]

the IOTF are much closer together and prevalence rates are lower using these standards (mean of 19.86%, 14.82% and 7.44% respectively).

This data is in stark contrast with a 2017 report from the Ministry of Health [7] that brought together data reported by medical facilities from 39 counties for 2016-2017, which quotes a prevalence of obesity of only 1.65% of children aged 0-19. This difference could reflect the inclusion of the 0-2 age group, but also the fact that in some cases obesity may not be officially recorded (and thus reported) as a chronic condition. The 2018 report of the National Institute of Public Health [6] however, also based on data from 2016-2017, highlights the importance of the problem by stating that obesity ranked as the second most frequent chronic condition in children, outnumbered only by refractive errors.

The studies reviewed here provided no clue as to the prevalence of severe obesity, but some data derived from previous COSI data is available [62], reporting a prevalence of 2.2% (WHO criteria) and 1.2% (IOTF criteria) respectively, with significantly higher numbers in boys.

The data that has been pooled together here mostly reflects the urban area (75% of children). A single study [63] provided data regarding the difference between the prevalence of excess weight in the rural versus urban areas, finding a slight excess in the rural environment (27.9% as opposed to 24.9%). This trend was also noted in the National Institute of Health report [6]. To note, this was not confirmed in the review performed by Chiriță-Emandi et al. [61].

The gender distribution is much more even, with an average of 44% of subjects in these papers being of male gender. According to the latest COSI round data (2015-2016) [64], there is a prevalence of excess weight, overweight and obesity of 31%, 16% and 15% in boys and a slightly lower one of 26%, 17% and 9% in girls.

Unfortunately, the extremely heterogenous data did not permit analysis of age group distribution.

Concerning the time trend of excess weight, it appears that there has been no increase in prevalence in recent years [18,61]. Prevalence data reported from the third and fourth COSI rounds are similar for Romania [64,65]. According to the 2018 National Institute of Public Health report [6], the local incidence of obesity has also been relatively stable.

Regarding the possible complications of excess weight, various potential problems have been reported, with increased probability of arterial hypertension, dyslipidemia and several metabolic disturbances (including diabetes) being the most consistent across studies. One study [46], has reported a surprisingly

high percentage of children with LV hypertrophy and even hypertrophic cardiomyopathy. We considered these findings with caution, as the authors did not mention the diagnostic criteria used.

Additional data is needed for other topics, such as the potential correlation with asthma severity, as not all studies were able to demonstrate this [66]. In addition to physical health implications, several psychological issues have been noted. The search strategy employed here did not reveal abundant information on the matter and it is possible this has not been consistently studied in a Romanian population. One study mentions lower use of contraception in obese adolescent girls [67]. More data is needed with respect to this topic, as excess weight bears a close relationship with psychological issues in adults and clearly cannot be overlooked in the pediatric patient.

There have been relatively few systematic attempts to tackle the excess weight problem. General recommendations about obtaining and maintaining a healthy weight can be found on numerous websites and in various articles. Some have tried to focus on the family doctor's (general practitioner's) role, emphasizing that prevention is key [68]. We have identified one small study in which the authors have tried to demonstrate the beneficial effect of a structured, personalized, physical exercise program, however comparative results were only reported in two subjects [69].

On a wider scale, the EPHE project [70] which ran from 2013 to 2015 in 7 countries including Romania, focused on community-based interventions (including games, workshops and educational materials on healthy diet, psychical activity and sleep). In Romania the authors demonstrated a statistically significant decrease in fruit juice consumption after the intervention, however this was not maintained on follow-up. Another initiative, the More and Less Europe study [71] aimed at preschoolers, proposes a slightly different approach, including a parent support program with group sessions, followed by a 6-month period of support by means of a mobile application. Recruitment has started in 2019 and results are pending.

## CONCLUSIONS

A worrying proportion of children are overweight or obese in Romania (roughly 18 to 31%, according to the definition used) and although the prevalence does not seem to be increasing, the problem cannot be ignored, as it may lead to a variety of physical and psychological issues for the child. Conditions such as arterial hypertension and dyslipidemia, typically encountered in adults, are being noted with increased

frequency in the pediatric population (being triggered or at least worsened by excess weight) and their full impact on quality of life and life expectancy is difficult to grasp.

Excess weight is, unfortunately, favored by the modern lifestyle; it is thus extremely difficult to devise an efficient action plan to address it. Modest benefit has been shown with community-based intervention, however the effects were short lived.

## REFERENCES

- World Health Organization. WHO | Obesity. WHO (2019). Available at: <https://www.who.int/topics/obesity/en/> (Accessed: 30th December 2019).
- Centrul Național de Evaluare și Promovare a Stării de Sănătate. European Association for the Study of Obesity. Ziua Europeană împotriva Obezității 2019 (2019).
- Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of Obesity Among Adults and Youth: United States, 2015-2016. *NCHS Data Brief* 1-8 (2017).
- World Health Organization. Global Health Observatory (GHO) data. WHO (2017). Available at: [https://www.who.int/gho/ncd/risk\\_factors/overweight\\_adolescents\\_text/en/](https://www.who.int/gho/ncd/risk_factors/overweight_adolescents_text/en/) (Accessed: 14th February 2020).
- Cucu MA et al. Raportul Național de Sănătate a Copiilor și Tinerilor din România 2016 (2016).
- Cucu MA et al. Raportul Național de Sănătate a Copiilor și Tinerilor din România 2018 (2018).
- Kassai VA, Ursu C, Dumitrache C, Stănescu CT. Evaluarea morbidității cronice prin dispensarizare în colectivitățile de copii și tineri – raport național 2018.
- Welcome, A. What Is the Definition of Obesity? | Obesity Medicine Association. Obesity Medicine Association (2017). Available at: <https://obesitymedicine.org/definition-of-obesity/> (Accessed: 14th February 2020).
- Garrow, JS, Webster, J. Quetelet's index (W/H<sup>2</sup>) as a measure of fatness. *Int. J. Obes.* 1985, 9:147-153 ( ).
- Freedman DS., Horlick M, Berenson GS. A comparison of the Slaughter skinfold-thickness equations and BMI in predicting body fatness and cardiovascular disease risk factor levels in children 1-4. *Am. J. Clin. Nutr.* 2013, 98:1417-1424.
- Wohlfahrt-Veje C et al. Body fat throughout childhood in 2647 healthy Danish children: Agreement of BMI, waist circumference, skinfolds with dual X-ray absorptiometry. *Eur. J. Clin. Nutr.* 2014, 68:664-670.
- Kuczmarski RJ et al. 2000 CDC growth charts for the United States: Methods and development. *Vital Heal. Stat. Ser. 11 Data from Natl. Heal. Surv. Natl. Heal. Nutr. Exam. Surv. Hisp. Heal. Nutr. Exam. Surv.* 2002, 11:1-190.
- De Onis M. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatr. Int. J. Paediatr.* 2006, 95:76-85.
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. *Br. Med. J.* 2000, 320:1240-1243.
- Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr. Obes.* 2012, 7:284-294.
- Huidumac C, Brîndușe LA. Evaluarea stării de nutriție a copiilor din ciclul primar conform metodologiei OMS prin participarea la proiectul European Childhood Obesity Surveillance Initiative (COSI) – Raport Național România 2017.
- Nechita (Atomei) O. Physical Activity during School – Strategy for Preventing Obesity. in International Conference on Sciences of Education (eds. Clipa, O, Domunco, C.-F.). Editura Lumen, Iași, 2016, p. 223-235.
- Cattaneo A, Monasta L, Stamatakis E, Lioret S, Castetbon K, Frenken F, Manios Y, Moschonis G, Savva S, Zaborskis A, Rito A, Nanu M, Vignerová J, Caroli M, Ludvigsson J, Koch F, Serra-Majem L, Szponar L, Van Lenthe FBJ. Overweight and obesity in infants and pre-school children in the European Union: A review of existing data. *Obesity Reviews* 2010, 11:389-398.
- Cinteză E, Balgradean M. Hypertension in romanian children and adolescents: A cross-sectional survey. *Maedica (Buchar)* 2013, 8:5-10.
- Preda MP, Mătășaru S. Obezitatea copilului. *Rom. Med. J.* 2011, LVIII:13-17.
- Valean C, Tatar S, Nanulescu M, Leucuta A, Ichim G. Prevalence of obesity and overweight among school children in Cluj-Napoca. *Acta Endocrinol. (Copenh)* 2009, 5:213-219.
- Mocanu V. Prevalence of overweight and obesity in urban elementary school children in Northeastern Romania: Its relationship with socioeconomic status and associated dietary and lifestyle factors. *Biomed Res. Int.* 2013.
- Melkevik O et al. Are associations between electronic media use and BMI different across levels of physical activity? *BMC Public Health* 2015, 15:497.
- Olaya B et al. Country-level and individual correlates of overweight and obesity among primary school children: A cross-sectional study in seven European countries. *BMC Public Health* 2015, 15.
- Chiriță-Emandi A, Puiu M, Gafencu M, Pienar C. Overweight and obesity in school age children in western Romania. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2013, 117:36-45.
- Chiriță-Emandi A, Puiu M, Gafencu M, Pienar C. Arterial hypertension in school-aged children in western Romania. *Cardiol. Young* 2013, 23:189-196.
- Pelin AM, Mătășaru S. Metabolic syndrome in obese children and adolescents. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2012, 116:957-61.
- Barbu CG et al. Obesity and eating behaviors in school children and adolescents -data from a cross sectional study from Bucharest, Romania. *BMC Public Health* 2015, 15:206.
- Tsitsika AK et al. Association between problematic internet use, socio-demographic variables and obesity among European adolescents. *Eur. J. Public Health* 2016, 26:617-622.
- Thaker VV. Genetic and epigenetic causes of obesity. *Adolesc. Med. State Art Rev.* 2017, 28:379-405.
- Iancu MA., Matei D, Bejan GC. Obezitatea copiilor – o problemă a societății noastre. *Rom. J. Med. Pract.* 2015, 10:176-181.
- Teslaru O, Oltean C, Gavriluță LA, Ilescu ML, Anton-Păduraru DT. Obezitatea la preșcolar – studiu cazistic. *Rom. J. Pediatr.* 2016, 65:116-119.
- Rito AI et al. Association between characteristics at birth, breastfeeding and obesity in 22 countries: The WHO European childhood obesity surveillance initiative – COSI 2015/2017. *Obes. Facts* 2019, 12:226-243.
- Mărginean O, Bănescu C, Pitea AM, Grama A. The role of interleukin-6 gene 572 G/C polymorphism in child obesity. *Jurnalul Pediatrului* 2014, XVII:39-40.
- Duicu C, Mărginean CO, Voidăzan S, Tripon F, Bănescu C. FTO rs 9939609 SNP Is Associated with Adiponectin and Leptin Levels and the Risk of Obesity in a Cohort of Romanian Children Population. *Med.* 2016 95:e3709.

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36. Mărginean CO et al. Correlations between leptin gene polymorphisms 223 A/G, 1019 G/A, 492 G/C, 976 C/A, and anthropometrical and biochemical parameters in children with obesity a prospective case-control study in a Romanian population – the nutrchild study. *Med. (United States)* 2016. 95:e3115.
37. Miclea D et al. Genomic study via chromosomal microarray analysis in a group of Romanian patients with obesity and developmental disability/intellectual disability. *J Pediatr Endocrinol Metab* 2019. 32:667-674.
38. Gorog K et al. Maternal smoking during pregnancy and childhood obesity: Results from the CESAR study. *Matern. Child Health J* 2011. 15:985-992.
39. Dabelea D, Pettitt DJ. Intrauterine diabetic environment confers risks for type 2 diabetes mellitus and obesity in the offspring, in addition to genetic susceptibility. *Journal of Pediatric Endocrinology and Metabolism* 2001. 14:1085-1091.
40. Trandafir LM, Temneanu OR. Pre and post-natal risk and determination of factors for child obesity. *Journal of Medicine and Life* 2016. 9:386-391.
41. Jeler Elena Corina, Mihăițan F. Corelatia între somn, obezitate și apneea în somn. *Rev. Soc. Med. Interna* 2016. 13:19-28.
42. Bel-Serrat S et al. Clustering of multiple energy balance-related behaviors in school children and its association with overweight and obesity – WHO european childhood obesity surveillance initiative (COSI 2015–2017). *Nutrients* 2019, 11.
43. Mocanu V, Bontea A, Anton-Păduraru DT. Eating behavior in response to acute stress. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2016. 120:223-227.
44. Russu G, Frasinariu OE, Trandafir LM. Cardiovascular suffering in childhood obesity. *Rom. J. Pediatr.* 2017. LXVI:55-59.
45. Novac O et al. Assessment of complications of excess weight in school-age children and adolescents. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2009. 113:740-744.
46. Luca AC, Iordache C. Obesity – a risk factor for cardiovascular diseases. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2013. 117:65-71.
47. Pop A, Al-Khzouz C, Zimmermann A, Grigorescu-Sido P. Dislipidemia la copiii și adolescenții obezi. *Clujul Med.* 2010. 83:166-169.
48. Mogoi M, Ilie C, Paul C, Velea IP. The evaluation of obesity-related cardiometabolic diseases: a simple anthropometric tool for a complicated matter. *Rom. J. Pediatr.* 2014. LXIII:259-325.
49. Dimitriu AG, Dimitriu L. Utility of research of plasma homocysteine – risk factor for cardiovascular diseases in obese school children. *Rom. J. Cardiol. Supplement* 2014, 211-212.
50. Chesaru BI, Dobre M, Murariu G, Nechita A. Risk for metabolic syndrome in a group of overweight children from South-East Romania. *Rom. Rev. Lab. Med.* 2013. 21:83-92.
51. Pitea AM, Man L, Baghiu MD, Mărginean CO. Dyslipidemia and inflammatory adipokines in a group of children with altered nutritional status. *Rom. J. Pediatr.* 2013. LXII:291-297.
52. Răcățianu N et al. Interplay between metabolic and thyroid parameters in obese pubertal children. Does visceral adipose tissue make the first move? *Acta Clin. Belgica Int. J. Clin. Lab. Med.* 2019.
53. Murgu A et al. Obesity – prognostic factor impact in bronchial asthma evolution in child. *Rom. J. Pediatr.* 2011. LX:41-48.
54. Agache IO, Ciobanu C. Lung Function, FeNO, and Difficult Asthma Predictive Value of Lung Function Trend and FeNO for Difficult Asthma in Children. *J Investig Allergol Clin Immunol* 2012. 22.
55. Bălănescu A et al. Lipid profile pattern in pediatric overweight population with or without NAFLD in relation to IDF criteria for metabolic syndrome: A preliminary study. *Rom. J. Intern. Med.* 2018. 56:47-54.
56. Tomșa Nicoleta-Ana, Meliț Lorena Elena, Aron Bianca, Mărginean CO. Obesity and liver disease in child – a case report. *Acta Medica Marisiensis* 2018. 64:41.
57. Olaru C et al. Some Risk Factors of Chronic Functional Constipation Identified in a Pediatric Population Sample from Romania. *Gastroenterol. Res. Pract.* 2016.
58. Belei O, Olariu L, Dobrescu A, Marcovici T, Marginean O. The relationship between non-alcoholic fatty liver disease and small intestinal bacterial overgrowth among overweight and obese children and adolescents. *J Pediatr Endocrinol Metab* 2017. 30:1161-1168.
59. Cordeanu A, Cordeanu EM, Al Diaconescu D. Obesity and group relations of teenagers. *Rev. Med. Chir. Soc. Med. Nat. Iasi* 2009. 113:197-205.
60. Câmpeanu M, Vădan A, Crișan B, Nemeti OM, Varga A. The incidence of physical deficiencies among 11-12 year old children, in relation with the body weight category. *Palestrica third Millenn. – Civiliz. Sport* 2013. 14:292-296.
61. Chiriță-Emandi A et al. Overweight and Underweight Prevalence Trends in Children from Romania – Pooled Analysis of Cross-Sectional Studies between 2006 and 2015. *Obes. Facts* 2016. 9:206-220.
62. Spinelli A et al. Prevalence of severe obesity among primary school children in 21 European countries. *Obes. Facts* 2019. 12:244-258.
63. Chiriță-Emandi A, Puiu M, Gafencu M, Pienar C. Arterial hypertension in school-aged children in western Romania. *Cardiol. Young* 2013. 23:189-196.
64. World Health Organization. Childhood Obesity Surveillance Initiative: *Highlights 2015-2017* (2017).
65. Ahrens W et al. WHO European Childhood Obesity Surveillance Initiative: Overweight and obesity among 6-9-year-old children. *Report of the third round of data collection 2012–2013* (2018).
66. Vălean C, Tătar S, Nanulescu M, Leucuța, A, Ichim, G. Relationship between asthma and obesity in school age students. *Pneumologia* 2009. 58:55-58.
67. Trandafir LM et al. Aspects of contraception and reproductive health in obese adolescent girls. *Rom. J. Pediatr.* 2016. LXV:258-308.
68. Iancu MA, Matei D, Bejan GC. Rolul medicului de familie în managementul copiilor și adolescenților supraponderali și obezi. *Rom. Med. J.* 2015. LXII:105-110.
69. Cristuta AM. The effects of therapeutic physical exercise on child obesity. *Interdiscip. J. Phys. Educ. Sport.* 2014. 14:44-52.
70. Mantziki K et al. Inequalities in energy-balance related behaviours and family environmental determinants in European children: Changes and sustainability within the EPHE evaluation study. *Int. J. Equity Health* 2016. 15:160.
71. Ek A et al. A randomized controlled trial for overweight and obesity in preschoolers: the More and Less Europe study – an intervention within the STOP project. *BMC Public Health* 2019. 19:945-957.