Children Overweight and Obesity Prevalence in the Russian Federation

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Introduction

Systematic reviews and meta-analyses make up analytical foundation for the evidence based medicine. They are an important factor for taking decisions at different healthcare levels: from a practicing doctor to medical service authorities while choosing the most efficacious ways of treatment and rational diseases prevention [1, 2]. Over the last 30 years (beginning from 80-90s of the last century) the number of overweight and obese children in the world has increased by 2-3 times in both developed and developing countries [3]. Epidemiological situation of prevalence of obesity in Russia is similar to that of other European countries. In Russia on average overweight in boys was found in 11.02% of cases including obesity – in 2.5% of boys, in girls correspondingly, it was found in 7.7% and 1.6% [3, 4, 5, 6]. However, these data vary in different regions of Russia and the world [7, 8, 9].

The study purpose is to estimate the prevalence of overweight and obesity in children population in the Russian Federation and neighbouring countries, by means of meta-analysis on the basis of systematic review of articles issued in 2007-2020.

Materials and methods.

Systematic review and meta-analysis have been performed in accordance with PRISMA recommendations [1]. To search for articles published, the main Russian medical articles systems were used, such as Pubmed database, electronic research library eLibrary.ru for the period from 2011 to 2020. Sources found in these databases were assessed according to the review theme relevance by their titles and abstracts by two authors independently. The required type of material was looked for in journal and conference articles the titles and abstracts of which contained the words "overweight", "obesity", "children" and "adolescents". To reveal any additional studies manual search was applied among literature lists of systematic reviews and articles issued during 2007-2020.

For the review the results of cross-sectional and incidence studies were selected. The main criterion of selection was: children physical development assessment should be carried out according to the following methods and standards stipulated by the WHO: «Child Growth Standards» (2006) и «WHO Growth Reference 2007» (2007) [10]. The articles that contained no specific description of the population studied were excluded. The duplicated data having been excluded, the analysis included 50 of 59 preliminary selected articles. In the studies selected totally 335840 children and adolescents aged from 1 to 19, who lived in the Russian Federation, Kazakh Republic and Ukraine, participated.

Statistical analysis was performed by means of MS Excel and MedCalc. Studies findings were joined in one common sample and divided into groups in accordance with age and sex. After that prevalence rate and 95% confidence interval [CI] for the rate were calculated. Odds ratio [OR], 95% confidence interval and level of significance were calculated for the groups (if confidence interval for odds ratio does not include 1, then the results are statistically significant at the level of 0.05).

Results.

According to WHO recommendations body mass index (BMI) individual parameters were used to register the overweight and obesity. BMI was calculated by means of dividing the body mass (kg) by square body length (м2). Overweight was diagnosed if a child BMI exceeded standard scale within the interval from +1 standard deviation (SD) to +2 SD or from 85 percentile (CI) to 95 CI; obesity was diagnosed if BMI exceeded standard scale within the interval from +2 SD or 95 CI [11]. In most articles (35 sources) authors preferred parameter standards (SD), the rest (15 sources) used centile tables (CI). Articles data analysis made it possible to reveal that overweight prevalence varied within 2.1% – 29.1% in children groups differing in age, sex and living conditions. Obesity prevalence in the same children groups also varied: from 0.9% to 42.7%. Data are presented in Table 1.

Study Data

Study	Criteria	n	Age (years)	Sex	Overweight	Obesity
Saratov, 2014 [1]	WHO, SD	247	8-10	B+G	41 (16.6%)	38 (15.4%)
		408	11-15		70 (17.2%)	45 (11.0%)
		77	16-17		9 (11.7%)	3 (4.0%)
Komi-Permian	WHO, SD	571	7-17	B+G	51 (8.9%)	23 (4.0%)

region, city, 2009[13]						
Komi-Permian region, village, 2009[13]	WHO, SD	489	7-17	B+G	57 (11.7%)	16 (3.3%)
Arkhangelsk, 2010[13]	WHO, SD	820	7-17	B+G	124 (15.1%)	49 (6.0%)
Arkhangelsk region, 2010[13]	WHO, SD	1596	7-17	B+G	235 (14.7%)	57 (3.6%)
Murmansk region, 2016[13]	WHO, SD	222	7-17	B+G	36 (16.2%)	17 (7.6%)
Repulbic of Komi, village, 2008[13]	WHO, SD	600	7-17	B+G	59 (9.9%)	23 (3.8%)
Perm, 2011[13]	WHO, SD	456	7-17	B+G	63 (13.,8%)	24 (5.2%)
Perm, 2018[13]	WHO, SD	567	7-17	B+G	107 (18.9%)	41 (7.2%)
Moscow, 2016[14]	WHO, SD	652	7-10	G 324 B 328	61 (18.8%) 65 (19.8%)	24 (7.4%) 52 (15.9%)
St.-Petersburg, 2009-2013[15]	WHO, SD	4618	7-17	B+G	840 (18.2%)	286 (6.2%)
Republic of Udmurtia, 2015-2016[16]	WHO, SD	1403	1-3	G 690 B 713	146 (21.1%) 158 (22.1%)	44 (6.4%) 47 (6.6%)
		1891	4-7	G 937 B 954	146 (15.6%) 147 (15.4%)	45 (4,8%) 67 (7.0%)
		2966	8-12	G 1460 B 1506	257 (17.6%) 262 (17.4%)	89 (6.1%) 187 (12.4%)
		1843	13-15	G 956 B 887	144 (15.1%) 158 (17.8%)	33 (3.4%) 89 (10.1%)
		1559	16-17	G 824 B 735	90 (10.9%) 99 (13.5%)	16 (1.9%) 32 (4.3%)
Krasnodar, 2008[17]	WHO, CI	6000	10-17	B+G	378 (6.3%)	300 (5.0%)
Khanty-Mansiysk autonomous district, village, 2019[18]	WHO, SD	254	3-6	B+G	29 (11.4%)	13 (5.1%)
Kaliningrad, 2014[19]	WHO, SD	229	10	B+G	30 (13.1%)	15 (6.5%)
		826	14-17	B+G	74 (9.0%)	34 (4.1%)
Moscow, 2011-2013[20]	WHO, SD	59	1-2	B+G	13 (27.1%)	3 (5.1%)
		47	2-3		5 (12.8%)	1 (2.1%)
Perm, 2005[21]	WHO, SD	444	13-14	B 285 G 159	32 (11.2%) 10 (6.3%)	9 (3.2%) 5 (3.1%)
Perm, 2013[21]	WHO, SD	384	13-14	B 174 G 210	26 (14.9%) 31 (14.8%)	11 (6.3%) 10 (4.8%)
Astrakhan, Ekaterinburg, Krasnoyarsk, Saint-Petersburg and Samara; 2014[22]	WHO, SD	5182	5,10,15	B+G	1031 (19.9%)	290 (5.6%)
Chelyabinsk, 2012-2013[23]	WHO, SD	757	3-17	B 377 G 380	60 (15.9%) 44 (11.6%)	40 (10.6%) 42 (11.1%)
Smolensk,	WHO, SD	817	7-10	B 414 G 403		49 (11.9%)

Study	Method	N	Age	Sex	Col A	Col B
2019 [24]						21 (5.2%)
Voronezh, 2017 [25]	WHO, SD	174	8-10	B+G	40 (23.0%)	27 (15.5%)
		196	11-14		30 (15.3%)	18 (9.2%)
		114	15-18		14 (12.3%)	5 (4.4%)
Tyumen, 2008 [26]	WHO, SD	390	8-11	B+G	59 (15.1%)	26 (6.7%)
Tyumen, 2017 [26]	WHO, SD	468	8-11	B+G	90 (19.2%)	74 (15.8%)
Smolensk, 2018 [27]	WHO, SD	3696	7-11	B+G	592 (16.1%)	338 (9.2%)
Republic of Bashkortostan, 2015 [28]	WHO, SD	908	14	B 461 G 447	69 (7.6%) 50 (5.5%)	39 (4.3%) 19 (2.1%)
Khanty-Mansiysk, 2020 [29]	WHO, SD	147	11-14	B+G	20 (13.6%)	19 (12.9%)
Oryol, 2018 [30]	WHO, SD	2098	7-18	B+G	305 (14.5%)	151 (7.2%)
Astrakhan, 2016 [31]	WHO, SD	1000	5,10,15	B+G	188 (18.8%)	47 (4.7%)
Krasnodar, 2011 [32]	WHO, SD	1047	7-17	B 723 G 324	117 (16.2%) 52 (16.0%)	24 (3.3%) 12 (3.7%)
Republic of Kazakhstan, 2016 [33]	WHO, SD	1498	6,5-7,5	B 785 G 713	139 (17.7%) 99 (13.9%)	30 (3.8%) 16 (2.2%)
Tomsk region, 2015 [34]	WHO, SD	7120	13-16	B 3551 G 3569	568 (16.0%) 492 (13.8%)	202 (5.7%) 171 (4.8%)
All Federal Regions of the RF, 2018-2019 [35]	WHO, CI	1051	7-11	B 558 G 493	53 (9.5%) 55 (11.1%)	129 (23.2%) 38 (7.8%)
		4650	12-16	B 2110 G 2540	420 (19.9%)	513 (24.3%)
					239 (9.4%)	119 (4,7%)
Republic of Kazakhstan, 2016 [36]	WHO, SD	2954	9	B 1515 G 1439	192 (12.7%) 173 (12.0%)	107 (7.1%) 79 (5.5%)
83 subjects of the RF, 2014 [37]	WHO, SD bioimpedance	246023	5-17	B 130682 G 115341	28619 (21.9%) 22260 (19.3%)	8886 (6.8%) 6113 (5.3%)
Moscow, 2011 [38]	WHO, CI	2800	1,5-18	B+G		247 (8.8%)
Khanty-Mansiysk autonomous district, village, 2018-2019 [39]	WHO, SD	302	7-17	B 302	35 (11.7%)	39 (13.1%)
Khanty-Mansiysk autonomous district, rural town, 2018-2019 [39]	WHO, SD	956		B 956	172 (18.0%)	74 (7.7%)
Republic of Komi, village, 2018-2019 [39]	WHO, SD	628		B 628	109 (17.4%)	58 (9.2%)
Moscow, 2015 [40]	WHO, SD	158	7-10	М+Д	30 (19.0%)	27 (17.1%)
Orenburg, 2019 [41]	WHO, SD	250	17-19	B 250	37 (14.8%)	18 (7.2%)
Saint-Petersburg, 2017-2018 [42]	WHO, CI	809	12-15	B 809	84 (10.4%)	110 (13.6%)
Krasnoyarsk region, 2017 [43]	WHO, CI	148	7-11	B 78 G 70	5 (6.4%) 6 (8.6%)	11 (14.1%) 4 (5.8%)
Murmansk region,	WHO, SD	358	7-17	B+G	58 (16.2%)	33 (9.3%)

Location, year [ref]	Standard	N	Age	Sex	Overweight	Obesity
2016-2018 [44]						
Republic of Buryatia, 2017 [45]	WHO, SD	269	11-17	B+G	23 (8.5%)	66 (24.5%)
All Federal regions of the RF, 2018 [46]	WHO, SD	1058	11	B505 G 553	78 (15.4%) 79 (14.3%)	94 (18.6%) 51 (9.2%)
		965	15	B 469 G 496	54 (11.5%) 52 (10.5%)	47 (10.0%) 18 (3.6%)
Saint-Peterburg, 2016-2017 [47]	WHO, CI	946	6-7	B 483 G 463	53 (11.0%) 45 (9.7%)	81 (16.8%) 43 (9.3%)
		2092	8-11	B 1093 G 999	150 (13.7%) 129 (12.9%)	190 (17.4%) 95 (9.5%)
		2925	12-15	B 1538 G 1387	203 (13.2%) 140 (10.1%)	240 (15.6%) 209 (15.1%)
		486	16-18	B 229 G 257	31 (13.7%) 26 (10.1%)	20 (8.7%) 9 (3.6%)
Saint-Petersburg, 2017 [48]	WHO, CI	865	12-15	G 865	86 (9.9%)	131 (15.1%)
Ivanteevka, Moscow region, 2013 [49]	WHO, SD	5666	0-14	B+G		254 (4.5%)
		1282	15-17	B 684 G 598		49 (8.2%) 65 (9.5%)
Kharkov, 2015 [50]	WHO, CI	4708	5-17	B+G	438 (9.6%)	283 (6.0%)
Chernogorsk, Republic of Khakas	WHO, CI	97	11	G 97	17 (17.5%)	6 (6.2%)

Location, year [ref]	Standard	N	Age	Sex	Overweight	Obesity
ia, 2017 [51]						
		140	12	G 140	11 (7.8%)	17 (12.3%)
		130	13	G 130	19 (14.6%)	20 (15.4%)
		510	14	G 510	52 (10.2%)	36 (7.1%)
		315	15	G 315	20 (6.3%)	25 (8.0%)
		138	16	G 138	9 (6.5%)	10 (7.2%)
		175	17	G 175	20 (11.4%)	7 (4.0%)
		118	18	G 118	8 (6.8%)	1 (0.9%)
Surgut, 2017 [52]	WHO, CI	268	13-17	B+G	47 (17.5%)	17 (6.3%)
Khanty-Mansiysk autonomous district, village, 2019 [54]	WHO, CI	965	4-18	B+G	57 (5.9%)	11 (1.2%)
Ekaterinburg, 2019 [55]	WHO, SD	470	9-15	B+G	137 (29.1%)	104 (22.1%)
Omsk region, 2018 [56]	WHO, CI	342	1-7	B+G	30 (8.8%)	27 (7.9%)
		249	8-12		36 (14.5%)	55 (22.1%)
		314	13-18		60 (19.1%)	134 (42.7%)
Tyumen, 2019 [56]	WHO, CI	2351	6-7	B 1192 G 1159	143 (12.0%) 127 (11.0%)	60 (5.0%) 46 (4.0%)
Krasnoyarsk, 2017 [57]	WHO, CI	436	14-17	B 212 G 224	31 (14.6%) 26 (11.6%)	30 (14.2%) 24 (10.7%)
Omsk region, 2017 [58]	WHO, SD	427	13-17	B+G	46 (10.8%)	5 (1.2%)

Ivanovo, 2016-2017 [59]	WHO, SD	319	10	B 155 G 164	31 (20.0%) 31 (19.0%)	25 (16.0%) 11 (7.0%)
Ufa, 2013 [60]	WHO, CI	803	5-7	B 425 G 378	9 (2.1%) 22 (5.8%)	12 (2.8%) 4 (1.1%)

The statistical analysis made by us showed that overweight and obesity were registered in 25.3% of study participants; the data are presented in Table 2. Overweight and obesity in children of pre-school age (1-7 years old) were registered less often than in school children (7-19 years old) (p<0.001); in girls rarer than in boys (p<0.001). Overweight and obesity marked in boys were more frequent than in girls in both pre-school (p=0.017) and school aged children (p<0.001).

Only overweight was marked in 18.9% of the study participants; equally often both in children under and over the age of 7. Overweight in boys was marked more often than in girls (p<0,001), but statistically significant difference in data was marked only in school-aged children (p<0,001). Obesity was registered more often in school children as compared to pre-school aged children (p<0,001), in boys – more often than in girls as totally in population (p<0,001) as well as in pre-school children (p=0,0002) and school children (p<0,001).

Children and Adolescent Overweight and Obesity Prevalence

Children groups		Overweight			Obesity			Overweight+Obesity		
Sex	Age	Prevalence rate (%)	95% CI	Number of articles	Prevalence rate (%)	95% CI	Number of articles	Prevalence rate (%)	95% CI	Number of articles
B+G	1–19	18.86	18.71–19.00	47	6.57	6.48–6,65	50	25.35	25.07–25.41	50
	1–7	13.26	9.27–10.03	14	6.08	5.56–6.63	15	19.34	18.41–20.30	15
	7–19	13.78	13.51–14.05	42	8.74	8.52–8.95	45	22.51	22.17–22.86	45
B	1–19	20.81	20.59–21.04	24	7.32	7.19–7.46	26	28.13	27.86–28.39	26
	1–7	13.54	12.39–14.77	7	7.09	6.26–7.99	8	20.63	19.20–22.13	8
	7–19 лет	15.33	14.80–15.88	19	10.67	10.23–11.12	20	26.09	25.39–26.80	20
G	1–18	18.12	17.90–18.35	24	5.51	5.38–5.63	25	23.61	23.35–23.86	25
	1–7 лет	13.40	12.23–14.65	7	5.02	4.31–5.80	8	18.42	17.05–19.87	8
	7–18	12.31	11.82–12.81	18	6.75	6.82–7.63	19	18.96	18.36–19.87	19

We have analyzed the risk of overweight and obesity development in children and adolescents by the materials published; odds ratio is presented in Table 3. In school children the risk of obesity development has been determined to be higher by 1.5 than in pre-school children. In boys the risk of overweight development is 1.2 times as higher as in girls in the whole population as well as among school children. In both the whole population and the two age groups the risk of obesity development is higher in boys than in girls.

Values of overweight and obesity development risk level

Groups compared	Overweight			Obesity			Overweight + obesity		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Boys and girls total	1.1875	1.1660–1.2094	<0.0001	1.3565	1.3167–1.3975	<0.0001	1.2664	1.2456–1.2876	<0.0001
Boys and girls aged 7-19	1.2902	1.2182–1.3665	<0.0001	1.6499	1.5385–1.7693	<0.0001	1.5085	1.4383–1.5822	<0.0001
Boys and girls age	1.012	0.8855–1.1566	0.8847	1.444	1.1891–1.7535	0.0002	1.1511	1.0258–1.2917	0.0167

d 1-7								
Children aged 7-19 and children aged 1-7	1.0457	0.9785 – 1.1176	0.1870	1.4781	1.3469 – 1.6221	<0.0001	1.2119	1.1450 – 1.2828	<0.0001

On the basis of epidemiological studies conducted in the RF and neighbouring countries the conclusion may be made that epidemiological situation of obesity and overweight prevalence in Russia differs in various regions, with maximum recorded in Omsk region, Republic of Buryatia, Ekaterinburg and minimum noted in Ufa (Fig 1).

Figure 1: Obesity incidence in children in RF and CIS countries (2005-2020)
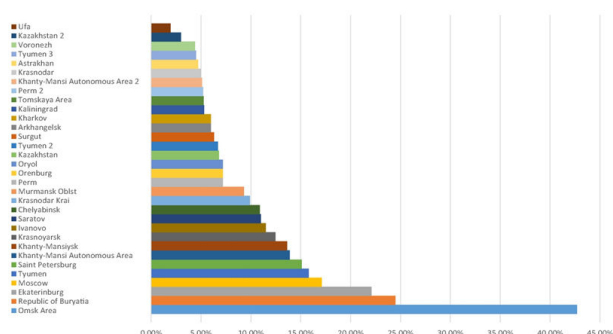
In case of similar obesity diagnostic criteria differences in regions may testify to sampling defects as well as to real unfavourable situation in some regions, which requires further detailing and additional preventive measures in particular regions.

Data on analysis of overweight and obesity prevalence changes in children and adolescents who live on the northern territories of Russia are of certain interest. So, studies carried out in Perm in 2005 and 2013 demonstrated increase in overweight incidence from 13.8% up to 18.9%, obesity incidence from 5.2% to 7.2% [21]. Similar tendency was marked by researchers from Tyumen: increase of overweight incidence is from 15.1% to 19.2% and obesity – from 6.7% to 15.8% [21].

Climate characteristics of Siberian and northern regions of children inhabitancy appear to contribute a lot to obesity development and progression in children due to long period of inactivity associated with long-lasting winter and extremely low temperatures. Some researchers note the ethnic factors role in the epidemiology of obesity in the regions of Buryatia, Republic of Chuvashia and some others.

It is difficult to assess prevalence rate of overweight and obesity in children in CIS countries because of the lack of presented studies.

Overweight and obesity were registered in 25.3% of participants in the Russian Federation and some neighbouring countries. A number of authors are of an opinion that presented data on overweight and obesity prevalence can be considered as only the "tip of an iceberg", whereas real data might be much bigger. Relatively few children with overweight and obesity come in sight of doctors. It is mostly patients with the 2nd degree obesity and higher who are medically followed up (15% of all overweight children), while most children with less marked changes are not followed up. It is these unmonitored children who are the most promising group for preventive work, since due to progressing character of the disease it is in this group that patients are going to develop higher degrees of obesity and associated complications. Besides that, the risk for obesity tends to persist into the adult life, it is known to increase if obesity develops in a child at the age of 2.

We have found no calculations of costs of expense on treatment of diseases due to obesity in a child in the Russian Federation. According to the Center for Disease Control and Prevention in the USA the expense amounted to $127000000 for the period from 1997-1999 to 2001 compared to $35000000 in 1979-1981. Data about indirect economic expenses on obese children are unknown. However, we can guess about their cost taking into consideration the increase of diseases accompanying obesity. Apart from that, the costs may include expense on sick-leave for parents of these children. A separate item of expense is the money that is allocated for the fight against obesity because even stabilization of incidence rate in the developed countries is gained with significant effort.

Thus, the present data allow to conclude the following:

- Overweight and obesity occur on average in 25.3% of children in Russia.
- Overweight prevalence varies within 2.1% – 29.1% in children groups differing in age, sex and living conditions.
- Obesity prevalence in the same children groups also varies significantly: from 0.9% to 42.7%.
- The highest prevalence rates are recorded in Buryatia and northern regions of our country.
- Overweight and obesity in pre-school aged children are registered rarer than in school children; overweight and obesity are more frequently noted in boys than in girls in both pre-school and school aged children.
- Over the last 15 years the number of overweight and obese children in the Russian Federation has been increasing, among them the number of little and pre-school aged children has also been growing.
- Epidemiological situation of obesity prevalence in Russia requires increasing prevention efforts among different ages of children including pre-school age.

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