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Review article

OVERNUTRITION AND OBESITY OF PRESCHOOL CHILDREN

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Dušan Nikolić[1], Aleksandar Gadžić[2], Stevan Stamenković[3]

[1]Academy of Vocational Studies South Serbia,
Department of the High School for Teachers, Bujanovac, Serbia
[2]Faculty of Physical Culture and Management in Sports, Singidunum University Belgrade
[3]Faculty of Sports and Physical Education, University of Niš, Serbia

Abstract. *Obesity is a growing concern in the developing world. The aim of this review is to analyze the research that studied the prevalence of obesity in preschool children in the period from 2001 to 2022. We collected 46 surveys. There are three sets of growth references commonly used to assess a child's weight status and health risk: BMI limit values published by the Centers for Disease Control and Prevention (CDC), the International Obesity Task Force (IOTF), and those published by the World Health Organization (WHO). Based on this, there are the following categories: malnutrition, normal nutrition, excessive nutrition and obesity. In accordance with the aim of this research, we collected data only on overnourished and obese children. The research has shown that the prevalence of overnourished and obese preschool children is high on all continents, regardless of which recommendations are used to define them. However, the most alarming data on obese preschool children are provided by studies that used the recommendations of the CDC (CDC - Centers for Disease Control and Prevention). The research shows that the highest prevalence of overnourished and obese preschool children is in North America. Such data are provided by research conducted by CDC, WHO and IOTF. The prevalence of overnourished and obese preschool children is not better in Europe either. Certain studies from Asia and Africa show us that their children have not yet caught up with their peers from North America and Europe in the prevalence of overnutrition and obesity. Research shows that there is a connection between overnutrition/obesity and socio-economic status of parents, daily routines, education of parents, duration of breastfeeding, degree of nutrition of parents, area where children live, the eating habits.*

Key words: *overnutrition, obesity, preschool children, IOTF, WHO, CDC.*

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Corresponding author: Dušan Nikolić
Academy of Vocational Studies South Serbia, Department of the High School for Teachers, Karađorđev trg, b.b
17 520 Bujanovac, Serbia
Phone: +381 17 853 692 • E-mail: nikolicdusan287@gmail.com

1. INTRODUCTION

Our species, Homo sapiens, appeared in central Africa approximately 300000 years ago. Genetic information suggest that our ancestors spread across the planet as independent hunting tribes. Agriculture appeared about 10000 years ago. Frequent migrations forced the first people to live actively. However, things have changed since then. In the beginning, the changes took place more slowly, while in the last few decades the pace of these changes has drastically accelerated and turned us into an inactive, sedentary population (Sharkey & Gaskill, 2007). Evolution has favored hunger over satiety signals, resulting in a preference for energy-dense foods. In the past, this predisposition was advantageous because energy could be stored during periods of high food availability and accessed during famines. Energy-dense foods are readily available today and sedentary behavior is common (Lanigan, et al., 2010). Obesity is a growing concern in the developing world. Since 1980, the number of overnourished and obese people has quadrupled. In developing countries, between 1980 and 2013, the prevalence of obesity in children and adolescents increased from 8% to 13% for both boys and girls. The prevalence of obesity among preschool children in Africa increased from 1990 to 2010 from 4% to 8.5%. It is similar in other parts of the world, and the continuation of this trend is expected (Gebremedhin, 2015). In today's environment, consumption of cheap and tasty foods full with sugar, salt and fat can prevent children from learning how to love and accept healthy foods. This leads to a diet rich in foods with high energy value and low consumption of fruits, vegetables, complex carbohydrates, meat, and low-fat dairy products. Such a dietary pattern is directly related to the risk of childhood obesity (Anzman, et al., 2010). The preschool period is especially crucial because it establishes long-term eating and physical activity habits with potential lifelong effects on health (Lanigan, et al., 2010). According to the WHO (World Health Organization) definition, overnutrition and obesity in children and adolescents, as well as in adults, are defined as unusual or excessive accumulation of fat that can endanger health (Ilić, 2014). Obesity is a serious problem affecting children of various ethnic backgrounds in developed and developing countries. The causes of obesity in preschool children are complex and multifactorial. Although 30-50% of the predisposition to obesity in preschool children can be explained by genetic factors, environmental influences play a key role (Lanigan, et al., 2010). Obesity is a major risk factor for many non-communicable diseases such as diabetes, cardiovascular disease and cancer. This phenomenon among children of preschool age is growing and more attention should be paid to it (Gebremedhin, 2015). Nutritional disorders in children at this age can have consequences for the organism in the form of inadequate physical growth, reduced cognitive and motor performance, as well as consequences for social-emotional development (Ilić, 2014). Childhood obesity is associated with serious health problems and the risk of premature illness and death later in life (De Onis, et al., 2010). There is evidence that obese children gain the greatest percentage of excess weight before the age of five and that this condition follows them through later childhood (Lanigan, et al., 2010). Traditional feeding practices and the perception that a "chubby baby is a healthy baby" persist, especially among those with low incomes. These traditional practices include frequent feedings in response to any sign of distress in children. Traditions are, by definition, slow to change, and changing them will be a major challenge (Anzman, et al., 2010).

1.1. The aim of the research

The aim of this review is to analyze the research that studied the prevalence of obesity in preschool children in the period from 2001 to 2022.

1.2. Research method

A descriptive method and theoretical analysis were used for the collection, classification and analysis of targeted research, and the material was searched on: Google, Google Scholar, PubMed and Kobson. The search was limited to works published in the period from 2001 to 2022. Key words used during the search were: obesity, preschool children, excessive nutrition and the consequences of obesity in preschool children. References from all papers were reviewed in order to find more studies dealing with this topic.

2. THEORETICAL CONSIDERATION OF THE PROBLEM

The degree of obesity is most often monitored based on the body mass index - BMI (*Body Mass Index*). In children and adolescents, BMI is calculated in the same way as in adults and represents the ratio of body mass in kilograms (kg) to the square of body height in meters (kg/m^2), but the interpretation of the obtained values is different for two reasons. The first is that the amount of fat in the body changes with age and the second is that the amount of fat in girls and boys differs (Ilić, 2014). There are three sets of growth references commonly used to assess a child's weight status and health risk: the BMI limit values published by the US Centers for Disease Control and Prevention (CDC), the International Obesity Task Force (IOTF) and those published by the World Health Organization (WHO) (Twells & Newhook, 2011). Charts used in children and adolescents take into account differences and allow the translation of BMI values into percentile values for a specific gender and age of the child. Percentiles determine the position of a certain index value in relation to a group of children of the same gender and age (Ilić, 2014). Based on this, there are the following categories: malnutrition, normal nutrition, overnutrition and obesity. In accordance with the aim of this research, we collected data only on overnourished and obese children. All research is presented in Table 3. In total, we collected 46 studies, and the basic characteristics of the research are shown in Table 1. Table 2 shows the classification of research according to the continent where the research was carried out. We carried out the statistical processing of the data following the same parameters, and based on that we obtained the prevalence of WHO, CDC and IOTF on different continents. Scientific studies that monitored the prevalence of obesity with some other or unknown recommendations were not included in the statistical processing, and their results were used in the discussion as a supplement.

Table 1 Classification of research according to the monitored parameter

Research that followed the recommendations	Number of research	Number of respondents
CDC	11	1 180 569
WHO	6	159 008
IOTF	10	438 809
CDC and WHO	1	387
CDC and IOTF	2	3 418
WHO and IOTF	1	2 435
WHO, IOTF and CDC	3	14 705
Research that followed other recommendations	12	70 505
Total	46	1 869 836
Total number of research CDC	17	1 199 079
Total number of research WHO	11	176 535
Total number of research IOTF	16	459 367

Of the total number of studies, 11 followed the recommendations of the CDC, 6 followed the recommendations of the WHO, 10 followed the recommendations of the IOTF, one study of the CDC and WHO recommendations, two studies of the CDC and IOTF recommendations, one study of the WHO and IOTF recommendations, three studies of the WHO, IOTF and CDC, and 12 research followed some other recommendations. Taken together, we have 17 studies in which overnutrition and obesity were monitored using CDC recommendations, 11 studies in which WHO recommendations were followed, and 16 studies in which IOTF recommendations were followed. The total number of respondents included in all surveys is 1 869 836. Of the total number of studies, 23 were conducted in Europe, 13 in Asia, 2 in Africa, 2 in Australia, 1 in South America and 5 in North America.

Table 2 Classification of research according to the continent where it was conducted

Location of research	Number of research	Number of respondents
Europe	23	282 191
Asia	13	24 654
Africa	2	155 996
Australia	2	230 364
South America	1	1 089
North America	5	1 175 542
Total	46	1 869 836

3. RESULTS OF THE RESEARCH

Table 3 shows 46 studies that studied the prevalence of overnutrition and obesity in preschool children. The total number of respondents included in all surveys was 1 869 836. The largest number of respondents participated in the research of Sekhobo, Edmunds, Reynolds, Dalenius & Sharma (2010) and amounted to 1 168 946 respondents, and the smallest in the research of Međedović, Osmankač, Dimitrić, Pantović, Nedeljkov, Grujičić (2014) and amounted to 45 respondents. Out of the total number, in 30 studies boys and girls were analyzed separately as well as together, and in 16 studies only the total prevalence for boys and girls was shown.

Table 3 Research results - list of all papers

References	Sample of respondents						Results					
							Boys		Girls		Total	
	N	Ma	Fe	Y	Place	Par.	Over.	Obes.	Over.	Obes.	Over.	Obes.
Sakamoto, et al. (2001)	1157	/	/	4-6	Saraburi Province (Thailand)	Thai nat.st.	/	/	/	/	(145) 12.5%	(178) 15.4%
Armstrong, et al. (2003)	64484	/	/	3-4	Scotland	UK 1990 BMI ref	/	/	/	/	(5505) 8.5%	(2788) 4.3%
Canning, Courage, & Frizzell (2004)	4161	2083	2078	3-5	Newfoundland and Labrador (Canada)	IOTF	(350) 16.8%	(162) 7.8%	(385) 18.5%	(170) 8.2%	(735) 17.6%	(332) 8%
Reilly et al. (2006)	545	273	272	Pr.	Glasgow (England)	UK 1990 BMI ref.	(69) 25.3%	(34) 12.5%	(54) 19.9%	(21) 7.7%	(123) 22.6%	(55) 10.1%
Wake, et al. (2007)	4934	2509	2425	4-5	Australia	IOTF	(351) 14%	(131) 5.2%	(400) 16.5%	(141) 5.8%	(756) 15.2%	(258) 5.5%
Senbanjo & Adejuyigbe (2007)	270	/	/	Pr.	Nigeria	/	/	/	/	/	(37) 13.7%	(14) 5.2%
Willows, Johnson & Ball (2007)	1044	521	523	5	Canada	CDC	(124) 23.8%	(211) 40.5%	(163) 31.2%	(179) 34.2%	(287) 27.5%	(390) 37.4%
						IOTF	(147) 28.2%	(109) 20.9%	(183) 35%	(113) 21.6%	(330) 31.6%	222) 21.3%
Manios, et al. (2007)	2374	1218	1156	1-5	Greece	CDC	(199) 16.3%	(193) 16%	(187) 16.2%	(179) 15.5%	(386) 16.3%	(372) 15.7%
						IOTF	(157) 12.9%	(76) 6.2%	(179) 15.5%	(94) 8.1%	(336) 14.1%	(170) 7.2%
Kumar, et al. (2008)	425	/	/	2-5	South India	WHO	/	/	/	/	(19) 4.47%	(6) 1.41%
Linardakis, et al. (2008)	856	447	409	4-7	(Greece) Crete	IOTF	(78) 17.6%	(46) 10.4%	(82) 20.4%	(45) 11.2%	(160) 18.7%	(91) 10.6%

References	Sample of respondents						Results					
	N	Ma	Fe	Y	Place	Par.	Boys		Girls		Total	
							Over.	Obes.	Over.	Obes.	Over.	Obes.
Kain, et al. (2009)	1089	539	550	5	Santiago (Chile)	WHO	(139) 25.8%	(100) 18.6%	(140) 25.5%	(70) 12.6%	(279) 25.6%	(170) 15.6%
Lioret et.al. (2009)	228	/	/	3-6	France	IOTF	/	/	/	/	(24) 10.5%	(7) 3%
Barron, et al. (2009)	323	176	147	4-6	Ireland	IOTF	(35) 19.9%	(12) 6.8%	(26) 17.7%	(14) 9.5%	(61) 18.9%	(26) 8.1%
Lim et al. (2009)	365	165	200	3-5	Detroit (USA)	CDC	/	/	/	/	(50) 12.9%	(40) 10.3%
Kaur, Sidhu & Sidhu (2010)	1745	875	870	2-5	Amritsar Pandzab (India)	BMI	(60) 6.85%	(18) 2.06%	(52) 5.97%	(17) 1.95%	(112) 6.42%	(35) 2%
Sekhobo, Edmunds, Reynolds, Dalenius & Sharma (2010)	180123	90.962	89.161	2-5	New York (USA) measured 2002.	CDC	(14281) 15.7%	(15827) 17.4%	(14444) 16.2%	(13909) 15.6%	(28640) 15.9%	(29720) 16.5%
	187766	94.822	92.944	2-5	New York (USA) measured 2003.	CDC	(15646) 16.5%	(16784) 17.7%	(15429) 16.6%	(14499) 15.6%	(30981) 16.5%	(31357) 16.7%
	198769	99.981	98.788	2-5	New York (USA) measured 2004.	CDC	(16897) 16.9%	(16797) 16.8%	(16992) 17.2%	(14818) 15%	(33990) 17.1%	(31604) 15.9%
	202945	101.676	101.269	2-5	New York (USA) measured 2005.	CDC	(17082) 16.8%	(15963) 15.7%	(17216) 17%	(14178) 14%	(34298) 16.9%	(30239) 14.9%
	200710	100.556	100.154	2-5	New York (USA) measured 2006.	CDC	(17396) 17.3%	(15586) 15.5%	(17227) 17.2%	(14022) 14%	(34723) 17.3%	(29504) 14.7%
	198633	99.714	98.919	2-5	New York (USA) measured 2007	CDC	(17251) 17.3%	(15456)15 .5%	(17212) 17.4%	(13750) 13.9%	(34562) 17.4%	(29199) 14.7%
Ali Musa & Hassan (2010)	550	283	267	0-5	Basra (Iraq)	CDC	/	/	/	/	(58) 10.5%	(18) 3.3%
Jovanović, et al. (2010)	193	88	105	4-5	Pančevo (Serbia)	WHO	/	/	/	/	(26) 13.5%	(29) 15%
Nichols et al. (2011)	129266	66.572	62.694	2	Australia	IOTF	(8062) 12.11%	(1278) 1.92%	(8658) 13.81%	(1323) 2.11%	(16714) 12.93%	(2598) 2.01%
	96164	48.948	47.216	3.5	Australia	IOTF	(7102) 14.51%	(1410) 2.88%	(8329) 17.64%	(1686) 3.57%	(15434) 16.05%	(3097) 3.22%

References	Sample of respondents						Results					
	N	Ma	Fe	Y	Place	Par.	Boys		Girls		Total	
							Over.	Obes.	Over.	Obes.	Over.	Obes.
Gaeini, et al. (2011)	755	377 (378)	378	3-6	Tehran (Iran)	CDC	(37) 9.81%	(18) 4.77%	(39) 10.31%	(17) 4.49%	(76) 10.07%	(35) 4.64%
Ma, et al. (2011)	8653	4498	4155	2-7	Southeast China	WHO	(462) 10.27%	(724) 16.1%	(484) 11.65%	(471) 11.34%	(946) 10.93%	(1195) 13.81%
						CDC	(466) 10.36%	(619) 13.76%	(509) 12.25%	(395) 9.51%	(975) 11.27%	(1014) 11.72%
						IOTF	(488) 10.85%	(278) 6.18%	(465) 11.2%	(248) 5.97%	(950) 10.98%	(526) 6.08%
Twells & Newhook (2011)	1026	537	489	Pr.	Newfoundland and Labrador (Canada)	WHO	(153) 28.5%	(63) 11.7%	(114) 23.3%	(53) 10.8%	(267) 26%	(116) 11.3%
						CDC	(100) 18.6%	(93) 17.3%	(96) 19.6%	(77) 15.7%	(196) 19.1%	(170) 16.6%
						IOTF	(88) 16.4%	(42) 7.8%	(99) 20.2%	(43) 8.8%	(187) 18.2%	(85) 8.3%
Đurašković, et al. (2012)	348	257	91	7	Niš (Serbia) measured 1988	WHO	(18) 7.00%	(12) 4.67%	(5) 5.48%	(2) 2.19%	(23) 6.61%	(14) 4.02%
	176	91	85	7	Niš (Serbia) measured 2008	WHO	(21) 23.08%	(16) 17.58%	(24) 28.23%	(13) 15.29%	(45) 25.57%	(29) 16.48%
Fatemeh, et al. (2012)	500	261	239	2-5	Birjand (Iran)	CDC	(25) 9.6%	(23) 8.8%	(28) 11.7%	(15) 6.3%	(53) 10.6%	(38) 7.6%
Despotović, et al. (2013)	516	265	251	7	Ćuprija (Serbia)	BMI	(29) 10.9%	(13) 4.9%	(22) 8.8%	(13) 5.2%	(51) 9.88%	(26) 5.04%
Al Alawi, et al. (2013)	387	197	191	0-5	Kingdom of Bahrain	WHO	/	/	/	/	(47) 12.1%	(10) 2.6%
						CDC	/	/	/	/	(38) 9.8%	(20) 5.2%

References	Sample of respondents						Results					
	N	Ma	Fe	Y	Place	Par.	Boys		Girls		Total	
							Over.	Obes.	Over.	Obes.	Over.	Obes.
Thibault, et al. (2013)	4048	2080	1968	5-7	Aquitaine (France)	IOTF	/	/	/	/	(293) 7.3%	(90) 2.2%
Vale, et al. (2013)	607	313	294	4-6	(Portugal) Porto	IOTF	(54) 17.2%	(28) 8.9%	(69) 23.5%	(31) 10.6%	(123) 20.3%	(59) 9.7%
Yen & Hu (2013)	329	175	154	3-6	Thailand	BMI DHT	/	/	/	/	(26) 8%	(21) 6%
Bagherian & Sadeghi (2013)	400	211	189	3-6	Iran	BMI	(23) 10.9%	(66) 31.3%	(30) 15.9%	(33) 17.5%	(53) 13.2%	(99) 24.8%
Vucerakovic & Mitrovic (2021)	36	19	17	5-6	Podgorica (Montenegro) measured 2013.	BMI	(5) 26%	(4) 21%	(3) 18%	(0) 0%	(8) 22.22%	(4) 11.11%
	46	25	21	5-6	Podgorica (Montenegro) measured 2020.	BMI	(7) 28%	(7) 28%	(3) 14%	(4) 19%	(10) 21.74%	(11) 23.9%
Stupar, Popović, & Vujović (2014)	206	114	92	6-7	(Serbia) Novi Sad	CDC	(16) 13.79%	(10) 8.62%	(7) 7.61%	(9) 9.78%	(23) 12%	(19) 9%
Ilić (2014)	1051	559	492	Pr.	Jagodina and Ćuprija (Serbia)	WHO	(122) 21.82%	(91) 16.28%	(83) 16.87%	(62) 12.6%	(205) 19.51%	(153) 14.56%
Međedović, et al. (2014)	45	19	26	6	Novi Sad (Serbia)	BMI	(2) 10.5%	(1) 5.3%	(5) 19.2%	(1) 3.8%	(7) 15.6%	(2) 4.4%
Djermanović, et al. (2015)	60	32	28	5-6	West of Republic of Serbia	CDC	(6) 18.75%	(4) 12.5%	(4) 14.3%	(4) 14.3%	(10) 16.7%	(8) 13.3%
Gebremedhin (2015)	155726	/	/	0-5	Sub-Saharan Africa - 26 count.	WHO	/	/	/	/	(6073) 3.9%	(4506) 2.9%
Kułaga, et al. (2016)	5026	2477	2549	2-6	Poland	WHO	(302) 12.2%	(121) 4.9%	(255) 10%	(87) 3.4%	(557) 11.1%	(208) 4.1%
						CDC	(426) 17.2%	(221) 8.9%	(487) 19.1%	(194) 7.6%	(913) 18.2%	(415) 8.3%
						IOTF	(302) 12.2%	(109) 4.4%	(372) 15%	(94) 3.8%	(674) 13.4%	(203) 4.1%

References	Sample of respondents						Results					
							Boys		Girls		Total	
	N	Ma	Fe	Y	Place	Par.	Over.	Obes.	Over.	Obes.	Over.	Obes.
Merkiel & Chalcarz (2016)	128	65	63	4-6	(Poland) Pila	CDC	/	/	/	/	(23) 18%	(7) 5.5%
Hassanzadeh-Rostami, et al. (2016)	8821	4618	4203	2-6	Iran	CDC	/	/	/	/	(502) 5.7%	(459) 5.2%
Silva-Santos, et al. (2017)	467	244	223	3-6	Porto (Portugal)	IOTF	(53) 21.6%	(15) 6.3%	(53) 23.8%	(28) 12.7%	(106) 22.7%	(45) 9.7%
Elkhodary, et al. (2017)	820	417	403	3-6	Saudi Arabia	BMI for Saudi pop	(37) 9%	(58) 14%	(49) 12%	(64) 16%	(86) 10%	(122) 15%
Ortiz-Marrón et al. (2018)	2435	1237	1198	4-6	Madrid (Spain)	WHO	(208) 16.8%	(67) 5.4%	(194) 16.2%	(66) 5.5%	(402) 16.5%	(133) 5.5%
						IOTF	(86) 7%	(30) 2.4%	(124) 10.3%	(44) 3.7%	(210) 8.6%	(74) 3%
Cvetković & Cvetković (2018)	50	/	/	6-7	Mladenovac (Serbia)	CDC	/	/	/	/	(3) 6%	(11) 22%
Ji, et al. (2018)	112	55	57	Pr.	Changsha City (China)	BMI	(7) 12.7%	(8) 14.5%	(10) 17.5%	(3) 5.3%	(17) 15.2%	(11) 9.8%
Garrido-Miguel, et al. (2019)	197755	/	/	2-7	27 European countries	IOTF	/	/	/	/	(38958) 17.9%	(10481) 5.3%
Pelemiš, et al. (2021)	188	107	81	6	Belgrade (Serbia)	CDC	(13) 12.1%	(8) 7.5%	(5) 6.1%	(6) 7.4%	(18) 9.6%	(14) 7.5%

Legend: N – sample of respondents; Ma – male; Fe – female; Y – years of age; Par. – monitored parameter; Over. – overnutrition; Obes. – obesity; *CDC – Centers for Disease Control and Prevention; IOTF – International Obesity Task Force*; *WHO – World Health Organization;* Pr. – children of preschool age; Thai nat.st. – Thai national standards; UK 1990 BMI ref. – Body mass index reference curves for the UK 1990; DHT – Department of Health in Taiwan; NCHS – National Center for Health Statistics; BMI for the Saudi pop. – recommendation by Al Herbish et al. (2009) for the Saudi population

Table 4 Analysis of papers that used CDC recommendations

CDC Total (boys+ girls)						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	4	1 171 381	197 727	16.88%	182 223	15.56%
Europe	7	8 032	1 376	17.13%	846	10.53%
Asia	6	19 666	1 702	8.65%	1 584	8.05%
TOTAL	17	1 199 079	200 805	16.75%	184 653	15.40%
CDC Boys						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	3	588 769	98 777	16.78%	96 717	16.43%
Europe	5	3 948	660	16.72%	436	11.04%
Asia	3	5 136	528	10.28%	660	12.85%
TOTAL	11	597 853	99 965	16.72%	97 813	16.36%
CDC Girls						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	3	582 247	98 779	16.97%	85 432	14.67%
Europe	5	3 906	690	17.67%	392	10.04%
Asia	3	4 772	576	12.07%	427	8.95%
TOTAL	11	590 925	100 045	16.93%	8 6251	14.60%

Of the total number of studies that followed CDC recommendations (17), in 11 studies, boys and girls were also analyzed separately (except collectively), while in six studies only the total percentage of boys and girls was shown.

Based on the analysis of 17 scientific studies that followed the recommendations of the CDC, and in which a total of 1 199 079 respondents were included, we arrive at the data that the prevalence of overnourished children (boys + girls) is 16.75%, and the prevalence of obesity is 15.4% in the world level (North America, Europe and Asia). By analyzing the continents separately, we arrive at the data that in North America the prevalence of overnourished children is 16.88%, and the prevalence of obese children is 15.56%. In Europe, the prevalence of overnourished children is similar to that in North America and amounts to 17.13%, but the prevalence of obesity is slightly lower and amounts to 10.53%. In contrast to Europe and North America, the prevalence of overnourished and obese children in Asia is significantly lower and amounts to 8.65% and 8.05% retrospectively.

By further analysis of 11 studies that followed the recommendations of the CDC, which analyzed boys and girls separately and together, we found that the prevalence of overweight boys is 16.72%, and the prevalence of obese boys is 16.36% at the world level (S. America, Europe and Asia). In North America, there are 16.78% of overnourished boys, and 16.43% of obese boys. In Europe, overnourished boys are similar to their peers from North America and there are 16.72% of them, while there are slightly fewer obese boys, and the prevalence is 11.04%. There are significantly fewer overnourished and obese boys in Asia than in North America and Europe, and the prevalence is 10.28% and 12.85% retrospectively.

Through further analysis of 11 studies that followed the recommendations of the CDC, which analyzed boys and girls not only collectively but also separately, we found that the prevalence of overnourished girls is 16.93%, and the prevalence of obese girls is

14.6% at the world level (North America, Europe and Asia). In North America, there are 16.97% of overnourished girls, and 14.67% of obese girls. In Europe, overnourished girls are similar to their peers from North America, and there are 17.67% of them, while there are slightly fewer obese girls, and the prevalence is 10.04%. There are significantly fewer overnourished and obese girls in Asia than in North America and Europe, and the prevalence is 12.07% and 8.95% retrospectively.

Table 5 Analysis of papers that used WHO recommendations

WHO total (boys + girls)						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
Africa	1	155 726	6 073	3.90%	4506	2.89%
N. America	1	1 026	267	26.02%	116	11.31%
S. America	1	1 089	279	25.61%	170	15.61%
Europe	5	8 881	1 235	13.91%	552	6.22%
Asia	3	9 465	1 012	10.69%	1211	12.79%
Total	11	176 187	8 866	5.03%	6555	3.72%
WHO Boys						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	1	537	153	24.49%	63	11.73%
S. America	1	539	139	25.79%	100	18.55%
Europe	4	4 364	653	14.96%	295	6.76%
Asia	1	4 498	462	10.27%	724	16.10%
Total	7	9 938	1 407	14.16%	1182	11.89%
WHO Girls						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	1	489	114	23.31%	53	10.84%
S. America	1	550	140	25.45%	70	12.73%
Europe	4	4 324	556	12.86%	228	5.27%
Asia	1	4 155	484	11.65%	471	11.34%
Total	7	9 518	1 294	13.60%	822	8.64%

Of the total number of studies that followed WHO recommendations (11), in 7 studies boys and girls were (except together) analyzed separately, while in four studies only the total percentage of boys and girls was shown.

Based on the analysis of 11 scientific studies that followed the recommendations of the WHO, and in which a total of 176 187 respondents were included, we arrive at the data that the prevalence of overnourished children (boys + girls) is 5.03%, and the prevalence of obesity is 3.72% at the world level (Africa, N. America, S. America, Europe and Asia). Such a low overall percentage was influenced by the results from Africa, where the prevalence of overnourished children is 3.9%, and the prevalence of obesity is 2.89%. Analyzing the results from other continents, we see that the percentages are significantly higher. In North America, the prevalence of overnourished children is 26.02%, and the prevalence of obesity is 11.31%. The situation is similar in South America, where the prevalence of overnourished children is 25.61%, and the prevalence of obesity is 15.61%. In Europe, that percentage is somewhat lower, so the prevalence of

overnourished children is 13.91%, and 6.22% of obese children. In Asia, the prevalence of overweight children is 10.69%, and the prevalence of obesity is 12.79%.

Through further analysis of 7 studies that followed the recommendations of the WHO, and which analyzed boys and girls separately and separately, we determined that the prevalence of overnourished boys is 14.16%, and the prevalence of obese boys is 11.89% at the world level (South America, North America, Europe and Asia). In South America, boys have the most alarming results. The prevalence of overnourished boys is 25.79%, and the prevalence of obese boys is 18.55%. Nor are the results any better in North America, where the prevalence of overnourished boys is 24.49%, and the prevalence of obese boys is 11.73%. In Europe, the results are somewhat better compared to the North and South America, but not encouraging. The prevalence of overnourished boys in Europe is 14.96%, and the prevalence of obese boys is 6.76%. Interesting results come from Asia, where the prevalence of overnourished boys is 10.27%, which is significantly less than the results on other continents, and the prevalence of obese boys is 16.1%, which is more than in Europe and North America, and almost the same as in South America.

Table 6 Analysis of papers that used IOTF recommendations

IOTF Total (boys + girls)						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	3	6 231	1 252	20.09%	639	10.26%
Australia	2	230 364	32 904	14.28%	5 953	2.58%
Europe	10	214 119	40 945	19.2%	11 246	5.25%
Asia	1	8 653	950	10.98%	526	6.08%
Total	16	459 367	76 051	16.55%	18 364	4%
IOTF Boys						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	3	3 141	585	18.62%	313	9.96%
Australia	2	118 029	15 515	13.15%	2 819	2.39%
Europe	7	6 112	765	12.52%	207	3.87%
Asia	1	4 498	488	10.85%	278	6.18%
Total	13	131 780	17 353	13.17%	3 617	2.74%
IOTF Girls						
Location	Nb. of analyzed research	Nb. of respondents	Overnutrition		Obesity	
			N	%	N	%
N. America	3	3 090	667	21.56%	326	10.55%
Australia	2	11 2335	17 387	15.48%	3 150	2.81%
Europe	7	5 976	905	15.14%	350	5.85%
Asia	1	4 155	465	11.19%	248	5.97%
Total	13	125 556	19 424	15.47%	4 074	3.24%

Through further analysis of 7 studies that followed the recommendations of the WHO, and which analyzed boys and girls not only collectively but also separately, we determined that the prevalence of overnourished girls is 13.6%, and the prevalence of obese girls is 8.64% at the world level (North America, South America, Europe and Asia). In South America, girls have the most alarming results. The prevalence of overnourished girls is 25.45%, and the prevalence of obese girls is 12.73%. Nor are the results any better in North America, where

the prevalence of overnourished girls is 23.31%, and the prevalence of obese girls is 10.84%. In Europe, the results are somewhat better compared to the North and South America, but not encouraging. The prevalence of overnourished girls in Europe is 12.86%, and the prevalence of obese girls is 5.27%. As for Asia, the prevalence of overweight girls is 11.65%, which is less than in North and South America, and approximately the same as in Europe, and the prevalence of obese girls is 11.34%, which is more than in Europe, and almost the same as in North and South America.

Of the total number of studies that followed the IOTF recommendations (16), in 13 studies, boys and girls were also (except together) analyzed separately, while in three studies, only the total percentage of boys and girls was shown.

Based on the analysis of 16 scientific studies that followed the recommendations of the IOTF, and in which a total of 459 367 respondents were included, we arrive at the data that the prevalence of overnourished children (boys + girls) is 16.55%, and the prevalence of obesity is 4% at the world level (S. America, Australia, Europe and Asia). In contrast to the results of research that followed the recommendations of the WHO and CDC, the prevalence of obese children is much lower here, while the prevalence of overnourished children is similar to the research that followed the recommendations of the aforementioned organizations. The data shows that according to the recommendations of the IOTF, children from North America lead the way in terms of the degree of overnutrition and obesity. The prevalence of overnourished children in the USA is 20.09%, and the prevalence of obesity is 10.26%. Alarming data also comes from Europe, where the prevalence of overnourished children is 19.2%, and the prevalence of obese children is 5.25%. Slightly more moderate data comes from Australia and Asia. In Australia, the prevalence of overnourished children is 14.28%, and the prevalence of obese children is 2.58%. In Asia, the prevalence of overnourished children is 10.98%, and the prevalence of obese children is 6.08%.

Through further analysis of 13 studies that followed the recommendations of the IOTF, which analyzed boys and girls not only collectively but also separately, we determined that the prevalence of overweight boys is 13.17%, and the prevalence of obese boys is 2.74% at the world level (S. America, Australia, Europe and Asia). In North America, the prevalence of overnourished boys is 18.62%, and the prevalence of obese boys is 9.96%. The prevalence of overnourished boys in Australia is 13.15%, and the prevalence of obese boys is 2.39%. Boys from Asia are not behind their peers from other parts of the world in excessive nutrition and their prevalence is 10.85%, and as far as obesity is concerned, boys from Asia are ahead of their peers from Europe and Australia, with a prevalence of 6.18%. In Europe, the prevalence of overnourished boys follows world trends and amounts to 12.52%, and the prevalence of obese boys is 3.87%, which is noticeably lower than in North America.

Through further analysis of 13 studies that followed the recommendations of the IOTF, and which analyzed boys and girls not only collectively but also separately, we determined that the prevalence of overnourished girls is 15.47%, and the prevalence of obese girls is 3.24% at the world level (S. America, Australia, Europe and Asia). For girls, the most alarming results also come from North America. The prevalence of overnourished girls is 21.56%, and the prevalence of obese girls is 10.55%. Similar results come from Europe and Asia. The prevalence of overnourished girls in Asia is 11.19%, and 5.97% of obese girls. The prevalence of overnourished girls in Europe is 15.14%, and 5.85% of obese girls. The lowest prevalence of obese girls is in Australia at 2.81%, but the percentage of overweight girls is similar to the other mentioned parts of the world at 15.48%.

Studies that followed some other recommendations (not CDC, WHO and IOTF) give us varied data. In Asia, the prevalence of obese preschoolers ranges from 2% to 24.8%, and the prevalence of overnourished children ranges from 6.4% to 15.2%. The prevalence of the overnourished boys ranges from 6.85% to 12.7%, and the prevalence of the obese boys from 2.06% to 31.3%. The prevalence of the overnourished girls ranges from 5.97% to 17.5%, and the prevalence of the obese girls from 1.95% to 17.5%. In Europe, the prevalence of the obese ranges from 4.3% to 23.9%, and the prevalence of the overnourished from 8.5% to 22.6%. The prevalence of overnourished boys ranges from 10.5% to 28%, and the prevalence of obese boys from 4.9% to 28%. The prevalence of overnourished girls ranges from 8.8% to 19.9%, and the prevalence of obese girls from 0% to 19%. One research paper from Africa shows us that the prevalence of overnourished preschool children is 13.7%, and the prevalence of obese 5.2%

4. DISCUSSION

The analysis of previous research shows that the prevalence of overnourished and obese preschool children is high on all continents, regardless of which recommendations are used to define them. However, the most alarming data on obese preschool children are provided by studies that used the recommendations of the CDC (CDC – Centers for Disease Control and Prevention). The prevalence of obese children in studies that used IOTF (IOTF – International Obesity Task Force) recommendations is lower than the prevalence in studies that used WHO and CDC recommendations. Willows, Johnson et al. (2007) on a sample of 1044 preschool children from Canada determined that the prevalence of overnourished was 27.5% according to CDC recommendations, and 31.6% according to IOTF recommendations. When it comes to obesity, the prevalence is 21.3% according to IOTF recommendations, and 37.4% according to CDC recommendations. The authors conclude that the IOTF reference provided more conservative estimates of obesity than the CDC reference. Manios, Costarelli et al. (2007) found in a sample of 2374 preschoolers in Greece that there is a difference in the prevalence of obesity given by CDC and IOTF references. The prevalence of obese children according to the IOTF reference was 7.2%, and 15.7% according to the CDC reference. The prevalence of overnourished children according to the IOTF reference was 14.1%, and 16.3% according to the CDC reference. Ma, Chen et al. (2011) found that there is a difference between the CDC, IOTF and WHO references on a sample of 8653 preschool children from Northeast China. The authors determined that the prevalence of overnourished children was 10.98% according to the IOTF, 11.27% according to the CDC and 10.93% according to the WHO reference. The prevalence of obese children is 6.08% according to the IOTF, 11.72% according to the CDC and 13.81% according to the WHO reference. Previous statements are also confirmed by Twells & Newhook (2011). On a sample of 1026 preschoolers from Newfoundland and Labrador (Canada), the authors determined that there is a difference between the CDC, IOTF and WHO references. The prevalence of overnourished children was 18.2% according to the IOTF, 19.1% according to the CDC and 26% according to the WHO reference. The prevalence of obese children was 8.3% according to the IOTF, 16.6% according to the CDC and 11.3% according to the WHO reference. The authors conclude that the CDC reference reported a much higher prevalence of obesity compared to other references. Al Alawi, Abdulatif et al. (2013)

found on a sample of 387 preschoolers from the Kingdom of Bahrain that WHO and CDC give different prevalence of overnutrition and obesity. The prevalence of overnourished preschoolers according to the WHO was 12.1%, and 9.8% according to the CDC reference. The prevalence of obese preschoolers according to the WHO was 2.6%, and 5.2% according to the CDC reference. Kułaga, et al. (2016) confirmed the previous research on a sample of 5026 preschoolers from Poland. The prevalence of overnourished preschoolers was 13.4% according to IOTF, 18.2% according to CDC and 11.1% according to WHO. The prevalence of obese preschoolers was 4.1% according to IOTF, 8.3% according to CDC and 4.1% according to WHO. Ortiz-Marrón et al. (2018) found, in a sample of 2 435 preschoolers from Spain, that the prevalence of overnourished and obese preschoolers provided by WHO and IOTF references is different. The prevalence of the overnourished was 16.5% according to WHO, and 8.6% according to IOTF. The prevalence of the obese was 5.5% according to WHO, and 3% according to IOTF.

Many studies have established that there is a connection between overnutrition/obesity and socio-economic status of parents, as well as daily routines. Armstrong, Dorosty et al. (2003) found in a sample of 74 500 children from Scotland that obesity is more common in poorer families. Thibault, et al. (2013) found on a sample of 4048 preschoolers from France that the prevalence of overnutrition and obesity was higher in children whose parents had a low or medium socio-economic status. Also, the research shows that there is a significant connection between the higher prevalence of overnutrition and obesity and forms of behavior such as: never or sometimes eating breakfast, never eating in the school canteen, never having breakfast, never or sometimes having a light afternoon meal and having a high sitting activity. Fatemeh, et al. (2012) found in a sample of 500 preschoolers from Iran (Birjand) that there is a significant association between overnutrition/obesity, the mother's occupation and the father's level of education. Manios, Costarelli et al. (2007) found that childhood obesity is related to the mother's education. Ali Musa & Hassan (2010) found on a sample of 550 preschoolers in Iraq that there is a significant positive relationship between the father's education and the number of hours watching television with excessive nutrition and obesity. Also, there is a negative association between the duration of breastfeeding and overnutrition and obesity. Senbanjo & Adejuyigbe (2007) found that the prevalence of overnutrition decreases with increasing duration of breastfeeding. Sakamoto, et al. (2001) found in a sample of preschool children from Thailand that there is a relationship between childhood obesity and the level of education of parents, as well as between obesity and household income. Wake, et al. (2007) found on a sample of 4 934 preschoolers in Australia that the body mass index of preschool children increases linearly with a decrease in mother's education and family income. Also, the authors determine that the parent's skill in the job he is engaged in is related to the body mass index of the children. More precisely, if the parents are less skilled in the work they do, it is more likely that the child will be in the heavier than the lighter category of the Body Mass Index. Despotović, Aleksopulos et al. (2013) determined on a sample of 516 preschoolers from Serbia that the factor of time spent watching TV programs and working with computers is a very significant factor in childhood obesity. Ji et al. (2018) found in a sample of 112 preschoolers from China that children who were obese had shorter sleep times compared to children of normal weight. Gebremedhin (2015) found in a sample of 155 726 preschoolers from Sub-Saharan Africa that the risk of overnutrition and obesity increases with decreasing maternal age and decreasing the number of siblings. Jovanović, et al. (2010) found on a sample of 193 preschoolers from Serbia (Pančevo) that the prevalence of insufficient physical activity among preschool children is high, especially among children with excessive nutrition

and obesity, and parents most often say that the reason for that is a lack of finances and a lack of sports facilities and fields. Hassanzadeh-Rostami, et al. (2016) found on a sample of 8821 preschoolers from Iran that the prevalence of overnutrition and obesity is higher in children living in urban areas compared to children from rural areas. The same conclusion was reached by Sakamoto, et al. (2001) on a sample of preschool children from Thailand. The authors determined that the prevalence of obese children in urban areas is 22.7%, and 7.4%. The only research that came to the conclusion that there is no association between obesity and socio-economic class is the research of Senbanjo & Adejuyigbe (2007) which was conducted on a sample of 270 preschool children from Nigeria.

Linardakis, et al. (2008) found in a sample of 856 preschool children from Crete that 59.8% consumed beverages with added sugar on a daily basis. The authors concluded that children who are heavy consumers of drinks with added sugar have a higher level of Body Mass Index and twice the risk of overnutrition and/or obesity. Lim et al. (2009) found in a sample of 365 preschoolers from Detroit that consumption of sweetened beverages was positively associated with Body Mass Index scores. The authors concluded that high consumption of sugar-sweetened beverages was significantly associated with obesity risk. Merkiel & Chalcarz (2016) determined on a sample of 128 preschoolers from Poland that children excessively consume energy through saturated fatty acids and sucrose and polysaturated fatty acids. Excessive intake of sodium and inadequate intake of dietary fiber, water, vitamin D, vitamin E, folate, niacin, calcium and potassium were also found. The authors conclude that preschool nutrition needs to be urgently improved to prevent nutrition-related diseases in preschoolers. Đermanović, et al. (2015) determined on a sample of 60 preschoolers from the Republic of Serbia that the average content of fat in the daily meal was 17.5g, protein 19.1g, and carbohydrates 101.5g. Research has shown that the number of portions of fruit, vegetables, milk and dairy products was less than one portion per day. Only the number of portions of meat and meat products was greater than one portion per day. The authors concluded that the daily meals in the preschool institution do not comply with the recommended intake for energy and carbohydrates, and the composition of the meals is inappropriate. The authors believe that parents and educators should encourage children to eat different types of fruits and vegetables, whole grain cereals and low-fat dairy products, and to balance food intake with recommendations.

Research shows that the level of nutrition of parents is positively related to the level of nutrition of children. Ji et al. (2018) found on a sample of 112 preschoolers from China that the body mass index of the parents is positively correlated with the body mass index of the child. Manios, et al. (2007) found, on a sample of 2 374 preschoolers in Greece, that there is an association between overnutrition of children and overnutrition of parents. Children are more likely to be obese if they have one or both obese parents. As the number of obese parents increases, so does the number of obese children. Children with one obese parent are 91% more likely to be overweight than those without an obese parent. Children who have both obese parents are 2.38 times more likely to be overweight than children who do not have obese parents. In a sample of 155 726 preschoolers from Sub-Saharan Africa, Gebremedhin (2015) determined that child overnutrition and obesity are positively related to maternal obesity. Obese mothers were 1.58 times more likely to have an undernourished or obese child. Jovanović, et al. (2010) found that overweight children often have overweight mothers in a sample of 193 preschoolers from Serbia.

Kain, Corvalán et al. (2009) found in a sample of 1 089 preschool children from Chile that birth weight is directly – positively related to the risk of obesity in the later period.

The same results were obtained by Fatemeh, et al. (2012) on a sample of 500 preschoolers from Iran (Birjand) and Ali Musa & Hassan (2010) on a sample of 550 preschoolers in Iraq.

Bagherian & Sadeghi (2013) found in a sample of 400 preschoolers from Iran that there is a positive association between a greater number of extracted and filled surfaces of primary teeth and severe caries with overweight and obesity. On the other hand, Yen & Hu (2013) determined in a sample of 329 preschoolers from Thailand that obesity is not significantly related to dental caries in preschool children. Cvetković & Cvetković (2018) determined on a sample of 50 preschoolers from Serbia that there is no statistically significant connection between the degree of nutrition and kyphotic and lordotic body posture.

Silva-Santos, Santos et al. (2017) found in a sample of 467 preschoolers from Portugal that obese preschoolers have six times less fitness than their peers who have a normal weight. Canning, Courage et al. (2004) believe that prevention measures should begin before the age of three. Reilly et al. (2006) found on a sample of 545 preschool children that additional activity in kindergarten of 30 minutes a day three times a week for 24 weeks, along with health education at home based on increasing physical activity through play and reducing sedentary behavior, is not sufficient to reduce body mass index.

Research shows that the highest prevalence of overnourished and obese preschool children is in North America. Such data are provided by research conducted by CDC, WHO and IOTF. The prevalence of overnourished and obese preschool children is not much better in Europe either. Certain studies from Asia and Africa show us that their children have not yet caught up with their peers from North America and Europe in the prevalence of overnutrition and obesity. However, there are studies that show that overnutrition and obesity are prevalent in Asian countries as well. Elkhodary et al. (2017) found, on a sample of 820 preschoolers from Saudi Arabia, that the prevalence of overnourished children was 10%, and the prevalence of obesity was 15%. Low prevalence appeared in the following countries: Gebremedhin (2015) found, in a sample of 155726 preschoolers from Sub-Saharan Africa, that the prevalence of overnourished children was 3.9%, and the prevalence of obesity was 2.9% (WHO). Gaeini, et al. (2011) found, on a sample of 755 preschoolers from Iran (Tehran), that the prevalence of overnourished children was 10.07%, and the prevalence of obesity was 4.64% (CDC). Lioret et al. (2009) on a sample of 228 preschool children from France determined that the prevalence of overnourished children was 10.5%, and the prevalence of obese children was 3% (IOTF). Barron, et al. (2009) on a sample of 323 preschoolers from Ireland determined that the prevalence of overnourished children was 18.9%, and the prevalence of obesity was 8.1% (IOTF). Kaur, et al. (2010) on a sample of 1745 preschoolers from India (Amritsar Punjab) determined that the prevalence of overnourished children was 6.42%, and the prevalence of obesity was 2%. Ali Musa & Hassan (2010) found, on a sample of 550 preschoolers in Iraq, that the prevalence of overnourished children was 10.5%, and the prevalence of obesity was 3.3%. Kumar, Mohanan et al. (2008) in a sample of 425 pre-school children from South India determined that the prevalence of overnourished children was 4.47% and obese 1.41% (WHO).

Garrido-Miguel et al. (2019) found, on a sample of 197 755 preschoolers from 27 European countries, that the prevalence of overweight is 17.9%, and the prevalence of obesity is 5.3% (IOTF). The authors concluded that Southern European countries showed the highest prevalence of overweight, especially Italy and Greece.

According to research carried out by Pelemiš, et al. (2021), Međedović, Osmankać et al. (2014), Ilić (2014), Stupar, Popović et al. (2014), Đurašković, et al. (2012) preschoolers in

Serbia do not lag behind preschoolers from Western Europe in terms of excessive nutrition and obesity.

Research shows that in recent years there has been an increase in the prevalence of overnutrition and obesity. Lim et al. (2009) found in a sample of 365 preschoolers from Detroit that within two years, the prevalence of overweight increased from 12.9% to 18.7%, and the prevalence of obesity from 10.3% to 20.4% (CDC). Đurašković, et al. (2012) determined that the prevalence of overnutrition in seven-year-olds increased from 6.61% to 25.57% from 1988 to 2008, and the prevalence of obesity from 4.02% to 16 .48% (WHO). Vuceraković & Mitrović (2021) determined that the prevalence of obesity among preschoolers increased from 11.11% to 23.9% from 2013 to 2020. Sekhobo, et al. (2010) showed that from 2002 to 2007 the prevalence in the USA was more or less constant. In 2002, the prevalence of preschoolers with excessive nutrition was 15.9%, then in 2003, 16.5%, in 2004, 17.1%, in 2005, 16.9%, in 2006, 17.3%, in 2007, 17.4%. In 2002, the prevalence of obese preschoolers was 16.5%, then in 2003, 16.7%, in 2004, 5.9%, in 2005, 14.9%, in 2006, 14.7%, and in 2007, 14.7%. Nichols et al. (2011) based on a sample of 129 266 two-year-old and 96 164 three-and-a-half-year-old children found that the prevalence of overnutrition and obesity decreased between 1999 and 2007, but socioeconomic differences also decreased.

5. CONCLUSION

An analysis of 46 studies showed that the prevalence of *overnourished* and *obese* preschool children is high on all continents, regardless of which recommendations are used to define them. However, the most alarming data on obese preschool children are provided by studies that used the recommendations of the CDC (CDC – *Centers for Disease Control and Prevention*). Research shows that the highest prevalence of overnourished and obese preschool children is in North America. Such data are provided by research conducted by CDC, WHO and IOTF. The prevalence of *overnourished* and *obese* preschool children is not much better in Europe either. Certain studies from Asia and Africa show us that their children have not yet caught up with their peers from North America and Europe in the prevalence of *overnutrition* and *obesity*. Research shows that there is a connection between *overnutrition/ obesity* and parents' socio-economic status, daily routines, parents' education, duration of breastfeeding, level of parents' nutrition, area where children live and eating habits. It is necessary to take preventive measures in order to stop the growing trend in the prevalence of overnourished and obese preschool children.

REFERENCES

Al Alawi, S., Abdulatif, F., Al Dhubaib, D., Mohammed, H., & Al Ansari, A. (2013). Prevalence of overweight and obesity across preschool children from four cities of the Kingdom of Bahrain. *International Journal of Medical Science and Public Health*, *2*(2), 507-510. https://doi.org/10.5455/ijmsph.2013.2.507-510

Ali Musa, W., & Hassan, M.K. (2010). Overweight and obesity among preschool children in Basrah. *The Medical Journal of Basrah University*, *28*(1), 1-8. https://doi.org/10.33762/mjbu.2010.49368

Anzman, S. L., Rollins, B. Y., & Birch, L. L. (2010). Parental influence on children's early eating environments and obesity risk: implications for prevention. *International journal of obesity*, *34*(7), 1116-1124. https://doi.org/10.1038/ijo.2010.43

Armstrong, J., Dorosty, A. R., Reilly, J. J., & Emmett, P. M. (2003). Coexistence of social inequalities in undernutrition and obesity in preschool children: population based cross sectional study. *Archives of disease in childhood*, *88*(8), 671-675. https://doi.org/10.1136/adc.88.8.671

Barron, C., Comiskey, C., & Saris, J. (2009). Prevalence rates and comparisons of obesity levels in Ireland. *British journal of nursing*, *18*(13), 799-803. https://doi.org/10.12968/bjon.2009.18.13.43208

Bagherian, A., & Sadeghi, M. (2013). Association between dental caries and age-specific body mass index in preschool children of an Iranian population. *Indian Journal of Dental Research*, *24*(1), 66. https://doi.org/10.4103/0970-9290.114956

Canning, P. M., Courage, M. L., & Frizzell, L. M. (2004). Prevalence of overweight and obesity in a provincial population of Canadian preschool children. *Canadian Medical Association. Journal*, *171* (3), 240-242. https://doi.org/10.1503/cmaj.1040075

Cvetković, N., & Cvetković, J. (2018). Nutritional levels and spine curvature disorders among preschool chidlren. *Facta Universitatis Series: Physical Education and Sport*, *16*(2), 309-318. https://doi.org/10.22190/FUPES180722027C

Despotović, M., Aleksopulos, H., Despotović, M., & Ilić, B. (2013). Stanje uhranjenosti dece predškolskog uzrasta. *Medicinski časopis Srpskog lekarskog društva okružne podružnice Kragujevac*, *47*(2), 62-68. https://doi.org/10.5937/mckg47-2071

De Onis, M., Blössner, M., & Borghi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *The American journal of clinical nutrition*, *92*(5), 1257-1264. https://doi.org/10.3945/ajcn.2010.29786

Đermanović, M., Miletić, I., & Pavlović, Z. (2015). Analiza unosa makronutrijenata i indeksa telesne mase kod dece predškolskog uzrasta u regiji zapadne Republike Srpske (Analysis of Macronutrients Intake and Body Mass Index in Preschool Children in the Western Region of the Republic of Srpska). *Srpski arhiv za celokupno lekarstvo*, *142*(11-12), 695-700. https://doi.org/10.2298/SARH1512695D

Đurašković, R., Pantelić, S., Nikolić, M., & Popović-Ilić, T. (2012). Razlike u težinsko visinskim odnosima i uhranjenosti učenika starih 7 godine merenih 1988. i 2008. godine. *Glasnik Antropološkog društva Srbije*, 181-191. https://doi.org/10.5937/gads1247181D

Elkhodary, H., Farsi, D., Merdad, L., Farsi, N., Alaki, S., Alamoudi, N., Bahdaila, D., & Bahammam, H. (2017). Prevalence of obesity among preschool children and its relation with dental caries. *Journal of Dentistry and Oral Hygiene*, *9*(1), 1-7. https://doi.org/10.5897/JDOH2016.0216

Fatemeh, T., Mohammad-Mehdi, H. T., Toba, K., Afsaneh, N., & Sharifzadeh, G. (2012). Prevalence of overweight and obesity in preschool children (2-5 year olds) in Birjand, Iran. *BMC Research Notes*, *5*(1), 1-6. https://doi.org/10.1186/1756-0500-5-529

Gaeini, A., Kashef, M., Samadi, A., & Fallahi, A. (2011). Prevalence of underweight, overweight and obesity in preschool children of Tehran, Iran. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, *16*(6), 821 -827. https://doi.org/10.1186/s40200-014-0121-2

Garrido-Miguel, M., Oliveira, A., Cavero-Redondo, I., Álvarez-Bueno, C., Pozuelo-Carrascosa, D. P., Soriano-Cano, A., & Martínez-Vizcaíno, V. (2019). Prevalence of overweight and obesity among European preschool children: a systematic review and meta-regression by food group consumption. *Nutrients*, *11*(7), 1698. https://doi.org/10.3390/nu11071698

Gebremedhin, S. (2015). Prevalence and differentials of overweight and obesity in preschool children in Sub-Saharan Africa. *BMJ Open*, *5*(12), 1-7. http://dx.doi.org/10.1136/bmjopen-2015-009005

Hassanzadeh-Rostami, Z., Kavosi, E., & Nasihatkon, A. (2016). Overweight and obesity among preschool children from Fars province of Iran: prevalence and associated factors. *Journal of research in health sciences*, *16*(1), 26.

Ilić, B. (2014). *Determinante gojaznosti dece predškolskog uzrasta* [Doktorska disertacija]. Univerzitet u Kragujevcu: Fakultet medicinskih nauka.

Ji, M., Tang, A., Zhang, Y., Zou, J., Zhou, G., Deng, J., Yang, L., Li, M., Chen, J., Qin, H., & Lin, Q. (2018). The relationship between obesity, sleep and physical activity in Chinese preschool children. *International journal of environmental research and public health*, *15*(3), 527. https://doi.org/10.3390/ijerph15030527

Jovanović, R., Nikolovski, D., Radulović, O., & Novak, S. (2010). Physical activity influence on nutritional status of preschool children. *Acta Medica Medianae*, *49*(1), 17-21.

Kain, J., Corvalán, C., Lera, L., Galván, M., & Uauy, R. (2009). Accelerated growth in early life and obesity in preschool Chilean children. *Obesity*, *17*(8), 1603-1608. https://doi.org/10.1038/oby.2009.37

Kaur, N., Sidhu, S. K., & Sidhu, S. (2010). Prevalence of overweight and obesity in preschool children of Amritsar, Punjab. *The Anthropologist*, *12*(3), 221-224. https://doi.org/10.1080/09720073.2010.11891158

Kumar, H. H., Mohanan, P., Kotian, S., Sajjan, B. S., & Kumar, S. G. (2008). Prevalence of overweight and obesity among pre-school children in semi urban south India. *Indian Pediatrics*, *45*(6), 497-499.

Kułaga, Z., Gurzkowska, B., Grajda, A., Wojtyło, M., Góźdź, M., & Litwin, M. (2016). The prevalence of overweight and obesity among Polish pre-school-aged children. *Developmental Period Medicine*, *20*(2), 143-149.

Lanigan, J., Barber, S., & Singhal, A. (2010). Prevention of obesity in preschool children. *Proceedings of the Nutrition Society*, *69*(2), 204-210. https://doi.org/10.1017/S0029665110000029

Linardakis, M., Sarri, K., Pateraki, M. S., Sbokos, M., & Kafatos, A. (2008). Sugar-added beverages consumption among kindergarten children of Crete: effects on nutritional status and risk of obesity. *BMC Public Health*, *8*(1), 1-7. https://doi.org/10.1186/1471-2458-8-279

Lioret, S., Touvier, M., Dubuisson, C., Dufour, A., Calamassi-Tran, G., Lafay, L., Volatier, J.L., & Maire, B. (2009). Trends in child overweight rates and energy intake in France from 1999 to 2007: relationships with socioeconomic status. *Obesity*, *17*(5), 1092-1100. https://doi.org/10.1038/oby.2008.619

Lim, S., Zoellner, J. M., Lee, J. M., Burt, B. A., Sandretto, A. M., Sohn, W., Ismail, A.I., & Lepkowski, J. M. (2009). Obesity and sugar-sweetened beverages in African-American preschool children: a longitudinal study. *Obesity*, *17*(6), 1262-1268. https://doi.org/10.1038/oby.2008.656

Ma, Y. N., Chen, T., Wang, D., Liu, M. M., He, Q. C., & Dong, G. H. (2011). Prevalence of overweight and obesity among preschool children from six cities of northeast China. *Archives of medical research*, *42*(7), 633-640. https://doi.org/10.1016/j.arcmed.2011.10.011

Manios, Y., Costarelli, V., Kolotourou, M., Kondakis, K., Tzavara, C., & Moschonis, G. (2007). Prevalence of obesity in preschool Greek children, in relation to parental characteristics and region of residence. *BMC Public Health*, *7*(1), 1-8. https://doi.org/10.1186/1471-2458-7-178

Međedović, B., Osmankać, N., Dimitrić, I., Pantović, M., Nedeljkov, N., Grujičić, D. (2014). Evaluacija fizičke aktivnosti i stanja fizičke forme dece predškolskog uzrasta. *TIMS Acta. 8*, 11-22. https://doi.org/10.5937/timsact8-5058

Merkiel, S., & Chalcarz, W. (2016). Preschool diets in children from Piła, Poland, require urgent intervention as implied by high risk of nutrient inadequacies. *Journal of Health, Population and Nutrition*, *35*(1), 1-13. https://doi.org/10.1186/s41043-016-0050-4

Nichols, M. S., Silva-Sanigorski, A.d, Cleary, J. E., Goldfeld, S. R., Colahan, A., & Swinburn, B. A. (2011). Decreasing trends in overweight and obesity among an Australian population of preschool children. *International journal of obesity*, *35*(7), 916-924. https://doi.org/10.1038/ijo.2011.64

Ortiz-Marrón, H., Ortiz-Pinto, M. A., Cuadrado-Gamarra, J. I., Esteban-Vasallo, M., Cortés-Rico, O., Rey-Gayo, L., Ordobas, M., & Galán, I. (2018). Persistence and variation in overweight and obesity among the pre-school population of the Community of Madrid after 2 years of follow-up. The eloin cohort. *Revista Española de Cardiología (English Edition)*, *71*(11), 902-909. https://doi.org/10.1016/j.rec.2017.12.024

Pelemiš, V., Mandić, D., Momčilović, Z., Momčilović, V., Srdić, V. (2021). Body composition and nutritional status of preschool children. *Facta Universitatis Series: Physical Education and Sport*, *19*(3), 1-10. https://doi.org/10.22190/FUPES201213003P

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., Lo Conte, R., Paton, J.Y., & Grant, S. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. *British Medical Journal*, *333*(7577), 1041-1043. https://doi.org/10.1136/bmj.38979.623773.55

Sakamoto, N., Wansorn, S., Tontisirin, K., & Marui, E. (2001). A social epidemiologic study of obesity among preschool children in Thailand. *International journal of obesity*, *25*(3), 389-394. https://doi.org/10.1038/sj.ijo.0801477

Sharkey., B. J., & Gaskill, S. E. (2007). *Vežbanje i zdravlje*. Beograd: Datastatus

Senbanjo, I. O., & Adejuyigbe, E. A. (2007). Prevalence of overweight and obesity in Nigerian preschool children. *Nutrition and health*, *18*(4), 391-399. https://doi.org/10.1177/026010600701800408

Sekhobo, J. P., Edmunds, L. S., Reynolds, D. K., Dalenius, K., & Sharma, A. (2010). Trends in prevalence of obesity and overweight among children enrolled in the New York State WIC program, 2002–2007. *Public Health Reports*, *125*(2), 218-224. https://doi.org/10.1177/003335491012500210

Silva-Santos, S., Santos, A., Vale, S., & Mota, J. (2017). Motor fitness and preschooler children obesity status. *Journal of sports sciences*, *35*(17), 1704-1708.

Stupar, D., Popović, B., & Vujović, P. (2014). Stanje uhranjenosti predškolske dece Novog Sada. *Glasnik Antropološkog društva Srbije*, *49*, 51-55. https://doi.org/10.5937/gads1449051S

Thibault, H., Carriere, C., Langevin, C., Déti, E. K., Barberger-Gateau, P., & Maurice, S. (2013). Prevalence and factors associated with overweight and obesity in French primary-school children. *Public health nutrition*, *16*(2), 193-201. https://doi.org/10.1017/S136898001200359X

Twells, L. K., & Newhook, L. A. (2011). Obesity prevalence estimates in a Canadian regional population of preschool children using variant growth references. *BMC pediatrics*, *11*(1), 1-6. https://doi.org/10.1186/1471-2431-11-21

Vale, S., Trost, S., Ruiz, J. J., Rego, C., Moreira, P., & Mota, J. (2013). Physical activity guidelines and preschooler's obesity status. *International Journal of Obesity*, *37*(10), 1352-1355. https://doi.org/10.1038/ijo.2013.109

Vucerakovic, M., & Mitrovic, M. (2021). *Changes in Nutritional Status of 5-6 year old Children in Podgorica between 2013 and 2020*. *Journal of Anthroplogy of Sport and Physical Education*, *5*(1), 9-12. https://doi.org/10.26773/jaspe.210102

Wake, M., Hardy, P., Canterford, L., Sawyer, M., & Carlin, J. B. (2007). Overweight, obesity and girth of Australian preschoolers: prevalence and socio-economic correlates. *International journal of obesity*, *31*(7), 1044-1051. https://doi.org/10.1038/sj.ijo.0803503

Willows, N. D., Johnson, M. S., & Ball, G. D. (2007). Prevalence estimates of overweight and obesity in Cree preschool children in northern Quebec according to international and US reference criteria. *American journal of public health*, *97*(2), 311-316. https://doi.org/10.2105/AJPH.2005.073940.

Yen, C. E., & Hu, S. W. (2013). Association between dental caries and obesity in preschool children. *European Journal of Paediatric Dentistry*, *14*(3), 185-189.

PREKOMERNA UHRANJENOST I GOJAZNOST PREDŠKOLSKE DECE

Gojaznost je sve veća briga sveta u razvoju. Cilj ovog preglednog rada je analiza istraživanja koja su proučavala prevalencu gojaznosti predškolske dece u periodu od 2001. do 2022. godine. Prikupili smo 46 istraživanja. Postoje tri skupa referenci rasta koji se obično koriste za procenu statusa težine deteta i zdravstvenog rizika: granične vrednosti BMI koje su objavili Centers for Disease Control and Prevention (CDC), International Obesity Task Force (IOTF) i one koje je objavila World Health Organization (WHO). Na osnovu toga postoje sledeće kategorije: pothranjenost, normalna uhranjenost, prekomerna uhranjenost i gojaznost. U skladu sa ciljem ovog istraživanja prikupljali smo podatke samo o prekomerno uhranjenoj i gojaznoj deci. Istraživanja su pokazala da je prevalenca prekomerno uhranjene i gojazne predškolske dece visoka na svim kontinentima bez obzira na to koje se preporuke koriste za njihovo definisanje. Ipak najalarmantnije podatke o gojaznoj predškolskoj deci daju istraživanja koja su koristila preporuke CDC (CDC - Centers for Disease Control and Prevention). Istraživanja pokazuju da je najveća prevalenca prekomerno uhranjene i gojazne predškolske dece u Severnoj Americi. Takve podatke daju nam istraživanja koja su koristila CDC, WHO i IOTF. Prevalenca prekomerno uhranjene i gojazne predškolske dece nije bolja ni u Evropi. Pojedine studije iz Azije i Afrike nam pokazuju da njihova deca nisu još uvek sustigla vršnjake iz Severne Amerike i Evrope u prevalenci prekomerne uhranjenosti i gojaznosti. Istraživanja pokazuju da postoji povezanost izmedju prekomerne uhranjenosti/gojaznosti i socio-ekonomskog statusa roditelja, svakodnevnih rutina, obrazovanja roditelja, trajanja dojenja, stepena uhranjenosti roditelja, područja na kome žive deca, navika u ishrani.

Ključne reči: *prekomerna uhranjenost, gojaznost, predškolska deca, IOTF, WHO, CDC*