REVIEW

Epidemiological behavior of childhood obesity: A continental point of view [version 1; peer review: awaiting peer review]

Maricarmen Chacin[1], Sandra Carrillo-Sierra[2], Pablo Duran[3], Bermany Garrido[3], Ruben Carrasquero[3], Manuel Nava[3], Juan Salazar[3], Lisse Angarita[4], Hazel Anderson[5], Henry Garcia-Pacheco[6], Ana Checa-Ros[7], Luis D'Marco[7], Diego Rivera-Porras[2], Valmore Bermúdez[1]

[1]Facultad de Ciencias de la Salud, Universidad Simon Bolivar, Barranquilla, Atlantico, 080002, Colombia
[2]Facultad de Ciencias Jurídicas y sociales, Universidad Simon Bolivar, Cúcuta, Norte de Santander, 540001, Colombia
[3]Endocrine and Metabolic Diseases Research Center. School of Medicine, Universidad del Zulia, Maracaibo, Zulia, Venezuela
[4]Escuela de Nutrición y Dietética, Facultad de Medicina, Universidad Andres Bello, Sede Concepción, Chile
[5]School of Medicine. School of Nutrition and Dietetics, Universidad del Zulia, Maracaibo, Zulia, Venezuela
[6]Unidad de Cirugía para la Obesidad y Metabolismo (UCOM), Maracaibo, Zulia, Venezuela
[7]Grupo de Enfermedades Cardiorrenales y Metabólicas, Departamento de Medicina y Cirugía, Universidad Cardenal Herrera-CEU, CEU Universities, Carrer Lluis Vives, 1, 46115, Valencia, Spain

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Abstract

Weight excess during the childhood has been one of the most critical public health problems worldwide in the past few decades. It is considered a significant predictor of adulthood obesity, increased cardiometabolic diseases, and premature mortality. Since the Industrial Revolution, childhood obesity has risen due to sedentary lifestyles and poor eating habits, contributing to the development of obesogenic environments around children in different parts of the world. In this regard, Oceania is positioned as the continent with the highest prevalence globally; however, these results did not consider Australia and New Zealand's data, probably due to the significant differences in population sizes. America has the second highest percentage of children under five who are overweight. Curiously, Asia's obesity rates are more significant in higher socioeconomic statuses and urban areas than in children aged 2-4 years. Likewise, Africa displays similar epidemiologic behaviour. Qatar and Kuwait are the countries with the highest obesity prevalence on the continent. Moreover, Europe exhibits a notable South-North gradient, which establishes a higher prevalence of obesity in Mediterranean countries than the Nordic ones. In this regard, various prevention and interventional programs have been developed to combat this silent

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epidemic, focusing their efforts on nutritional education, improving children's and parents' lifestyles, and fighting the influence of the media on their behaviour, and decisions. Therefore, the objective of this review was to describe the epidemiological behaviour of childhood obesity from a continental perspective.

Keywords
Childhood obesity, overweight, diabetes mellitus, hypertension, public health.

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Corresponding author: Maricarmen Chacin (maricarmen.chacing@unisimon.edu.co)

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List of abbreviations

BMI: Body Mass Index
COSI: Childhood Obesity Surveillance Initiative
ENSANUT: Health and Nutrition Survey
EU: European Union
GBD: Global Burden of Disease
HPS: Health Promotion Switzerland
IDF: International Diabetes Federation
IOTF: International Obesity Taskforce
KiGGS: German Health Interview and Examination Survey for Children and Adolescents
KNHANES: Korean National Health and Nutrition Examination Survey
MENA: the Middle East and North Africa
MS: Metabolic Syndrome
NCMP: National Child Measurement Programme
NHANES: National Health and Nutrition Examination Survey
NIN: National Institute of Nutrition
OECD: Organization for Economic Cooperation and Development
PAHO: Pan-American Health Organization
SISVAN: Dietary and Nutritional Surveillance System
T2DM: Type 2 Diabetes Mellitus
UNICEF: United Nations International Children's Emergency Fund
WBG: World Bank Group
WHO: World Health Organization

Introduction

In the past few decades, the prevalence of childhood obesity has increased dangerously, reaching epidemic proportions in several regions worldwide.[1] In that sense, between 2000 and 2018, overweight prevalence rose from 10% to 18% in children and teenagers between 5 and 19 years old; meanwhile, by 2018, 41 million kids under five years old had overweight globally. Moreover, according to the World Health Organization (WHO), the childhood obesity prevalence worldwide was 5.6%, the equivalent to 38.3 million children (excluding Europe), of which 45% were located in Asia and 24% in Africa.[2–4]

The progressive industrialization interplaying with environmental and genetic factors has been considered the leading contributor to childhood obesity in Westernized countries.[5,6] Likewise, emotional and psychosocial stress, parents' dietary habits, maternal breastfeeding history, environmental chemicals, and adverse life situations could increase childhood obesity risk factors.[7–11] Accordingly, it has been noticed that childhood obesity, especially in children with severe obesity or with a relevant family history of obesity, tends to be strongly associated with overweight persistence during adulthood.[12,13] Thus, implementing a proper and timely approach to addressing childhood obesity is of paramount importance.

Obesity profoundly influences public health dynamics since its comorbidities cause a substantial economic burden on the health systems.[14–18] In this context, weight excess is responsible for significantly high health costs in the United States, accounting for about $147 billion in 2008; and approximately 6% of the medical expenses in Europe.[19,20] Given these circumstances, the epidemiological surveillance of childhood obesity acquires paramount importance in preventing its more fearful cardiometabolic complications and other psychosocial problems like anxiety, depression, sleep disorders, low self-esteem, disturbing social relations, and learning process in childhood.[17–19]

As a result, epidemiological researchers, governmental and non-governmental entities have monitored the temporal changes in childhood overweight and obesity prevalence worldwide.[12,21] Therefore, it is convenient to recognize the factors linked to excessive weight in children, its epidemiological evolution, and future trends. Hence, recognizing the critical importance of identifying the factors contributing to excess weight in children, tracking how these trends evolve, and predicting future patterns is essential. Therefore, the primary aim of this review is to provide a comprehensive understanding of how childhood obesity behaves from a continental perspective, which involves analyzing its prevalence and associated factors across different continents or regions.

Methods

This is a narrative review in which an extensive literature search was performed on Scopus, EMBASE, PubMed, ISI Web of Science, and Google Scholar databases, from their inception to August 2022. The terms "childhood obesity,"

"childhood overweight," "Europe," "Asia," "America," "Middle Eastern countries" and "Africa" were the keywords used in the search. The quality assessment of the studies used in this review was performed by 3 of the authors, and studies with minimal risk of bias were used.

Childhood obesity in Europe: What is the current situation?

Obesity and overweight in European children have increased in the last 20 years. The collaboration between the WHO, International Obesity Taskforce (IOTF), European Union (EU), and several research institutes, made it possible to gather a considerable amount of representative data of the European nations.[22] According to the IOTF criteria, 17.9% of the European children (between 2 and 7 years old) have excessive weight, while 5.3% are obese.[23] For that reason, the WHO started a surveillance system to study childhood obesity (Childhood Obesity Surveillance Initiative, COSI) to assess the epidemiological behavior of overweight and obesity in European children between 6 and 9 years old (Figure 1).

Since the beginning of this initiative in 2007, 21 countries have participated in at least one data gathering round between 2007 and 2013. The 2013 round had a sample size of 636,933 children (323,648 boys and 313,285 girls) and demonstrated considerable fluctuation in overweight and obesity prevalence between the enlisted countries exhibiting a pronounced south-to-north gradient in which the southernmost countries like Greece, Spain, Italy, San Marino,

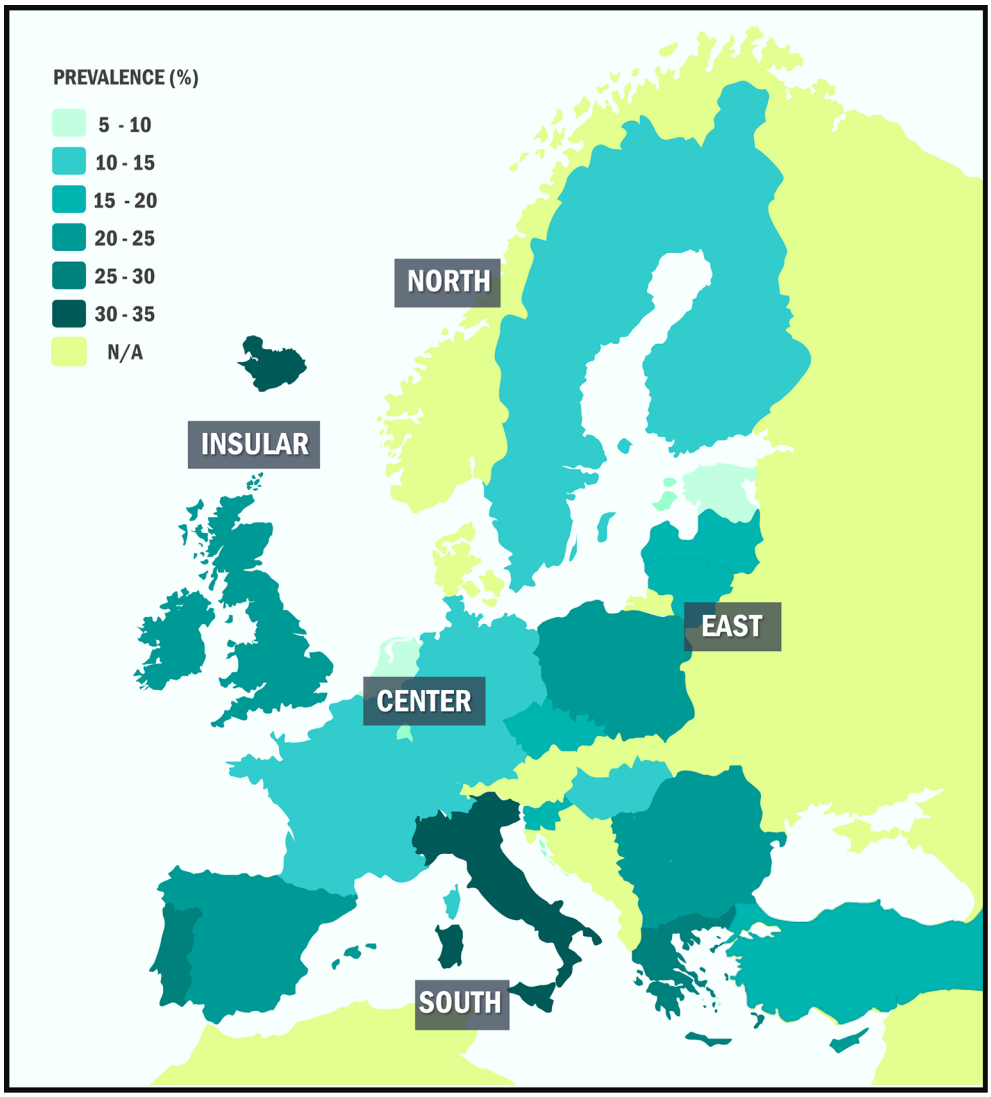

Figure 1. Obesity prevalence in children aged between 2 and 7 years in Europe. Abbreviation: N/A: not available. Source: Food Group Consumption, 2019.[23] Epidemiological behavior of obesity in European children with IOTF criteria.

Portugal, Malta and The Republic of North Macedonia had the highest overweight and obesity prevalence in contrast to those located in the north, such as Latvia, Lithuania, Norway and Ireland.[24] In this vein, data extracted from the third data collection round (2012-2013) from COSI shows that Greece exhibited the highest prevalence of overweight and obesity with 52% for boys and 43% for girls, and 28% and 20% for boys and girls, respectively; followed by Italy with 44% overweight for boys and 40% for girls, and 23% obesity for boy and 15% for girls. Contrarily, Norway stands out among the countries with the lowest prevalence, with 24% overweight and only 7% obesity for boys and girls.[24]

Moreover, the fourth COSI round (2015-2017) showed the highest overweight, and obesity rates continued to be a significant concern in the southern European region. Nonetheless, although some countries such as Greece, Italy, Spain, Portugal, and Slovenia, decreased their obesity prevalence, they still hold the top ten leading countries with childhood obesity in this continent (Table 1).[25] Likewise, the Mediterranean countries with the highest prevalence were Cyprus and Greece; moreover, the above list includes Italy, San Marino and Malta. Predominantly, Nordic countries achieved the lowest prevalence; notably, Denmark had 18% overweight for boys and 20% for girls, and 5% obesity for both. Additionally, Sweden with 10% for boys and 7% for girls, Finland with 11% for boys and 9% for girls, and Norway with 7 % for boys and 5% for girls follow the list of countries with the lowest obesity rates.[25] In addition, very few insular European countries participated in the latter study. Notably, Ireland has exhibited a decreasing trend in the prevalence of childhood obesity compared to the last data gathering.

In Eastern Europe, stable behavior in secular obesity trends was observed for The Czech Republic, while the situation is not clear for Latvia and Lithuania.[25] It is essential to highlight that, even though most Russian territory belongs to Asia, a significant proportion of its population lives in the European zone, as is the case of some ex-soviet republics such as Ukraine.[26,27] In this regard, some studies have reported that Russia has a very particular milieu with a wide variety of risk factors predisposing childhood obesity development. For example, a recent study conducted by Bocharova *et al.* found a ten-year prevalence increase from 12.9% to 26.1% between 2008 and 2018; regrettably, access to better data in English is challenging, and this fact is an obstacle to in-deep and more comprehensive analysis.[28] The last report from COSI took into account the data gathered between 2015 and 2017, reporting only in Moscow, a prevalence of overweight and obesity in boys of 27% and 10% respectively; meanwhile, girls exhibited 22% and 6% respectively.[25]

Table 1. Overweight and obesity prevalence in boys and girls aged between 6-9 years, by Childhood Obesity Surveillance Initiative (COSI). 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.[24,25]

COUNTRIES		COSI 2012/2013				COSI 2015/2017			
		Overweight		Obesity		Overweight		Obesity	
		Boys (%)	Girls (%)	Boys (%)	Girls (%)	Boys (%)	Girls (%)	Boys (%)	Girls (%)
SOUTH	Greece	38[e]	43[e]	22[e]	16[e]	42	38	20	14
	Spain	43[e]	40[e]	19[e]	15[e]	42	41	19	17
	Italy	44[d]	40[d]	23[d]	15[d]	42	38	21	14
	San Marino	42[d]	33[d]	21[d]	17[d]	39	32	19	9
	Portugal	33[e]	36[e]	15[e]	13[e]	29	32	12	11
	Malta	33[e]	33[e]	18[e]	16[e]	37	35	18	15
	Republic of Macedonia	28	26	13	10	31	29	16	13
	Cyprus[a]	-	-	-	-	43	43	21	19
CENTER	France[a]	-	-	-	-	25	23	9	6
	Slovenia	34[e]	31[e]	15[e]	10[e]	24	24	10	8
	Belgium	23[e]	25[e]	10[e]	9[e]	-	-	-	-
	Austria[a]	-	-	-	-	30	22	12	6
	Poland[a]	-	-	-	-	32	29	14	10
	Germany*	-	-	-	-	-	-	-	-
	Netherlands*	-	-	-	-	-	-	-	-
	Switzerland*	-	-	-	-	-	-	-	-

Table 1. *Continued*

COUNTRIES		COSI 2012/2013				COSI 2015/2017			
		Overweight		Obesity		Overweight		Obesity	
		Boys (%)	Girls (%)	Boys (%)	Girls (%)	Boys (%)	Girls (%)	Boys (%)	Girls (%)
EAST	Montenegro[a]	-	-	-	-	37	29	19	9
	Albania	24[d]	20[d]	10[d]	5[d]	23	16	11	5
	Lithuania	26[e]	22[e]	11[e]	7[e]	28	23	12	8
	Latvia	25[e]	21[e]	9[e]	7[e]	25	21	9	6
	Bulgaria	30[e]	27[e]	14[e]	11[e]	30	29	16	11
	Croatia[a]	-	-	-	-	37	28	16	10
	Serbia[a]	-	-	-	-	36	29	17	8
	Romania	28[d]	23[d]	14[d]	8[d]	31	26	15	9
	Hungary[a]	-	-	-	-	28	28	14	11
	Czechia	23[e]	20[e]	10[e]	6[e]	23	19	10	6
NORDIC	Denmark[a]	-	-	-	-	18	20	5	5
	Norway	24[d]	24[d]	7[d]	7[d]	24	22	7	5
	Sweden[a]	-	-	-	-	27	28	10	7
	Finland[a]	-	-	-	-	28	27	11	9
INSULAR	Ireland	24[e]	25[e]	8[e]	7[e]	27	20	9	5
	The United Kingdom*	-	-	-	-	-	-	-	-
	Iceland*	-	-	-	-	-	-	-	-

Legend: For the 2012/2013 COSI study, overweight and obesity percentages were stratified into four groups (6-years old, 7-years old, 8-years old, 9-years old).
*Countries that did not participate in COSI studies are denoted as follows: a: Countries that did not participate in the COSI 2012/2013 studies; d: Refers to 8-year-olds in the COSI 2012/2013 study; e: Refers to 7-year-olds in the COSI 2012/2013 study.

Contrary to the past years, countries from central Europe made an appearance in this report. For instance, France, Poland, and Austria show relatively low rates than the other nations. On the other hand, Slovenia had a notorious downturn compared to its previous records. Countries like The Netherlands, Switzerland, Iceland, The United Kingdom, and Germany did not participate in this initiative.[29]

Notwithstanding, the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) aimed to long-term surveillance of Germany's childhood overweight and obesity prevalence. In this program, children aged 3-6 and 7-10 exhibited a 9.1% and 15.4% overweight prevalence. On the other hand, obesity prevalence was 2.9% and 6.4% in the same age groups.[29,30] As a result, KiGGS Wave 1 (2009-2012) pointed out that ultimately the rates reached a plateau when contrasted to KiGGS' checkpoint of 2003-2006. Furthermore, the overweight and obesity prevalence rate in children aged between 4 and 10 and teenagers aged between 11 and 17 were slightly higher but not statistically significant.[31] Lastly, the data gathered from the KiGGS Wave 2 (2014-2017) showed a prevalence of 15.4% and 5.9% for overweight and obesity, respectively, with no differences between sex. In summary, compared to the reference study, KiGGS (2003-2006), there was no increment in the prevalence of overweight or obesity in general.[32]

The Netherlands showed a similar behavior because, in 2009, about 14.8% of Dutch girls and 12.8% of boys were overweight, while 2.2% of girls and 1.8% of boys were obese. The aforementioned overweight prevalence is two to three times higher than the registered back in 1980 and nearly four to six times higher for obesity; notably, the most substantial increment of these rates was achieved in the last decades.[33] However, a national study pointed out that the previous overweight prevalence trends had stalled in the country's main cities like Amsterdam, Rotterdam, The Hague, and Utrecht, but neither rural nor smaller towns. Albeit the stalling trends denoted previously, overweight and obesity still have higher rates than in the eighties; thus, it is still considered a public health issue to be solved in The Netherlands.[34]

As mentioned above, Switzerland did not participate in the 2015-2017 COSI study.[29] Moreover, the Health Promotion Switzerland (HPS) program identified that from 2010 to 2011 about 20.1% of children and teenagers were overweight or

obese in large cities like Basel, Bern, and Zurich. Furthermore, during 2014-5 and 2015-16, students' overweight and obesity prevalence was 16.4%. Interestingly, in the 2017-2018 school period, a 3% decrement in the overall prevalence was observed. Hence, the number of affected children has decreased slightly; however, researchers claimed that epidemiological surveillance remains essential despite these declining rates.[29,35–37]

Other countries with independent epidemiological surveillance systems are Iceland and the United Kingdom.[25] The latter holds an obesity monitoring system for those aged between 4 and 5 and 10 and 11 years, known as the National Child Measurement Programme (NCMP). For 2017-2018, overweight and obesity prevalence was higher for those aged between 10 and 11 (34.3%) compared to those aged between 4 and 5 years (22.6%).[38,39] Additionally, obesity and overweight prevalence in England has increased among minor children, showing obesity numbers of 9.5% and 12.8% for overweight in those between 4 and 5 years old. In contrast, those aged between 10 and 11 years displayed a prevalence of 20.1% for obesity and 14.2% for overweight.[40,41]

On the other hand, the NCMP found that Wales exhibited higher prevalence rates than England. In the age group of 4 to 5 years, 11.9% of children were obese, and 14.6% were classified as overweight. Also, the data from Scotland indicated that 12% of the children had the risk of developing overweight, while 10% had become obese. On its part, due to the small sample size of North Ireland, it was not possible to perform significant comparisons between age groups over time; nevertheless, it was reported that about 8% of children aged between 2 and 10 years and 10% of children between 11 and 15 years old had obesity.[40]

Regardless of a South-North pattern, some exceptions do not follow this behavior in Europe's insular countries, as in Iceland. For example, the Organization for Economic Cooperation and Development (OECD) stated that by 2016, 30.9% of children aged between 5 and 9 years were overweight, and 12.6% had obesity, while 27% of those aged between 10 and 19 years were overweight and 8.5% had obesity. Likewise, a different behavior was found within the Nordic countries, given that Icelandic children appeared among the children with the highest rates of obesity in Europe.[42]

Interestingly, a recent meta-analysis that included 28 European countries reported a stabilizing trend concerning excess weight in the child population, mainly in the continent's north. However, despite these positive findings, Garrido *et al.*[23] showed in their results that some Mediterranean countries failed to exhibit this pattern. Different authors have coined this phenomenon as the South-North Gradient,[43–46] which supports the high prevalence rates found in the countries located in the South, highlighting the significant socioeconomic and lifestyle differences between the two regions.[47]

Additionally, it is crucial to take into account the impact of socioeconomic, as sudden socioeconomic changes could lead to increased childhood obesity in the most disadvantaged population groups.[48–50] For example, a recent longitudinal study including 2,401 European children assessed metabolic alterations regardless of diet or physical activity. In this context, the study succeeded in showing (in contrast to children of families without such impairments) that certain indicators of socioeconomic disadvantages such as unemployed parents, low family income, and incomplete educational level, were correlated with a high metabolic risk in the children of these families.[51] Therefore, the rise in childhood obesity prevalence in these underprivileged households may result from certain aspects, such as living a healthy lifestyle and not being a priority.[51]

On the other hand, weight disorders also interact with many factors ranging from genetic variations to environmental and dietetic influences.[52,53] In this case, the number of Mediterranean countries that adhered to the '70s ideal Mediterranean Diet has experienced a noticeable decrement[54] due to socioeconomic factors that force them to abandon their usual healthy diet for one that is more westernized.[55,56]

There are certainly other risk factors for childhood obesity; for instance, the lower sizes found in southern countries.[57,58] Also, geographical changes can lead to higher obesity rates.[59] Besides, sleep duration, extended periods of watching television,[60] and a sedentary lifestyle can heavily influence the prevalence rates of childhood obesity in those countries and contribute to higher obesity rates in this southern part of the continent.[43,61]

Childhood obesity in Asia: A public health issue

The Asian continent is considered to have severe public health issues regarding weight problems. In fact, for 2020, The United Nations International Children's Emergency Fund (UNICEF), along with WHO and the World Bank Group (WBG), made a report concerning the levels and trends in childhood malnutrition globally (excluding Europe) due to the lack of epidemiologic evidence regarding this matter within some of its regions (Figure 2). This report rated Asia as the most heavily affected continent, given that it has 30.9% of the total global children under five years old with overweight, the equivalent to 17.2 million children. Furthermore, when segmented into sub-regions, Western Asia has the highest

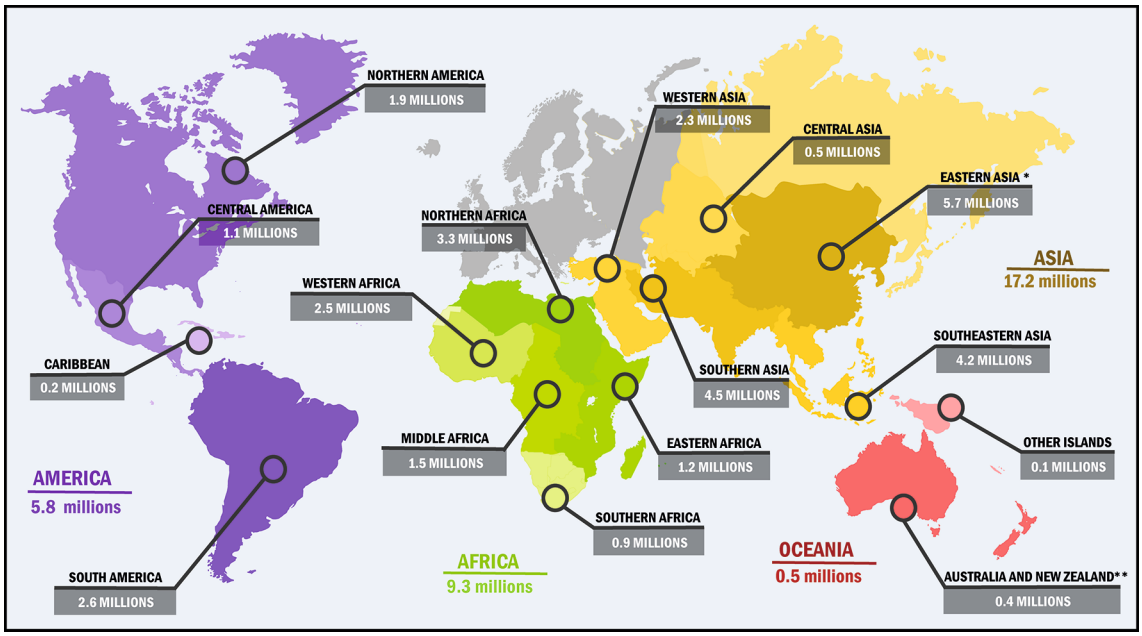

Figure 2. Overweight prevalence in children under 5 years old. Source: UNICEF, WHO, World Bank Group joint malnutrition estimates, Edition 2020.[4] Note: *East Asia excluding Japan; ** Prevalence of Australia and New Zealand was estimated from data provided by Australia. Europe prevalence was not estimated because there is no data available covering all its regions.

prevalence with 8.4% (2.3 million patients), followed by Southeastern Asia with 7.5% (4.2 million), Eastern Asia with 6.3% (5.7 million), Central Asia with 6.2% (0.5 million), and lastly South Asia with 2.5% (4.5 million).[4] Notably, the obesity prevalence is more significant in higher socioeconomic strata and urban areas, contrary to the pattern found in other continents where the overweight is commonly found at lower socioeconomic levels.[62]

Along these lines, a study published by Kim *et al.*[63] reported a progressive increment in obesity rates in Korean children (aged 6 to 18 years) from 8.7% in 2007 to 15.0% in 2017. Moreover, Bahk and Khang[64] performed a study to evaluate the trends in measures of childhood obesity among Korean children, using the data from five waves of the Korean National Health and Nutrition Examination Survey (KNHANES) including 18,174 children aged between 2 and 19. According to WHO charts, 31.2% of the boys were overweight, and 10.9% were obese, whereas overweight and obesity among girls were 21% and 4.6%, respectively (Table 2).

Regarding China, Zhang *et al.*[65] reported overweight and obesity trends in children and teenagers aged between 7 and 18 years in the 2011-2015 period. It was evidenced that according to WHO, IOTF, and Working Group for Obesity in China (WGOC) criteria, overweight and obesity prevalence were 15.5% and 8.8%, 13.1% and 5.7%, 11.9%, and 8.8%, respectively. Moreover, 7-11 years old children displayed a 16% and 9.6% overweight and obesity prevalence, in contrast to the 14.6% and 7.4% in the 12-18 age group.

Similarly, according to a study carried out by the Global Burden of Disease (GBD) 2015 Obesity Collaborators, which addressed the prevalence of obesity in children and teenagers aged between 2 and 19 years in 195 countries, China obtained first place with an overall prevalence of 5.1%, followed by India with 3%. Notably, children aged between 2 and 4 years were the most affected in both sexes, reporting 2.7 million obese boys (5.2%) and 2.3 million obese girls (4.9%).[66]

Likewise, obesity's prevalence has turned into a concern for the Japanese Health Ministry.[67] As a result, Nakano *et al.*[68] executed a six-year longitudinal study that included 16,245 children; the aim was to assess overweight and obesity's epidemiologic behavior for as long as they attended primary school. As a result, overweight and obesity prevalence was 15-23% and 4-7% in boys and 15-18% and 2-4% in girls, respectively. Moreover, it is worth mentioning that 60-80% and 35-70% of the boys with overweight and obesity in a primary school maintained the same pattern when reaching secondary school; conversely, the girls had lower rates, as 50-70% of them had overweight, and 30-60% had obesity when attending secondary school. Additionally, Morita *et al.*[69] reported that out of 315 teenagers, 15.2% had obesity (48 students). Nonetheless, as the study found, most of them spent all their time in academic tutoring and showed better school performance than those assigned more time to physical activity.

Table 2. Overweight and obesity prevalence in Asian, African, and Pacific children and teenagers.

Continent	Author (REF)	Country	Age	Sample size	Criteria	Overweight			Obesity		
						Overall (%)	Boys (%)	Girls (%)	Overall (%)	Boys (%)	Girls (%)
Asia	Bahk and Khang[64]	Korea	2-19	18174	WHO	-	31.2	21	-	10.9	4.6
					IOTF	-	24	16.7	-	5.4	3.1
					CDC	-	25.7	16.4	-	10.5	3.9
					KCDC	-	18.4	17.5	-	7.4	7.1
			2-9	-	WHO	-	33.7	24.7	-	13.5	5.9
					IOTF	-	21.1	16.8	-	6.4	3.7
					CDC	-	27.3	19.4	-	13.6	5.6
					KCDC	-	18.1	16.4	-	8.3	6
			10-19	-	WHO	-	29.9	19	-	9.4	3.8
					IOTF	-	25.7	16.6	-	4.9	2.7
					CDC	-	24.8	19	-	8.7	2.9
					KCDC	-	18.6	18.1	-	6.9	7.7
	Zhang *et al.*[65]	China	7-18	1617	WHO	15.5	17.1	13.7	8.8	12.9	4.4
					IOTF	13.1	14	12.2	5.7	7.9	3.3
					WGOC	11.9	14	9.7	8.8	10.5	7.1
	GBD obesity collaborators[66]	China	2-19	-	IOTF	-	-	-	5.1	-	-
		India	2-19	-	IOTF	-	-	-	3	-	-
			2-4			-	-	-	-	5.2	4.9
			5-9			-	-	-	-	2.9	4.1
			10-14			-	-	-	-	2.1	
			15-19			-	-	-	-	4.9	1.7
	Nakano *et al.*[68]	Japan	-	16245	IOTF	-	15-23	15-18	-	4-7	2-4
	Morita *et al.*[69]	Japan	-	315	CDC	-	-	-	15.2	-	-

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Table 2. *Continued*

Continent	Author (REF)	Country	Age	Sample size	Criteria	Overweight			Obesity		
						Overall (%)	Boys (%)	Girls (%)	Overall (%)	Boys (%)	Girls (%)
Africa	Farrag *et al.*[70]	Kuwait	<20	-	IOTF, WHO and CDC*	-	-	-	-	60.4	41.3
		KSA				-	-	-	-	43.6	34.8
		Egypt				-	-	-	-	36.8	35.8
		UAE				-	-	-	-	35.9	-
		Qatar				-	-	-	-	31.7	33.7
		Libya				-	-	-	-	-	36.6
	Al Alwan *et al.*[71]	Saudi Arabia	6-16	1243		21.1	21.5	21.3	12.7	17.4	9.3
	Ng *et al.*[21]	Qatar	<20	19244	IOTF	-	33.5	22.1	-	18.8	15.5
		Iran				-	21.6	26.2	-	5.9	7.2
		Iraq				-	19.5	25	-	8.2	8.2
		Libya				-	32.5	41.7	-	14.5	22.1
		Moroccos				-	22.5	25.9	-	7.9	9.1
		Democratic Republic of Congo				-	8.5	12.6	-	4.9	4.4
		Syria				-	32.9	33.3	-	13.9	15.4
		Turkey				-	20.4	19.8	-	7.1	5.7
Oceania	Australian Government[74]	Australia	2-5	-	WHO	-	-	-	8.8	-	-
			10-13			-	-	-	30.8	-	-
			14-17			-	-	-	29.8	-	-
	Pengpid et al[75]	Fiji	13-16	10424	IOTF	13.9	-	-	5.2	-	-
		Kiribati				32.5	-	-	7.4	-	-
		Samoa				32.6	-	-	19.3	-	-
		Solomon Islands				18.9	-	-	2.7	-	-
		Tonga				37.6	-	-	21.1	-	-
		Vanuatu				11.5	-	-	0.4	-	-
	New Zealand Ministry of Health[76]	New Zealand	2-14			20.2	19.1	21.3	9.4	10.6	8.2
			2-4			20.3	-	-	4.3	-	-
			5-9			19.2	-	-	10.3	-	-
			10-14			21	-	-	11.4	-	-

Abbreviations: WHO: World Health Organization; IOTF: International Obesity Taskforce; CDC: Centers for Disease Control and Prevention; KCDC: Korean Centers for Disease Control and Prevention; WGOC: Working Group on Obesity in China.
*The systematic review by Farrag *et al.*[72] included studies that used different criteria to determine childhood obesity.

Weight issues in Africa and Middle East: From malnutrition to childhood obesity

Despite childhood malnutrition has been the leading problem to be solved in the African continent, obesity and overweight prevalence have risen drastically over the past years. According to the UNICEF/WHO/World Bank Group report about child malnutrition trends, Africa represents the second geographic area with the highest prevalence of childhood overweight with 25% of the worldwide cases, the equivalent to 9.3 million children under five affected. Noteworthy, the overweight prevalence within the different African regions goes as follows: Southern Africa scored the highest with 12.7% overweight prevalence, followed by Northern Africa with 11.3%, Middle Africa with 5.1%, Eastern Africa with 3.7%, and lastly Western Africa with the lowest prevalence by 1.9%.[4] Although South Africa has the lowest childhood overweight and obesity prevalence, the frequency of these conditions increased by 400% per decade between 1975 and 2016.[57] It is also essential to address that the African continent suffers from other weight-related disorders such as growth stunting, affecting 151 million children under five years.[4]

In that matter, Farrag *et al.*[70] carried out a systematic review that included studies from 2010 to 2015. This research intended to assess the obesity and overweight epidemiological behavior in children and teenagers between 2 and 19 years old who lived in regions of the Middle East and North Africa (MENA); consequently, reporting increasing numbers of obesity, especially in the gulf area in the recent years. Moreover, the top five countries with the highest numbers of overweight male children and teenagers were Egypt, Kuwait, Lebanon, Syria, and Saudi Arabia, with a prevalence ranging between 28.2% and 19.5%. On the other hand, the countries with the highest numbers of overweight female children and teenagers were Egypt, Libya, Kuwait, Saudi Arabia, and Syria, with a prevalence ranging between 28.2% and 20%. Likewise, Kuwait stood out as the leading country affected by obesity in children and teenagers, with a prevalence of 34.8% and 20.5% in boys and girls, respectively. Additionally, the same authors evidenced that physical inactivity degree, screen time, and family socioeconomic status are risk factors for childhood obesity.

On the other hand, Al Alwan *et al.*[71] conducted a cross-sectional study to determine overweight and obesity prevalence in 1,243 Saudi children between 6 and 16 years old from Riyadh schools. Overweight prevalence rates were 21.1% and 12.7% for obesity. Similarly, a systematic review by Ng *et al.*[21] that included 1,769 studies from 183 countries assessed the prevalence of overweight and obesity in individuals between 2 and 19 years old. The proportion of overweight and obesity in boys in African countries were, respectively, as follows: in Qatar 33.5% and 18.8%, in Iran 21.6% and 5.9%, in Iraq 19.5% and 8.2%, in Libya 32.5% and 14.5%, in Morocco 22.5% and 7.9%, in the Democratic Republic of the Congo 8.5% and 4.9%, in Syria 32.9% and 13.9%, and lastly in Turkey 20.4% and 7.1%. Furthermore, the prevalence of overweight and obesity in girls were, respectively, as follows: in Qatar 22.1% and 15.5%, in Iran 26.2% and 7.2%, in Iraq 25% and 8.2%, in Libya 41.7% y 22.1%, in Morocco 25.9% and 9.1%, in the Democratic Republic of the Congo 12.6% and 4.4%, in Syria 33.3% and 15.4%, and finally in Turkey 19.8% and 5.7%.

Childhood obesity in Oceania: A worse scenario

Like other continents, overweight and obesity's epidemiologic behavior represents a public health issue in Oceania.[72] According to the report on child malnutrition assessed by UNICEF/OMS/WBG, 9.4% of children under five years old in Oceania were overweight, amounting to 100,000 children; conversely, Australia and New Zealand's data were reported separately, possibly due to their population size and composition influence. However, Australia and New Zealand's overweight prevalence reached 20.7%, equating to 0.4 million children. Remarkably, those countries' sub-regional estimates are based only on Australian institutions' data.[4]

A 2017 Australian Government report confirmed a secular change in overweight and obesity prevalence over the last 30 years: Children between 2 and 5 years (born in 2010-2013) presented 8.8% overweight/obese prevalence, in contrast to those born in 1990-1993 exhibiting 4.2% overweight/obesity prevalence. Children aged 10-13 years and born between 2002 and 2005 were overweight/obese in 30.8%; in contrast, those born in 1982-1985 were only overweight/obese in 23.95 %. Finally, teenagers born between 1998 and 2001 were overweight/obese in 29.8% of the cases, but in those born in 1978-1981, only 18.7% had weight problems.[73]

Furthermore, the New Zealand Ministry of Health's latest report showed that 20.2% and 9.4% of children between 2 and 14 years old were overweight and obese. Apart from that, the research found that those children who belonged to the lowest socioeconomic status group had the highest prevalence of overweight and obesity compared to high socioeconomic status (26.8% vs 14% regarding overweight, and 6.9% vs 19.4% in the case of obesity). Additionally, when segmented by age groups, it was reported that 20.3% of children from 2 to 4 years old were overweight, and 4.3% were obese, making a total of cases of 24.6%. Also, children from 5 to 9 years old were overweight at 19.2%, and 10.3% were obese (Overall 29.5%), while overweight and obesity prevalence in children from 10 to 14 years old were 21% and 11.4%, respectively (Overall 32.5%). Moreover, overweight and obesity in Maori were 28.9% and 13.2%, respectively (Overall 42.1%), and overweight and obesity prevalence in pacific islanders' children was 31% and 29.1%, respectively

(both 60.1%). Contrarily, one study found that children of European and Asian ancestry had prevalence rates of 18.2% and 7.2% of overweight and obesity (both 25.4%), along with 15.7% and 3.4% of overweight and obesity (both 19.1%), respectively.[74]

Notwithstanding, to estimate childhood obesity in other Oceanian islands, Pengpid *et al.*[75] executed a study based on the Global School-Based Student Health Survey data, including 10,424 students aged 13-16 years from Fiji, Kiribati, Samoa, Solomon Islands, Tonga, and Vanuatu. These islands' overweight and obesity prevalence rates were 18.2% and 6.1%, respectively. Mainly, Tonga had the highest prevalence rates (37.6% of overweight and 21.1% obesity), followed by Samoa (32.6% of overweight and 19.3 obesity), Kiribati (32.5% of overweight and 7.4% of obesity), Solomon Islands (19.8% of overweight and 2.7 obesity), Fiji (13.9% of overweight and 5.2% of obesity), and finally, Vanuatu (11.5% of overweight and 0.4% of obesity). This study concluded that soft drinks, sedentary behavior, smoking habits, and psychosocial factors (suicidal ideation, social and family support) were significantly related to overweight, obesity, or both. Contrarily, the authors evidenced that vegetable intake, alcohol consumption, physical activity, and other psychosocial factors such as discrimination, anxiety, and loneliness were not related to overweight or obesity.

Childhood overweight and obesity in the Americas

For a long time, childhood overweight and obesity have increased in different regions of the American continent; thus, several research groups are currently studying this issue.[76–79] According to the last UNICEF/WHO/WBG report on levels and trends of childhood malnutrition, America has 5.8 million children under the age of five years with overweight prevalence distributed as follows: North America has 8.9% overweight prevalence, followed by South America with 7.9%, the Caribbean Region with 7.0%, and Central America with 6.9%; thus, making this continent the 3rd one with the highest number of children affected by overweight.[4]

In the United States, according to the Centers for Disease Control and Prevention (CDC) and the U. S department of health and human services, childhood obesity prevalence has increased in the last years from 13.9% (1999-2000) to 18.5% (2015-2016), involving 13.7 million children and teenagers between 2 and 19 years. The preschool age group (2-5 years old) had a prevalence of 13.9%, followed by the age group between 6 and 11 years with 18.4% and the teenagers with 20.6%. Moreover, considering the ethnic groups, 22.0% of the young African Americans and 25.8% of the Hispanics were obese, numbers considerably higher than those found in young white non-Hispanics (14.1%) and non-Hispanic Asians (11%)[80] (Table 3).

Additionally, regarding the overweight and obesity epidemiologic behavior of American Natives in the USA, Zephier *et al.*[81] analyzed the Aberdeen Area Indian Health Data that included 11,583 native Americans aged between 5 and 17 years from 18 tribes located in North Dakota, South Dakota, Iowa, and Nebraska. Consequently, 48.1% and 29.4% of the boys had overweight and obese, respectively, while the girls' prevalence was 46.3% and 26.1%. Obesity prevalence varied by ethnicity with particular dietary habits playing a significant role. Native Americans, for example, tend to consume high amounts of fat, which contributes to their higher obesity rates.

In this vein, Skinner *et al.*[82] analyzed the National Health and Nutrition Examination Survey (NHANES) 2015-2016 database, including all the children and teenagers aged between 2 and 19 years, reporting a 35.1% in overweight prevalence and 26.4% for obesity. When data were stratified according to age groups, the overweight and obesity prevalence was as follows: children aged 2 to 5 years was 26.0% and 15.7%, children aged between 6 and 8 years showed 32.8% and 25.3%, the group of 9 to 11 years had 35.6% and 24.8%, the group of 12 to 15 years had 38.7% and 30.3%, and the last group of 16 to 19 years had 41.5% and 34.5%. Thus, a growing trend for overweight and obesity was observed concerning age increment.

Like the United States, Canada also exhibits worrying obesity statistics. Between 1978-1979 and 2004, this clinical entity increased from 6.3% to 12.7% (102% increase). In contrast, overweight augmented from 17% to 28%, increasing 29%.[83] Likewise, according to the Canadian Health Measures Survey published in 2011, a third (31.5%) of the population between 5 and 17 years old had overweight (19.8%) and obesity (11.7%), equating to 1.6 million affected children and teenagers. When stratified by sex and age, it was observed that boys had a 15.1% prevalence and girls 8%. However, more significant differences were shown in the 5 to 11 years group because 19.5% of the boys and 6.3% of girls were obese.[84] Moreover, in 2014, the Toronto Public Health Student Survey was executed, with a sample of 6,053 students aged between 12 and 17 years (currently studying 7th to 12th grade), showing an overweight prevalence of 20% and 9% for obesity (11% for boys and 6% for girls).[85]

Regarding Latin America, childhood overweight and obesity are a public health concern coexisting with a critical sociopolitical background in some countries, behaving like a growing medium for a growing tendency to increase as

Table 3. Overweight and obesity prevalence in American children and teenagers.

Region	Country	Author (REF)	Age	Sample size	Criteria	Overweight			Obesity		
						Overall (%)	Boys (%)	Girls (%)	Overall (%)	Boys (%)	Girls (%)
North America	United States	Hales *et al.*[80]	2-19	-	CDC	-	-	-	18.5	19.1	17.8
			2-5			-	-	-	13.9	14.3	13.5
			6-11			-	-	-	18.4	20.4	16.3
			12-19			-	-	-	20.6	20.2	20.9
		Zephier *et al.*[81]	5-17	11538	CDC	42.3-46.8	48.1	46.3	24.1-28.4	29.4	26.1
		Skinner *et al.*[82]	2-19	3340	CDC	35.1	34.8	35.5	26.4	27.8	24.8
			2-5			26	26	25.9	15.7	16.5	14.7
			6-8			32.8	31.6	34.2	25.3	24.6	26.2
			9-11			35.6	43.8	27.8	24.8	29.7	20.3
			12-15			38.7	38.2	39.2	30.3	33.5	28.7
			16-9			41.5	34.8	47.9	34.5	33.5	35.4
	Canada	Shields *et al.*[83]	2-17	8661	WHO	-	-	-	12.7	14.8	10.6
					IOTF	-	-	-	8.2	9.1	7.2
					CDC	-	-	-	12.5	14.3	10.7
			2-6	1557	WHO	-	-	-	10.6	11.8	9.4
					IOTF	-	-	-	6.3	6.3	6.4
					CDC	-	-	-	13.7	15	12.4
			7-11	2985	WHO	-	-	-	14.3	16.1	12.5
					IOTF	-	-	-	8	8.5	7.5
					CDC	-	-	-	12.4	13.8	11
			12-9	4099	WHO	-	-	-	12.4	15.1	9.4
					IOTF	-	-	-	9.4	11.1	7.4
					CDC	-	-	-	12.1	14.3	9.6
		Roberts *et al.*[84]	5-17	-	WHO	19.8	19.4	20.2	11.7	15.1	8
			5-11			19.7	19.8	19.6	13.1	19.5	6.3
			12-17			19.9	18.9	20.9	10.2	10.7	9.6
			5-17	-	IOTF	16.4	15.8	17	8.4	9.5	7.1
			5-11			14.7	-	-	7.9	-	-
			12-17			18	-	-	8.9	-	-
		Toronto Public Health[85]	12-17	6053	WHO	20	-	-	9	11	6

Table 3. *Continued*

Region	Country	Author (REF)	Age	Sample size	Criteria	Overweight			Obesity		
						Overall (%)	Boys (%)	Girls (%)	Overall (%)	Boys (%)	Girls (%)
Central America	Mexico	Rivera *et al.*[86]	<5	-	WHO	9.8	-	-	-	-	-
			5-11			-	19.5	20.2	-	17.4	11.8
			12-19			-	19.6	23.7	-	14.5	12.1
		Shamah-Levy *et al.*[90]	<5	1993	WHO	-	14.7	18.4	-	6.5	5.8
			5-11	3184		-	15.4	20.6	-	18.3	12.2
			12-19	2581		-	18.5	26.4	-	15	12.8
South America	Chile	Rivera *et al.*[86]	<5	-	WHO	8.2	-	-	-	-	-
			6-7			24.6	-	-	13.1	-	-
			14-15			24.4	-	-	6.6	-	-
		Corvalan *et al.*[91]	<5	-	WHO	9.3	-	-	-	-	-
			>5			30.1	-	-	-	-	-
		Cañoles *et al.*[89]	4-6	250	WHO	27.7	-	-	19.1	-	-
	Argentina	Rivera *et al.*[86]	<5	-	WHO	10.4	-	-	-	-	-
		Corvalan *et al.*[91]	<5	-	WHO	9.9	-	-	-	-	-
	Brazil	Rivera *et al.*[86]	5-9	-	WHO	-	18.2	20.2	-	16.6	11.8
			10-19			-	15.7	15.4	-	5.8	4
		Corvalan *et al.*[91]	<5	-	WHO	7.3	-	-	-	-	-
			>5			20.5	-	-	-	-	-
	Peru	Rivera *et al.*[86]	<5	-	WHO	6.9	-	-	-	-	-
		Corvalan *et al.*[91]	<5	-	WHO	7.2	-	-	-	-	-
	Ecuador	Ramos-Padilla *et al.*[95]	5-19	3680	WHO	17.8	-	-	6.3	-	-
	Venezuela	SISVAN[96]	<5	371318	WHO	13.12	-	-	-	-	-
			0-2	139769		9.47	9.11	10.48	-	-	-
			2-6	138405		12.7	12.42	12.41	-	-	-
			7-14	92144		19.31	19.09	18.04	-	-	-
		Herrera Cuenca *et al.*[97]	7-12	1350	WHO	15.1	11.4	18.2	26.4	31.4	22.3
		National Institute of Nutrition[98]	7-17	6120		-	15.32	13.73	-	10.63	8.53
			7-12	5572	-	17.57	-	-	9.87	-	-
			13-17	6717		12.03	-	-	9.33	-	-
		Araujo *et al.*[100]	10-16	501	WHO	14.7	-	-	16.37	-	-

Table 3. *Continued*

Region	Country	Author (REF)	Age	Sample size	Criteria	Overweight			Obesity		
						Overall (%)	Boys (%)	Girls (%)	Overall (%)	Boys (%)	Girls (%)
	Colombia	Rivera *et al.*[86]	<5	-	WHO	5.2	13.7	-	5.2	-	-
			10-17			13.2	-	-	3.4	-	-
		Fajardo *et al.*[102]	7-11	326	NCHS	22.4	22.4	22.3	15.3	21.7	9.4
		*Health Ministry of Colombia[103]	<5	-	WHO	6.3	7.5	5.1	-	-	-
			5-12			24.4	25.3	23.5	-	-	-
			13-17			17.9	14.8	21.1	-	-	-
		Briceño *et al.*[104]	5-9	1055	WHO	16.21	-	-	4.45	-	-
		Medina *et al.*[105]	5-17	411	WHO	11.4	13.6	8.9	1.9	1.4	2.6
		Rodríguez Barrera *et al.*[106]	10-14	679	WHO	19.9	-	-	4.1	-	-
		Reina *et al.*[108]	8-10	70	WHO	23	-	-	17	-	-
		Zambrano-Plata *et al.*[109]	10-13	382	WHO	32	-	-	17	-	-
			14-16			25	-	-	15	-	-
			17-18			28	-	-	4	-	-
		WINSISVAN[110]	<5	17160	WHO	4	-	-	2	-	-
			5-12			12	-	-	8	-	-
			13-17			13	-	-	8	-	-

Abbreviations: WHO: World Health Organization; IOTF: International Obesity Taskforce; CDC: Centers for Disease Control and Prevention; NCHS: National Center for Health Statistics.
*The prevalence rates proportionated by the Health Ministry of Colombia englobes both overweight and obesity (excessive weight).

children get older.[86–88] In contrast, overweight augmented from 17% to 28%, increasing 29%.[81–83] The Pan American Health Organization (PHO) reported that in Latin America and the Caribbean, about 7.2% of the children under five years old are overweight, which amounts to 3.9 million children, out of which 2.5 million live in South America, 1.1 million in Central America and 200.000 in the Caribbean.[89]

For that reason, Rivera *et al.*[86] executed a study to expose a global perspective of the obesity problem in Latin America, reporting that Argentina had the highest prevalence of overweight children under the age of 5 years with a worrying 10.4%, followed by Mexico (9.8%), Chile (8.2%), Peru (6.9%) and Colombia (5.2%). Regarding those over the age of 5 years, Brazil showed an obesity prevalence of 11.8% in girls and 16.6% in boys, it was 11.8% for girls and 17.4% for boys in Mexico, whereas Chile showed 13.1% for both sexes and, lastly, Colombia showed 5.2% for both sexes. Concerning teenagers, Mexico exhibited a prevalence of 12.1% for girls and 14.6% for boys; Chile had 6.6% in both sexes, Brazil reported a 4% for girls and 5.8% for boys, and Colombia showed 3.4% for both boys and girls.

Furthermore, Shamah-Levy *et al.*[90] analyzed the Mexican Health and Nutrition Survey (ENSANUT) data from 7,758 children and teenagers. Those who are under the age of 5 years showed an obesity prevalence of 5.8% for females and 6.5% for boys. The highest frequencies were found in the school-age group, indicating that 11.2% of the girls and 18.3% of the boys were obese. This study found a 12.8% prevalence in girls and 15% in boys in teenagers. Likewise, the authors stated that the epidemiological behavior of overweight and obesity in Mexico does not follow a specific trend, making it highly heterogeneous in children and teenagers.

In South America, Chile has the highest overweight prevalence in children over the age of 5.[91] By 2011, the Organization for Economic Cooperation and Development (OECD) published a report positioning Chile as the 6th country with the highest prevalence of childhood obesity worldwide.[92] Moreover, according to the national health survey data (2016-2017), 27.6% of teenagers between 15 and 19 years old were overweight, and 12.2% were obese.[93] Furthermore, Cañoles *et al.*[94] studied a sample of 250 pre-school children in the Chilean public education system, reporting that 54.5% of them had a poor nutritional state (underweight, overweight, and obesity), out of which 27.7% of the children had overweight, and 19.1% had obesity.

Concerning Ecuador, Ramos-Padilla *et al.*[95] assessed the epidemiologic behavior of excessive weight in the urban population of Riobamba, registering an overweight prevalence of 17.8% and 6.3% for obesity. Nonetheless, Espinoza *et al.*[92] carried out a study in children between 5 and 11 years old from a rural south American Indian native population reported an acute malnutrition prevalence of 21.5% and chronic malnutrition prevalence of 22.3%.

In Venezuela, according to the Dietary and Nutritional Surveillance System (SISVAN), by 2007, the prevalence of overweight/obesity among pre-school children was 12.7%, whereas the prevalence among scholars and teenagers raised to 19.3%.[96] Furthermore, a study carried out by Herrera-Cuenca *et al.*[97] assessed the anthropometric characteristics of 1,350 children aged between 7 and 12 years in 8 Venezuelan cities, reporting an overweight prevalence of 15.1% followed by an obesity prevalence of 26.4%. Additionally, according to the National Institute of Nutrition (NIN) papers regarding the current status of childhood overweight and obesity, it was reported that by the years 2008-2010, 17.5% and 9.8% of the children had overweight and obesity, respectively. For teenagers aged between 13 and 17 years, the overweight prevalence was 12%, and the obesity prevalence was 9.3%. According to the authors, excessive weight in Venezuela tends to decrease as individuals age.[98]

On the other hand, Araujo *et al.*[99] assessed the presence of MS in 501 Venezuelan children and teenagers, reporting that, according to the International Diabetes Federation (IDF) criteria, the prevalence of MS was 2.9%, primarily seen in children with overweight and obesity, which had a prevalence of 14.7% and 16.3%, respectively. Nonetheless, Venezuela is not exempt from the coexistence of childhood obesity and malnutrition. Regrettably, the situation in Venezuela is complex, and it is not exempt from the coexistence of childhood obesity and malnutrition. What makes this situation even more concerning is the lack of up-to-date and comprehensive epidemiological data. The available information published by national health ministry is both scarce and outdated. This presents a significant challenge for policymakers, healthcare professionals, and researchers who rely on accurate and current statistics to address public health issues effectively. The absence of recent data hinders the ability to assess the true extent of the problem, identify trends, and develop targeted interventions. As a result, there is an urgent need for improved data collection and reporting mechanisms to monitor and combat the growing public health concerns related to childhood nutrition in Venezuela.

What is the current state of Colombia?

In light of childhood malnutrition and obesity in Colombia, it has been suggested that this country faces a double malnutrition load; that is to say, the coexistence of a lacking and an excessive nutritional state as a consequence of an

accelerated nutritional transition, a common phenomenon in developing countries.[100,101] By 2011, the Organization for Economic Cooperation and Development (OECD) published a report positioning Chile as the 6th country with the highest prevalence of childhood obesity worldwide.[92] Moreover, according to the national health survey data (2016-2017), 27.6% of teenagers between 15 and 19 years old were overweight, and 12.2% were obese.[93] Furthermore, Cañoles *et al.*[94] studied a sample of 250 pre-school children in the Chilean public education system, reporting that 54.5% of them had a poor nutritional state (underweight, overweight, and obesity), out of which 27.7% of the children had overweight, and 19.1% had obesity.

In this regard, Fajardo *et al.*[102] carried out a study with a sample of 326 children aged between 7 and 11 years from Bogota, reporting an overweight and obesity prevalence of 22.4% and 15.3%, respectively. Concerning the children's nutritional patterns (Obtained through the 24-hour reminder), it was observed that their diet was composed of 13% proteins, 35% fats, and 52% carbohydrates. Furthermore, the physical activity assessment revealed that 17% exercised 6 to 7 days a week for 20 minutes, being the boys more active than the girls (67.4% vs 44%; p=0.0002). Lastly, the authors evidenced that 67.8% of them dedicated 1 to 4 hours to watching TV during the midweek, increasing to 75.9% on weekends.

Since 2005, the government and the Health Ministry of Colombia have applied a Nutritional State National Survey on children, teenagers, and adults every five years. The last report was published in 2015, stating that 6.3% of the children under five years old had overweight (7.5% boys and 5.1% girls), 25.6% played active games in the pre-scholar age, and 61.9% spent excessive time in front of a screen. Besides, 24.4% of the school-age children had excessive weight (overweight and obesity), 31.1% fulfilled the physical activity recommendations, and 67.6% spent too much time in front of a screen. Similarly, teenagers had an excessive weight prevalence of 17.9%, 13.4% achieved the physical activity recommendations, and 76.6% spent too much time in front of a screen. Moreover, this survey stated that the time in front of a screen increased in the highest socioeconomic levels.[103]

Conversely, it has been described that the place the children inhabit could potentially act as an important risk factor in the development of childhood obesity.[100] In this regard, Briceño *et al.*[104] executed a non-probabilistic study with a sample of 1055 scholars from rural and urban areas of the department of Boyaca, reporting a general overweight prevalence of 16.21% and 4.45% for obesity. Besides, after assessing this phenomenon in the urban area, it was observed that 18.85% and 5.64% of the children had overweight and obese, respectively; meanwhile, in the rural area, the overweight prevalence was 6.31%, and obesity was 0%. Similarly, another study executed by Medina *et al.*[105] aimed to evaluate the nutritional state and BMI of 411 children and teenagers in 17 schools in Cundinamarca's rural area, exhibiting 11.4% had overweight and 1.9% obesity. The rest of the 74.2% of the individuals had average weight (with 11.2% of them at risk of being underweight), and 1.2% had underweight. The authors concluded that 25.7% of the Mesa municipality population in Cundinamarca had some compromise in their nutritional state, confirming the coexistence of both nutritional disturbances in Colombia.

Also, a study carried out in the city of Medellin by Rodriguez Barrera *et al.*[106] assessed the prevalence of obesity and the quality of life of 679 school-age children aged between 10 and 14 years, using the Kidsgreen-27 for the quality of life and the WHO's software ANTRO-PLUS for the nutritional and anthropometric evaluation. It was reported that 19.9% of the sample had overweight, and 4.1% had obesity. Moreover, the authors concluded that school-age children's quality of life with excessive weight was lower than their peers with normal weight. Besides, they presented a significant difficulty in executing physical activity and had more substantial health issues along with lower social compliance. Notwithstanding, these results can vary according to age, sex (an increased commitment was observed in boys than in girls), and specific cultural determinants such as self-perception and the definition of the corporal image.

The particular case of the North of Santander department

North of Santander Department health report stated that childhood malnutrition represents one of the most relevant problems to tackle, and suggest performing epidemiological studies with appropriate and representative sample sizes.[106] Although the last results from the National Nutritional Survey do not report specific data from North of Santander, the Eastern Region of Colombia (which includes the North of Santander) presented an overweight prevalence in children under five years of 6.7%.[107]

In Cúcuta, Reina *et al.*[108] carried out a study to identify the risk factors related to overweight and obesity in 70 children of both sexes, reporting that 23% of the children were overweight, and 17% were obese; also, it was noticed that the highest prevalence of both entities belonged to the socioeconomic levels 2 and 3. Likewise, assessing children's dietary habits lead to conclude that 30% of them did not perform any physical activity while 60% spent 1 to 2 daily hours of TV (out of which 23% had overweight); besides, they also spent 1 to 2 hours a day playing videogames.

Along these lines, Zambrano *et al.*[109] executed another study in Cucuta with a sample of 382 children and teenagers from public schools, reporting that 55% had some nutritional impairment, with an overweight prevalence of 29% followed by obesity with 15%. Similarly, children between 10 and 13 years old showed an overweight prevalence of 32% and obesity of 17%, the boys being the most affected group. Conversely, the self-perception assessment of a student overweight revealed that 64% considered themselves thin, 24% thought they had a normal weight, and just 12% perceived themselves as overweight. This finding raises a question of whether their self-perception of normality was influenced by the assumption that obesity equates good health.

In 2020, a paper from the Nutritional Surveillance "WINSISVAN" regarding Northern Santander was published, which included 17,160 children and teenagers under 18 years old (53% were girls and 47% boys), out of which 92% were affiliated with a subsidized healthcare system, 28% lived in a rural area and 72% in an urban area. Based on the nutritional diagnosis, 15% of the children under the age of 5 were at risk of becoming overweight, 4% had it already, and 2% were obese. Moreover, the age group of 5-12 years showed that 12% had overweight, and 8% were obese. Lastly, concerning the age group of 13-17 years, 13% had overweight, and 8% were obese.[110]

It is mandatory to mention data concerning malnutrition and low length, given that the latter is a crucial diagnostic point when assessing children's nutritional state because of its relationship with chronic malnutrition or long-term dietary deprivation.[111–113] North of Santander Department health report stated that childhood malnutrition represents one of the most relevant problems to tackle, and suggest performing epidemiological studies with appropriate and representative sample sizes.

It was reported that the total prevalence of malnutrition among children under five years old was 4% and 4% for acute malnutrition; meanwhile, 9% were diagnosed with low length, and 21% were at risk of developing it. By assessing the same variables in children aged between 5 and 12 years, 7% had a low length for their age, and 21% were at risk of developing it. Additionally, 5% and 15% of the children aged between 5 and 12 years presented an underweight or underweight risk. Similarly, 7% of those aged between 13 and 17 years were underweighted, and 14% were at risk of becoming underweight.[110] The latter results support the double nutritional load lying in this region.

Conclusions

This review's findings suggest that despite the effort that has been put into investigating and addressing obesity, it remains a critical health problem worldwide. Notably, overweight and obesity are seen in the wealthiest nations and low and middle-income countries, posing a threat to any person or family member regardless of age, sex, race, and family obesity history. Furthermore, many researchers claim that the primary determinant in increasing obesity prevalence has been lifestyle modifications. Thus, physical activity patterns such as the decrement in outdoor activities increased exposure to entertainment technologies, and sedentarism are among the most critical risk factors for childhood obesity.[62]

Even though each continent and the countries within each continent could exhibit a particular pattern regarding populational childhood weight behavior, the reality is that excess weight disorders are rising globally. Nevertheless, Europe′s childhood obesity prevalence shows an apparent stabilization; in North America, childhood obesity is a growing concern in parallel with the rise of adult obesity epidemics, and incredibly, South America is experiencing the double burden of obesity and malnutrition.

Data availability

No data are associated with this article.

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