

## ORIGINAL

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ePublish: 2016 Sep 13**PREVALENCE OF CHILDHOOD OBESITY BY SEX AND REGIONS IN PERU, 2015****Akram Hernández-Vásquez (1), Guido Bendezú-Quispe (2), Marilina Santero (1) y Diego Azañedo (3).**

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Conflicts of interest: None to declare

**ABSTRACT**

**Background:** Childhood obesity is a global problem, sociodemographic and cultural factors influence its presence. An analysis of disparities in the prevalence of childhood obesity in Peru was made by sex and region in 2015.

**Methods:** Analysis of the information reported by the *Sistema de Información del Estado Nutricional* of the number of obesity cases in 2,336,791 children under five years, evaluated in public health facilities during 2015. The distribution of obesity cases was analyzed by sex and region of residence, also a spatial projection of the regional prevalence of obesity and the prevalence differences between men and women was performed.

**Results:** Data from 2,336,791 children under five was analyzed. An obesity prevalence of 1.52% (girls: 1.3% and boys: 1.7%) was found; the highest prevalence were observed in urban areas (girls: 1.5% and boys: 1.9%) and on the Costa (girls: 1.9% and boys: 2.5%). Highest prevalence of obesity were in Tacna (girls: 3.2% and boys: 3.9%), Moquegua (girls: 2.4% and boys: 3.1%) and Callao (girls: 2.3% and boys: 2.8%).

**Conclusions:** Childhood obesity predominates on the coast and in urban areas of Peru particularly among boys. The regions of higher prevalence of obesity were Tacna Moquegua and Callao.

**Key words:** Obesity, Child, preschool, Child Nutrition disorders, Peru, Geographic information systems. Health information systems.

**RESUMEN****Prevalencia de obesidad en menores de cinco años en Perú según sexo y región, 2015**

**Fundamento:** La obesidad infantil es un problema global. Factores sociodemográficos y culturales influyen en su presencia. El objetivo fue conocer la prevalencia de obesidad infantil en Perú según sexo y región en el año 2015.

**Métodos:** Análisis de la información reportada por el Sistema de Información del Estado Nutricional del número de casos de obesidad en 2.336.791 menores de cinco años evaluados en 7.929 establecimientos públicos de salud durante el 2015. Se analizó la distribución de los casos de obesidad según sexo y regiones de residencia, además se realizó una proyección espacial de las prevalencias regionales de obesidad y las diferencias de las prevalencias entre niños y niñas.

**Resultados:** Se analizaron los datos de 2.336.791 menores. Se encontró una prevalencia de obesidad del 1,52% (niñas: 1,3% y niños: 1,7%). Se observaron las mayores prevalencias en las zonas urbanas (niñas: 1,5% y niños: 1,9%) y en la región costera (niñas: 1,9% y niños: 2,5%). Las prevalencias más altas se encontraron en Tacna (niñas: 3,2% y niños: 3,9%), Moquegua (niñas: 2,4% y niños: 3,1%) y Callao (niñas: 2,3% y niños: 2,8%).

**Conclusiones:** La obesidad infantil predomina en la costa y áreas urbanas del Perú, especialmente entre los niños. Las regiones con mayor prevalencia son Tacna, Moquegua y Callao.

**Palabras clave:** Obesidad, Preescolar, Trastornos de la nutrición del niño, Perú, Sistemas de información geográfica. Sistemas de información en salud.

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## INTRODUCTION

The world population, especially those living in developing countries, are going through a phenomenon known as “nutrition transition”. This process, associated with a series of changes in food consumption patterns, lifestyles, socioeconomic and sanitary conditions, leads to an accelerated growth in the proportion of people who are overweight or obese, as well as reducing cases of malnutrition<sup>(1,2)</sup>, a situation that can be observed in Peru<sup>(3,4)</sup>.

In 2010, the estimated prevalence of overweight and obesity was 6.7 % in pre-school children around the world. Furthermore, in low- and middle-income countries an increase in the prevalence of these disorders from 6.1% in 2010 to 8.6% in 2020 is predicted<sup>(5)</sup>. It is important to consider that childhood represents one of the most vulnerable age groups, in which the presence of obesity can bring negative effects of morbidity and mortality in the present and in the future, generating high costs for health systems<sup>(6,7)</sup>.

Obesity in children brings serious consequences for physical, social and emotional well-being<sup>(8)</sup>. The gain of adiposity due to high caloric intake early in life is associated with problems in growth, bone age, early pubertal transition and persistence of obesity in adolescence and adulthood<sup>(9-12)</sup>. Likewise, current evidence suggests that being obese is involved with the presence of an increased risk of non-communicable disease onset, like type 2 diabetes mellitus, cardiovascular disease, depression and dental caries, among others<sup>(13)</sup>. On the other hand, it is known that socio-demographic and/or economic disparities in a country shape the existence of childhood obesity in different geographical areas and in relation with the sex. For example, in the United States it is estimated that between 1988-1994 and 2007-2008 boys had a faster increase in the prevalence of obesity than girls (0.7 % vs 0.5 %). Additionally, in 2007, the national

prevalence of overweight and obesity between the ages of 10 to 17 years was 31.6 %, with a range between states from 23.1 to 44.4 %, which was significantly influenced by differences in health insurance and family income<sup>(14,15)</sup>. In addition, cultural and social factors influence differences in the prevalence found by sex, as the concept of gender in a particular place influences the perception of physical activity and daily food intake<sup>(16,17)</sup>.

A better understanding of these disparities could help identify risk factors and etiology of this disease to better focus strategies that attempt to halt their advance, considering that preventive strategies in children are more successful than those made in adults<sup>(18)</sup>.

As mentioned, the study aimed to estimate the prevalence of childhood obesity in Peru during 2015 in relation to the place of residence of the child and sex.

## SUBJECTS AND METHODS

**Study design and setting.** Ecological, descriptive and cross-sectional study of spatial distribution. The nutritional information was obtained from the Sistema de Información del Estado Nutricional (SIEN) of all children under five years who were treated and evaluated for growth and development control in 7,929 public health facilities (PHFs) distributed throughout Peru between the 1st of January and the 31 of December 2015. Although the information comes from PHFs, it should be noted that these had the highest number, distribution and presence in the country, and also in some places represent the only provision of health services for the population. Under this consideration, 2,336,791 (81.7 %) children under five years from the total of the country estimated at 2,861,874 were evaluated and recorded in 2015.

The information was evaluated with geopolitical divisions of Peru, areas of

residence, and natural regions the units of analysis. It should be noted that, following a period of decentralization, Peru was divided geopolitically into 25 regions with 196 provinces and these are composed of 1,854 districts managed by their own municipalities; the latter being the smallest political-administrative unit of territorial organization. At the same time, geopolitical regions are distributed in three natural regions: the coast near the Pacific Ocean that is home of the largest urban population, the highlands consisting of the Andean region and the jungle composed by the Peruvian Amazon (figure 1).

**Sources of information.** The information about the children evaluated and the cases of obesity was from the SIEN, which was

made by the National Institute of Health for Peru (NIH) through the National Centre of Alimentation and Nutrition (CENAN). Active since 2003, its aims are to record, process, report and analyze nutritional information of the population that goes to the HPFs of Peru, including health stations, health centers and hospitals of the Ministry of Health of Peru.

Nutritional information reported was obtained from the examination of children in the area of growth and development of the HFCs of any level of care. In these medical appointments a nutritional assessment of anthropometric measures is performed by qualified and trained nurses, with weighing scales, measuring tape that meet technical specifications and established quality con-

**Figura 1**  
**Peru geopolitical division, formed by 25 regions into three natural regions**



trol, and these are distributed by the Ministry of Health staff to all the HPFs (19). Processes, conditions and anthropometric techniques were standardized in the guide for taking anthropometric measures which must followed by personnel performing these activities in any HPF of the country and is part of the “Health Technical Standard for the Control Growth and Development of the girl and the boy under five years”<sup>(19)</sup>. The results of each evaluation are recorded in a comprehensive care card that contains the number of the national identity document (ID) of the child, which allows tracking and identification of the child in any HPF; also, according to the ID number, the results are individually recorded in all recording and monitoring instruments established by the technical standard. Determining a case of obesity is performed based on the criteria established by the World Health Organization (WHO), which considers the existence of obesity when weight by height exceeds by more than three standard deviations (SD) the median pattern growth<sup>(19)</sup>.

The results of each nutritional evaluation, along with the age, sex, date of attention, district of residence, among others, are recorded manually in the HPF in pre-established formats, which are referred to registration data centers (data entry points) for registration in SIEN and subsequent national consolidation in the CENAN. It should be noted that in the different stages of the process there are several quality controls and records monitored, as well as automated processes that allow the acquisition of every record of each child according to the ID number and thereby avoid duplication of information (data children attending several HPFs).

Information of the number of children under five years evaluated and cases of obesity by sex and district registered in the SIEN was requested and provided by the CENAN, which was consolidated into

a Microsoft Excel 2013 spreadsheet (Microsoft, Redmond district, WA) according to the geographic location code districts for later assignment as urban or rural district.

The characterization of the status of urban and rural districts was conducted by Supreme Decree No. 090-2011 -PCM containing the list of rural municipalities of Peru defined as those whose urban population is not greater than 50% of its total population. With this list, we categorized each of the districts included in the spreadsheet with data from SIEN.

The last source of information is a cartographic base under the shapefile format (.shp) containing the 25 existing regions in Peru for 2007 which was developed by the National Institute of Statistics and Informatics (INEI).

**Statistic analysis.** The methodological design applied for data analysis was divided into two phases. A quantitative, descriptive and transversal phase, and a spatial phase. In the first, using the statistical software Stata version 14.0 (StataCorp LP, College Station, TX, USA), the spreadsheet was imported, to estimate the prevalence of overall childhood obesity and sex of each of the 25 regions of Peru as well as for some features such as place of residence and natural region where the children lived. The differences were determined by chi-square test. The prevalence obtained were exported to a spreadsheet of Microsoft Excel 2013. The second phase was a spatial exploration using ArcGIS Desktop software, 10.4 version (ESRI Inc., Redlands, CA, USA), starting from the integration of the spreadsheet to the district cartographic base in shapefile format (shp) which obtained a resulting layer of childhood obesity prevalence and its difference by sex for each region.

**Ethical considerations.** The study did not require the approval of a review board because it is an analysis of aggregated secondary data that are from public domain and does not permit the identification of the minors evaluated.

## RESULTS

Between January 1 and December 31, 2015 a total of 1,146,978 girls and 1,189,813 boys under five years old were evaluated in the Peruvian public health facilities. The prevalence of obesity was 1.52%. By gender, 15,104 girls (1.3%) and 20,389 boys (1.7 %). The highest prevalence were founded in urban areas (girls: 1.5 % and boys: 1.9 %) and in the coast natural region (girls: 1.9 % and boys: 2.5%) as well as in the urban area of the coast for both sexes (girls: 2.0% and boys: 2.6 %) and in the urban area of the highlands for boys. No statistically significant differences between urban and rural prevalence in girls of the highlands were found. In the jungle, the prevalence of obesity was higher in rural areas among children of both sexes (table 1).

The highest prevalence of childhood obesity for both boys and girls were identified in the regions of Tacna (boys 3.9% and girls 3.2%), Moquegua (boys 3.1% and girls 2.4%) and Callao (boys 2.8% and 2.3% girls). Regarding the ranking occupied by the regions according to the prevalence of childhood obesity by sex, the greatest difference was found in the Madre

de Dios region, which lies in 11th place for boys and 15th for girls, with a percentage difference between their prevalence of 0.7 %. In the case of Pasco , the prevalence in boys corresponds to 18th position, and 13th in girls with a percentage difference of 0.1%; Tumbes ranked 5th in prevalence in boys, and in the case of girls ranked 8th with a percentage difference of 0.9 %. No changes were reported in the ranking greater than 1 or 2 positions for the other regions (table 2).

In the spatial distribution we observed the highest national prevalence of obesity in the regions of Callao, Lima, Ica, Moquegua and Tacna, ranging between 2.2 % and 3.6 %; the lowest prevalence were observed in Loreto, Junín, Cusco, Apurímac and Ayacucho, with a range between 0.6 % and 0.9 % (figure 2).

Also, figure 3 shows that the regions which had the highest differences in the prevalence of obesity among region between girls and boys were: Tumbes, La Libertad, Madre de Dios, Moquegua and Tacna, with differences between 0.57 and 0.9 %. In contrast, Ucayali, Pasco, Junin, Cusco and Apurímac, showed the minor differences ranging from 0.06 % to 0.2 %.

**Table 1**  
**Percentages of children under five with obesity by residential area and natural regions of Peru, SIEN 2015**

		Boys				Girls			
		Evaluated	Obesity	% (SD)	p	Evaluated	Obesity	% (SD)	p
Area of residency	Urban	818,129	15,741	1.9 (0.015)	< 0.001	786,445	11,587	1.5 (0.014)	< 0.001
	Rural	371,684	4,648	1.3 (0.018)		360,533	3,517	1.0 (0.016)	
Natural region	Coast	487,254	12,131	2.5 (0.022)	< 0.001	469,827	9,128	1.9 (0.020)	< 0.001
	Mountain	542,897	6,345	1.2 (0.015)		521,542	4,553	0.9 (0.013)	
	Forest	159,662	1,913	1.2 (0.027)		155,609	1,423	0.9 (0.024)	
Coast	Urban	423,984	10,946	2.6 (0.024)	< 0.001	408,214	8,253	2.0 (0.022)	< 0.001
	Rural	63,270	1,185	1.9 (0.054)		61,613	875	1.4 (0.048)	
Mountain	Urban	303,585	3,778	1.2 (0.020)	< 0.001	291,117	2,583	0.9 (0.017)	0.21
	Rural	239,312	2,567	1.1 (0.021)		230,425	1,970	0.9 (0.019)	
Forest	Urban	90,560	1,017	1.1 (0.035)	< 0.001	87,114	751	0.9 (0.031)	0.01
	Rural	69,102	896	1.3 (0.043)		68,495	672	1.0 (0.038)	

\*\* Differences in proportions were determined by the chi-square test, SD: standard deviation. Obesity is considered when the weight for height exceeds by more than three standard deviations median growth pattern (according to WHO).

**Table 2**  
**Prevalence of childhood obesity by political administrative regions of Peru, SIEN 2015**

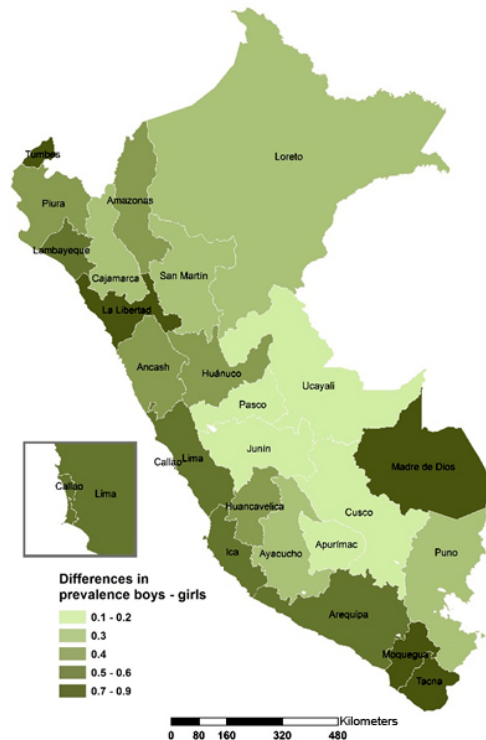
Regions	Boys				Girls			
	Evaluated	Obesity	% (SD)	Ranking	Evaluated	Obesity	% (SD)	Ranking
Amazonas	29,634	387	1.3 (0.066)	14	29,190	294	1.0 (0.058)	14
Ancash	53,184	830	1.6 (0.054)	12	51,465	580	1.1 (0.047)	12
Apurímac	23,248	148	0.6 (0.052)	25	22,451	129	0.6 (0.050)	25
Arequipa	75,786	1,284	1.7 (0.047)	10	72,587	852	1.2 (0.040)	10
Ayacucho	33,998	297	0.9 (0.050)	23	32,572	211	0.6 (0.044)	23
Cajamarca	95,919	1,058	1.1 (0.034)	20	93,240	765	0.8 (0.030)	21
Callao	19,095	531	2.8 (0.120)	3	18,358	425	2.3 (0.110)	3
Cusco	74,875	609	0.8 (0.033)	24	70,677	436	0.6 (0.029)	24
Huancavelica	22,614	276	1.2 (0.073)	16	21,746	191	0.9 (0.063)	18
Huánuco	50,765	620	1.2 (0.049)	15	48,384	440	0.9 (0.043)	17
Ica	32,591	796	2.4 (0.086)	6	31,465	591	1.9 (0.077)	5
Junín	52,041	491	0.9 (0.042)	22	50,082	390	0.8 (0.039)	22
La Libertad	67,542	1,640	2.4 (0.059)	7	65,412	1,200	1.8 (0.052)	6
Lambayeque	34,752	802	2.3 (0.080)	8	33,703	607	1.8 (0.072)	7
Lima	219,595	5,992	2.7 (0.035)	4	211,535	4,593	2.2 (0.032)	4
Loreto	56,270	598	1.1 (0.043)	21	54,975	454	0.8 (0.038)	20
Madre de Dios	10,014	166	1.7 (0.128)	11	9,773	93	1.0 (0.098)	15
Moquegua	5,426	168	3.1 (0.235)	2	5,177	124	2.4 (0.212)	2
Pasco	13,468	158	1.2 (0.093)	18	12,887	138	1.1 (0.091)	13
Piura	85,683	1,476	1.7 (0.044)	9	82,289	1,063	1.3 (0.039)	9
Puno	48,111	582	1.2 (0.050)	17	46,519	430	0.9 (0.044)	16
San Martín	40,837	459	1.1 (0.052)	19	39,032	325	0.8 (0.046)	19
Tacna	10,559	417	3.9 (0.190)	1	10,451	334	3.2 (0.172)	1
Tumbes	12,011	309	2.6 (0.144)	5	11,437	191	1.7 (0.120)	8
Ucayali	22,907	303	1.3 (0.075)	13	22,639	257	1.1 (0.070)	11

SD: standard deviation. Obesity is considered when the weight for height exceeds by more than three standard deviations median growth pattern (according to WHO)

**Figure 2**  
**Regional prevalence of childhood obesity in Peru**



**Figure 3**  
**Differences between regional prevalence of childhood obesity in Peru, boys – girls**



## DISCUSSION

Our study reports disparities in the distribution of childhood obesity by sex in Peruvian territory with respect to area of residence and natural regions. The presence of these differences must be taken into account prior to the planning of public health measures to address the problem of childhood obesity in Peru.

Regarding the differences according to sex, it was a predominance of males, according to what was reported in the international and regional literature<sup>(2,17)</sup>, also it agrees with previous work in the country<sup>(20,21)</sup>. Regional differences in relation to sex of children under five years could be due to different types of factors, both biological and social and / or environmental. It has been reported that genetic factors such as allelic

variation of the FTO gene would relate to the development of childhood obesity and in adults, also the development of a differential pattern of obesity by sex<sup>(22,23)</sup>. Other factors such as hormonal, ethnicity and social factors reported in studies performed in pubertal and prepubertal as well as environmental factors could explain this difference and become potential targets for intervention<sup>(24)</sup>.

The presence of obesity in developing countries is predominantly urban, regarding the acquisition of new dietary patterns associated with economic growth and changes in lifestyles in cities<sup>(1,25)</sup>. In Peru, according to the results of our study, there is a higher prevalence of childhood obesity distributed in urban areas, located mainly in the coastal region, the same ones that tend to have a higher rate of wealth, typical of these areas

of the country compared with the highlands and forests (higher quantity of rural areas and poverty rate), this distribution being in line with that reported in previous studies in the country<sup>(20,21)</sup>. A greater number of obese children were identified in rural areas of the jungle in relation to residents of urban areas for both sexes, a possible explanation for this phenomenon is the decline in the poverty gap between urban and rural areas of the forest due to the implementation of social programs to fight poverty and malnutrition, requiring further studies on the behavior of obesity in this area of the country. Overall, these findings contrasts with those present in developed countries, whose highest prevalence of childhood obesity are in rural areas<sup>(26)</sup>. It is interesting that literature indicates that people with low socioeconomic levels in developed countries have higher rates of obesity, while in middle- and low-income countries the opposite phenomenon occurs<sup>(1,25)</sup>.

Another factor that could explain the distribution of obesity in children under five reported is calorie intake relative to daily requirement, since in the country the results of a report by the NIH shows that in under three years 50% of these did not meet the daily energy requirement with a difference of 20 percentage points in rural areas compared to urban, which would determine lower prevalence of obesity in this group. On this point, the mentioned study does not report sex difference in achieving minimum energy consumption. In addition, in natural regions, more than 50% under the highlands and forests do not reach the required value as in the poor and extreme poor which reside in higher proportion in these regions<sup>(27)</sup>, explaining the results found in our study and requiring further studies evaluating Peru as a country with double burden of nutritional disease, for both overeating and a sedentary lifestyle and nutritional and caloric deficit<sup>(2,4)</sup>.

It is important to highlight the role of obesogenic environments in the development of obesity, including lifestyles with low levels of

physical activity which also favor the acquisition of overweight and obesity along with a high caloric intake, favor the perpetuation of the problem through generations<sup>(28)</sup>. These environments also act as a differentiating factor regarding gender in the pattern of obesity, according to the cultural and social traditions of communities with respect to food and / or certain physical activity by gender<sup>(29)</sup> and may explain the disparity reported by sex and area residence found in this study. On this point, the spatial representation of the factors involved in the formation or not of an obesogenic environment would be a useful measure for the development of future interventions related clearances and land use at local and district level among others, to facilitate the development of physical activity and promote access to varied and healthy foods<sup>(30)</sup>.

This study has limitations proper to the methodology used. Being a study based on secondary data, it is likely the omission or error in the entry of some data by the nursing staff performing the anthropometric measurement; however, registration by the NEIS has a system of quality control validation data in the event of feeds back to the HPFs comments for verification and / or correction, this system also allows control of the duplications reference to the number of ID card of the child to record only the last nutritional assessment conducted within the corresponding reporting period<sup>(31)</sup>. Another important limitation is the use of aggregate data limiting conducting more detailed analyzes according to the characteristics of interest. It could be the characterization of an urban or rural district (rural if the urban population is less than 50%); however, and although it could be questionable and differ from the definitions of other countries is regulated and used by decree in Peru. This limitation in the definition of a district could mean that those with a near cutoff urban population can be characterized in one category or another and that may influence our results, however, it is difficult to determine the magnitude of this effect by socio-demographic phenomena of internal migration,



the geographical diversity of Peru and the years since the last national census, which highlights the need for statistics and sources of timely and accurate information. The data analyzed in this study, in addition to covering 81.7% of the total population of children under five years estimated for the country in 2015, have regional representation mainly in regions where the supply of health services is a predominantly public, being useful in the future to have data available in smaller units of analysis, for example within each district, with the goal of knowing closely the pattern of obesity in relation to the factors that influence its presentation as urban residence or rural and gender differentials, in order to locate groups most in need of intervention and develop policies to prevent childhood obesity, with efficient use of resources that are often limited to a very vulnerable population.

We conclude that with respect to the pattern of obesity in children under five years in Peru, statistically significant differences in relation to sex and place of residence were found, presenting higher prevalence in boys younger than five years, residents of urban areas and in the regions of Tacna, Moquegua and Callao. There are factors that influence the disparity of childhood obesity by sex within regions, and further studies are needed for the identification and knowledge of how they are distributed in order to clarify the picture of the problem and establish programs being necessary aimed at reducing the prevalence of childhood obesity acting at home and community level and intervening in preventing development of obesogenic environments, facilitating access to free space, healthy food and encouraging the development of physical activity in children.

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