



# Prevalence of double burden on malnutrition at household level in four Latin America countries

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## Abstract

*Objectives:* to estimate the prevalence of maternal overweight and short stature in children at household level in Brazil, Bolivia, Colombia and Peru.

*Methods:* a cross-sectional descriptive study. Population-based studies on children (0-5 years old) and women (15 to 49 years old) who participated in the Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher (National Survey on Children and Women Demography and Health) in Brazil and the Encuesta Nacional de Demografía y Salud, (National Survey on Demography and Health), in Bolivia, Colombia and Peru. Variables of interest: overweight mother and child with short stature, a double burden when both outcomes are present. Global prevalence and stratification, according to rural and urban areas and 95% confidence intervals, were estimated.

*Results:* the global sample consisted of 26,506 households. The prevalence of double burden was 9.3% in Bolivia (CI95%= 8.3-10.4), 6.7% in Peru (CI95%= 5.9-7.5), Colombia (3.2%; CI95%= 2.8-3.6) and Brazil (2.2%; CI95%= 1.4-3.2). The highest prevalence were observed in the rural areas in Bolivia (13% vs 6.5%;  $p < 0.001$ ) and Peru (11.9% vs 4.1%;  $p < 0.001$ ).

*Conclusions:* the highest prevalence were registered in Peru and Bolivia, and the lowest in Brazil and Colombia.

**Key words** Child, Height-for-age, Overweight, Prevalence, Stunted growth



## Introduction

The Brazilian population has experienced a rapid process of epidemiological and nutritional transition. In this context, non-transmittable chronic diseases are responsible for approximately 80% of causes of death in the Americas.<sup>1</sup> Similarly, there was an increase in the prevalence of obesity, estimated at 20%,<sup>2</sup> greater than the 13% calculated worldwide.<sup>1</sup> Studies report a 58% prevalence of overweight in Latin America,<sup>2</sup> reaching a difference of 10 percentage points between men and women in more than 20 countries.<sup>2</sup> Furthermore, it is estimated that in 2010, 3.4 million deaths worldwide were attributed for being overweight.<sup>3</sup>

Previous researches have shown that the economic development of countries in general has been accompanied by the changes in the population's lifestyle. The changes have led to a reduction in the level of physical activity and an increase in the consumption of highly energetic food,<sup>4,5</sup> which may explain the significant increase in overweight. In this context, short stature in child continues to be a public health problem. Studies show that short stature in children is associated with approximately half of children's deaths under the age of five worldwide.<sup>1</sup>

Thus, there was a characterization of existence of a double burden of nutritional outcomes, maternal overweight and short stature in children has been described as a phenomenon related to the epidemiological changes experienced in an accelerated manner in low and middle income population countries.<sup>6</sup> Analyzes describes factors, as maternal as to children's socioeconomic, in addition to biological, genetic and nutritional factors, which are key determinants of short stature in children.<sup>7,8</sup> In 2016, the prevalence of this event was still 12% in Latin American countries and the Caribbean.<sup>9</sup>

Some determinants of short stature may appear to be distinct from overweight determinants. However, there is evidence that biological, environmental and socioeconomic factors that contribute to both the risk or prevalence of short stature, may also contribute to excess maternal weight, simultaneously.<sup>1,5</sup>

The presence of short stature in children and maternal overweight from the same family has been observed in the literature, especially in places suffering from poor economic development.<sup>10-12</sup> For example, Argentina<sup>10</sup> and Guatemala,<sup>11</sup> have reported prevalence rates of 12% and 17%, respectively. Another study was carried out by using data from 42 countries (27 from Africa, 8 from Latin

America and 7 from Asia) evidenced a prevalence of double burden greater than 10% in Egypt, Bolivia, Guatemala and Peru. The research demonstrated that the main component of double burden in Latin America was overweight, while in African and Asian populations was short stature.<sup>12</sup> In Brazil, the prevalence of double burden presents strong regional differences.<sup>13,14</sup> In Colombia, double burden was 5.1%, including other outcomes such as anemia.<sup>15</sup>

In general, overweight and short stature in children are approached as events of independent determinants, however, they must be understood as a result of common determinants.<sup>6</sup> Short stature in children can be a predisposing factor for being overweight in adulthood,<sup>16</sup> which is associated with the development of certain types of cancer, cardiovascular diseases, type II diabetes and other metabolic disorders.<sup>6</sup> Therefore, it is necessary to understand the magnitude of the paradoxical coexistence of unsatisfactory nutritional outcomes, which impacts throughout the life cycle.<sup>6,16</sup>

Thus, this study aims to estimate the prevalence of maternal overweight and short infant stature (double burden on nutritional outcomes) in the mother-child binomial in Brazil, Bolivia, Colombia and Peru, using available population data for each of these countries. Household surveys present a broad set of indicators for planning, monitoring and impact assessment in the areas of population, health and nutrition of women and children in developing countries.<sup>17</sup> In addition to the representative samples used in these studies, the surveys allow to guarantee national representativeness and research comparability.<sup>18</sup>

## Methods

This is a descriptive and cross-sectional study, which used data from four population-based surveys conducted in the countries of South America: the *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher* (PNDS) (National Survey on Children and Women Demography and Health), conducted in Brazil between 2006 and 2007,<sup>19</sup> and the *Encuesta Nacional de Demografía y Salud*, (ENDSA) held in Bolivia in 2008,<sup>20</sup> in Colombia (ENDS) between 2009 and 2010,<sup>21</sup> and in Peru (ENDES), during 2012.<sup>22</sup>

The four databases are part of the DHS Measure project (Demographic and Health Survey), whose investigations are conducted on a global scale, with the support from the United States Agency for Development (USAID), in partnership with other international institutions.<sup>23</sup>

For the construction of the final database in Brazil, based on the PNDS, data relating to Households, Women, Pregnancies and Children were done, as described in a previous study.<sup>17</sup> In the case of Bolivia, Colombia and Peru, we used databanks referring to the individual questionnaires on Women, which present data corresponding to their children under the age of five. The inclusion of some available variables in the database on Households is highlighted, using those variables that code each residence.

In Brazil, data from the PNDS were collected between November 3, 2006 and May 3, 2007. A total of 14,617 selected households and 15,575 women aged, 15 to 49 years old were interviewed.<sup>19</sup> In Bolivia, data from ENDSA were collected from February to June 2008. Of the 20,003 households selected, 16,939 women, aged 15 to 49 years old were interviewed.<sup>20</sup> In Colombia, data from ENDS were collected from November 2009 to November 2010, so that 51,447 households were selected and 49,818 women were interviewed.<sup>21</sup> Finally, in Peru, data from ENDES were collected from March to December 2012. A total of 27,488 households were selected and 23,888 women were interviewed.<sup>22</sup>

The data collection was carried out by trained teams following standardized protocols, in order to guarantee the quality of the information collected and the international comparability of the data.<sup>23</sup> However, although the questionnaires are standardized, some variables were specific for each country. Thus, the variables of common interest for the four countries were used for data analysis.

The selection criteria included the population of women, aged 15 to 49 years old, with their children under 60 months (5 years old). In cases where the mother had more than one child under the age of five, the oldest of them was considered for analysis. Pregnant women or women with a BMI <18.5, twin children and those with implausible stature/age values were excluded from the analysis. Women and children with incomplete data on variables of interest were not considered.

The outcome variable was obtained from the combinations of the following conditions: mother with or without excess weight and child with or without short stature. The simultaneous presence of maternal overweight and short stature of the child was defined as a double burden.

Overweight was considered as a Body Mass Index (BMI)  $\geq 25$  kg/m<sup>2</sup>. BMI was calculated using the following formula: weight/height<sup>2</sup>. The children's low stature was defined by the height/age indicator z-score (HAZ). In addition, we considered

HAZ as a value of <-2 standard deviations (SD).<sup>18</sup>

For the description of the studied populations, the frequencies and 95% confidence intervals (CI) of the following variables were estimated: age ( $\geq 24$  months and <24 months), sex (male and female) and short stature in children (no and yes); age ( $\geq 25$  and <25 years) and maternal BMI (<25 and  $\geq 25$  kg/m<sup>2</sup>); and double burden of nutritional outcomes. Graphs were constructed with the prevalence and 95% confidence interval on nutritional outcomes (short stature in children, maternal overweight and double burden) for each country. A graph was also constructed with the prevalence and the 95% confidence interval of the double burden (short stature in children and maternal overweight). As this is the variable of greatest interest for this study, only the double burden was stratified by urban and rural areas in each country. The differences between the strata whose chi-square test presented  $p < 0.05$  were considered significant.

The data were analyzed using the STATA program version 13.1.<sup>24</sup> An unconditional analysis of subpopulations was carried out, including exclusions.<sup>25</sup> As this is a complex sampling plan, unconditional analysis has a greater potential to correctly estimate standard errors.<sup>25</sup>

The surveys were approved by the respective ethics committees in each country. All the participants received information about the objective of the research and their rights, and then asked to sign an Informed Consent Form. After the investigation and the release of the final report, the databases were made available for the public domain, on the Internet, and can be accessed by anyone who is interested, at the following websites: <<http://bvsm.s.saude.gov.br/bvs/pnds/index.php>> and <<https://dhsprogram.com/data/available-datasets.cfm>>.

## Results

Table 1 shows the losses of mother-child binomials from the different countries studied after the eligibility criteria were implemented.

Results from the four countries showed that about 60% of the children were 24 months old or older and 50% were male. Regarding the age of women, approximately 60%, in Brazil and Colombia, and 70%, in Bolivia and Peru, were 25 years old or older. About 40% of the women had a BMI  $\geq 25$  kg/m<sup>2</sup> (overweight) in the four countries. The prevalence of short stature in children was 5.6% (CI95%=4.2-7.5) in Brazil, 20.4% (CI95%=18.7-22.2) in Bolivia, 8.1% (CI95%=7.5-8.8) in

**Table 1**

Summary of the study data: initial number of women and children, number of losses and final sample size in Brazil, Bolivia, Colombia and Peru.

	Brazil	Bolivia	Colombia	Peru
Sample size of women 15 to 49 years of age and their children up to 60 months of age	4,882	8,091	16,939	9,187
Mother-child binomial losses				
By exclusion criteria - Stage 1	1,873	2,697	4,990	1,954
Lack of information - Stage 2	345	31	482	221
Final sample	2,664	5,363	11,467	7,012

Colombia, and 12.5% (CI95%=11.4-13.6) in Peru. In relation to the double burden, a prevalence of 2.2% (CI95%=1.47-3.2) was observed in Brazil, 9.3% (CI95%=.3-10.4) in Bolivia, 3.2% (CI95%=2.8-3.6) in Colombia, and 6.7% (CI95%=6.0-7.5) in Peru (Table 2).

Figure 1 shows the prevalence of nutritional outcomes for the four studied countries. In Peru, the prevalence of maternal overweight was greater than 50% (53.2%; CI95%=51.5-54.8), followed by Bolivia (43.4%; CI95%=41.3-45.5), Colombia (42.7%; CI95%=41.5-43.9) and Brazil (41.1%; CI95%=37.8-44.5). In Brazil, the prevalence of short stature in children was 3.5% (CI95%=2.4- 4.9). In Bolivia, the prevalence of this condition was 11.1% (CI95%=9.9-12.4), which was greater than Colombia (5.0%; CI95%=4.4-5.5). Peru, in turn, had a higher prevalence when compared to Colombia (5.8%; CI95%=5.2-6.6).

The general prevalence of double burden was 2.2% in Brazil (CI95%=1.4-3.2), 3.2% in Colombia (CI95%=2.8-3.6), 6.7% in Peru (CI95%=5.9-7.5) and 9.3% in Bolivia (CI95%=8.3-10.4).

Figure 2 shows the prevalence of double burden, considering the area of residence. The double burden were more prevalent in the rural areas in Bolivia (13%, CI95%=11.4-14.8, in rural areas *versus* 6.5%, CI95%=5.4-7.9, in urban areas;  $p < 0.001$ ) and Peru (11.9%, CI95%=10.4-13.5, in rural area *vs* 4.1%, CI95%=3.4-4.9, in the urban area;  $p < 0.001$ ). In the rural area in Brazil, the prevalence of double burden was similar to those found in the urban area of Colombia. In the rural area in Colombia, the prevalence of double burden was similar to those found in the urban area of Peru. Bolivia and Peru which had a similar prevalence of double burden in the rural area. However, Bolivia has a greater prevalence of double burden in the urban area.

It should be pointed out that in Bolivia, the

prevalence of double burden in the rural area is twice as of the urban area. In Peru, this difference is even greater, with the prevalence of double burden in rural areas as it is almost three times more than in the urban ones. In Colombia, the prevalence found was 3.0% (CI95%=2.5-3.5) in the urban area and 3.6% (CI95%=2.9-4.5) in the rural area. In Brazil, it was 2.0% (CI95%=1.3-3.3) in the urban area and 2.7% (CI95%=1.6-4.4) in the rural. However, the prevalence of double burden did not differ statistically between rural and urban areas in Brazil and Colombia ( $p=0.43$  and  $0.19$ , respectively).

## Discussion

This study estimated the prevalence of double burden, maternal overweight and short stature in children in household level in four Latin American countries. The greatest prevalence of double burden were observed in Bolivia and Peru. In Colombia, the prevalence of double burden was similar to Brazil. When the data were categorized by area of residence, the four countries had the highest double burden in the rural areas: Bolivia and Peru had the greatest prevalence, followed by Colombia and Brazil. Small urban/rural differences were observed in the populations of Brazil and Colombia, which were not statistically significant. In Peru and Bolivia, however, urban/rural differences stood out as statistically significant.

Previous studies carried out in Latin American countries observed greater prevalence than those observed in Bolivia and Peru. Data analysis from a representative sample of a Guatemalan population (The Guatemala Living Standards Measurement Survey) of mothers and their children aged 6 to 60 months old, confirmed the prevalence of a double burden of 17%.<sup>11</sup> Another study, carried out in regions of Argentina with children over two years of

Table 2

Percentage and confidence interval on maternal and children's variables in Brazil, Bolivia, Colombia and Peru.

Variables	Brazil			Bolivia			Colombia			Peru		
	n	%	CI95%	n	%	CI95%	n	%	CI95%	n	%	CI95%
Population sample*	2,664			5,363			11,467			7,012		
Child's gender												
Male	1,360	52.0	48.9 - 55.2	2,710	50.6	48.9 - 52.3	5,900	51.7	50.4 - 52.9	3,533	50.8	49.3 - 52.2
Female	1,304	48.0	44.8 - 51.1	2,653	49.4	47.8 - 51.1	5,567	48.3	47.1 - 49.6	3,479	49.2	47.8 - 50.7
Child's age (months)												
≥ 24	1,788	63.6	60.4 - 66.8	3,664	68.6	67.0 - 70.1	7,724	67.2	66.1 - 68.3	4,738	66.7	65.2 - 68.1
< 24	876	36.4	32.2 - 39.6	1,699	31.4	29.9 - 33.0	3,743	32.8	31.7 - 33.9	2,274	33.3	31.9 - 34.8
Mother's age (years)												
≥ 25	1,719	61.0	57.4 - 64.4	3,767	71.9	70.5 - 73.4	7,339	65.4	64.2 - 66.6	5,091	73.3	71.7 - 74.8
< 25	945	39.0	35.6 - 42.6	1,596	28.1	26.6 - 29.5	4,128	34.6	33.4 - 35.8	1,921	26.7	25.2 - 28.3
Maternal BMI**												
< 25 kg/m <sup>2</sup>	1,510	56.7	53.5 - 59.9	2,560	47.3	45.4 - 49.2	6,089	54.2	53.0 - 55.4	2,898	40.2	38.6 - 41.7
≥ 25 kg/m <sup>2</sup>	1,154	43.3	40.1 - 46.5	2,803	52.7	50.8 - 54.6	5,378	45.8	44.6 - 47.0	4,114	59.8	58.3 - 61.4
Child' height by age												
No	2,515	94.4	92.5 - 95.8	4,299	79.6	77.8 - 81.3	10,367	91.9	91.2 - 92.5	6,007	87.5	86.4 - 88.6
Yes	149	5.6	4.2 - 7.5	1,064	20.4	18.7 - 22.2	1,100	8.1	7.5 - 8.8	1,005	12.5	11.4 - 13.6
Double burden***												
No	2,595	97.8	96.8 - 98.5	4,880	90.7	89.6 - 91.7	11,037	96.8	96.4 - 97.2	6,502	93.3	92.5 - 94.0
Yes	69	2.2	1.47 - 3.2	483	9.3	8.3 - 10.4	430	3.2	2.8 - 3.6	510	6.7	6.0 - 7.5

\* Complex sample plan. Corresponds to the total number of mother-child binomials considered for analysis in the survey, but without the post-stratification of weights; \*\* BMI= Body Mass Index; \*\*\*Overweight mother and short stature in children.

age and their mothers, reported a prevalence of 12%.<sup>10</sup> Surveys conducted in Asian countries observed even higher prevalence, such as in Malaysia, at 19.4%,<sup>26</sup> and in Bandung, Indonesia, which reached 30.6%.<sup>27</sup>

It is worth noting that the prevalence of maternal overweight among the studied populations was similar, affecting more than 40% of the women. Regarding short stature by age, the prevalence ranged from 3.5% in Brazil to 11.1% in Bolivia. This finding demonstrates that the prevalence of double burden possesses a main component of short stature in children. Hence, the magnitude of the prevalence of double burden suggests a chronic socioeconomic deprivation situation, expressed by negative environmental influences on children's health and reflecting on low socioeconomic level conditions and the development of a country<sup>8</sup> and to the context of nutritional transition in these populations.

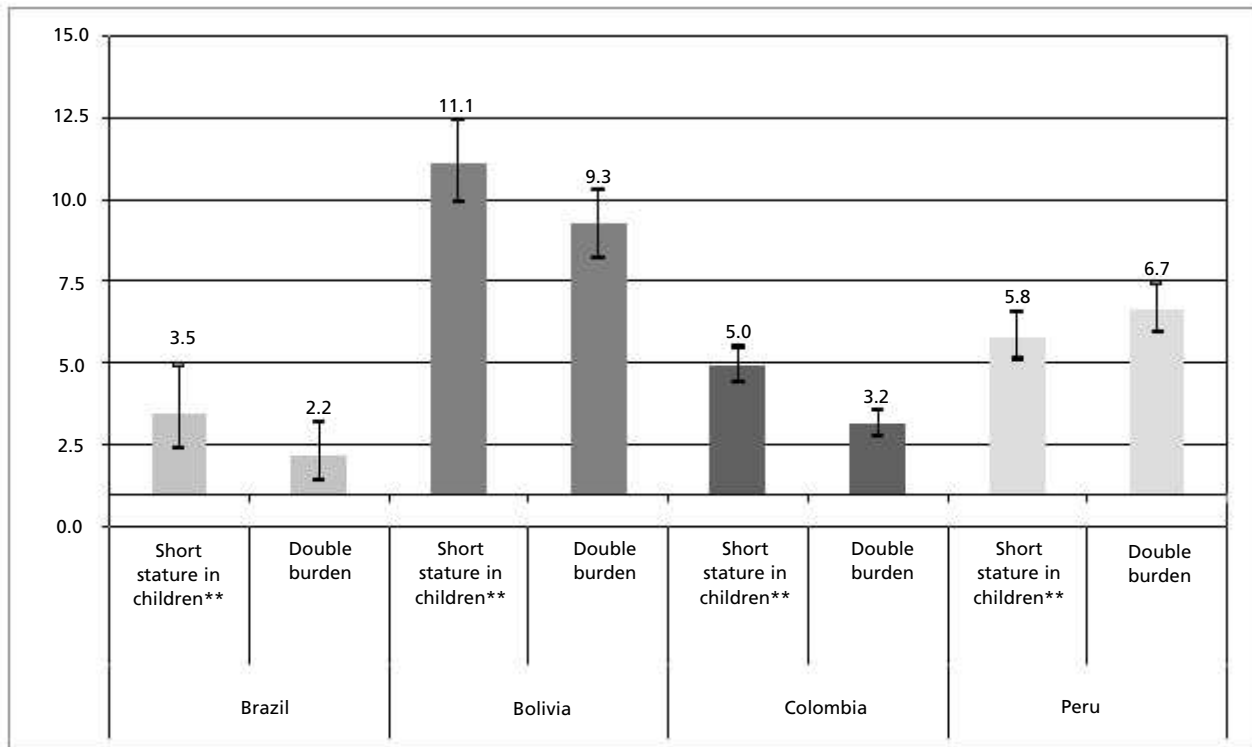
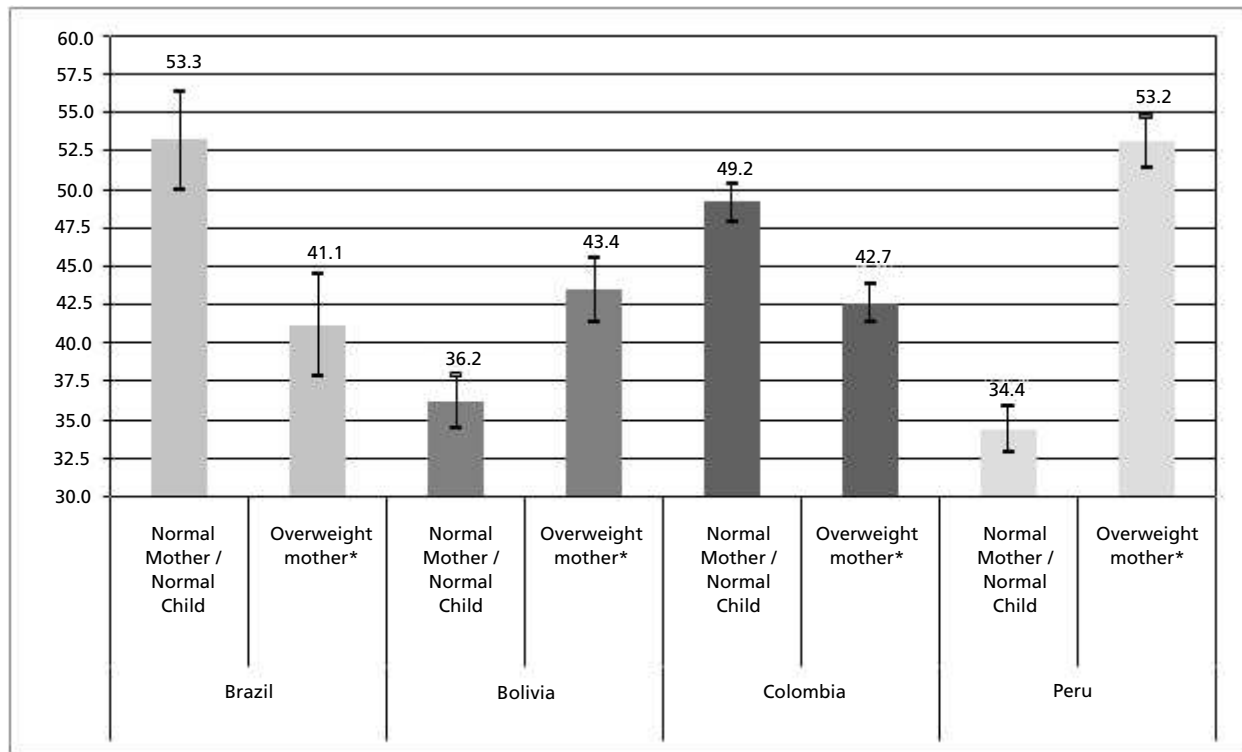
Over the past decades, there was a decline in the prevalence of short stature among Brazilian children under the age of five, which explains in some way the low prevalence of double burden in Brazil. This result was attributed to several factors, such as

urbanization, increased maternal schooling, expanding access to health services, increased population income and public social protection policies.<sup>28</sup> Currently, most Latin American countries are more intensely organized in the international markets, with consequent economic growth, which has made these countries increasingly more urbanized.<sup>12</sup> Thus, the relation between double burden and economic development is emphasized, since the double burden was more prevalent in families living in rural areas in Guatemala, which these families had worse socioeconomic conditions.<sup>11</sup>

In addition, from the analyzes of the present study, we observed that there is similarity between the prevalence of double burden in the following countries: Bolivia, Peru, Colombia, and Brazil. It is possible to relate these prevalence to the GDP (Gross Domestic Product) per capita that each country reported in the year in which its DHS was developed. Colombia and Brazil had higher values than Bolivia, but Peru had the greatest GDP per capita. Bolivia had the lowest GDP per capita, roughly \$4,500. In Peru, it was \$10,900 dollars. Colombia, in turn, had a GDP per capita of \$9,800 and Brazil,

Figure 1

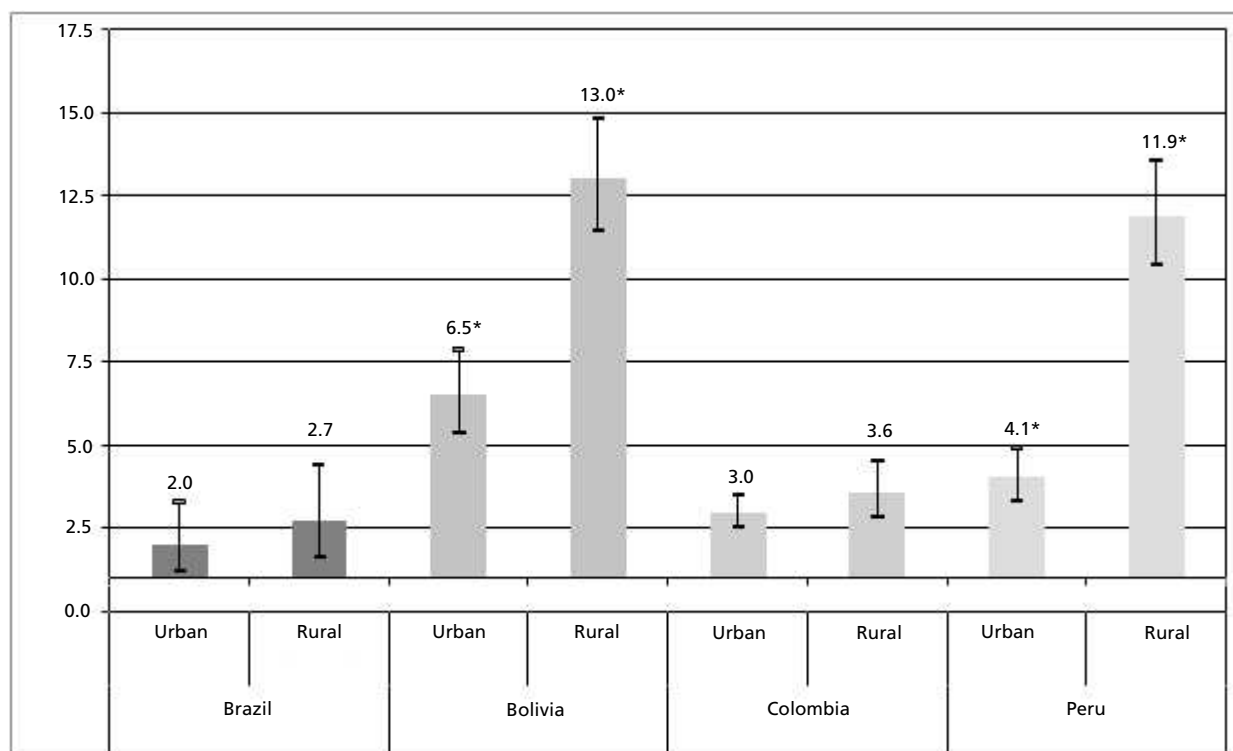
Prevalence and confidence interval of the double burden of mother-child binomial in Brazil, Bolivia, Colombia and Peru.



\* Binomial on overweight mothers and children with normal height; \*\*Binomial of eutrophic mothers and short stature in children.

Figure 2

Prevalence and confidence interval of the double burden of the mother-child binomial in Brazil, Bolivia, Colombia and Peru according to the area of residence.



\* $p < 0.05$ .

\$8,800 dollars.<sup>29</sup>

However, GDP per capita, an indicator of the economic growth, is an average of the household income, making it necessary to consider social inequality for its best assessment. In addition, the health conditions in the country are the result of the economic growth associated with the improvement of factors which do not strictly linked to the income,<sup>30</sup> such as coverage on health services, education, sanitation and a potable water supply.

In the international reference population, the prevalence of short stature in children is 2.5% (z-score  $\leq -2$ ) and the percentage of double burden found in countries like Brazil and Colombia were close to this value. Thus, contexts of economic development at the levels of these countries would be sufficient to achieve a prevalence of double burden below 5%. The results of the present study highlight the importance of the government strategies and the public health service systems, which aim at determining the double burden of malnutrition. Therefore, it is important to develop research that identifies the factors associated with the double

burden of the populations in these regions.

One of the limitations of the present study was the loss of samples due to missing data on the variables of interest. Individuals who presented loss of information were not included in the constructed indicator variables and, therefore, were not part of the analyzes. However, we emphasize that there were samples with national representativeness, which attests to their internal validity. Another limitation concerns the difference in the periods when surveys were carried out, which could make it difficult to compare the prevalence rates among the countries. However, the studied phenomenon does not change over the short periods of time, since the maximum difference among the countries is six years. In addition, the data used were the most current available in each country, which contains the necessary information for the present study.

The double burden of the disease, with the simultaneous presence of overweight and short stature can be considered as an indicator of low socioeconomic levels and, at the same time, a stage of accelerated nutritional transition. This last

phenomenon can be explained by the relative change in food consumption habits attributed to the decrease in consumption of fresh food, replacing with more processed food, which have a high content of simple fats and sugars. The prevalence of this phenomenon would indicate the level of development that each population is experiencing. In Brazil and Colombia, the double burden can be considered low, and in the populations of Peru and Bolivia, they continue to show the prevalence rates are above 5%, which is characterized as a public health problem in these same countries.

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### Authors' contribution

Temponi HR performed the data acquisition and analysis, participated in the writing, interpretation of the results and the review of the article; Velasquez-Melendez G defined the study design, participated in the writing, the interpretation of results and the review of this article. All authors approved the final version of the manuscript.



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