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Trend in prevalence of anemia in children between 6 and 35 months in Peru during the period 2014-2019
Tendencia de la prevalencia de anemia en niños de 6 a 35 meses en el Perú durante el período 2014-2019

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B.M., P.H.A. conceived and designed the analysis.
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Declaration of conflict of interest
The authors declare no current conflicts of interest.

RESUMEN
Introducción: En el Perú, 4 de cada 10 niños menores de 3 años padecen de anemia.
Objetivo: determinar la tendencia de la prevalencia de anemia en niños de 6 a 35 meses, durante el período 2014-2019. **El estudio:** realizamos un análisis secundario de secciones transversales anuales repetidas para el período. Usamos la prueba chi-cuadrado de significancia conjunta para cada categoría de variables de exposición. **Hallazgos:** los principales resultados muestran una disminución de la prevalencia de anemia infantil durante el período 2014-2019 del 46,92% al 40,33%, específicamente en niñas y niños de 12 a 24 meses. **Conclusiones:** la disminución fue mayor en las áreas rurales, en las regiones naturales de Sierra y Selva, entre los hijos de madres con mayor nivel de educación y los hogares con mayor quintil de riqueza. La región de Puno presenta la menor disminución de anemia infantil durante el período analizado.
Palabras clave: Anemia; Anemia Ferropriva; Enfermedades Nutricionales y Metabólicas; Salud Pública; Perú

ABSTRACT
Introduction: In Peru, 4 out of 10 children under 3 years of age suffer from anemia.
Objective: to determine the trend in the prevalence of anemia in children aged 6 to 35 months, during the period 2014-2019. **The study:** We perform a secondary analysis of repeated annual cross sections for the period. We used the chi-square test of joint significance for each category of exposure variables. **Findings:** The main results show a decrease in the prevalence of childhood anemia during the 2014-2019 period from 46.92% to 40.33%, specifically in girls and boys aged 12 to 24 months. **Conclusions:** The decrease was greater in rural areas, in the natural regions of Sierra and Selva, among the children of mothers with a higher level of education and households with the highest wealth quintile. The Puno region presents the smallest decrease in childhood anemia during the period analyzed.

Keywords: Anemia; Anemia Iron Deficiency; Nutritional and Metabolic Diseases; Public Health; Peru

INTRODUCTION

Childhood anemia is a global public health problem, especially in low and middle income countries (LMIC) which includes higher costs for health systems (1,2). In Latin America, anemia prevalence among children under 6 months old, varies between 4 and 19% (3).

Peru has the second highest prevalence of anaemia in the region, affecting 4 out of every 10 children under the age of 3 years (3). The national cost for cognitive loss due to anemia corresponds to 0.51% of the GDP (Growth Domestic Product) per capita, 0.14% for a loss of education and 0.20% for a loss in productivity (4). Given its importance, the National Plan for the Reduction and Control of Maternal and Child Anemia and Chronic Child Malnutrition in Peru (5) and the Multisector Plan to Fight Anemia (6) were developed in recent years. They planned to reduce the prevalence of childhood anemia to 19% by 2021 (5). Although some studies have evaluated the trend in the childhood anemia prevalence until 2011 (7), there is no current information about this trend. Thus, the objective of the present study is to determine the trend in childhood anemia across selected characteristics within the period 2014-2019 in Peru.

METHOD

We conducted a secondary analysis of repeated annual cross-sections using the Demographic and Family Health Survey (ENDES for its acronym in Spanish) for the period 2014-2019.

The ENDES is a public database developed by the National Institute of Statistics and Informatics (INEI for its acronym in Spanish), without any access to confidential data (http://iinei.inei.gob.pe/microdatos/). It helps to obtain updated information, and to analyze the changes, trends and determinants of fertility, mortality and health in Peru.

The design of the survey sample was probabilistic, 'sampling-weights' by departments and areas, stratified, multi-stage, and independent for each department. Clusters were selected from every department and the selected dwellings were visited in each cluster. The ENDES is representative at the national level, by geographical areas (urban / rural) and for each of the 25 administrative regions of Peru.

The main indicator to analyze is the anemia prevalence for children aged between 6 and 35 months at the national level and adjusted to altitude, following the method by the INEI. The anemia chapter of the ENDES collects anthropometric information (weight and height) and results of the hemoglobin test of women and children under 5 years old. We included as exposure variables, the sex (male / female), the ranges of age (6-11 months / 12-23 months / 24-35 months), the geographical areas (rural / urban), the natural regions (Coast / Mountain / Jungle), the mother's education level, including primary education, high-school education and higher education level (non-university, university and postgraduate higher education) and the household wealth quintiles including wealth from very low, low, middle, middle high and high level. We used the module for complex samples svy (Survey complex data-analysis) from the Stata® 15.0 software version (Stata Corporation, College Station, Texas, USA) in accordance with the ENDES sampling specifications.

We calculated the anemia prevalence for children aged between 6 and 35 months generally and according to each exposure variable. We used the chi-squared (X^2) test of joint significance for every category of exposure variables. Statistical significance was defined as a p-value < 0.05. For the annual trend analysis, we used graphical methods with the political maps of Peru, for the prevalence of anemia for children aged between 6-35 months at the regional level.

RESULTS

At the national level, childhood anemia has decreased from 46.92% to 40.33% during the 2014-2019 period, being higher among girls and children between one and two years old. With respect to the geographical level, we observe that even though anemia is higher in rural areas, it has considerably decreased during the period, compared to urban areas. Therefore, we identify a much greater decrease in the Mountain and Jungle regions, compared to the Coastal region. Concerning the mother's education level, anemia is lower among children with mothers with a high level of education; there has also been a significant decrease among children with mothers with a basic level of education. Finally, in relation to wealth quintiles, we observe that households with higher quintiles present a lower childhood anemia prevalence, including a significant decrease among the quintiles 1, 2 and 4 (being the quintile 1-5, lower and higher, respectively) (**Table 1**).

Table 1. Prevalence of childhood anemia (6 to 35 months) in selected characteristics, 2014-2019

| Variables	2014	2015	2016	2017	2018	2019	p-value
General Prevalence	46.92	43.41	43.61	43.61	43.55	40.33	0.004
Sex							
Female	45.64	40.66	42.06	41.85	41.61	37.43	0.011
Male	48.13	45.99	45.00	45.36	45.43	43.12	0.194
Age groups							
6-11 months	61.65	59.63	59.34	59.53	59.71	59.24	0.866
12-23 months	55.63	50.91	51.53	48.93	49.64	45.09	0.001
24-35 months	31.69	29.53	29.29	30.33	30.40	26.33	0.457
Geographical zone							
Rural	57.56	51.13	53.37	53.32	50.98	49.40	0.001
Urban	42.34	40.49	39.95	39.98	40.86	36.93	0.312
Natural region							
Coast	38.26	36.92	36.72	36.12	37.73	34.12	0.636
Mountain	55.93	53.06	51.82	52.05	50.28	48.84	0.022
Jungle	56.85	47.99	51.66	53.65	50.54	45.51	<0.001
Mother's education level							
Primary	55.80	48.43	51.80	52.52	51.90	50.12	0.005
High School	46.35	44.04	43.85	43.72	44.36	40.61	0.263
Higher Education[a]	31.44	30.49	29.87	30.73	31.35	28.25	0.969
Wealth quintile[b]							
Very low wealth	57.84	52.04	53.82	55.36	53.57	51.20	0.020
Low weatlth	54.25	50.49	52.32	49.12	47.93	44.85	0.015
Middle wealth	45.50	42.37	43.82	42.73	41.59	37.77	0.448
Middle high wealth	38.12	38.03	31.43	33.58	38.29	32.87	0.006
High wealth	26.46	27.77	28.45	26.18	27.14	24.11	0.912

Source: ENDES. Own elaboration
a. Higher Education includes non-university, university and postgraduate higher education.
b. According to ENDES technical sheet

After studying the trend in childhood anemia at regional level, we observe that prevalence decreased in 16 regions Huancavelica, Junín, Madre de Dios, Pasco and Puno regions

with higher childhood anemia prevalence (higher than 60%). In 2019, among the regions with a greater decrease in childhood anemia prevalence, only the Puno region maintained a prevalence higher than 65% (**Figure 1**).

Figure 1. Prevalence of anemia in children from 6 to 35 months at the regional level, 2014 and 2019
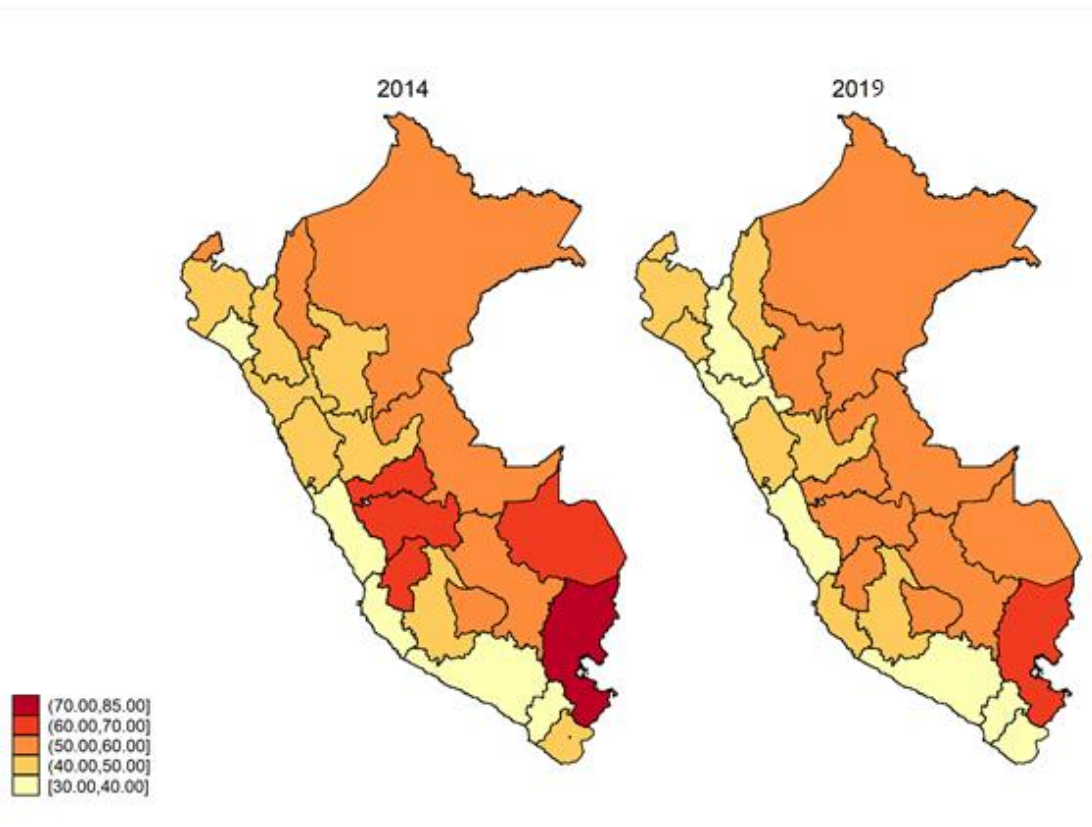
Source: ENDES. Own elaboration

DISCUSSION

Although from our study, childhood anemia decreased, it is high compared to another study which showed a decrease in the prevalence of anemia from 50.4% to 30.7% during the period 2000-2011 (7). However, this study included children under 5 years old; therefore, it was not directly comparable to this latter. Another study, using the ENDES survey during the 2007-2013 period, showed an anemia prevalence in children under 3 years old of 47.9% (8), higher than our study (36.3%), which confirms a decreasing trend in relation to the childhood anemia in Peru. However, we cannot affirm yet, that the decrease observed in our study could be related to the effects of the National Plan for the Reduction and Control of Maternal-Infant Anemia and Chronic Infant Malnutrition in Peru (2017) and the Multisectoral Plan for the Fight against Anemia (2018), due to the minor lapse since its implementation. Therefore, these effects are probably due to other previous policies, such as the Universal Insurance Act implementation (9).

Globally, a decrease in the prevalence of childhood anemia has been identified. A systematic review showed that the worldwide prevalence of childhood anemia decreased from 47% to 43% in children aged from 6 to 59 months and in Central, Latin American and Caribbean countries it decreased from 38% to 33% between 1995 and 2011 (10). However, the proportion of this trend is likely to vary across countries and regions. A study in the Northeast region of Brazil revealed that within the period 2005 to 2015, anemia decreased from 45.1 to 27.4% in children between 6 to 60 months (11).

Unlike the trend until 2011, our results suggest that anemia in children under 2 years of age has improved. Since this group includes a particularly vulnerable population such as infants (12). It is likely that some policies already implemented related to the Universal Insurance Act or the water, sanitation, and hygiene (WASH) conditions have been influenced to decrease the child anemia during the period (9,13). This prioritization probably responds to the evidence that until 2013, being under 24 months old was considered a risk factor for anemia in Peru (8). Additionally, it is likely that some strategies of the National Plan for the Reduction and Control of Maternal and Child Anemia and Chronic Child Malnutrition in Peru have worked (5). These include delayed umbilical cord ligation during childbirth, preventive iron, and folic acid supplementation for children from 4 months of age, and iron-rich complementary foods of animal origin (5). Likewise, it includes screening or ruling out anemia at 6 months, control of growth and development, and quality and timely health care, among others (5). Regarding iron-rich complementary foods from animal origin, it is important to emphasize that in some regions, distrust of these strategies will probably drive the use of this foods over other measures, including some results showing positive effects on child anemia (14,15).

Children from the Mountain and Jungle were more affected by anemia. Although in these regions there was a significant decrease in people living below the poverty line, this is still higher compared to the Coastal region. In effect, by 2015 the percentage of people living below the poverty line was 8.7%, 6.5% and 0.8% in the Mountain, Jungle and Coast respectively (16).

In a similar way, the coast is the region with the highest wealth and education level. Although it has improved in both genders, there has been a greater improvement in education among women (16). It was suggested that a mother with a poor educational level provides a risk factor for anemia in Peruvian children (8). Thus, from 2016, the percentage of the population with non-higher education was 9.1% for women and 8.8% for men whereas university education was 21.5% for women and 17.3% for men (16),

which explains our findings on improvements in anemia associated with a better wealth and education level of mothers.

This heterogeneity is similar in other LMICs. A systematic review showed that although the prevalence of anemia has decreased in many LMIC, anemia inequalities among children persists in most LMIC according to their index of inequality and the relative index of inequality (17).

Although some efforts to improve social determinants of health have tried to cover all regions of the country, these improvements are not homogeneous. In that sense, for 2016, Puno was one of the regions with the worst coverage of pension insurance (15.7% compared to a national average of 29.1%), health insurance (70.1% compared to a national average of 75.5%), access to drinking water (71.3% compared to a national average of 88%) and sewage (60.3% compared to a national average of 70.1%) (16). It has been suggested that water, sanitation, and hygiene (WASH) conditions are associated with medical consultations for childhood anemia in Peru (13). Likewise, Puno was the region with the worst initial education attendance rate (69.3% comparing to 79.2% on average), findings which may explain the fact that childhood anemia has increased in this region and is lower compared to the rest of the country (16).

In conclusion, anemia prevalence decreased during the period 2014-2019, specifically among girls and children aged 12-24 months. Moreover, the decrease was higher in rural areas and in Mountain and Jungle natural regions, among children with mothers with higher education levels, and households with higher wealth quintile. On the other hand, the Puno region presented the lowest decrease in childhood anemia during the analyzed period.

Our study is somehow limited. First, based on self-report, it might include wrong information gotten from mothers due to memory biases or deliberate omissions. Secondly, the anemia evaluated is due to any cause and, although the majority of cases are due to iron deficiency, only more specific studies would allow an adequate assessment of the type of anemia affecting children in Peru. Nevertheless, it is the first study to analyzing the children anemia during the 2014-2019 period.

Finally, we recommend to facilitate access and availability of iron supplements in all health center in the country, regardless of the level of care where children are monitored. We also recommend to follow-up of the mother in view of the possibility of early detection of malnutrition or anemia and implementation of an exclusive nutritional program.

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