



# Monitoring inequality changes in full immunization coverage in infants in Latin America and the Caribbean

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## ABSTRACT

**Objective.** To compare inequalities in full infant vaccination coverage at two different time points between 1992 and 2016 in Latin American and Caribbean countries.

**Methods.** Analysis is based on recent available data from Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and Reproductive Health Surveys conducted in 18 countries between 1992 and 2016. Full immunization data from children 12–23 months of age were disaggregated by wealth quintile. Absolute and relative inequalities between the richest and the poorest quintile were measured. Differences were measured for 14 countries with data available for two time points. Significance was determined using 95% confidence intervals.

**Results.** The overall median full immunization coverage was 69.9%. Approximately one-third of the countries have a high-income inequality gap, with a median difference of 5.6 percentage points in 8 of 18 countries. Bolivia, Colombia, El Salvador, and Peru have achieved the greatest progress in improving coverage among the poorest quintiles of their population in recent years.

**Conclusion.** Full immunization coverage in the countries in the study shows higher-income inequality gaps that are not seen by observing national coverage only, but these differences appear to be reduced over time. Actions monitoring immunization coverage based on income inequalities should be considered for inclusion in the assessment of public health policies to appropriately reduce the gaps in immunization for infants in the lowest-income quintile.

## Keywords

Immunization; social inequity; infant; Latin America; Caribbean region.

Vaccinations represent one of the safest and most cost-effective public health interventions. In 1974, the World Health Organization (WHO) established the Expanded Program on Immunization to control vaccine-preventable diseases, saving millions of lives each year (1). Despite the advances, an estimated 23 million children worldwide do not receive the recommended basic vaccines for the first year of life (2). Coverage of the third dose of diphtheria, tetanus toxoid, and pertussis (DTP) in one-year-old children is an indicator of immunization program performance. Global coverage of DTP is 86%, still below the 90% target (3), particularly in four WHO regions: Africa (76%), Eastern Mediterranean (82%), the Americas (87%), and South-East Asia (89%) (4).

The Americas region is a world leader in eradicating diseases such as polio, measles, and rubella by introducing new vaccinations, laws, and immunization policies (5). The region faces challenges in guaranteeing universal access and expanding coverage while working with limited resources (6). Barriers to reaching a good coverage include poor access to immunization systems, lack of parent education, cultural beliefs, and low income, among others (7–9).

Equity is essential to achieving sustainable economic, social, and environmental development (10). Differences in how vaccination benefits are distributed increase the burden of disease, limit economic development, and reduce the chances of achieving high, equitable immunization coverage rates in the

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population (11). Progress in immunization coverage is normally expressed using national immunization averages. The equity dimension should analyze coverage beyond national averages and include different subgroups of the population. This is because socioeconomic status, education, place of residence, sex, and others factors may not be visible at national level (12, 13). For this reason, in addition to the national averages, more complex measures of health inequality were included in our study, in particular the slope index of inequality (SII) and the relative concentration index (RCI). These indices describe the gradient of immunization across multiple subgroups weighted for population size (14).

Monitoring subgroups can help prioritize and improve vaccination strategies to address immunization gaps and reach the entire population. Some studies (2, 15) have documented inequalities in immunization in the region, but not all have focused exclusively on full immunization status (16). To close this gap in the analysis, the objective of this study is to compare the magnitude and distribution of disparities in full immunization by socioeconomic status in infants in Latin America and the Caribbean (LAC) between 1992 and 2016.

## MATERIALS AND METHODS

This was an observational-ecological study based on full immunization data, disaggregated by country, obtained from the WHO Global Health Observatory data repository (17), as a product of microdata reanalysis from Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and Reproductive Health Surveys, conducted from 1992 to 2016. Our study outcome was full immunization, defined as the percentage of children 12–23 months who received a dose of *Bacillus Calmette-Guérin* (BCG) vaccine, three doses of polio vaccine (excluding polio at birth), three doses of combined DTP vaccine, and one dose of measles vaccine. Because some countries use alternative vaccination schemes (18–29 or 15–26 months), mostly based on the age at which the measles vaccine is administered, we excluded Colombia-2015, Cuba-2014, Haiti-2013, Jamaica-2005, Panama-1996, Suriname-2016, and Trinidad and Tobago-2011 (18). This adjustment in the indicator was made using the definitions found in the Health Equity Monitor Compendium of Indicator Definitions (19). Socioeconomic data were disaggregated by wealth quintile (Q1: poorest, Q2: poor, Q3: middle, Q4: rich, and Q5: richest). Demographic surveys classify a household's socioeconomic level according to its access to basic services and the home's characteristics and infrastructure (20).

### Country selection

Countries were included based on availability of complete data for the variables of interest and survey year. Most recent immunization coverage analysis was done with data from the most recent survey conducted in each country between 1992 and 2016. As shown in Tables 1 and 2, the year of the most recent survey is not the same for all countries. Analysis of immunization differences over time was done with data from the last two surveys conducted during the study period, except for the countries that had only one year of data, i.e., Brazil, Jamaica, Mexico, and Panama.

## Data analysis

To analyze the latest immunization coverage, we measured absolute (difference Q5 - Q1) and relative (ratio Q5 / Q1) changes in immunization data for each country. Median values were also calculated to compare the gradient of coverage between socioeconomic status. To study how immunization disparities have changed over time, we measured absolute differences in coverage in one subgroup compared to another (21). Specifically, differences between the two surveys were analyzed by comparing the annual absolute change in national coverage and the annual absolute difference for each quintile (Q1 and Q5) (19). We also included more complex inequality measures data (SII and RCI) from the WHO repository (16). A positive value in both indices indicates that immunization coverage is greater in the richest quintile, while a negative value means that the coverage is greater in the poorest quintile (22). Annual absolute rate of change was calculated by subtracting the national average in the previous survey from the national average in the latest survey and dividing by the number of years between surveys. Annual absolute differences in the rate of change were calculated by subtracting the annual change rates of the richest quintile from the annual change rates in the poorest quintile, producing an annual difference in the rate of change in percentage points. A positive value demonstrates faster coverage growth for the poorest quintile, while a negative value reflects a more favorable difference in the rate of change for the richest quintile. The interpretation of the differences in coverage for all possible scenarios has been detailed elsewhere (22). The average improvement level was obtained by averaging the differences in national coverage in the recent and previous surveys. Statistical significance was established with 95% confidence intervals (CI). All statistical analyses were performed using Microsoft Excel.

## RESULTS

### Analysis of immunization coverage using most recent available surveys

Coverage by wealth quintile varied extensively between and within countries (Table 1). The median full immunization coverage was 69.9%, according to data from the 18 countries included (interquartile range is 22 percentage points: 57.1% to 79.3%). Two-thirds of the countries had national coverage much higher than the combined countries average (68.3%). Higher-income absolute inequality was high in eight countries, exceeding the regional median of 5.6 percentage points between the first and fifth quintiles. Only Belize, El Salvador, and Jamaica showed lower-income absolute inequality, demonstrating that in absolute terms, coverage was significantly higher in quintile one than in quintile five. The highest level of inequality was observed in Haiti, with a difference of 37 percentage points (95% CI: 24.7–49.4) between the richest and poorest quintiles, and a relative inequality at least twice as high in quintile five compared to quintile one. Of the 18 countries in the study, 12 had higher-income inequality with a positive SII; only in Guyana was the index not significantly different from zero. Although six countries had negative indices, indicating a lower-income inequality, the corresponding results of positive and negative values from RCI and SII were the same. Bolivia and Guyana were not significantly different from zero (Table 2).

TABLE 1. Full immunization coverage in children 12–23 months of age by wealth quintile in 18 LAC countries, 1992–2016

| Country            | Survey | Year | Wealth quintile |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------|--------|------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                    |        |      | Q1              |      |      | Q2   |      |      | Q3   |      |      | Q4   |      |      | Q5   |      |      |
|                    |        |      | E               | LCL  | UCL  | E    | LCL  | UCL  | E    | LCL  | UCL  | E    | LCL  | UCL  | E    | LCL  | UCL  |
| Belize             | MICS   | 2015 | 65.2            | 53.2 | 75.6 | 64.0 | 52.9 | 73.9 | 62.8 | 49.2 | 74.6 | 65.2 | 52.1 | 76.3 | 45.2 | 31.5 | 59.6 |
|                    | MICS   | 2011 | 66.9            | 56.6 | 75.7 | 66.7 | 56.5 | 75.5 | 69.3 | 55.8 | 80.1 | 63.0 | 50.1 | 74.2 | 58.4 | 44.5 | 71.1 |
| Bolivia            | DHS    | 2008 | 77.9            | 72.3 | 82.6 | 78.4 | 72.0 | 83.6 | 77.3 | 70.7 | 82.8 | 80.3 | 73.5 | 85.7 | 80.6 | 72.6 | 86.6 |
|                    | DHS    | 2003 | 48.2            | 42.6 | 53.9 | 49.2 | 40.8 | 57.7 | 44.1 | 37.5 | 50.9 | 58.8 | 52.1 | 65.3 | 57.3 | 46.7 | 67.3 |
| Brazil             | DHS    | 1996 | 56.6            | 50.6 | 62.5 | 74.2 | 67.1 | 80.2 | 84.9 | 78.0 | 89.9 | 83.1 | 75.0 | 89.0 | 74.3 | 62.7 | 83.3 |
|                    | DHS    | 2010 | 64.2            | 60.2 | 68.0 | 68.3 | 64.2 | 72.2 | 71.8 | 67.4 | 75.7 | 70.1 | 64.4 | 75.2 | 67.3 | 60.3 | 73.7 |
|                    | DHS    | 2005 | 47.6            | 42.8 | 52.4 | 56.2 | 51.6 | 60.6 | 66.5 | 61.4 | 71.3 | 62.4 | 55.8 | 68.5 | 71.5 | 64.2 | 77.8 |
| Costa Rica         | MICS   | 2011 | 86.1            | 68.6 | 94.6 | 95.2 | 89.1 | 98.0 | 94.1 | 85.5 | 97.7 | 77.2 | 47.1 | 92.8 | 90.9 | 66.1 | 98.1 |
|                    | DHS    | 1992 | 76.1            | 64.8 | 84.6 | 84.1 | 74.0 | 90.8 | 86.6 | 76.3 | 92.8 | 87.3 | 76.8 | 93.5 | 75.0 | 58.0 | 86.7 |
| Dominican Republic | MICS   | 2014 | 37.7            | 33.8 | 41.8 | 44.3 | 39.5 | 49.2 | 51.3 | 45.6 | 57.0 | 46.0 | 40.1 | 52.0 | 52.8 | 45.5 | 60.0 |
|                    | DHS    | 2013 | 49.1            | 35.3 | 53.9 | 56.7 | 52.5 | 75.9 | 60.9 | 42.1 | 63.1 | 57.8 | 38.9 | 63.5 | 75.6 | 44.3 | 72.7 |
|                    | DHS    | 2004 | 40.5            | 32.0 | 49.6 | 52.7 | 44.0 | 61.2 | 66.3 | 55.7 | 75.5 | 58.7 | 47.6 | 69.0 | 64.2 | 50.2 | 76.2 |
| Ecuador            | DHS    | 1999 | 60.9            | 53.6 | 67.8 | 66.9 | 59.9 | 73.3 | 74.4 | 67.6 | 80.2 | 76.8 | 67.8 | 83.9 | 86.3 | 80.7 | 90.4 |
|                    | MICS   | 2014 | 81.2            | 74.7 | 86.3 | 82.8 | 76.8 | 87.5 | 82.1 | 75.5 | 87.3 | 73.7 | 64.8 | 81.1 | 73.9 | 64.9 | 81.3 |
| El Salvador        | DHS    | 2008 | 75.1            | 67.0 | 81.7 | 88.4 | 82.2 | 92.6 | 83.5 | 76.7 | 88.6 | 74.5 | 65.5 | 81.8 | 81.5 | 67.9 | 90.2 |
|                    | DHS    | 2014 | 51.8            | 46.5 | 57.0 | 56.6 | 51.3 | 61.8 | 59.9 | 54.7 | 64.9 | 68.9 | 63.8 | 73.6 | 62.4 | 55.9 | 68.5 |
| Guatemala          | DHS    | 2008 | 74.8            | 70.7 | 78.5 | 72.0 | 66.2 | 77.2 | 70.1 | 63.7 | 75.7 | 69.6 | 62.3 | 76.0 | 63.6 | 53.4 | 72.7 |
|                    | MICS   | 2014 | 73.8            | 66.5 | 80.0 | 70.8 | 58.9 | 80.4 | 65.2 | 51.2 | 76.9 | 70.3 | 56.9 | 81.0 | 79.7 | 69.1 | 87.3 |
| Guyana             | DHS    | 2009 | 59.9            | 50.6 | 68.6 | 71.6 | 57.7 | 82.3 | 64.6 | 52.3 | 75.2 | 68.8 | 52.4 | 81.5 | 57.9 | 44.4 | 70.4 |
|                    | DHS    | 2016 | 29.9            | 23.8 | 36.9 | 36.6 | 29.6 | 44.2 | 37.1 | 29.9 | 44.9 | 51.5 | 43.0 | 59.8 | 66.9 | 55.7 | 76.5 |
| Haiti              | DHS    | 2012 | 42.9            | 34.8 | 51.4 | 46.3 | 39.4 | 53.4 | 53.0 | 46.1 | 59.8 | 41.9 | 34.4 | 49.7 | 42.6 | 33.1 | 52.6 |
|                    | DHS    | 2011 | 87.2            | 84.1 | 89.7 | 85.0 | 80.6 | 88.6 | 81.9 | 77.0 | 86.0 | 83.7 | 74.3 | 90.1 | 87.8 | 82.2 | 91.8 |
| Honduras           | DHS    | 2005 | 77.0            | 73.0 | 80.5 | 77.3 | 73.0 | 81.0 | 77.6 | 72.8 | 81.8 | 71.8 | 65.0 | 77.8 | 68.2 | 60.5 | 75.0 |
|                    | MICS   | 2011 | 95.1            | 73.0 | 80.5 | 96.0 | 73.0 | 81.0 | 82.2 | 72.8 | 81.8 | 91.4 | 65.0 | 77.8 | 84.3 | 60.5 | 75.0 |
| Mexico             | MICS   | 2015 | 61.9            | 54.2 | 69.0 | 49.2 | 41.8 | 56.6 | 39.6 | 29.8 | 50.2 | 47.6 | 36.1 | 59.4 | 62.1 | 44.7 | 76.8 |
| Nicaragua          | DHS    | 2006 | 77.9            | 72.1 | 82.7 | 87.5 | 82.8 | 91.1 | 86.8 | 78.9 | 92.1 | 90.5 | 83.6 | 94.6 | 88.4 | 78.9 | 94.0 |
|                    | DHS    | 2001 | 64.0            | 58.5 | 69.2 | 77.8 | 71.5 | 83.1 | 78.0 | 71.8 | 83.2 | 71.9 | 63.2 | 79.2 | 71.5 | 60.7 | 80.3 |
| Panama             | MICS   | 2013 | 51.8            | 43.0 | 60.4 | 65.0 | 55.8 | 73.2 | 47.9 | 36.9 | 59.0 | 62.3 | 49.0 | 74.0 | 63.7 | 46.3 | 78.1 |
| Paraguay           | MICS   | 2016 | 62.4            | 55.4 | 68.9 | 51.8 | 43.1 | 60.4 | 66.3 | 56.7 | 74.8 | 62.2 | 52.8 | 70.8 | 66.5 | 55.6 | 75.9 |
|                    | DHS    | 2008 | 60.0            | 50.0 | 69.2 | 74.4 | 61.0 | 84.4 | 79.6 | 66.6 | 88.4 | 79.0 | 64.5 | 88.6 | 74.3 | 53.3 | 88.0 |
| Peru               | DHS    | 2016 | 69.0            | 64.5 | 73.2 | 74.4 | 70.9 | 77.6 | 71.5 | 67.4 | 75.3 | 76.7 | 72.1 | 80.7 | 74.6 | 68.7 | 79.7 |
|                    | DHS    | 2015 | 67.1            | 58.5 | 67.4 | 63.7 | 64.0 | 70.7 | 72.6 | 71.1 | 78.3 | 65.2 | 68.0 | 76.5 | 74.4 | 67.7 | 77.8 |
| Latest median      |        |      | 64.1            | 69.6 | 70.8 | 69.8 | 71.5 | 56.0 | 60.4 | 65.1 | 62.8 | 59.2 | 69.1 | 76.6 | 76.3 | 77.2 | 77.3 |

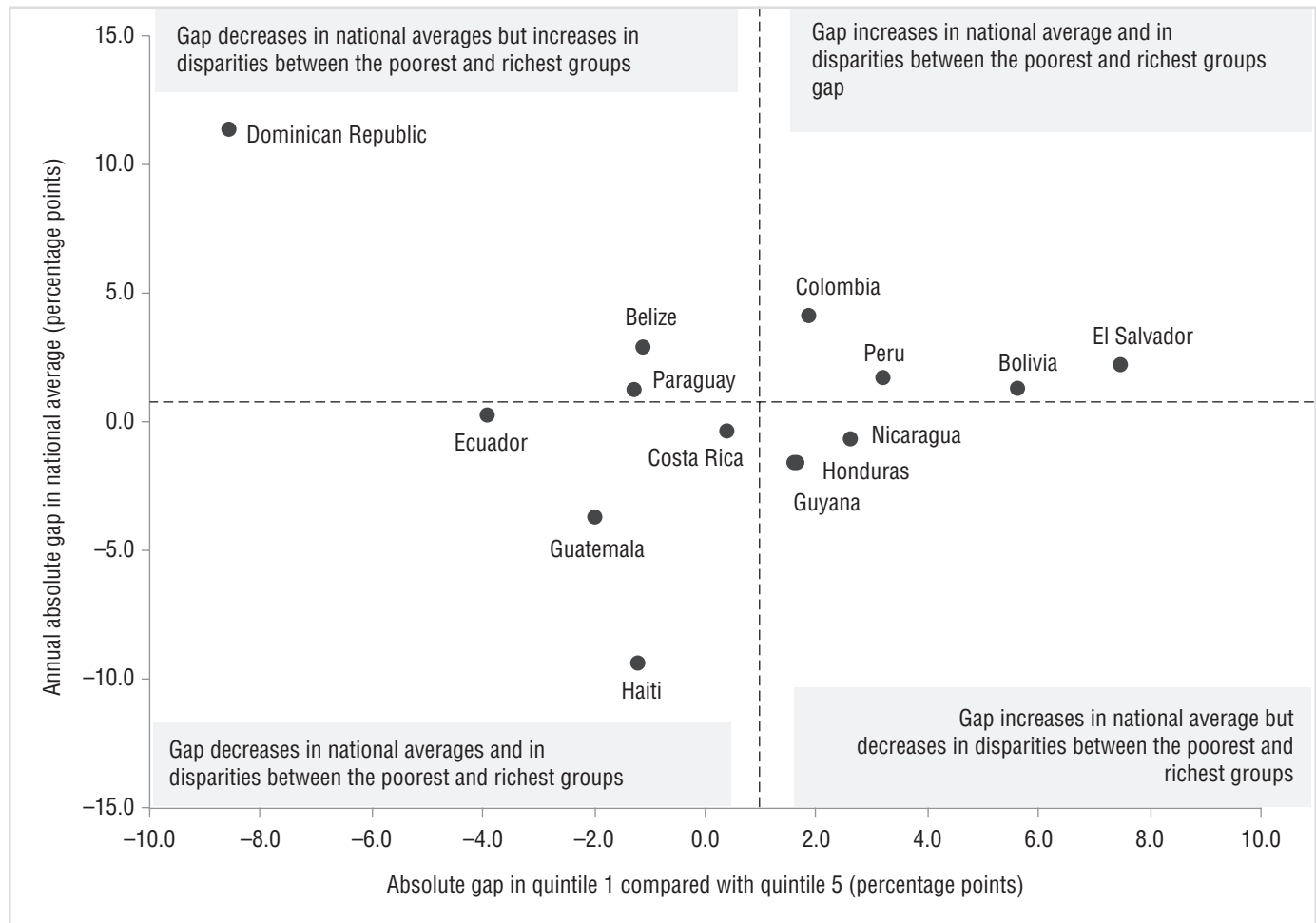
Source: Prepared by the authors from the study data. MICS, Multiple Indicator Cluster Survey; DHS, Demographic and Health Survey; E, Median value; LCL, lower limit of the 95% confidence interval; UCL, upper limit of the 95% confidence interval.

**TABLE 2. Disparities in national full immunization coverage in children 12–23 months of age in 18 LAC countries, 1992–2016**

| Country            | Survey | Year | Socioeconomic status |      |       |                        |       |      |                        |     |     |              |       |      |              |      |      |
|--------------------|--------|------|----------------------|------|-------|------------------------|-------|------|------------------------|-----|-----|--------------|-------|------|--------------|------|------|
|                    |        |      | National average (%) |      |       | Absolute gap (Q5 - Q1) |       |      | Relative gap (Q5 / Q1) |     |     | SII (95% CI) |       |      | RCI (95% CI) |      |      |
|                    |        |      | Mean                 | LCL  | UCL   | E                      | LCL   | UCL  | E                      | LCL | UCL | E            | LCL   | UCL  | E            | LCL  | UCL  |
| Belize             | MICS   | 2015 | 61.0                 | 54.7 | 67.0  | -20.1                  | -38.3 | -9.1 | 0.7                    | 0.4 | 0.9 | -18.4        | -33.2 | -3.6 | -4.7         | -9.9 | 0.5  |
|                    | MICS   | 2011 | 65.5                 | 60.4 | 70.3  | -8.4                   | -25.0 | 8.1  | 0.9                    | 0.6 | 1.1 | -8.9         | -25.8 | 8.0  | -1.9         | -6.2 | 2.4  |
| Bolivia            | DHS    | 2008 | 78.6                 | 75.8 | 81.2  | 2.7                    | -6.0  | 11.3 | 1.0                    | 0.9 | 1.1 | 3.0          | -3.9  | 10.0 | 0.6          | -1.2 | 2.4  |
|                    | DHS    | 2003 | 50.6                 | 47.3 | 53.9  | 9.1                    | -2.7  | 21.0 | 1.2                    | 0.9 | 1.4 | 12.0         | 4.0   | 19.9 | 3.8          | 0.2  | 7.3  |
| Brazil             | DHS    | 1996 | 72.6                 | 69.1 | 75.8  | 17.7                   | 5.8   | 29.6 | 1.3                    | 1.1 | 1.5 | 30.6         | 20.9  | 40.3 | 6.6          | 4.0  | 9.3  |
|                    | DHS    | 2010 | 68.2                 | 66.1 | 70.2  | 3.1                    | -4.6  | 10.9 | 1.0                    | 0.9 | 1.2 | 6.0          | 0.2   | 11.9 | 1.5          | -0.3 | 3.2  |
| Colombia           | DHS    | 2005 | 58.9                 | 56.4 | 61.4  | 23.9                   | 15.5  | 32.3 | 1.5                    | 1.3 | 1.7 | 27.2         | 20.9  | 33.4 | 7.4          | 5.0  | 9.7  |
|                    | MICS   | 2011 | 89.6                 | 83.1 | 93.8  | 4.8                    | -13.5 | 23.0 | 1.1                    | 0.8 | 1.3 | -2.0         | -12.3 | 8.4  | -0.2         | -4.1 | 3.8  |
| Costa Rica         | DHS    | 1992 | 82.4                 | 77.9 | 86.2  | -1.1                   | -18.6 | 16.5 | 1.0                    | 0.8 | 1.2 | 5.9          | -9.0  | 20.7 | 1.1          | -1.9 | 4.2  |
|                    | MICS   | 2014 | 45.8                 | 43.3 | 48.3  | 15.1                   | 6.7   | 23.4 | 1.4                    | 1.2 | 1.6 | 16.4         | 10.8  | 21.9 | 5.7          | 2.8  | 8.7  |
| Dominican Republic | DHS    | 2013 | 54.4                 | 48.3 | 60.3  | 14.8                   | -2.5  | 32.1 | 1.3                    | 0.9 | 1.8 | 11.4         | -1.5  | 24.2 | 3.3          | -2.3 | 8.9  |
|                    | DHS    | 2004 | 53.0                 | 48.2 | 57.8  | 23.8                   | 7.8   | 39.7 | 1.6                    | 1.1 | 2.1 | 32.1         | 24.4  | 39.8 | 9.6          | 4.5  | 14.7 |
| Ecuador            | DHS    | 1999 | 72.7                 | 69.4 | 75.7  | 25.4                   | 16.7  | 34.0 | 1.4                    | 1.2 | 1.6 | 29.6         | 24.3  | 35.0 | 6.6          | 4.3  | 8.9  |
|                    | MICS   | 2014 | 79.3                 | 76.0 | 82.2  | -7.3                   | -17.3 | 2.8  | 0.9                    | 0.8 | 1.0 | -10.6        | -17.9 | -3.3 | -2.2         | -4.4 | 0.0  |
| El Salvador        | DHS    | 2008 | 34.5                 | 32.0 | 37.1  | 6.4                    | -6.8  | 19.6 | 1.1                    | 0.9 | 1.3 | 0.6          | -7.0  | 8.2  | 0.2          | -2.3 | 2.7  |
|                    | DHS    | 2014 | 59.1                 | 56.5 | 61.6  | 10.6                   | 2.4   | 18.8 | 1.2                    | 1.0 | 1.4 | 18.5         | 11.7  | 25.4 | 5.0          | 2.6  | 7.4  |
| Guatemala          | DHS    | 2008 | 71.1                 | 68.5 | 73.7  | -11.2                  | -21.7 | -0.7 | 0.9                    | 0.7 | 1.0 | -11.3        | -18.5 | -4.0 | -2.5         | -4.7 | -0.4 |
|                    | MICS   | 2014 | 71.6                 | 66.1 | 76.5  | 5.9                    | -5.4  | 17.1 | 1.1                    | 0.9 | 1.2 | 0.7          | -11.4 | 12.8 | 0.1          | -2.9 | 3.2  |
| Guyana             | DHS    | 2009 | 63.4                 | 58.0 | 68.5  | -2.0                   | 18.0  | 14.0 | 1.0                    | 0.7 | 1.2 | 1.4          | -15.9 | 18.6 | 0.3          | -4.5 | 5.1  |
|                    | DHS    | 2016 | 41.8                 | 37.6 | 46.1  | 37.0                   | 24.7  | 49.4 | 2.2                    | 1.6 | 2.8 | 39.6         | 30.6  | 48.6 | 15.5         | 10.6 | 20.5 |
| Haiti              | DHS    | 2012 | 46.7                 | 43.9 | 49.5  | -0.3                   | -13.2 | 12.6 | 1.0                    | 0.7 | 1.3 | -1.0         | -10.7 | 8.6  | -0.4         | -4.9 | 4.1  |
|                    | DHS    | 2011 | 85.1                 | 82.7 | 87.1  | 0.6                    | -4.9  | 6.1  | 1.0                    | 0.9 | 1.1 | -1.7         | -7.0  | 3.7  | -0.3         | -1.7 | 1.0  |
| Honduras           | DHS    | 2005 | 75.6                 | 73.9 | 77.3  | -8.8                   | -17.0 | -0.6 | 0.9                    | 0.8 | 1.0 | -10.1        | -17.0 | -3.3 | -2.1         | -3.9 | -0.3 |
|                    | MICS   | 2011 | 89.7                 | 84.5 | 93.3  | -10.9                  | -24.1 | 2.3  | 0.9                    | 0.7 | 1.0 | -13.3        | -25.8 | -0.8 | -2.3         | -4.8 | 0.1  |
| Jamaica            | MICS   | 2015 | 51.7                 | 47.1 | 56.2  | 0.2                    | -17.9 | 18.3 | 1.0                    | 0.7 | 1.3 | -11.9        | -21.0 | -2.9 | -3.6         | -8.6 | 1.4  |
| Mexico             | DHS    | 2006 | 85.0                 | 82.2 | 87.5  | 10.6                   | 1.5   | 19.5 | 1.1                    | 1.0 | 1.3 | 15.3         | 9.0   | 21.5 | 2.8          | 1.0  | 4.6  |
| Nicaragua          | DHS    | 2001 | 72.0                 | 68.9 | 74.9  | 7.5                    | -3.7  | 18.7 | 1.1                    | 0.9 | 1.3 | 9.5          | 1.1   | 17.9 | 2.1          | -0.4 | 4.6  |
|                    | MICS   | 2013 | 57.1                 | 51.9 | 62.2  | 11.9                   | -6.6  | 30.5 | 1.2                    | 0.9 | 1.6 | 9.0          | 7.8   | 10.2 | 2.5          | -2.4 | 7.3  |
| Panama             | MICS   | 2016 | 61.1                 | 57   | 65.1  | 4.1                    | -8.2  | 16.4 | 1.1                    | 0.9 | 1.3 | 7.8          | -2.9  | 18.6 | 2.0          | -1.4 | 5.3  |
| Paraguay           | DHS    | 2008 | 71.5                 | 65.8 | 76.7  | 14.3                   | -5.8  | 34.4 | 1.2                    | 0.9 | 1.6 | 23.8         | 12.1  | 35.4 | 5.3          | 0.9  | 9.7  |
|                    | DHS    | 2016 | 73.1                 | 71.1 | 74.9  | 5.6                    | -1.4  | 12.6 | 1.1                    | 1.0 | 1.2 | 6.6          | 0.5   | 12.7 | 1.5          | -0.1 | 3.0  |
| Peru               | DHS    | 2015 | 69.9                 | 67.9 | 71.8  | 10.0                   | 3.3   | 16.7 | 1.2                    | 1.0 | 1.3 | 13.0         | 6.9   | 19.1 | 3.0          | 1.4  | 4.6  |
| Latest median      |        |      | 69.9                 | 66.1 | 72.55 | 5.6                    | -5.15 | 17.7 | 1.1                    | 0.9 | 1.3 | 6.3          | -1.35 | 12.3 | 1.5          | -1.3 | 3.5  |

Source: Prepared by the authors from the study data. MICS, Multiple Indicator Cluster Survey; DHS, Demographic and Health Survey; E, Median value; LCL, lower limit of the 95% confidence interval; UCL, upper limit of the 95% confidence interval; SII, slope index of inequality; RCI, relative concentration index.

**FIGURE 1. Absolute gaps in full immunization coverage observed between surveys, as reported in Table 1, among children 12–23 months of age from the poorest quintile compared to the richest, in 14 countries of LAC, 1992–2016.<sup>a</sup> Countries in the lower left corner show the best outcomes in decreasing immunization inequalities both in national averages and for the poorest socioeconomic groups.**



Source: Prepared by the authors from the study data.

<sup>a</sup> Gray boxes describe undesirable and desirable scenarios. Dark-gray circles indicate countries. Dashed lines indicate the median value.

## Immunization coverage differences between surveys

Analysis of coverage differences between surveys included data from 14 countries. Brazil, Jamaica, Mexico, and Panama were excluded because there was no second survey data available during the study period. In most countries (57%), the national coverage was higher in the year in which the most recent survey was conducted, compared to coverage from the previous survey, which varied widely (range: 41.4% [Haiti] to 89.6% [Costa Rica]). Six countries (Belize, Dominican Republic, Ecuador, Guatemala, Haiti, and Paraguay) showed negative values with a decrease in national coverage between surveys (Table 2). The average level of improvement in national coverage between countries was 4% (range: -19.7% [Ecuador] to 44.8% [El Salvador]). Analysis of differences between surveys showed that four countries achieved an increase in national coverage along with a faster improvement in quintile one compared to quintile five. Differences in the rate of change were significant

in Guyana, Honduras, and Nicaragua, where the full immunization rate in the richest quintile exceeded the poorest quintile by at least 0.6 percentage points per year. Belize, Dominican Republic, and Paraguay showed increases in the rate of change in the lower-income group, resulting in a faster improvement in the first quintile and surpassing the fifth quintile. Rate changes resulting in negative differences were important in Costa Rica, Ecuador, Guatemala, and Haiti, with reductions of at least 10 percentage points per year, resulting in a significantly reduced immunization coverage among children from the poorest households during the two periods studied (Figure 1).

## DISCUSSION

Our findings indicate that the countries in our study advanced toward full immunization coverage, obtaining an average coverage higher than the other WHO regions (65%) (23). However, despite these advances, there are significant socioeconomic disparities in coverage rates that vary widely between and within



countries. Our results show that although some countries have made great progress in reducing inequalities, in others these have increased, coinciding with other published studies (16, 22). Analysis of immunization differences between surveys showed different improvement patterns in the countries studied. In Bolivia, Colombia, El Salvador, and Peru there was an increase in equality in universal coverage, where children from the poorest households witnessed further progress in coverage and inequality was reduced, achieving a desirable scenario (22). We think that additional studies are needed to document the individual and community determinants leading to full immunization that could explain the differences in the context of each country. In general terms, many factors may have contributed to these results, including: public health and social security infrastructure, political commitment, the development of integrated health networks, and access to health services (23, 24).

To our knowledge, this is the first study that addresses the state of socioeconomic inequalities in full immunization focused exclusively on infants from LAC countries. The findings of this study have critical relevance for the region when analyzing changes and socioeconomic differences in the state of immunization. We hope that the results will contribute to the development of public health policies that guarantee universal coverage and equitable access to vaccines, particularly for the poorest children. Policies should be oriented to: (i) incorporate immunization monitoring in all socioeconomic subgroups; (ii) develop strategies for integrating health programs and health services; (iii) strengthen intersectoral alliances between key actors; (iv) prioritize vulnerable population groups; and (v) systematize successful experiences (1, 16).

To achieve universal vaccination, nations must begin to monitor immunization among the different economic subgroups within the population to plan and implement health strategies that guarantee all children have equitable access to vaccinations—especially the poorest children. Vaccinations reduce both poverty and direct and indirect health care costs by preventing diseases. Thus, they become a social protection measure that increases quality of life. Easier access to vaccinations should be adopted as a strategy to achieve economic development in countries within the LAC region.

## Limitations

The findings in this report are subject to some limitations. As a country-level study, we cannot make causal inferences at the individual level. Some countries do not conduct demographic surveys, or their periodicity is limited, and so our analysis did not cover all countries within the LAC region. Our study uses a secondary data source and its validity depends on the quality and reliability of the sources. The inequality measures used have their own limitation because they do not consider group sizes or changes in coverage in the intermediate quintiles. The analysis of differences over time used data from different surveys that could limit the comparability between periods.

## Conclusions

LAC countries experienced significant reductions over time in full immunization inequalities among different socioeconomic groups. While there appear to be decreases in the relative gap in immunization coverage in many countries, these decreases are still small. These disparities persist and, therefore, countries must make a special effort to improve conditions for the poorest children, considering the population's political, economic, and social characteristics that have individual and collective impacts.

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## Seguimiento de los cambios en las desigualdades con respecto a la cobertura de la inmunización completa en lactantes en América Latina y el Caribe

### RESUMEN

**Objetivo.** Comparar las desigualdades en cuanto a la cobertura de la inmunización completa en los lactantes en países de América Latina y el Caribe. en dos puntos diferentes en el tiempo: 1992 y el 2016.

**Métodos.** El análisis se basa en datos obtenidos recientemente a partir de las encuestas demográficas y de salud, las encuestas de grupos de indicadores múltiples y las encuestas de salud reproductiva realizadas en 18 países entre 1992 y el 2016. Los datos de la cobertura de la inmunización completa en lactantes (de 12 a 23 meses de edad) fueron desglosados por quintil de riqueza. Se midieron las desigualdades absolutas y relativas entre el quintil de ingresos más altos y el quintil de ingresos más bajos. Se midieron las diferencias en 14 países a partir de los datos disponibles para dos puntos en el tiempo. Se determinó la significación mediante intervalos de confianza del 95%.

**Resultados.** La mediana general de los niveles de cobertura de inmunización total fue de 69,9%. Aproximadamente un tercio de los países presentan una brecha de desigualdad con respecto al quintil de ingresos más altos, con una diferencia entre medianas de 5,6 puntos porcentuales en 8 de 18 países. En los últimos años, Bolivia, Colombia, Perú y El Salvador han logrado el mayor avance en cuanto a la mejora de la cobertura en términos de la población correspondiente al quintil de ingresos más bajos.

**Conclusiones.** En este estudio, la cobertura de inmunización completa en los países muestra brechas de desigualdad con respecto al quintil de ingresos más altos que no se evidencian con tan solo observar el nivel de cobertura a nivel nacional. Sin embargo, estas desigualdades parecen disminuir con el transcurso del tiempo. Debería considerarse la posibilidad de que las medidas de seguimiento de la cobertura de inmunización con base en las desigualdades de los ingresos sean incluidas en la evaluación de las políticas de salud pública. Esto permitiría reducir de manera apropiada las brechas en cuanto a la inmunización en los lactantes en el quintil de ingresos más bajos.

**Palabras clave** Inmunización; inequidad social; lactante; América Latina; región del Caribe.

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## Monitoramento do avanço das desigualdades na cobertura vacinal completa em lactentes na América Latina e no Caribe

### RESUMO

**Objetivo.** Comparar as desigualdades na cobertura vacinal completa infantil em dois momentos distintos entre 1992 e 2016 em países da América Latina e Caribe.

**Métodos.** A análise se baseou em dados recentes provenientes de Pesquisas Nacionais de Demografia e Saúde, Inquéritos por Conglomerados de Múltiplos Indicadores e Pesquisas de Saúde Reprodutiva realizados em 18 países entre 1992 e 2016. Os dados de cobertura vacinal completa em crianças entre 12 e 23 meses de idade foram desagregados por quintis de renda. Foi mensurada a desigualdade absoluta e relativa entre os quintis de maior e menor renda. A magnitude destas diferenças foi avaliada em 14 países com dados disponíveis nos dois momentos considerados. O nível de significância foi determinado com o uso de intervalos de confiança de 95%.

**Resultados.** A mediana global de cobertura vacinal completa foi de 69,9%. Cerca de um terço dos países apresenta alto nível de desigualdade de renda, com uma diferença mediana de 5,6 pontos percentuais em 8 dos 18 países. Bolívia, Colômbia, El Salvador e Peru obtiveram maior avanço nos últimos anos com o aumento do nível de cobertura na população nos quintis de menor renda destes países.

**Conclusões.** A análise da cobertura vacinal completa infantil nos países estudados indica altos níveis de desigualdade de renda que não são evidentes quando se observa somente a cobertura nacional. No entanto, estas diferenças parecem que vêm diminuindo. Deve-se considerar incluir ações de monitoramento da cobertura vacinal com base nas desigualdades de renda ao se avaliar as políticas de saúde pública a fim de reduzir apropriadamente a disparidade na cobertura vacinal de lactentes pertencentes ao quintil de menor renda.

**Palavras-chave** Imunização; iniquidade social; lactente; América Latina; região do Caribe.

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