Public Health in Practice 5 (2023) 100384

Contents lists available at ScienceDirect

Public Health in Practice

journal homepage: www.sciencedirect.com/journal/public-health-in-practice

Inequalities in COVID-19 vaccination coverage in Peru: An ecological study

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ARTICLE INFO

Keywords:
COVID-19
Vaccination
Socioeconomic inequalities
Peru

ABSTRACT

Objective: To assess the correlation between COVID-19 vaccination coverage and the Human Development Index (HDI) at the provincial level in Peru.
Study design: Ecological study.
Methods: We conducted a cross-sectional ecological study based on secondary data analysis. Coverages of the first, second, and third doses of the vaccine against COVID-19 and the HDI were evaluated. The magnitude of the correlations was assessed using Spearman's rank correlation coefficients with their corresponding bootstrapped 95% confidence intervals (95% CI). Scatter plots were also constructed.
Results: A total of 196 provinces were included. There was a moderate correlation between the first dose of the COVID-19 vaccine and the HDI ($r = 0.3807$ [95% CI 0.2585–0.5030], $p < 0.0001$). The same direction was found for the second ($r = 0.4064$ [95% CI 0.2853–0.5276], $p < 0.0001$) and third dose ($r = 0.4435$ [95% CI 0.3201–0.5669], $p < 0.0001$).
Conclusions: A positive correlation was found between COVID-19 vaccination coverage and the HDI, suggesting the presence of inequalities in access to vaccines. Individualised strategies are needed in lower HDI regions to tackle inequalities.

1. Introduction

The COVID-19 pandemic severely impacted all health systems worldwide and sparked a major economic downturn. However, the course of the pandemic radically shifted after the implementation of vaccines, saving billions of lives [1]. Although COVID-19 vaccine acceptance across low and middle-income countries is high, its access in some countries it still limited [2]. In this context, ensuring wide vaccination coverage is crucial.

The COVID-19 vaccination campaign encompasses four vaccines in Peru: Sinopharm, Pfizer/BioNTech, Moderna, and Oxford/AstraZeneca. The vaccines are distributed free of charge by the Ministry of Health (MINSA, for the Spanish acronym) in private and public settings. Initially, COVID-19 vaccination campaigns only targeted people over 18 years of age regardless of their nationality and were progressively approved for the vaccination of children [3].

Given the fragmentation and segmentation of the Peruvian health system and its vulnerability, achieving broad vaccination coverage against COVID-19 is key. Nevertheless, although COVID-19 vaccines are administered free of charge in Peru, there may be inequalities in access to them. Therefore, the objective of our study was to preliminarily assess the correlation between COVID-19 vaccination coverage and the Human Development Index (HDI) at the provincial level in Peru.

2. Methods

2.1. Setting and study design

We conducted an ecological study based on secondary data analysis of COVID-19 vaccination coverage and the HDI at the provincial level. Peru is an upper-middle-income country, administratively divided into 24 departments, 196 provinces, and 1845 districts.

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https://doi.org/10.1016/j.puhip.2023.100384
Received 25 January 2023; Received in revised form 18 March 2023; Accepted 29 March 2023
Available online 6 April 2023
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2.2. Variables

COVID-19 vaccination coverage was obtained from the Single National Repository of Health Information (REUNIS, for the Spanish acronym), constructed by the MINSA, which updates all-containing information daily [4]. Our data included the first, second, and third COVID-19 vaccination coverage in adults (individuals aged 12 years and over) downloaded on December 10th, 2022. At that time, the national coverage of the first, second and third dose reached 93.93%, 90.19% and 73.66% of the population, respectively.

The HDI is defined by the United Nations Development Programme as a composite measure of a country's average social and economic development. Statistically, it is formulated based on three dimensions: life expectancy at birth, gross national income per capita, and mean years of schooling and expected years of schooling. We collected this variable from the website of the Peruvian Institute of Economics (IPE, for the Spanish acronym). It is calculated annually at both provincial and district level and is publish publicly and free of charge [5].

2.3. Procedures and data analysis

The information about COVID-19 vaccination coverage at the provincial level was downloaded from REUNIS [4] and the provincial HDI of 2019 was downloaded from the IPE [5]. The databases were merged in a Microsoft Excel sheet and were then imported into RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA (URL http://www.rstudio.com/) for further analysis. The normality assumption was tested with the Shapiro Wilk test and histograms, which showed a non-normal distribution. Thus, the magnitude of the correlation was calculated using Spearman's rank correlation coefficient. A bootstrap analysis with 1000 replications was performed to estimate the corresponding 95% confidence intervals (95% CI). Scatter plots were also constructed.

3. Results

A total of 196 provinces were included. COVID-19 vaccination coverage among the different provinces ranged from 42.68% to 100% for the first dose, from 32.6% to 98.93% for the second dose, and from 15.85% to 88.94% for the third dose.

There was a moderate correlation between the first dose of the COVID-19 vaccine and HDI ($r = 0.3807$ [95% CI 0.2585–0.5030], $p < 0.0001$). The same direction was found for the second ($r = 0.4064$ [95% CI 0.2853–0.5276], $p < 0.0001$) and third dose ($r = 0.4435$ [95% CI 0.3201–0.5669], $p < 0.0001$) (Fig. 1 and Supplementary 1).

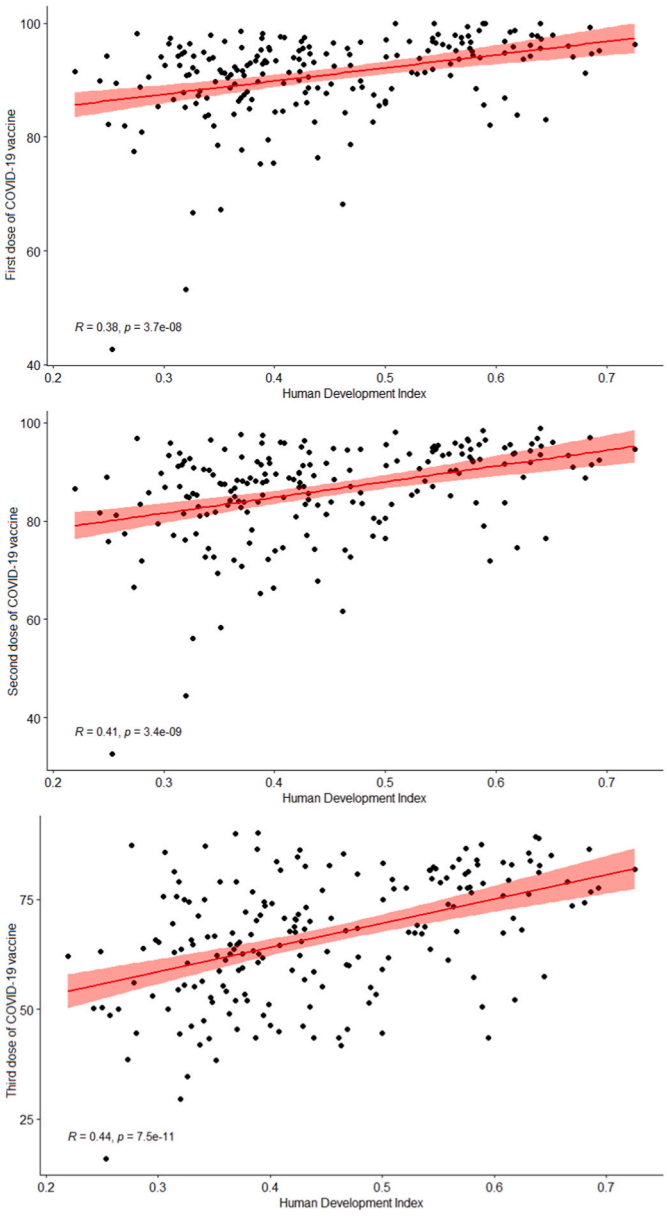


Fig. 1. COVID-19 vaccination coverage (first, second, and third dose) and Human Development Index at the provincial level.

4. Discussion

The present ecological study preliminarily evaluated the correlation between the first, second, and third dose vaccination coverage against COVID-19 and the HDI at the provincial level. We found that COVID-19 vaccination coverage increased as the HDI increased, suggesting the presence of inequalities in access to vaccines, despite being administered free of charge. Even though this correlation may be affected by the effect of multiple confounders that have not been considered, several studies have described the presence of inequalities in vaccination [6–8], thus, in-depth analysis of this topic is urgently needed in Peru.

Inequality in vaccination coverage is a well-known phenomenon worldwide [6–8]. In relation to child immunization, several factors associated with adherence to the immunization schedule have been identified, including the low socio-economic and educational level of mothers [9], which are two indirect components of the HDI. Although the reasons for this association vary by country, some social determinants, which worsened during the pandemic, may influence vaccination coverage [9,10]. Therefore, it is not surprising that, as in the case of child vaccination [6,9], there might be inequalities related to COVID-19 vaccination coverage.

COVID-19 vaccination coverage varies between countries according to the HDI, with a higher HDI implying higher vaccination coverage. European countries have higher HDI scores and more adequate health resources, African countries have lower HDI values and fewer health resources, and Asian and South American countries have medium HDI and intermediate vaccination levels [7]. In Peru, there are significant variations in the HDI, and thus, vaccination coverage may vary among regions.

COVID-19 vaccination coverage and HDI are positively correlated, but our study did not assess the reasons for this association. However, one reason may be related to the intention to vaccinate against COVID-19 [11] and the possibility of having received a booster dose [12]. Having a lower educational level and living in a rural area were found to be associated with having received a booster dose in Peru [12]. These factors are relevant in explaining this correlation, as cities with these characteristics have lower HDI values. In addition, numerous cities with lower HDI are located in hard-to-reach areas were vaccination

campaigns may be delayed, thereby indicating inequalities in access to vaccines.

4.1. Limitations of this study

Our study has some limitations. Taking into account the ecological study design, the association found is not necessarily present at the individual level. Also, only correlation can be inferred, but not causality. Furthermore, although the HDI was calculated in 2019 and the COVID-19 vaccination campaign started in 2021, it was the most updated database. Moreover, since the fourth dose and bivalent booster of COVID-19 vaccine is currently being administered and, therefore, their coverages are still low, they have not been evaluated. Finally, our results were significant in the period in which the variables were collected.

In conclusion, COVID-19 vaccination coverage for the first, second and third doses was higher in high HDI regions. This finding highlights the need for individualised strategies in lower HDI regions to address inequalities in COVID-19 vaccination coverage.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

Ethical approval was not required as this study was based on secondary data analysis of publicly available databases.

Data availability statement

The data that supports the findings of this study are openly available on the webpages of the REUNIS [4] and IPE [5]. The merged database is available upon request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhip.2023.100384.

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