Efficacy of the CoronaVac® Vaccine in a Region of the Colombian Amazon, Was Herd Immunity Achieved?

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Short report

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Abstract

Introduction. Currently, more than 1.8 billion doses of SARS-CoV-2 vaccines have been applied worldwide. However, some developing countries are still a long way from achieving herd immunity through vaccination. In some territories, such as the Colombian Amazon, mass immunization strategies have been implemented with the CoronaVac® vaccine. Due to its proximity to Brazil, where one of the variants of interest of SARS-CoV-2 circulates.

Objective. To determine the efficacy of the CoronaVac® vaccine in a population of the Colombian Amazon.

Methods. Between February 24, 2021, and May 19, 2021, a descriptive observational study was carried out in which a population of individuals over 18 years of age immunized with two doses of the CoronaVac® vaccine was evaluated. The study site was in the municipality of Mitú, Vaupés, in southeastern Colombia, a region located in the Amazon bordering Brazil. Results. 87% of the urban population of the Mitú municipality were vaccinated with CoronaVac®. To date, 2.1% of vaccinated individuals have become ill, and only 0.1% of these require hospitalization. No deaths attributable to COVID-19 have been reported among vaccinated individuals, and the vaccine has shown 97% efficacy against mild disease and 100% against severe infection.

Conclusions. The herd immunity achieved through mass vaccination in this population has made it possible to reduce the rate of complicated cases and mortality from COVID-19 in this region of the Colombian Amazon.

Highlights

- CoronaVac® has shown 97% efficacy against mild disease and 100% against severe infection in this indigen population.
- CoronaVac® reduces the mortality rate from 2.2% in 2020 to 0% in 2021.
- The herd immunity was achieved through mass vaccination in this region of the Colombian Amazon.

Introduction

Currently, around 168 million cases and more than three million deaths from Coronavirus disease 2019 (COVID-19) have been reported, and more than 1.8 billion doses of vaccines against SARS-CoV-2 have been applied worldwide (https: // coronavirus. jhu.edu/map.html). However, in developing countries such as Colombia, only 6% of its population has been immunized, so herd immunity is still far from being achieved. (https://ourworldindata.org/covid-vaccinations). Due to proximity to countries such as Brazil, where the appearance of the P.1 variant has endangered the health system of this country (1), Colombian Amazon was prioritized with the vaccination's program

Due to storage and transportation facilities, the CoronaVac® vaccine (Sinovac, China) was chosen for mass immunization in tropical regions of Colombia, such as the Amazon. This vaccine platform consists of a chemically inactivated SARS-CoV-2 virus and has proven to be safe, effective, and immunogenic against this new virus, and around 100 million doses of this vaccine have been applied worldwide (2). As of May 23, 2021, Colombia has received 13,299,364 vaccines against COVID-19; 7,500,000 (56%) from Sinovac, 4,642,560 (35%) from Pfizer-Biotech, and 1,156,800 (9%) from AstraZeneca, and it is essential to note that of the total number of vaccines applied in this country to date, 36.2 % corresponds to CoronaVac® (3).

This work aimed was to determine the efficacy of the CoronaVac® vaccine in a population of the Colombian Amazon.

Methods

A descriptive observational study was carried out in which a population of individuals older than 18 years immunized with two doses of the CoronaVac® vaccine (Sinovac, China) was evaluated. The study period was between February 24, 2021, to May 19, 2021. The work was developed in the municipality of Mitú, Vaupés, Colombia, a region located in the southeast of Colombia (Amazonas) bordering Brazil (Figure 1). Mitú is the capital of Vaupés and has 7,856 inhabitants, immunized with two doses with an interval of 20 days with the CoronaVac® vaccine that uses SARS-CoV-2 chemically inactivated with beta-Propiolactone (4,5). Sociodemographic and clinical characteristics data of patients were obtained.

Ethical aspects. The research was carried out following the international ethical standards given by the World Health Organization (WHO) and the Pan American Health Organization, supported by the Declaration of Helsinki and the Ministry of Health of Colombia resolution number 008430 of 1993 and endorsed by the Committee of Ethics of the Institute of Biological Research of the Tropic, University of Córdoba.

Analysis of data. The data were analyzed using the statistical package for the Social Sciences version 27 (SPSS), and univariate analysis was performed. For qualitative variables, it was performed through the calculation of absolute and relative frequencies. The measures of central tendency were calculated as quantitative variables.

Results

Characteristics of the evaluated population. 61.3% of the population of the municipality of Mitu is predominantly indigenous. 87% (6,829 people) completed their vaccination schedule with two doses of CoronaVac®. 45.3% of those vaccinated were women and 54.7% men, the median age was 38.4 years and 87.3% were under 60 years of age, seven (0.1%) women were pregnant and voluntarily vaccinated (Table 1).

Incidence of SARS-CoV-2 infections after vaccination. Until May 26, 2021, 145 cases have been presented, corresponding to 2.1% of vaccinated individuals (Table 2). Regarding the severity of the infection, the age range, under 60 years there were 128 infections, of these 126 (2.2%) were mild infections and 2 (0.04%) with moderate severity, and in those over 60 years, there were only 17 (1.5%) mild infections (Table 3).

In April 2021 in Mitu, a new peak of SARS-CoV-2 was observed with 156 cases. This increase is much lower than the August 2020 peak, where 327 were reported (Figure 2). When comparing the fatality rate, it was 2.2% before vaccination and 0% in the immunized population (Table 4).

Vaccination efficacy in the different forms of the severity of COVID-19. Regarding the efficacy of the vaccine, it was observed that it was 97.9% to prevent mild forms and 99.7% for the case of moderate forms. The vaccine was 100% effective in preventing severe and or critical cases, and to date, no cases of death attributed to SARS-CoV-2 have been reported among the vaccinated group (Table 4).

Discussion

The vaccine demonstrated a significant of 97% efficacy for preventing SARS-CoV-2 infections in different stages of severity. With this efficacy, herd immunity may have been achieved through mass vaccination in this population. The vaccine's efficacy in a predominantly indigenous population is similar in size to the phase III studies conducted in Turkey and Brazil, in which between 7,000 and 13,000 participants were evaluated (6).

SARS-CoV-2 infections among those vaccinated were mild, and their management was ambulatory. In addition, it has been seen that vaccination with the immunogen from the pharmaceutical company Sinovac has prevented the appearance of complicated infections and fatal outcomes (7). These findings are consistent with those reported by phase III studies carried out in Brazil, where it was shown that this vaccine reduces the risk of hospitalization and death between 84% to 100% of individuals vaccinated with CoronaVac® (7). However, our results in the older than 60 years show differences with what was published in Brazilian older adults by Ranzani et al (8), they found a protection of 49.4%. The vaccine's reduction could be explained because 83% of their cases were infected with the P.1 variant of SARS- CoV-2.

Furthermore, it is essential to analyze the course of infection over time and the impact of vaccination against SARS-CoV-2. In April 2021, the third wave of COVID-19 cases began in Colombia. However, the incidence was much lower than observed in the first peak of the pandemic between April and June 2020. The new cases presented in 2021 in the vaccinated population could be due to the Brazilian variant P.1 of SARS-CoV-2 (9). However, the morbidity and mortality of this new variant seem to be controlled with the CoronaVac® vaccine.

Regarding the efficacy of this vaccine, it was observed that it was 97% against mild disease and 100% against severe infection in this population. Our findings are similar to Turkey's phase III study for CoronaVac®, in which an efficacy of 91% was observed. In contrast to studies in Brazil and Chile, which reported low overall efficacy of 50.38% and 65%, respectively. However, it is essential to highlight that in the Chilean population, this vaccine reduced the proportion of hospitalization in intensive care unit (ICU) (90%) and mortality from SARS-CoV-2 (86%) (10,11). The epidemiological moments of vaccination must also be taken into account. For example, Chile began vaccination with a low viral transmission different from the epidemiological scenario studied in Brazil. When the transmission is lower, there is less chance that vaccination will fail (12).

So far, SARS-CoV-2 is a virus that is efficiently transmitted and quickly infects the unvaccinated population. Due to the lack of genotypic information for the Mitú municipality, we do not know if the P1 variant (Brazil) managed to spread or if the action of the vaccine contained it. On the other hand, another of the limitations of this work could be in a possible under-registration of the mild infections registered in this vaccine population, since it was not possible due to the type of study that was proposed to carry out a strict follow-up by RT- qPCR to this population cluster.

Finally, we can infer that to date; herd immunity has been achieved through mass vaccination in this population, which has impacted the reduction of complicated cases and the mortality rate from COVID-19. However, pediatric populations remain unvaccinated, which could cause few breakthrough infections with an increase in the number of cases at a given epidemiological moment. It is essential to continue long-term surveillance to measure the effect of vaccination in this population. It is unknown if the vaccine's immunity will be maintained over time and if a booster of this immunogen is needed in the short or medium term. There is still a long work to be done on this critical research topic that will be key to controlling and mitigating the pandemic caused by SARS-CoV-2.

List Of Abbreviations

COVID-19, Coronavirus Disease 2019; WHO, World Health Organization; ICU, Intensive Care Unit.

Declarations

Ethical approbation. The research was carried out following the international ethical standards given by the WHO and the Pan American Health Organization, supported by the Declaration of Helsinki, and national legislation, resolution number 008430 of 1993 of the Ministry of Health of Colombia that regulates the studies in health. Furthermore, this work was endorsed by the ethics committee of the Tropic Biological Research Institute.

Consent for publication. Not applicable.

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Tables

Table 1. Characteristic of the individuals vaccinated with two doses in Mitu municipality.

Characteristic of the individuals vaccinated (%)	
Sex	
Female	3096 (45.3)
Male	3733 (54.7)
Median age in years (range)	38.4 (18-95)
Individuals < 60 years	5719 (83.7)
Individuals > 60 years	1110 (16.3)
Ethnicity	
Indigenous	4189 (61.3)
Afro-Colombian	128 (1.9)
Other	2512 (36.8)
Pregnant women vaccinated	
Yes	7 (0.1)
Total of people with two doses	6829 (87)

Table 2. Characterization of the SARS-CoV-2 infected individuals post-vaccinated.

Characteristic of the individuals infected (%)	
Female	85 (58.6)
Male	60 (41.4)
Test used for SARS-CoV-2 diagnostic	
Antigen	67 (46.2)
RT-qPCR	78 (53.8)
Severity of COVID-19	
Mild	143 (2.1)
Moderate	2 (0.03)
Severe	0
Critic	0
Type of treatment	
Ambulatory care	143 (98.6)
Hospitalized	2 (1.4)
Total of people infected with COVID-19	145 (2.12)

Table 3. Severity of COVID-19 in population vaccinated according to age range < 60 years vs > 60 years.

Severity of COVID-19 according to age range (%)	
< 60 years	
Mild	126 (2.2)
Moderate	2 (0.04)
Severe	0
Critic	0
> 60 years	
Mild	17 (1.5)
Moderate	0
Severe	0
Critic	0

Table 4. Efficacy of the Coronavac vaccine.

Effectiveness of CoronaVac	
Prevent mild forms	97.9%
Prevent moderate forms	99.7%
Prevent severe or critic forms	100%
Prevent deaths	100%
Mortality rate pre-vaccination*	2.2%
Mortality rate post-vaccination	0%

*Data obtained from DANE Colombia. (https://www.dane.gov.co/files/investigaciones/poblacion/defunciones-covid19/boletin-defunciones-covid-2020-02mar-2021-17ene.pdf)

Figures

Figure 1

The geographic location of the municipality of Mitu. This figure showed that Mitu is located in the southeast of Colombia on the border with Brazil. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

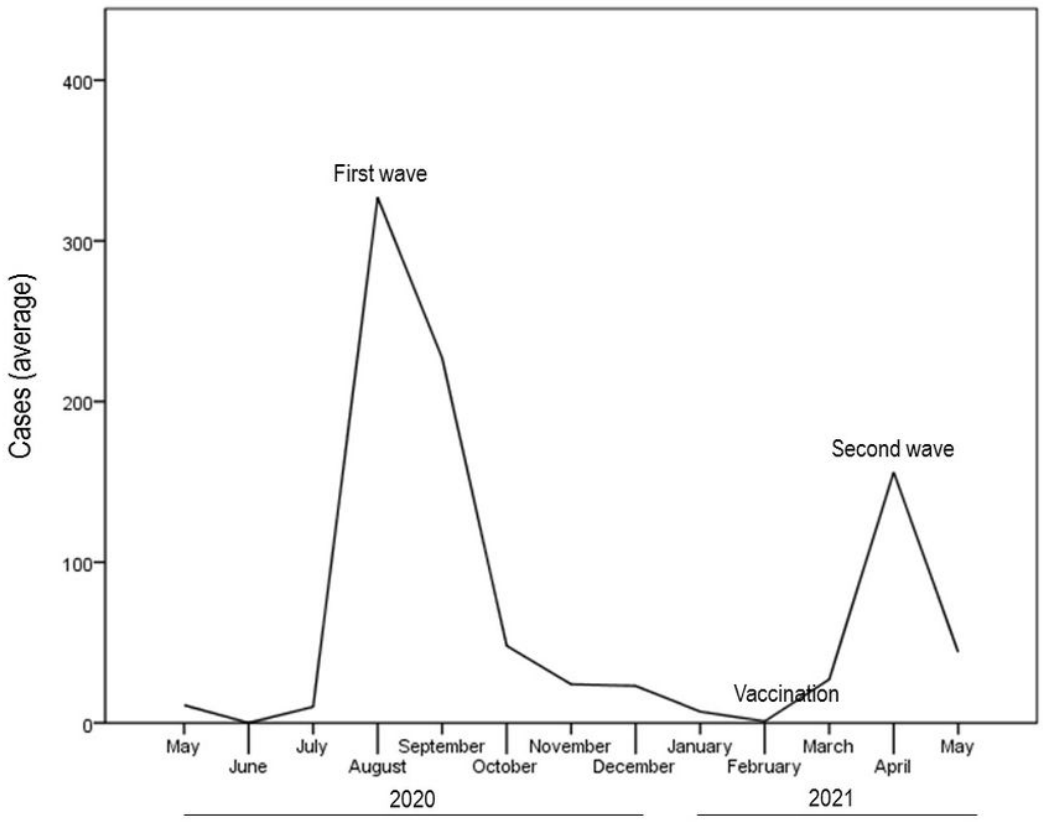

Figure 2

Characterization of COVID-19 cases in Mitu municipality. This figure showed a first peak or wave of cases of COVID-19 in August 2020, with a significant drop of cases in November 2020. The vaccination in this municipality started in February 2021 and in April was showed a second wave of cases lower than the wave of 2020.