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High Vaccine Hesitancy during the COVID-19 Emergency Campaign on the Tourist Island of Marajó, Amazon Region of Brazil

Leonardo Miranda dos Santos[1,4,*], Letícia Vitória Carvalho Oliveira[1], Érica dos Santos Martins[1], Klicia de Fatima Souza de Azevedo[2], Geraldo Mariano Moraes Macedo[3], Ana Claudia Caldeira Tavares Martins[1], Karla Valéria Batista Lima[1], Christian de Mello Vieira[1], Rogério Valois Laurentino[4] and Luiz Fernando Almeida Machado[4]

[1]Department of Natural Sciences, Center for Social Sciences and Education – State University of Pará, Belém 66050-540, PA, Brazil

[2]Department of Pharmacy, Institute of Biological Sciences – Federal University of Pará, Belém 66075-110 PA, Brazil

[3]Tropical Dermatology Outpatient Clinic, Tropical Medicine Center – Federal University of Pará, Belém 66055-240, PA, Brazil

[4]Laboratory of Virology, Institute of Biological Sciences, Federal University of Pará, Belém 66075-110, PA, Brazil

[*]Corresponding Author: Leonardo Miranda dos Santos, Department of Natural Sciences, Center for Social Sciences and Education – State University of Pará, Belém 66050-540, PA, Brazil, E-mail: leonn_bio20@yahoo.com.br

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Abstract

Introduction: Coronavirus Disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a respiratory infection that can progress to severe conditions and death. Objective: To verify the profile of anti-COVID- 19 vaccine hesitancy in a municipality on the tourist island of the Marajó Archipelago, in the Amazon region of Brazil.

Methodology: This is a cross-sectional study, carried out between January 2021 and August 2022. SINAN and the Municipal Health Department of Salvaterra were consulted to obtain data on COVID-19 Vaccination Coverage. Statistical analysis was performed using bioestat 5.0 software. To verify the odds ratio of not completing the vaccination schedule, the estimate of the proportion parameter and the Odds Ratio test were performed. A 95% Confidence Interval was considered for a p-value less than/equal to 0.05. This study did not require an ethics committee review because it used secondary data.

Results: A high rate of general vaccine hesitancy was observed (59.3%). Only 8,151 people [40.7% (95% CI: 40%-41.4%)] completed the vaccination schedule.

Conclusion: More than half of the referenced population did not complete the emergency vaccination schedule against COVID-19, revealing low vaccination adherence in the population. Further studies are needed to evaluate vaccination adherence and inhibit anti-vaccine attitudes in the Brazilian Amazon.

Keywords: Amazon; SARS-CoV-2; Vaccination; COVID-19; Tourism

Introduction

Coronavirus Disease 2019 (COVID-19) is a respiratory infection caused by the novel coronavirus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) that was first identified on December 31, 2019 in the city of Wuhan (Hubei Province), China and with rapid spread, it was declared a pandemic on March 11, 2020 by the World Health Organization (WHO) and as of the date of writing this article, COVID-19 data reveal 695,781,740 cases and 6,919,573 deaths worldwide and 38,973,832 cases and 713,860 deaths in Brazil [1-5]. Research centers around the world have been working hard to produce an effective vaccine in the shortest possible time, so by December 2020, more than 10 billion doses of vaccines had been ordered by several countries, with around half of the doses being purchased by rich countries. The rapid development of the vaccine was implemented under Emergency Use Authorization and prioritized high-risk populations, including frontline health care workers, the elderly, and people with comorbidities, and was later extended to other population strata [6]. In Brazil, vaccination against COVID-19 began on January 17, 2021. Initially, the emergency use vaccines against COVID-19 were Astrazeneca (ChAdOx1) [7] and Pfizer (BNT162b2) [8], Janssen (Ad26.COV2.S) [9] and CoronaVac [10]. However, despite the rapid development of COVID-19 vaccines, information about the importance of getting vaccinated was not readily available. Brazil's Unified Health System (SUS) established emergency vaccination campaigns against COVID-19 in a decentralized manner throughout the country during 2021-2022 [11-15]. The Strategic Advisory Group of Experts (SAGE), a working group of the World Health Organization (WHO), defined vaccine hesitancy as "the delay in acceptance or refusal of vaccines despite the availability of vaccination services" and has shown itself to be another major obstacle in the fight against the COVID-19 pandemic [16,17]. In Brazil, as in many countries, the factors that influenced vaccine hesitancy were political-partisan disputes over the use of the vaccine, the limited availability of vaccines at the beginning of the vaccination campaign and false information that questioned vaccine safety [18]. The northern region of the country has been severely impacted, with more than 2.9 million confirmed cases, more than 51,000 deaths and a mortality rate of over 282.7 per 100,000 inhabitants [2]. The northern state of Pará has also seen a significant burden, surpassing 901,181 confirmed cases and more than 19,291 deaths. The incidence rate in Pará is over 10,200 per 100,000 population, and the mortality rate exceeds 214 per 100,000 population [19]. In tourist cities, such as the Marajó Island region, a region in the North of the Brazilian Amazon, national and international tourism is provided by its culture, art and natural beauty and the epidemiological profile becomes more complex when local populations are immunologically vulnerable to COVID-19, and there may be a socioeconomic impact that can last for long periods [20, 21]. In remote areas of the Amazon, such as the city of Salvaterra, the lack of information has a far-reaching impact on society, as a large part of the population, despite readily accepting the vaccine, lacks reliable means of information. Furthermore, in this region, public education and health education systems are deficient, which encourages the spread of fake news. In these cases, the safety generated by broad vaccination coverage for both tourists and the local community is essential. The objective of this study was to verify the profile of vaccine hesitancy during the emergency vaccination campaign against COVID-19 in a city on the tourist island of Marajó, in the Amazon region of Brazil.

Materials and Methods

Type and population of study

This is a cross-sectional, analytical study that analyzed the vaccine hesitancy profile in the target population from January 28, 2021 to August 16, 2022 in the city of Salvaterra, a Brazilian municipality on Marajó Island, State of Pará, Amazon region of Brazil. The Marajó Island archipelago, located in the north of the Brazilian Amazon, has sixteen municipalities called the Marajó mesoregions. According to the Brazilian Institute of Geography and Statistics (IBGE) [22], Salvaterra has a territorial area of 918,563 km2, and in 2021 it had an estimated population of 24,392 people who live basically from agriculture and fishing (figure 1).

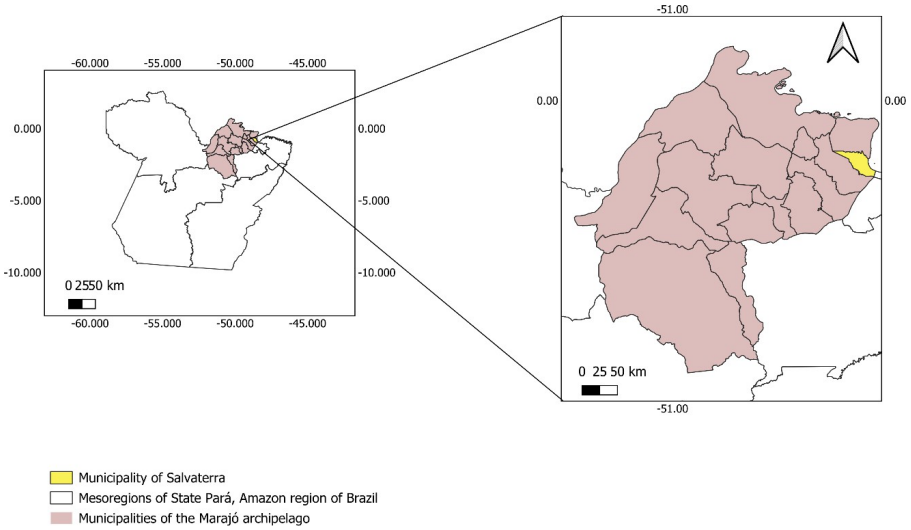


Figure 1: Location map of the municipality of Salvaterra, in the Marajó Island Archipelago, in the State of Pará, in the Brazilian Amazon. Map produced by QGIS software version 3.32.0.

It has a municipal human development index of 0.608 (2010) [22]. In addition to having 8 quilombola communities. According to the National Registry of Health Establishments (CNES), there are 16 registered establishments in the municipality, with health posts and family health units in the center and in the rural area [20]. A Vaccination Coverage Report (COVID-19) provided by the Municipal Health Department of Salvaterra (SEMUSA) was used. Searches were carried out in the Notifiable Diseases System (SINAN), of the Informatics Department of the Unified Health System (DATASUS), of the Brazilian Ministry of Health.

Study Variables and Eligibility Criteria

The variables of this study were children aged 5 to 11 years, adolescents aged 12 to 17 years, young people and adults aged 18 to 59 years, elderly people over 60 years and people with some comorbidity considered a risk for the development of severe COVID-19. Those who completed the third annual booster dose (age groups 12 to 17 years, 18 to 49 years, over 60 years and people with comorbidities) were considered to have completed the vaccination schedule. For pediatric doses, those who completed the two annual doses were considered to have completed the vaccination schedule [21]. It was considered D1 (first dose), D2 (second dose), DR (third booster dose). The inclusion criteria were all population groups that were prioritized in the emergency COVID-19 vaccination campaign in the municipality of Salvaterra, located in the Marajó archipelago, in the Amazon region of Brazil. These data are available on the official websites of the Brazilian Ministry of Health SINAN/DATASUS and were provided by the health team of the Municipal Health Department of Salvaterra (SEMUSA). The exclusion criteria were incomplete and/or lost data and COVID-19 death rates during the period of this emergency vaccination campaign.

Ethical Aspects

This work did not require the approval of a Research Ethics Committee, as it uses secondary data available on public domain websites such as the SINAN and SEMUSA websites in Salvaterra.

Statistical Analysis

Data were tabulated using Excel (Microsoft). Bioestat 5.0 was used for statistical analysis. The proportion parameter estimation test was used to estimate population parameters. The odds ratio test was used to verify the odds ratio of the population not completing the vaccination schedule (vaccine hesitant). A 95% Confidence Interval was considered for a p-value less than/equal to

0.05.

Results

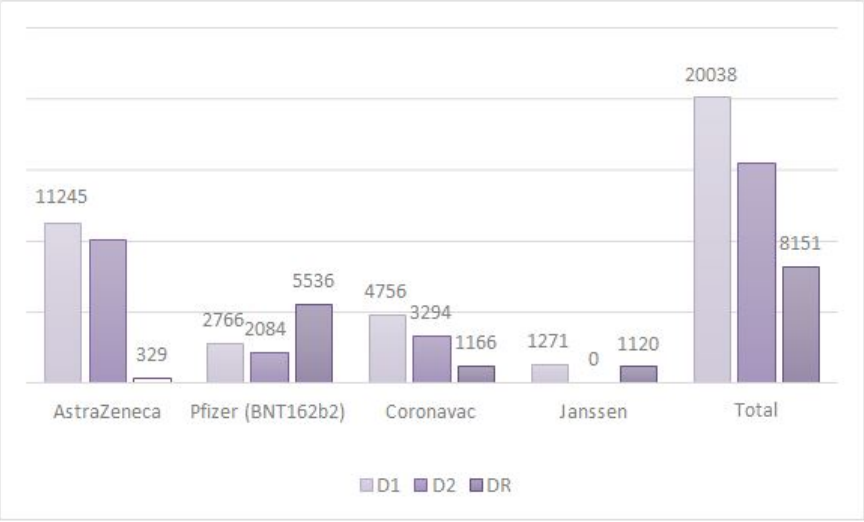
10823441320334A total of 21,965 individuals were estimated to complete all stages of the vaccination schedule in the emergency plan against COVID-19. Four types of vaccines divided into D1, D2 and DR doses were made available for Astrazeneca (ChAdOx1), Pfizer (BNT162b2), Coronavac (CoronaVac) and Janssen (Ad26.COV2.S) with D1 and DR, totaling 43,945 doses applied (Tables 1).

Table 1: Types of vaccine used in the emergency vaccination campaign against COVID-19 in the municipality of Salvaterra, on the tourist island of the Marajó Archipelago, in the Amazon region of Brazil between 2021-2022.

VACCINE	APPLIED DOSES N (%)*
Astrazeneca (ChAdOx1)	21.659 (49,3)
Pfizer (BNT162b2)	10.451 (23,8)
Coronavac (CoronaVac)	9.444 (21,5)
Janssen (Ad26.COV2.S)	2.391 (5,4)
Total	43.945†

*Data SEMUSA . † Relative value of the total number of vaccination phases D1: first dose, D2: second dose, DR: booster dose.

A total of 20,038 people received D1 and the single dose of Janssen (Ad26.COV2.S), 15,463 people received D2. Only 8,151 people completed the vaccination schedule with DR [40.7% (95% CI: 40%-41.4%)] revealing a prevalence of vaccine hesitancy of 59.3% (Figure 1).



Graphic 1: Dosing schedule for emergency vaccination against COVID-19 in the general population in the municipality of Salvaterra, on the tourist island of the Marajó Archipelago, Amazon region of Brazil between 2021-2022.

Adapted data SEMUSA Salvaterra. D1: first dose; D2: second dose; DR: booster dose. Frequency of vaccine hesitant people 77,2% (20.038 /15.463), with parameter estimation of the proportion of 40.7% (IC:95%: 40%-41,4%).

Of an estimated population of 2,862 children aged 5 to 11 years, 67.4% (1,936/2,862) started the vaccination schedule and only

53.4% (1,034/1,936) (OR: 1.8238; [95% CI]: 1.6196-2.0538; p< 0.0001) completed this schedule.

In adolescents aged 12 to 17 years, the estimated population was 2,900; however, 83.5% (2,423/2,900) started the vaccination schedule and only 14.6% (355/2,423) (OR: 29.5908; [95% CI]: 25.4845-34.3588; p < 0.0001) completed this schedule.Of the estimated population of 13,260 young people and adults aged 18 to 59 years, 91.1% (12,076/13,260) started the vaccination schedule and only 50.1% (6,053/12,076) (OR: 12.1354; [95% CI]: 11.3288-12.9994; p< 0.0001) completed this schedule.

The estimated population of elderly people over 60 years of age was 2,390, with 95.2% (2,276/2,390) starting the vaccination schedule, only 83.8% (1,906/2,276) (OR: 5.0698; [95%CI]: 4.0975-6.2728; p < 0.0001) completing this schedule.

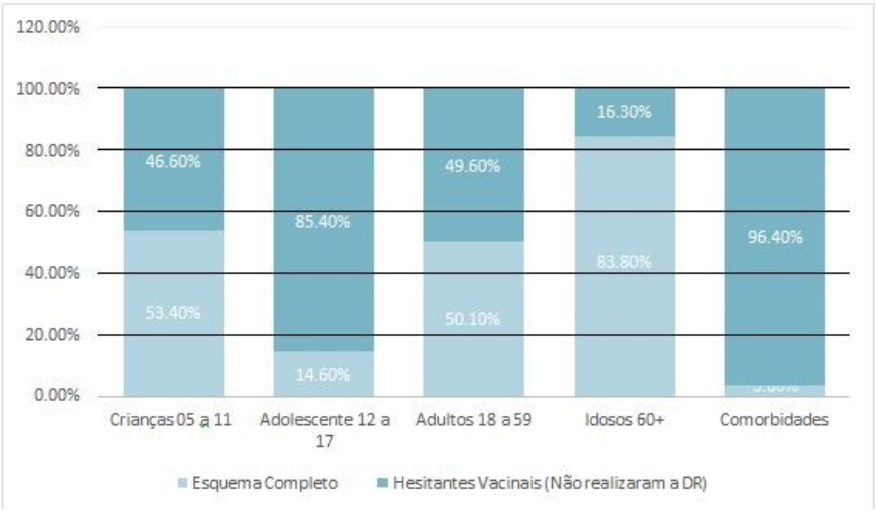
Finally, of an estimated population of 553 people with some type of comorbidity, although 45.3% (251/553) started the vaccination schedule, only 3.6% (9/251) (OR: 22.3481; [95% CI]: 11.2530-44.3826; p < 0.0001) completed this schedule. (Table 2).

Table 2: COVID-19 vaccination adherence profile in the municipality of Salvaterra, on the tourist island of the Marajó Archipelago, Amazon region of Brazil between 2021-2022

Variables	Estimated total population †		Start of vaccination schedule (D1)		Complete vaccination schedule (D2/DR)		Odds Ratio ‼	IC (95%) ‼	p-valor δ
			N	(%)+	N	(%)++			
5-11*	2.862	Yes	1936	67,4	1034	53,4	1.8238	1.6196-2.0538	<0,0001
		No	926	32,6	902	46,6			
12-17*	2.900	Yes	2.423	83,5	355	14,6	29.5908	25.4845-34.3588	<0,0001
		No	477	16,5	2.068	85,4			
18-59*	13.260	Yes	12.076	91,1	6.053	50,1	12.1354	11.3288-12.9994	<0,0001
		No	1.184	8,9	7.207	49,9			
		Yes	2.276	95,2	1.906	83,8			
> 60*	2.390	No	114	4,8	484	16,3	5.0698	4.0975-6.2728	<0,0001
Comorbidities	553	Yes	251	45,3	9	3,6	22.3481	11.2530-44.3826	<0,0001
		No	302	54,7	242	96,4			

*Age range in years . †Dados SEMUSA de Salvaterra. D1:first dose. D2: second dose. DR: booster Dose. ⁺ Frequency relative to the estimated total population. ⁺⁺ Relative frequency of the population that started the vaccination scheduleIC95%: 95% Confidence Interval . $^{\delta}$Statistically *significant p-value*.

There was a high rate of people who did not complete the recommended dose schedule for immunization against COVID-19 (vaccine hesitancy) (Graph 1). In children aged 5 to 11 years, the frequency of vaccine hesitancy was 46.6% (902/1936). In adolescents aged 12 to 17 years, the frequency of vaccine hesitancy was 85.4% (2,068/2,423). In young people and adults aged 18 to 59 years, the frequency of vaccine hesitancy was 49.9% (7,207/12,076). In elderly people over 60 years of age, the frequency of vaccine hesitancy was 16.3% (484/2,276). In people with some type of comorbidity, the frequency of vaccine hesitancy was 96.4% (242/251).



Graphic 2: Comparison between vaccination groups that did not complete the emergency vaccination schedule against COVID-19 in the municipality of Salvaterra, on the tourist island of the Marajó Archipelago, Amazon region of Brazil between 2021-2022.

Source: Adapted from SEMUSA of Salvaterra.

Discussion

In this study, we found a high frequency of vaccine hesitancy during the emergency vaccination campaign against COVID-19 in a municipality on the tourist island of the Marajó Archipelago, in the Amazon region of Brazil, where more than half (59.3%) of the target population did not complete the vaccination schedule, which is an important public health problem, as in the short and long term, it reveals a scenario of high vulnerability to severe cases and death from COVID-19 among residents and visitors to this region of the Marajó Archipelago. Although poor countries have been "at the back of the queue" in vaccine distribution and purchasing schemes during the COVID-19 pandemic, vaccine acceptance rates are higher in developing countries than in developed countries [23]. The Marajó Island archipelago, located in the North of the Brazilian Amazon, has sixteen municipalities that, despite being a place of intense national and international tourism due to its strong culture, art and natural beauty, is a region marked by high socioeconomic vulnerability and a low Human Development Index) [22]. Therefore, in this pilot study, we initially chose only one municipality to understand the low vaccination profile for COVID-19 and subsequently look for its possible contributing factors. In addition, we believe that low vaccination rates are also present in other municipalities, mainly because they share demographic, socioeconomic and logistical similarities [22]. In these cases, the flow of people is intense and the epidemiological profile of COVID-19 is more complex, mainly due to it being a small immunologically vulnerable population that maintains contact with varied populations. In these cases, the emergence and introduction of new variants of SARS-CoV-2 are facilitated and generate a great epidemiological and socioeconomic impact. In addition, countries that have had low COVID-19 vaccination face periodic outbreaks with a relevance of moderate, severe cases and death [20, 21].

The frequency of vaccine hesitancy in this study was similar to COVID-19 vaccine hesitancy profiles in several low- and middle-income countries around the world [15, 24]. In many of these cases, a significant decrease in adherence to the COVID-19 vaccination schedule was observed in Brazil, probably because during the booster doses, there was a drop in the number of cases and deaths from COVID-19, and this generated a false sense of lasting security that encouraged part of the population to give up on the booster doses [25]. We analyzed the public repository of the Brazilian Ministry of Health and found that vaccination against COVID-19 has low adherence, revealing high rates of people who did not complete the three-dose schedule or single dose plus booster, mainly in the North region of Brazil [38], such as Acre (99%), Amapá (97%), Amazonas (72%), Pará

(98%), Rondônia (98%), Roraima (98%) and Tocantins (99%) [26, 27].

The pandemic has had multifactorial consequences and tourism has been severely affected, with a 74% drop28. Although most Brazilians have good vaccine acceptance [29], movements against vaccination have historically been reported in Brazil. However, vaccine hesitancy has shown greater potential in low acceptance [30]. We did not investigate the causes of low vaccine uptake among our population, however, we believe that the causes are multifactorial, such as religion, popular beliefs, insecurity generated by adverse reactions and the widespread dissemination of false information about vaccine efficacy and safety18. The lack of reliable information on the biological safety of vaccines is the main reason for vaccine hesitancy in several populations, including among health professionals [31,32]. Other causes can be pointed out for the phenomenon of vaccine hesitancy in our population, such as failures in the management and implementation of health policies, logistical and structural difficulties in the conservation of vaccines, especially those with a nucleic acid platform, which make adherence and territorialization of health services in vaccination campaigns unfeasible [30,33].

Children aged 5 to 11 years were almost twice as likely to not complete the vaccination schedule (OR: 1.8238) and we believe that this is a consequence of the hesitant behavior of their parents and guardians, for the same reasons mentioned above, however, parental refusals and delays in adhering to routine childhood immunizations are largely responsible for a significant number of unvaccinated/under-vaccinated children, disease outbreaks, comorbidities and premature death[34]. However, in our study, this was the population with the highest vaccination adherence when compared to other populations. Adolescents aged 12 to 17 years were observed to have a high probability of almost 30 times of not completing their vaccination schedule (OR: 29.5908). As with children, people in this age group still depend on their parents' permission to get vaccinated and largely prefer not to subject them to the anti-COVID-19 vaccination schedules [35]. Although severe cases of COVID-19 are less common in this age group, vaccination is essential to reduce the transmission of the virus and ensure population immunity. These young people are of school age and are not as dependent on their parents as children, and therefore tend to naturally gather together with little epidemiological concern due to the spontaneity of their social relationships [36, 37]. Because they are not vaccinated, they become a population with a high potential for transmissibility, especially in the home environment among older people, being the main responsible for repeated outbreaks of this infection in the school environment, and consequently, for the closure of schools [38, 39]. Vaccination of adolescents and young people should be considered a top priority in order to improve or archive herd immunity in the shortest possible time, as they have a more effective and long-lasting immune response and are characterized by their high mobility, and therefore, carry the highest incidence of COVID-19 infection [40].

Young people and adults aged 18 to 59 were more than 12 times more likely to not complete their COVID-19 vaccination schedule (OR: 12,1354). This population, despite tending to be less spontaneous in their social relationships and coexistence than adolescents, are people who are highly mobile, as they travel through different environments and perform some professional activity. Therefore, the vulnerability of this population compromises professional activities and the economy. This age group tends to be more inquisitive about issues regarding vaccine type, efficacy, and adverse reactions [41, 42]. Those over 60 years of age are considered to have high morbidity and lethality from COVID-19 and are not a population with a high vaccine acceptance profile. In our study, it was observed that they are five times more likely to not complete the vaccination schedule (OR: 5.0698). Adults over 50 years of age have been classified as a risk group for severe COVID-19 disease since the beginning of the pandemic [43], tending to have a decreased lasting immune response against COVID-19, making them vulnerable to developing acute respiratory distress syndrome in a shorter period of time [44].

In this study, people with comorbidities were 22 times more likely to hesitate to fully vaccinate (OR=22.3481); some live in rural communities that are difficult to access and feel unable to travel to the health center for vaccination, so that stage D1 took place primarily in homes and in stages D2 and DR, vaccination campaigns took place at sentinel health centers. People with developmental disorders, congenital and acquired neurological disabilities, cancers, sickle cell disease, kidney and heart failure,

and diabetes, asthma, hypertension, obesity, chronic lung diseases, and chronic liver diseases are associated with the severity of COVID-19 disease and, therefore, have become a priority group for vaccination against COVID-19 [39,45].

The main limitations of this study were that it was not possible to evaluate changes in vaccine hesitancy rates because our study was cross-sectional. Furthermore, we used secondary data that were deposited in official public domain systems and thus there is a possibility of sampling bias, which made it impossible for us to include other sociodemographic and epidemiological variables in our analyses and to perform multivariate analyses.

Conclusion

The emergency vaccination scheme against COVID-19 in a municipality on the tourist island of the Marajó Archipelago, in the Amazon region of Brazil, did not reach the minimum coverage required for the control of vaccine-preventable diseases. Despite the high acceptance at the beginning of the vaccination campaign, the same acceptance was not observed at the end of the campaign, revealing a high vulnerability to severe cases and death from COVID-19 for both the local population and tourists, with possible implications for local public health, as well as for economic and social factors. Additional studies are needed to evaluate and monitor the acceptance and adherence to the COVID- 19 vaccine, as well as to intensify health education measures to inhibit anti-vaccine attitudes in this municipality and throughout the Brazilian Amazon tourist region.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

All authors contributed to the development of research. Conceptualization: L.M.S, L.F.A.M. Data curation: E.S.M., L.C.O., A.C.C.T.M., K.V.B.L., C.M.V., K.F.S.A., G.M.M.M., L.M.S. Investigation and methodology: E.S.M., L.M.S. Formal analysis: R.V.L., K.V.B.L., L.F.A.M., L.M.S. Writing—original draft: R.V.L., L.F.A.M., L.M.S.

Writing—review & editing: R.V.L., L.F.A.M., L.M.S.

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