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Prevalence and Predictors of Intention to be Vaccinated Against COVID-19 in Thirteen Latin American and Caribbean Countries

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Abstract

The presence of a significant number of people who do not intend to be vaccinated could negatively impact efforts to control the COVID-19 pandemic. Therefore, this study sought to determine the prevalence of intention to be vaccinated against COVID-19 and associated sociodemographic and psychosocial factors in thirteen countries in Latin America and the Caribbean (LAC). A total of 5510 people from 13 LAC countries participated. Frequencies, percentages, bivariate analyses using chi-square tests, and Poisson regression analysis with robust variance were used. The countries with the highest prevalence of intention to be vaccinated were Brazil (96.94%), Cuba (89.59%), Chile (84.59%), and Mexico (78.33%). On the other hand, the countries with the lowest prevalence were El Salvador (54.01%), Paraguay (55.87%), and Uruguay (56.40%). Prevalence is also reported according to some sociodemographic and health variables. It was found that country, male sex, hours exposed to information about COVID-19, university education, living in an urban area, belief in the animal origin of the virus, perceived likelihood of contracting COVID-19, perceived severity of COVID-19, and concern about infecting others significantly predicted intention to be vaccinated in the 13 LAC countries. While most countries had a high prevalence of intention to be vaccinated, there are still subgroups that have levels of intention that may be insufficient to predict the presence of community immunity. In this sense, knowing the estimates of vaccination intention rates, as well as the associated sociodemographic and psychological factors, can be used to plan actions and interventions that will inform about the safety and benefits of vaccines, as well as strengthen trust in health authorities.

Keywords Intention to be vaccinated · Latin America and the Caribbean · Prevalence · Epidemiology

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Introduction

The COVID-19 pandemic continues to affect people worldwide (Urrunaga-Pastor et al., 2021). As of November 13, 2021, more than 250 million diagnosed cases and more than 5 million deaths from COVID-19 have been reported worldwide (Coronavirus Resource Center, 2021), with Latin America and the Caribbean (LAC) being one of the regions most affected by the pandemic (Burki, 2020). LAC's vulnerability to the pandemic is greater due to high rates of poverty and inequality, delayed responses by populist governments, resource-constrained health systems, and a higher prevalence of chronic diseases (Burki, 2020; Pablos-Méndez et al., 2020). Thus, as of November 13, 2021, Brazil (21,939,196 cases and 610,491 deaths), Mexico (3,841,661 cases and 290,872 deaths), Argentina (5,304,059 cases and 116,222 deaths), Colombia (5,026,822 cases and 127,721 deaths), and Peru (2,212,514 cases and 200,573 deaths) are the countries most affected by COVID-19 in LAC (Coronavirus Resource Center, 2021).

Immunization programs through vaccines are the main health strategies to mitigate the spread of this disease and save more lives (Lurie et al., 2020). According to Our World in Data (2021), as of when this article was written, about 32% of the world's population has received at least one dose of any vaccine against COVID-19, while 24% are fully vaccinated, having received the recommended two doses. Thus, 4.84 billion doses of vaccine have been administered worldwide, averaging 34.95 million doses per day; however, only 1.3% of people in low-income countries have received at least one dose. According to the same portal, about 80% of the population in LAC has not had access to full doses of the vaccine. Among the countries that applied the most doses of vaccine in Latin America are Brazil, with more than 68.9 million, and Mexico, with about 31.8 million. However, neither country has yet managed to surpass 25% of the population inoculated with at least one dose. It is estimated that immunization programs prevent about 2 to 3 million deaths annually, making them a fundamental tool of preventive health care (World Health Organisation, 2020). In this sense, having between 67 and 80% of the population vaccinated (referred to as "herd immunity") will reduce the spread of the disease (Randolph & Barreiro, 2020). However, there is some doubt about the degree and duration of protection offered by vaccines against COVID-19 (Altmann et al., 2020). This has led to about 20% of the population in pandemic-affected countries being unwilling to be vaccinated against COVID-19 (Lazarus et al., 2021). Other studies worldwide have reported that vaccine acceptance can range from 24% in Kuwait to 97% in Ecuador (Sallam, 2021). In LAC, a study conducted in 20 countries also reported that about 20% of the population does not intend to be vaccinated against COVID-19, where 81.2% are afraid of its adverse effects (Urrunaga-Pastor et al., 2021). Intention to be vaccinated is a conscious cognitive process, which expresses people's closeness to the final decision to be vaccinated (Fall et al., 2018). Therefore, understanding the development of intentions to be vaccinated against COVID-19 will identify the best strategy for coping with the disease (DeRoo et al., 2020).

Mistrust of vaccines has been identified as one of the top ten threats to global health (Paul et al., 2021). Furthermore, a systematic review of 23 academic research studies and 103 opinion surveys indicated an increase in distrust of the COVID-19 vaccine in the general population, jeopardizing the achievement of herd immunity (Lin et al., 2021). Different health behavior models have been proposed and used to explain the factors that motivate or dissuade people to adopt health-related behaviors, such as the intention to be vaccinated (Mercadante & Law, 2021; Shmueli, 2021). One of these is the Health Belief Model (HBM; Rosenstock, 1974), which has been developed specifically to focus on prevention and previously used in vaccination studies, including for COVID-19 (Champion & Skinner, 2008; Coe et al., 2012; Wong et al., 2020; Zampetakis & Melas, 2021). The HBM suggests that different factors, including personal characteristics, demographic, and psychological variables (such as perceived susceptibility, perceived severity, perceived benefits, calls to action, and self-efficacy, among others), directly impact beliefs and lead to individual intention. In the context of the COVID-19 pandemic, intention to receive the COVID-19 vaccine is an important behavior within this model.

Based on the HBM, there are a number of sociodemographic and psychological factors that are associated with the intention to receive a vaccination. Intention to be vaccinated is a complex process, which varies according to time and context (Al-Mohaithef & Padhi, 2020). A global study on the likely acceptance rates of a COVID-19 vaccine, conducted among 13,426 people in 19 countries, indicated that people older than 25 years of age, women, people who had greater economic resources and higher educational attainment, and those who were diagnosed with the disease or had family members diagnosed with the disease were more likely to agree to be vaccinated (Lazarus et al., 2021). Other variables significantly associated with intention to be vaccinated against COVID-19 include having a partner and having received a previous vaccination, while place of residence showed no significant relationships (Al-Mohaithef & Padhi, 2020; Al-Qerem & Jarab, 2021; Malik et al., 2020; Meier et al., 2021; Ruiz & Bell, 2021). However, it has also been suggested that some of the variables mentioned above, such as gender, age, and educational level, in addition to the number of people living in the household and political or religious ideology show no association with intention to be vaccinated (Berg & Lin, 2020). In LAC, a study of 472,521 adults in 20 LAC countries reported that women and those of non-binary gender were less likely to be vaccinated, while those with a greater fear of becoming seriously ill or having a family member become ill, people with depressive symptoms, those who receive more frequent recommendations from family and friends, and health workers or officials had a higher prevalence of intention to be vaccinated (Urrunaga-Pastor et al., 2021).

The previous study, conducted in LAC, did not consider some important psychological variables. Thus, for example, lower anti-vaccine conspiracy beliefs and higher perceived susceptibility and perceived severity of COVID-19 impact the intention to be vaccinated against COVID-19 (Ruiz & Bell, 2021; Wong et al., 2021). Vaccine mistrust and fear are related to misinformation originating from antivaccine movements (Kalichman et al., 2021). Antivaccine groups portray

vaccines as more dangerous than the disease itself by linking vaccines to the presence of other conditions, as seen by linking the measles, mumps, and rubella vaccine to autism (Smith, 2017). The misinformation caused by anti-vaccine movements may prolong the duration of the COVID-19 pandemic, generate a higher mortality rate, and increase health inequalities, as well as economic and social disparities (Ransing et al., 2021). Perceived severity refers to the belief that contracting the disease can bring serious consequences for oneself and others, whereas perceived susceptibility is the belief of a high risk of contracting the disease. In this sense, individuals who feel more threatened or perceive high levels of risk from COVID-19, as well as those who perceive high levels of risk of infecting themselves or others, would be more likely to have high levels of intention to be vaccinated against COVID-19 (Zampetakis & Melas, 2021). Assessing the risk of becoming infected and infecting others is an important extension of the HBM model in the context of COVID-19 vaccination, where the goal is to provide individual protection, but also protection to others and prevent the spread of disease. This is particularly important during a pandemic, where one of the goals is to achieve herd immunity (Burke et al., 2021).

Currently, there is still limited evidence on intention to be vaccinated against COVID-19 in LAC (Urrunaga-Pastor et al., 2021). Therefore, having a thorough knowledge about the prevalence of intention to receive a COVID-19 vaccine and identifying the factors that influence such intention would allow LAC governments to design targeted and effective vaccination programs that increase the final decision to be vaccinated (Yan et al., 2021). The objectives of this study were (1) to determine the prevalence of intention to be vaccinated against COVID-19 in thirteen LAC countries and (2) to identify sociodemographic and psychosocial predictors of intention to be vaccinated against COVID-19. Based on previous scientific findings, it is hypothesized that country, sex, number of hours exposed to information about COVID-19, educational level, area of residence, conspiracy ideas about the origin of the virus, perception of contracting COVID-19, perception of the severity of COVID-19, and concern about infecting others predict intention to receive a COVID-19 vaccine.

Methods

Participants

Participants were members of the general population from 13 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Paraguay, Peru, and Uruguay), selected by snowball sampling. The inclusion criteria were (1) to be of legal age and (2) to give informed consent. Also, the sample size was already predefined, as this study was conducted with existing data from a larger project on the impact of the COVID-19 pandemic on mental health in Latin American countries (Caycho-Rodríguez et al., 2021a, b).

Instruments

Socio-demographic Variables

A specific questionnaire was constructed for this study to identify the sociodemographic characteristics of the participants, such as sex (male, female, other), age (age groups: 18–24 years old, 25–34 years old, 35–44 years old, 45–54 years old, 55–64 years old and ≥ 65 years old), country (Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Paraguay, Peru and Uruguay), educational level (“What is your educational level?": secondary or lower, at least some vocational school and at least some university), place of residence (“What type of area do you live in?": Urban and Rural), diagnosis of COVID-19 (“Have you had COVID-19?": No or maybe no and Yes or maybe yes), diagnosis of COVID-19 in family members or friends (“Have you had family members diagnosed with COVID-19?," “Have you had friends diagnosed with COVID-19?": Yes and No), time exposed to information about COVID-19 (“During the last 2 weeks, how much time have you been exposed to information about COVID-19?": 1–3 h, 3–5 h, 5–7 h, and > 7 h), living with vulnerable people (“In your household, do you live with vulnerable people [children, elderly, people with any chronic illness]?": Yes or No), presence of a chronic disease (“Do you suffer from chronic diseases [such as diabetes, hypertension or similar conditions]?": Yes or No), and main source of information about COVID-19 vaccines (“What is your main source of information about COVID-19 vaccines?": Official sources, TV, family/friends, or other and social networking). To assess belief about the origin of COVID-19, the question asked by Chen et al. (2020) was adapted (“From what you have seen or heard, which do you think is more likely to be the origin of the coronavirus?": arose naturally or was intentionally developed in a laboratory).

Intention to be Vaccinated

Intention to be vaccinated was measured with the following question: “How likely would you be to decide to be vaccinated against COVID-19, if the vaccine were available?” The response options were 1 = not at all likely, 2 = very unlikely, 3 = unsure, 4 = somewhat likely, and 5 = very likely. This question has been used in a previous study in the USA (Ruiz & Bell, 2021) and in Peru (Caycho-Rodríguez et al., 2021a). The use of single-item measures of intention to be vaccinated against COVID-19 has been common practice in studies during the pandemic (see, for example, Latkin et al., 2021; Shmueli, 2021; Zampetakis & Melas, 2021).

Other Psychological Variables

Questions were constructed for some psychosocial variables associated with intention to be vaccinated against COVID-19. Perceived probability of contracting COVID-19 was assessed using the single item “I think my probability of contracting COVID-19 during the next 6 months is,” which has 6 response options (1 = virtually nonexistent, 2 = very small, 3 = small, 4 = large, 5 = very large, 6 =

virtually 100%). Likewise, the perceived likelihood of dying from COVID-19 was assessed with the question “How likely are you to die if you contract COVID-19?,” which has 6 response options (1 = virtually nonexistent, 2 = very small, 3 = small, 4 = large, 5 = very large, 6 = virtually 100%). To assess the perceived severity of COVID-19, we used the question “How serious do you consider COVID-19 to be?” which has 5 response options (1 = not at all serious, 2 = somewhat serious, 3 = serious, 4 = quite serious, and 5 = very serious). Finally, concern about infecting others with COVID-19 was assessed with the question “How concerned are you about transmitting COVID-19 to another person?” with 4 response options (1 = not at all, 2 = somewhat, 3 = quite a lot, and 4 = very much). All questions have been used in previous studies and have demonstrated predictive ability for the intention to be vaccinated against COVID-19 in samples from Latin American countries (Caycho-Rodríguez et al., 2021c, d).

Procedure

Data were collected between February and March 2021 in all participating countries. During this time period, the status of vaccination in participating countries varied. For example, on December 24, 2020, Argentina received the first 300,000 doses of Sputnik V vaccine and on December 29, 2020, began its vaccination process. Mexico, on Dec. 24, began the vaccination of 1.4 million health workers with the Pfizer-BioNTech vaccine; while on Feb. 15, 2021, it began the vaccination of people over 60 years of age with the AstraZeneca-Oxford vaccine. Chile, in December 2020, received the first 10,000 doses of Pfizer-BioNTech vaccines and began inoculation of frontline health workers in Santiago. By February 2021, Chile reached more than 1 million vaccinations, and as of February 9 reached 5.58 vaccinations per 100 people. On February 9, Peru began vaccinating its citizens with 300,000 doses from the Chinese laboratory Sinopharm. On March 1, Uruguay began vaccinating military, police, and education workers with 192,000 doses of Sinovac. On February 25, Guatemala received 5000 doses of the Moderna vaccine and began vaccinations that same day. El Salvador began administering the first doses of AstraZeneca-Oxford vaccine on February 17. Figure 1 presents the number of vaccines administered between February and March 2021 in the participating countries based on data derived from Our World in Data (2021). It is important to mention that during the data collection period, Cuba did not initiate its vaccination process.

All countries followed the same data collection procedure. A questionnaire was created through the Google Forms platform, which was shared to all participants through social networks (Facebook, WhatsApp, Twitter, and Instagram) and email. The questionnaire had a section of objectives, informed consent, and sociodemographic questions and psychosocial variables. Participants had to answer all the questions to complete the evaluation. The confidentiality of the information was guaranteed. The project was approved by the Ethics Committee of the Universidad Privada del Norte in Peru (registry number: 20213002).

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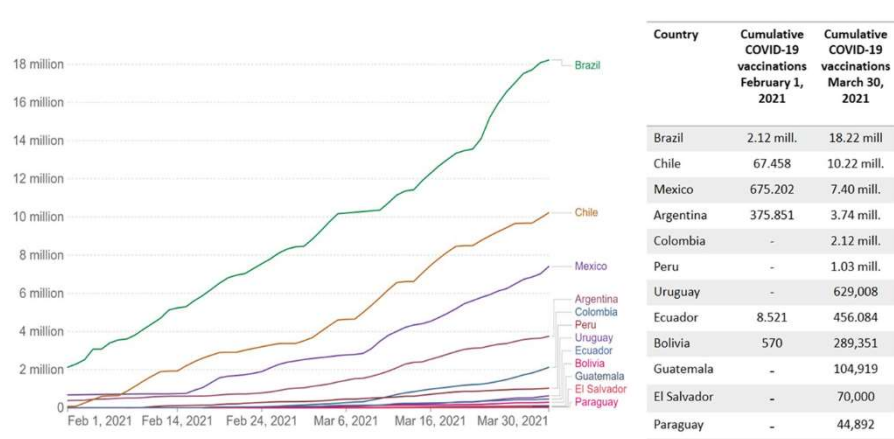


Fig. 1 Number of vaccines administered between February and March 2021 in participating countries based on data derived from Our World in Data (2021). <https://ourworldindata.org>. Own elaboration

Data Analysis

Statistical analysis was performed using R (version 4.0.3) together with the lme4 package (version 1.1-23). For the descriptive analysis, means and standard deviations were calculated. Welch's ANOVAs were used to examine the association between each study variable and intention to be vaccinated. Later, given that observations were clustered within countries, random-intercept hierarchical linear regressions were also computed. This was done first with a series of simple regressions and then with a multiple regression that included all variables.

Results

Sample Characteristics

We analyzed data from 5510 participants distributed across 13 Latin American countries. Most were young or middle-aged adults, while only a small percentage (2.38%) were 65 or older. Also, the majority of participants self-identified as female. Notably, this was a disproportionately educated sample, as inferred from the large percentage of participants who had at least some university education (78.91%). One surprising finding is that half of the total sample (50.71%) believed that virus responsible of COVID-19 was a lab leak instead of a zoonotic disease of natural origin. Finally, most participants perceived COVID-19 as a serious threat and were very worried about infecting others. The detailed information about the sample characteristics is presented in the first columns of Table 1.

Table 1 General characteristics, descriptive statistics of intention to be vaccinated in each group, and bivariate associations

Variable	Total (<i>n</i> = 5510)		Intention to be vaccinated		<i>F</i>	<i>p</i>	ω^2
	<i>n</i>	%	<i>M</i>	<i>SD</i>			
Country					90.22	<.001	.09
Argentina	325	5.90	4.13	1.35			
Bolivia	252	4.57	3.93	1.26			
Brazil	327	5.93	4.84	0.53			
Chile	524	9.51	4.47	1.05			
Colombia	372	6.75	4.02	1.28			
Cuba	317	5.75	4.65	0.80			
Ecuador	451	8.19	3.84	1.37			
El Salvador	698	12.67	3.47	1.46			
Guatemala	324	5.88	3.79	1.45			
Mexico	300	5.44	4.31	1.15			
Paraguay	877	15.92	3.54	1.49			
Peru	360	6.53	4.08	1.32			
Uruguay	383	6.95	3.58	1.45			
Age					1.33	.251	.00
18–24	1683	30.54	3.92	1.33			
25–34	1671	30.33	3.94	1.40			
35–44	1087	19.73	4.03	1.34			
45–54	580	10.53	3.97	1.39			
55–64	358	6.50	4.04	1.30			
≥ 65	131	2.38	4.04	1.45			
Gender					27.59	<.001	.00
Male	1585	28.77	4.11	1.30			
Female	3925	71.23	3.91	1.38			
Marital status					4.55	.011	.00
Single	3260	59.17	3.93	1.37			
Married or cohabiting	1859	33.74	4.04	1.32			
Divorced or widowed	391	7.10	3.94	1.44			
Had COVID-19					3.97	.047	.00
No or maybe no	4151	75.34	3.99	1.36			
Yes or maybe yes	1359	24.66	3.90	1.38			
Family member had COVID-19					6.03	.014	.00
No	2564	46.53	3.92	1.39			
Yes	2946	53.47	4.01	1.34			
Friend had COVID-19					28.52	<.001	.01
No	1265	22.96	3.78	1.43			
Yes	4245	77.04	4.02	1.34			
Exposure to COVID-19 information during 2 last weeks					46.69	<.001	.02

Table 1 (continued)

Variable	Total (<i>n</i> = 5510)		Intention to be vaccinated		<i>F</i>	<i>p</i>	ω^2
	<i>n</i>	%	<i>M</i>	<i>SD</i>			
1–3 h	2809	50.98	3.76	1.43			
3–5 h	1008	18.29	4.13	1.23			
5–7 h	530	9.62	4.17	1.27			
> 7 h	1163	21.11	4.23	1.27			
Education					28.19	<.001	.01
Secondary or lower	683	12.40	3.59	1.42			
At least some vocational school	479	8.69	3.98	1.44			
At least some university	4348	78.91	4.02	1.33			
Lives with people at high risk					3.01	.083	.00
No	2136	38.77	3.93	1.37			
Yes	3374	61.23	3.99	1.36			
Area					23.03	<.001	.00
Urban	4868	88.35	4.00	1.35			
Rural	642	11.65	3.71	1.46			
Has a chronic disease					17.98	<.001	.00
No	4651	84.41	3.93	1.37			
Yes	859	15.59	4.14	1.31			
Belief about COVID-19's origin					545.47	<.001	.09
Animal origin	2716	49.29	4.38	1.10			
Lab leak	2794	50.71	3.56	1.47			
Main source of information on vaccines					12.24	<.001	.00
Official sources, TV, family/friends, or other	4666	84.68	3.99	1.35			
Social networking	844	15.32	3.81	1.42			
Perceived probability of getting COVID-19					71.00	<.001	.01
Small, very small, or nonexistent	3062	55.57	3.83	1.43			
Large, very large, or complete certainty	2448	44.43	4.14	1.26			
Perceived probability of dying from COVID-19					56.51	<.001	.01
Small, very small, or nonexistent	2676	48.57	3.82	1.43			
Large, very large, or complete certainty	2834	51.43	4.10	1.28			
Perceived severity of COVID-19					318.94	<.001	.09
Very serious	3561	64.63	4.19	1.23			
Serious or somewhat serious	1855	33.67	3.66	1.43			
Not serious at all	94	1.71	1.54	1.12			
Worry about infecting others					114.51	<.001	.08
Very much	3658	66.39	4.17	1.26			
Quite a lot	1322	23.99	3.81	1.32			
Somewhat	388	7.04	3.18	1.49			
Not at all	142	2.58	2.33	1.72			

Prevalence and Variables Associated with Intention to be Vaccinated

On a scale of 1 to 5, the overall mean intention to be vaccinated against COVID-19 was 3.97 ($SD = 1.36$). Table 1 shows how this average varies in each of the variable categories. The countries with the highest mean intention to be vaccinated were Brazil ($M = 4.84$), Cuba ($M = 4.65$), Chile ($M = 4.47$), and Mexico ($M = 4.31$). On the other hand, the countries with the lowest averages were El Salvador ($M = 3.47$), Paraguay ($M = 3.54$), and Uruguay ($M = 3.58$).

In general, the following variables were significantly associated with intention to be vaccinated, according to the ANOVAs: country, gender, marital status, having had COVID-19, a family member or friend having had it, the number of hours exposed to information about the disease, educational level, having a chronic disease, the main source of information about vaccines, the perceived probability of getting or dying from COVID-19, the perceived severity of the disease, and the concern about infecting others. However, in many of these cases, the magnitude of the effect was negligible and very close to zero. The variables with the strongest association with intention to be vaccinated were country, belief about the origin of the virus, perceived severity of the disease, and concern about infecting others (Table 1).

Hierarchical linear models confirmed the findings of the bivariate analyses. In the multiple regression analysis, the only variables that continued to show significant associations with the intention to be vaccinated were male gender, having a friend who had COVID-19, the number of hours exposed to information, university education, living in an urban area, having a chronic disease, attributing a zoonotic origin to the virus, the perceived probability of becoming infected, the perceived severity of the disease, and the concern about infecting others. As in the bivariate analyses, the most marked differences were observed in relation to the following variables: attributed origin of the virus, perceived severity, and concern about infecting others (Table 2).

Discussion

The rapid progress in developing effective and safe vaccines against COVID-19 in a short period of time is an unprecedented achievement (Graham, 2020). However, vaccine hesitancy may limit efforts to control the pandemic (Harrison & Wu, 2020). Against this backdrop, a study was conducted on the intention to be vaccinated against COVID-19 in 5510 individuals from 13 LAC countries. Overall, the global mean score of intention to be vaccinated against COVID-19 was 3.97 ($SD = 1.36$), which ranged from 3.47 to 4.84 among the 13 Latin American countries. The differences found could be explained by increased confidence due to the proximity of the arrival of vaccines or the start of the vaccination process. This can be observed in countries such as Brazil, Chile, and Mexico, which showed the highest prevalence percentages and had already started their vaccination processes at the time the data for this study were collected. The availability and potential access to the vaccine would motivate greater vaccination, as opposed to when the vaccine was only

Table 2 Simple and multiple hierarchical linear regressions with random intercept and fixed slopes

Variable	Simple regressions			Multiple regression		
	<i>b</i>	95% CI	<i>p</i>	<i>b</i>	95% CI	<i>p</i>
Age						
18–24		Ref. group			Ref. group	
25–34	0.06	(–0.03, 0.15)	.188	–0.01	(–0.10, 0.08)	.824
35–44	0.10	(0.00, 0.21)	.048	0.04	(–0.07, 0.14)	.505
45–54	0.02	(–0.10, 0.15)	.728	0.01	(–0.12, 0.14)	.890
55–64	0.16	(0.01, 0.32)	.037	0.14	(–0.02, 0.30)	.077
≥ 65	0.09	(–0.15, 0.32)	.483	0.16	(–0.08, 0.39)	.199
Gender						
Male		Ref. group			Ref. group	
Female	–0.22	(–0.30, –0.15)	<.001	–0.24	(–0.31, –0.17)	<.001
Marital status						
Single		Ref. group			Ref. group	
Married or cohabiting	0.06	(–0.01, 0.14)	.103	0.03	(–0.05, 0.11)	.423
Divorced or widowed	–0.08	(–0.22, 0.06)	.271	–0.05	(–0.19, 0.09)	.481
Had COVID-19						
No or maybe no		Ref. group			Ref. group	
Yes or maybe yes	0.01	(–0.07, 0.09)	.850	0.00	(–0.08, 0.07)	.960
Family member had COVID-19						
No		Ref. group			Ref. group	
Yes	0.06	(–0.01, 0.13)	.109	0.01	(–0.06, 0.07)	.857
Friend had COVID-19						
No		Ref. group			Ref. group	
Yes	0.24	(0.15, 0.32)	<.001	0.09	(0.00, 0.17)	.039
Exposure to COVID-19 information during 2 last weeks						
1–3 h		Ref. group			Ref. group	
3–5 h	0.28	(0.18, 0.37)	<.001	0.16	(0.08, 0.25)	<.001
5–7 h	0.28	(0.16, 0.40)	<.001	0.12	(0.01, 0.23)	.037
> 7 h	0.28	(0.19, 0.37)	<.001	0.14	(0.06, 0.23)	.001
Education						
Secondary or lower		Ref. group			Ref. group	
At least some vocational school	0.04	(–0.12, 0.19)	.644	0.03	(–0.11, 0.18)	.631
At least some university	0.32	(0.21, 0.42)	<.001	0.23	(0.13, 0.33)	<.001
Lives with people at high risk						
No		Ref. group			Ref. group	
Yes	0.05	(–0.02, 0.13)	.142	–0.03	(–0.09, 0.04)	.419
Area						
Urban		Ref. group			Ref. group	
Rural	–0.22	(–0.33, –0.11)	<.001	–0.14	(–0.24, –0.04)	.007
Has a chronic disease						
No		Ref. group			Ref. group	
Yes	0.17	(0.08, 0.27)	<.001	0.09	(0.00, 0.19)	.042

Table 2 (continued)

Variable	Simple regressions			Multiple regression		
	<i>b</i>	95% CI	<i>p</i>	<i>b</i>	95% CI	<i>p</i>
Belief about COVID-19's origin						
Animal origin		Ref. group			Ref. group	
Lab leak	-0.70	(-0.77, -0.64)	<.001	-0.61	(-0.67, -0.54)	<.001
Main source of information on vaccines						
Official sources, TV, family/friends, or other		Ref. group			Ref. group	
Social networking	-0.11	(-0.21, -0.02)	.022	-0.05	(-0.14, 0.03)	.237
Perceived probability of getting COVID-19						
Small, very small, or nonexistent		Ref. group			Ref. group	
Large, very large, or complete certainty	0.32	(0.25, 0.39)	<.001	0.16	(0.09, 0.22)	<.001
Perceived probability of dying from COVID-19						
Small, very small, or nonexistent		Ref. group			Ref. group	
Large, very large, or complete certainty	0.23	(0.16, 0.30)	<.001	0.00	(-0.07, 0.07)	.924
Perceived severity of COVID-19						
Very serious		Ref. group			Ref. group	
Serious or somewhat serious	-0.46	(-0.53, -0.39)	<.001	-0.30	(-0.38, -0.23)	<.001
Not serious at all	-2.53	(-2.78, -2.27)	<.001	-1.64	(-1.91, -1.37)	<.001
Worry about infecting others						
Very much		Ref. group			Ref. group	
Quite a lot	-0.26	(-0.34, -0.18)	<.001	-0.17	(-0.24, -0.09)	<.001
Somewhat	-0.86	(-0.99, -0.73)	<.001	-0.63	(-0.76, -0.50)	<.001
Not at all	-1.68	(-1.89, -1.47)	<.001	-0.94	(-1.16, -0.72)	<.001

a hypothetical possibility. It is also possible that a greater sense of risk in countries would be related to greater intention to receive the vaccine, as previous studies have shown (Caserotti et al., 2021; Dror et al., 2020; Lin et al., 2021). Likewise, having generally positive or negative attitudes toward vaccination may be a factor of variation in the intention to be vaccinated against COVID-19 (Sherman et al., 2021).

During the data collection period, in the highest prevalence countries, the number of diagnosed cases and deaths was increasing. In Cuba, the outlook for COVID-19 was not favorable, as the country was in a phase of resurgence (second wave) characterized by daily diagnoses of high numbers of people infected with the virus, much higher compared with diagnoses on a similar date in the first stage of the disease. To date, 2,730,305 samples had been tested in the country and 64,414 were positive; (c) of the 64,414 confirmed cases, 3596 were active cases, 60,378 patients had recovered, and 384 patients were reported to have died. In Chile, 1,039,623 positive cases were reported (896,231 with laboratory confirmation and 143,392 probable cases without laboratory confirmation) with a cumulative incidence rate of 5342.8

per 100,000 population. In Mexico, during the study period, more than 2,238,887 people were reported infected and 203,210 total deaths were registered due to COVID-19, resulting in a daily average of 560 deaths associated with COVID-19. Similarly, it is possible that news of oxygen deprivation and lack of available hospital beds increased the sense of vulnerability, and thus, the rate of intention to receive a COVID-19 vaccine. However, there is high variability in prevalence rates between countries. The fact that not all people fully intend to receive a COVID-19 vaccine is a cause for concern as it could delay pandemic control as well as social and economic recovery in Latin America.

On the other hand, the results show that men have a higher intention to be vaccinated compared to women, which is consistent with some previous findings (Kreps et al., 2020; Ruiz & Bell, 2021; Urrunaga-Pastor et al., 2021; Yan et al., 2021). The lower intention to be vaccinated observed in women may be explained by some concerns specific to this group, such as the belief that COVID-19 vaccines cause infertility (Sallam et al., 2021) and greater concern and fear about side effects (Bono et al., 2021). Also, married people and those with higher education have higher prevalence and significantly predict intention to vaccinate, which is similar to results from previous studies (Al-Mohaithef & Padhi, 2020; Omar & Hani, 2021; Rhodes et al., 2021; Ruiz & Bell, 2021; Wang et al., 2020). Related to this, a previous study on the acceptability of receiving an influenza vaccination indicated that single people, compared to married people, have lower intention to be vaccinated because of perceived lower risk of transmission to co-resident family members (Wada & Smith, 2013). Likewise, the higher prevalence of anxiety symptoms during the COVID-19 pandemic in married compared to single people (Santabárbara et al., 2021) may be an explanatory factor in the differences in intention to be vaccinated between men and women. This is even more important if one takes into consideration that anxiety is an important predictor of intention to be vaccinated (Bendau et al., 2021). Furthermore, having a friend who had COVID-19 was a predictive factor. This would be associated with the idea of herd immunity and in the protection of loved ones which, in turn, is an important factor for vaccine acceptance (Williams et al., 2020). In this sense, vaccination against COVID-19 could be partially predicted by a motivation to protect others. Thus, interventions aimed at increasing vaccination against COVID-19 should focus on how the disease may affect not only the individual but also harm others, such as family members and Friends (Wolff, 2021).

Another important result indicates that those living in urban areas have a higher prevalence and predicted intention to be vaccinated. Previous findings indicate that living in rural areas, which in LAC are characterized by lower levels of education, higher rates of poverty, low adherence to health safety standards, and low trust in the health system, is associated with greater fear of adverse effects from vaccines (Sallam, 2021; Urrunaga-Pastor et al., 2021). Furthermore, many rural areas in LAC lack adequate health coverage, which increases the risk of misinformation and resistance to immunization strategies (Atun et al., 2015; Paul et al., 2021; Urrunaga-Pastor et al., 2021). In addition, lower perception of the risk of COVID-19, together with low educational level, could explain a lower vaccine acceptance rate in rural areas (Abedin et al., 2021). Similarly, it is suggested that those participants with lower educational attainment may have limited access to information about

COVID-19 vaccines, raising doubts about their effectiveness (Omar & Hani, 2021). Other studies indicate that college-educated people were more likely to believe that the vaccine will provide protection to those who receive it (Cordina & Lauri, 2021). However, other findings indicate that less educated participants were more willing to be vaccinated (Chen et al., 2021). It appears that those with higher levels of education agreed that newer vaccines may be riskier than older vaccines and require more accurate information than those with lower levels of education (Smith, 2017). These results suggest that governments should provide people, regardless of their level of education, with more scientific evidence about the effectiveness of vaccines. Therefore, there is a need to strengthen and adapt communication strategies on the effectiveness of vaccines in these populations (French et al., 2020). Furthermore, overall, the lower intention to be vaccinated in people living in rural areas, low-income and with low educational levels may also be explained by pre-existing doubts about vaccines in general present in these groups, less health awareness and literacy, less trust and interaction with health professionals, and greater concerns about costs (Khubchandani et al., 2021). Greater doubts, concerns, and mistrust in people from rural areas and of low educational level may generate a greater presence of anxiety symptoms, which have been shown to play an important role in the intention to be vaccinated (Bendau et al., 2021).

Additionally, whether participants have a chronic disease is also an important predictor of intention to be vaccinated. People with chronic diseases (such as cardiovascular, respiratory, diabetes, and cancer) are more likely to develop severe COVID-19 symptoms and have a higher mortality rate than the general population (Jordan et al., 2020). This creates a greater sense of vulnerability to potential COVID-19 infection (Iacob et al., 2021). In addition, previous studies have reported that people with chronic illnesses had greater concern about the pandemic, greater threat perception, and greater perceived benefit from vaccines (Iacob et al., 2021). In the present study, the presence of a chronic illness was self-identified, which provides information on the perception of risk based on the individual's belief about their health status. The presence of self-reported comorbidities has been associated with the adoption of preventive behaviors against COVID-19, such as social distancing and use of masks, as well as support for community-level health interventions, such as vaccination (Ricotta et al., 2021). However, other studies also suggest that about one-third of chronically ill people are not confident or willing to be vaccinated against COVID-19 (Abedin et al., 2021). Similarly, an earlier study in Germany reported that chronically ill people did not get vaccinated against influenza due to distrust of the vaccine and lower perceived risk of the disease (Bödeker et al., 2015). Factors such as high concern about vaccine efficacy and possible side effects as well as lack of confidence may explain the unwillingness to get vaccinated (Napolitano et al., 2020). Faced with this scenario, raising awareness of the benefits of the vaccine through the media can motivate and increase the prevalence of intention to be vaccinated in this group. This reaffirms the current health policy of considering people with chronic diseases as a priority group for vaccination against COVID-19 (Wong et al., 2021).

Similarly, the belief that the virus has an animal or natural origin was one of the most significant predictors. A study in Italy came to similar conclusions, where

people who believed that the virus had an unnatural origin were more likely to be undecided on whether or not they would be vaccinated (Prati, 2020). This is related to the presence of conspiracy theories, which suggest that the SARS-CoV-2 virus was created in a laboratory or is the product of intentional manipulation (Calisher et al., 2020). Previous studies have shown that these types of beliefs are a barrier to engaging in health protective behaviors, including vaccination (Eicher et al., 2014; Jolley & Douglas, 2014; Oliver & Wood, 2014). In LAC, as well as in other regions, the lack of adequate treatment of information and media contradictions have generated an “infodemic,” leading to belief in non-validated information that could generate distrust or rejection of vaccines against COVID-19 (Urrunaga-Pastor et al., 2021). From a psychological perspective, the belief in COVID-19 conspiracy theories and compliance with preventive measures to minimize the risk of infection would be associated with a greater perception of uncertainty, higher perceived risk of disease, and high level of perceived stress, which could lead to feeling a lack of control over the situation (Alper et al., 2020; Swami et al., 2016). Likewise, people with higher cognitive reflection or more analytical thinking are less likely to believe in conspiracy theories and better detect fake news (Bronstein et al., 2019; Pennycook & Rand, 2019; Stanley et al., 2021). Overall, this result replicates previous robust findings that conspiracy attitudes (in particular, conspiracy beliefs about the manipulated origin of the virus) are associated with negative or hesitant vaccination intentions (Mattia et al., 2021). However, these beliefs should not be seen as an ignorant or irrational response, but rather, an opportunity for responsible and respectful dialogue about the virus and the disease in general that takes into account the concerns and perceptions of people in LAC (Nihlén Fahlquist, 2018). This suggests that information about the non-human origin of the Sars-CoV-2 virus may be an important component within information campaigns to overcome vaccine hesitancy in the region.

Currently, social media has been reported to be the source of information associated with the most doubts and misconceptions about COVID-19 vaccines that may promote a decrease in intention to be vaccinated (Puri et al., 2020; Sallam et al., 2021). Therefore, it is not surprising that, in this study, people who have social networks as their main source of information have the lowest intention to be vaccinated against COVID-19. A previous study indicated that the proportion of misinformation about vaccines was higher in Brazil, Colombia and Venezuela than in other Latin American countries (Ceron et al., 2021). This could be associated with the ease of social networks to spread inaccurate information about the safety of COVID-19 vaccines (Wilson & Wiysonge, 2020). However, it has also been suggested that social media may have a more moderate effect than previously thought (Ruiz & Bell, 2021). In this regard, other studies suggest that the use of social networks to obtain information related to the COVID-19 vaccine is associated with increased intention to receive the vaccine (Mo et al., 2021). Correct information about vaccination via social media can strengthen trust in vaccines (Luo et al., 2021). Social media combine advantages of mass media and interpersonal relationship channels, which are particularly effective in increasing people’s understanding of the benefits and need for a COVID-19 vaccine based on scientific knowledge (Mo et al., 2021). Thus, messages should consider the accuracy

of the information, the characteristics and preferences of the users, and the type of social network used to ensure the effectiveness of the communication. Therefore, research should be conducted to measure more precisely the patterns of use of social networks and link them to the attitudes, beliefs, and behaviors related to COVID-19 that people in the evaluated countries have. Related to this, the present study found that people exposed to COVID-19-related information for longer periods of time have a higher intention to get vaccinated. This has been observed in previous studies on COVID-19, influenza, and HPV vaccines, where frequency of exposure to vaccination-related information was associated with higher positive beliefs and greater use of those vaccines (Ahmed et al., 2018; Ortiz et al., 2019; Zhang et al., 2021). In this regard, longitudinal studies are needed to test whether more exposure to positive information in different media, such as social networks, enhances positive perceptions and increases intention to be vaccinated against COVID-19.

From the HBM model, the results also suggest that perceived high likelihood of contracting COVID-19, high perceived likelihood of dying from COVID-19, higher perceived severity of COVID-19, and high concern about infecting others significantly predict intention to be vaccinated. In this sense, the likelihood that people in the 13 participating countries will engage in health-promoting behaviors, such as receiving the COVID-19 vaccine, may be determined in part by their perceptions of the health threat (Yan et al., 2021). Beliefs about the likelihood of contracting COVID-19 and perceived severity are important constructs within health belief models and have shown association with intention to receive other vaccines, such as influenza (Iacob et al., 2021; Ling et al., 2019). A high perception of COVID-19 risk may generate people's awareness and understanding of COVID-19 vaccines, leading to better acceptance of COVID-19 vaccines (Asefa et al., 2020). From a psychological perspective, the presence of a personal risk perception and concern about infecting others suggests that intentions to be vaccinated against COVID-19 may be predicted by a motivation to protect oneself and others (Wolff, 2021). Furthermore, from risk-as-feeling theory (Slovic et al., 2004; Slovic & Peters, 2006), risk perception depends on specific characteristics of the object or situation of danger. In the case of COVID-19, the transition from pre-blockade to blockade has become both a physical and psychological threat (Caserotti et al., 2021). Thus, the findings suggest the need to increase risk perception among the population in the 13 participating countries, as high-risk perception has been associated with a higher frequency of preventive behaviors against infectious diseases, improving epidemic control (Verelst et al., 2016).

Strengths and Limitations

A major strength of this study is the participation of a large multinational sample from 13 LAC countries. In addition, the results provide a demographic and health profile of the people who have the highest intention to be vaccinated in the region. However, there are also some important limitations to consider. First, although we tried to have as many LAC countries as possible, most were from South America (Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, and Peru) and only three from

Central and North America (El Salvador, Guatemala, and Mexico). In this sense, future research should include a larger number of countries from all LAC regions. Second, non-probabilistic sampling was used, which does not allow for a representative sample and prevents us from generalizing the findings to the entire general population of the participating countries. Third, due to restrictions on movement and social interaction in the countries evaluated, an online survey, disseminated through social networks and email, was used to collect information. However, the use of this method can lead to selection bias, as reflected in the large majority of people with university education and living in urban areas. This means that the sample is not completely generalizable to the population of each of the countries involved. Fourth, another limitation lies in the use of a single-item measure to assess intention to be vaccinated. It has been suggested that the complex and multidimensional nature of intention to be vaccinated necessitates different measurement approaches to adequately identify intention or not to receive the vaccine (Larson et al., 2016; Wong et al., 2020). Therefore, it is recommended that future studies use multiple statements of intention to be vaccinated. Fifth, the cross-sectional design of the study provides information only at one point in time and does not allow us to establish a causal relationship between intention to be vaccinated and the other variables assessed. Due to the dynamic and changing context of the pandemic, with variations in the perception of threat and the development of the vaccination processes against COVID-19, it is crucial to conduct longitudinal studies. Sixth, the intention to be vaccinated and the other psychological variables were assessed by self-report measures, which could lead to the presence of social desirability bias and underreporting of information. Seventh, we did not consider variables such as race and ethnicity, which have been shown to be associated with possible variation in willingness to be vaccinated against COVID-19 (Tirupathi et al., 2020).

Conclusion

The success of COVID-19 immunization programs depends largely on population vaccination rates. Our findings suggest that the prevalence of intention to be vaccinated against COVID-19 ranged from 54.01 to 96.94% among the 13 Latin American countries included in the study. While most countries had a high prevalence of intention to be vaccinated, there are still identifiable subgroups that have levels of intention to accept a vaccine that may be insufficient to predict the presence of community (or “herd”) immunity. In this sense, knowing estimates of vaccination intention rates, as well as associated sociodemographic and psychological factors, can be used to plan actions and interventions that will inform about vaccine safety and benefits, as well as strengthen trust in health authorities (Lin et al., 2021; Weintraub et al., 2021). This will promote mass vaccination in the region and reduce the negative impact of COVID-19. Vaccinating the majority of the population will prevent deaths and accelerate the process of economic reactivation in LAC countries (Kohli et al., 2021). It is important to consider the perception that people have towards COVID-19 and to generate confidence in the population about vaccines. Thus, it will be important to implement a transparent public health policy, with clear,

precise, and evidence-based communication strategies that emphasize the risks of the disease and the strengths of the health care system (Yan et al., 2021). In this sense, health authorities in the countries of the region should use social networks to engage in dialogue with the population (Pedersen et al., 2020) or establish communication campaigns that allow people to talk to their doctors about vaccines (Comino et al., 1997). Generating greater confidence about COVID-19 vaccines will also strengthen immunization programs for all vaccine-preventable diseases.

Author contribution TC-R, LWC, PDV, and CC-L provided initial conception, organization, and main writing of the text. LWV and PDV analyzed the data and prepared all figures and tables. AV-V, DS-A, MR-B, MW, CR-J, RP-C, MG, MC, PM, DAP, RM-H, AS-P, MELR, IFF, CF-M, ABF, DXP-C, IEV-R, RC, BPT, W.AG, and CI-E were involved in data collection for their respective countries and acted as consultants and contributors to research design, data analysis, and text writing. The first draft of the manuscript was written by TC-R, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data availability The database is available with a request to the corresponding author.

Code Availability Does not apply.

Declarations

Ethics Approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Universidad Privada del Norte (Registration number: 20213002).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent for Publication Does not apply.

Conflict of Interest The authors declare no competing interests.

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