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Prevalence and factors associated with not receiving the booster dose of the COVID-19 vaccine in adults in Latin America and the Caribbean

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ABSTRACT

Background: Booster doses have been described as effective in reducing hospitalizations and deaths from the new variants. However, its coverage is heterogeneous in Latin America and the Caribbean (LAC), one of the regions most affected by the pandemic. We aimed to assess the factors associated with not receiving a coronavirus disease 2019 (COVID-19) vaccine booster dose in adults from LAC.

Methods: We analyzed a secondary database compiled by the University of Maryland and Facebook assessing the global impact of COVID-19. We included Facebook users over 18 years of age who resided in LAC and responded to the survey between February 13, 2022, and March 14, 2022. We evaluated sociodemographic characteristics, comorbidities, food, and economic insecurity, mental health, and vaccination-related practices. We calculated crude (cPR) and adjusted (aPR) prevalence ratios with their respective 95% confidence intervals (95%CI).

Results: The sample included 154,841 adults from 20 LAC countries. 33.7% (n = 46,459) reported not receiving the COVID-19 booster vaccine. Being under 75 years old, having a college, high school, pre-university, primary, or lower education, having no or 1 to 2 comorbidities, living in a town, having food insecurity, depressive symptoms, and having had COVID-19, were associated with a higher prevalence of not receiving the booster dose. In contrast, being female or non-binary and having anxiety symptoms were associated with a lower prevalence of not receiving the booster dose.

Conclusions: Approximately three out of 10 adults surveyed in LAC reported not having received the booster vaccine. Authorities must design campaigns that promote receiving a booster dose considering the factors found.

1. Introduction

In the scenario of the coronavirus disease 2019 (COVID-19) pandemic, vaccines constitute the most cost-effective strategy to reduce infections, hospitalizations, and deaths in patients infected with SARS-CoV-2 [1,2]. According to the World Health Organization (WHO), by the beginning of April 2022, more than 11 billion doses of vaccines against COVID-19 had been administered worldwide, with more than five billion people having received at least one dose and more than 4.4 billion people having had two doses [3]. However, despite these efforts, regions such as Africa have reported fewer than 20 doses administered per 100 people [3]. These data have important consequences for global public health, such as the emergence of new variants of the virus with greater transmission capacity [4–6].

Follow-up studies in patients vaccinated against COVID-19 showed a decrease in antibody production, which, together with the appearance

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of new variants, raised the need for booster doses in patients who completed the initial two doses of the vaccine against SARS-CoV-2 [6–8]. Given this, various countries have been providing booster doses against COVID-19. Booster doses have been shown to be effective in reducing hospitalizations and deaths from the new variants, as well as being cost-effective in some health systems, which is why several countries have incorporated boosters into their vaccination schedules [7,9,10]. However, as with the initial doses, the vaccination intent of the booster dose is not universal [11,12]. Studies in Poland, Jordan, China, Denmark, Italy, and Singapore showed that between 44.6% and 95.5% of the general population intend to receive a booster dose [13–19]. This intention is influenced by aspects such as confidence in vaccines, fear of side effects, history of chronic diseases, gender, age or level of education of the people [13–18].

Latin America and the Caribbean (LAC) is one of the regions most affected by the pandemic, with the intention to vaccinate against COVID-19 with the first schedule being 80% in adults and 92.2% in the case of vaccination in children [11,12]. As in the rest of the world, the coverage of the booster dose is heterogeneous and at the beginning of April 2022 varied from 70.43 per 100 people in Chile, 41.46 per 100 in Argentina or 36.57 per 100 in Peru, to coverage as low as 18.57 per 100 in Honduras or 10.27 per 100 in Bolivia [20]. Considering the benefits of a booster dose for public health, knowledge of the factors associated with not having applied the vaccine booster would be useful to improve the design of strategies that seek to increase the proportion of people who have received a booster dose against COVID-19. Although the intention to receive a booster dose has been studied, these studies did not include LAC countries [13–19] and to the best of our knowledge, the associated factors have not been studied in a population that has already received this dose. Therefore, the objective of this research was to study the factors associated with not receiving a booster dose of the COVID-19 vaccine in adults in LAC.

2. Methods

2.1. Study design

We conducted an analytical cross-sectional study based on data collected by the University of Maryland and Facebook (Facebook, Inc., Menlo Park, CA, USA) on the global trend and impact of COVID-19. Both institutions designed a survey available online through Facebook to assess sociodemographic characteristics, comorbidities, mental health, economic and food insecurity, compliance with mitigation strategies against COVID-19, and practices related to vaccination against this disease.

2.2. Population, sample, and sampling

The study population consisted of Facebook users over 18 years of age. We included in the analysis users who resided in LAC and who responded to the survey between February 13, 2022, and March 14, 2022. We excluded participants who did not respond to the dependent variable (self-reported having received at least one booster dose of any COVID-19 vaccine) or that they did not know if the dose they received was a booster. In addition, we excluded responses that had incomplete data on the variables of interest. Likewise, we excluded participants from Haiti because the booster dose vaccination process had not yet started during the period of time analyzed. Thus, we analyzed 154,841 adults from LAC (Fig. 1).

The sampling frame for the random selection of participants included all Facebook users over 18 years of age from a region and country. The survey authors conducted stratified random sampling using administrative boundaries within countries or territories to provide geographic coverage. The selection of the surveyed participants was random based on the sampling frame, which was recalculated daily, and included participants who are Facebook users with similar characteristics throughout each day. If a Facebook user refused to participate, another was randomly invited within the sampling frame. Participants could only take the survey once over an eight-week period.

2.3. Questionnaire

The survey used was available from April 23, 2020, in more than 200 countries and in the main language of the territory. The latest version of the survey (version 13, updated on January 30, 2022) consisted of eight sections: 1) The first section included five questions about symptoms related to COVID-19; 2) The second section included three questions about performing diagnostic tests for COVID-19; 3) The third section included 18 questions related to vaccination against COVID-19; 4) The fourth section included six questions related to sociodemographic data; 5) The fifth section included four questions on behaviors related to COVID-19; 6) The sixth section included information about the perception, prevention practices and sources of information against COVID-19; 7) The seventh section included questions related to health conditions and aspects related to children; and 8) The eighth section included two questions about the participant's occupation. This survey has been used to develop previous studies [11,12,21–23], and the survey methodology has been described in greater detail previously [24].

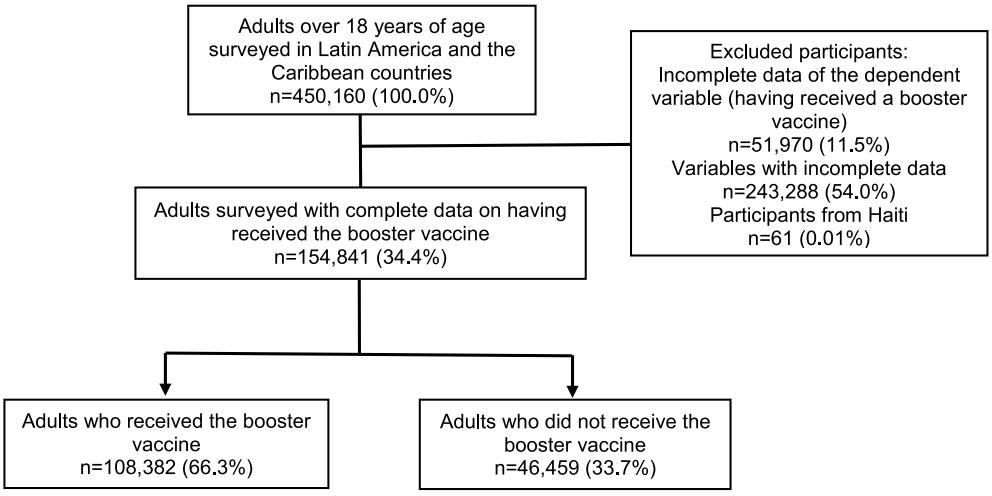

Fig. 1. Flowchart of the selection of the study sample.

2.4. Variables

2.4.1. Outcome variable: not receiving a COVID-19 booster dose

We assessed whether adults had not received a booster dose of the COVID-19 vaccine using the following survey question: Have you received an additional dose or booster shot of the COVID-19 vaccine? This question had four possible alternatives: yes, I received an additional dose or booster; yes, I received 2 or more additional doses or booster shots; no, I have not received an additional dose or booster shot; and I don't know. Subsequently, we dichotomized the variable considering the first two alternatives as having received the booster dose against COVID-19, while the third was considered as not having received a booster dose. We excluded participants who answered the fourth option.

2.5. Independent variables

Sociodemographic variables: We included the following sociodemographic variables (the categories considered for these variables in the study are described in parentheses): gender (male, female and non-binary), age (18–24, 25–34, 35–44, 45–54, 55–64, 65–74 or greater than or equal to 75 years), area of residence (city, town or village/rural area), educational level (completed primary school/less than primary school/no formal education, school complete secondary/pre-university/high school (or equivalent), complete university or postgraduate), employment (yes or no).

Comorbidities, personal history, and history of COVID-19: Participants reported the following comorbidities: asthma, chronic obstructive pulmonary disease or chronic bronchitis or emphysema, cancer, diabetes mellitus, high blood pressure, kidney disease, compromised or weakened immune system, heart attack or other heart disease and obesity. We generated a variable that grouped comorbidities as: none, one to two, and greater than or equal to three. We also included self-reporting of having had COVID-19 (yes or no).

Food and economic insecurity: We assessed food insecurity with the following survey question: How worried are you about having enough to eat in the next week? This question had four possible answers: very worried, somewhat worried, not too worried, and not worried at all. We considered the first three responses as food insecurity. On the other hand, we defined economic insecurity using the following question: How worried are you about your household's finances in the next month? It had four possible answers: very worried, somewhat worried, not too worried, and not worried at all. We defined economic insecurity using the first three answers.

Anxiety and depression symptoms: We assessed anxiety symptoms using the question: During the last 7 days, how often did you feel so nervous that nothing could calm you down? This question is part of the Kessler Psychological Distress Scale (K10), and the survey had 5 possible answers: all the time, most of the time, some of the time, a little of the time and none of the time. Therefore, we dichotomized the variable considering the first three alternatives as the presence of anxiety symptoms. We assessed depressive symptoms using the following survey question: How often did you feel so depressed in the past 7 days that nothing could cheer you up? This question is part of the K10, and the survey had five possible answers: all the time, most of the time, some of the time, a little of the time and none of the time. Therefore, we dichotomized the variable considering the first four alternatives as the presence of depressive symptoms.

2.6. Statistical analysis

We downloaded the database in Microsoft Excel 2019 ® format for each day within the study period, then imported and merged the data in the Stata/SE ® version 17.0 statistical software (StataCorp, College Station, TX, USA). Finally, we performed the statistical analysis considering the complex sampling of the survey and the svy command.

We estimated weighted proportions with their respective 95% confidence intervals (95%CI) and absolute frequencies to describe the characteristics of the participants. We used the Chi-square test with Rao-Scott correction to perform the bivariate analysis between the independent variables and not having received a COVID-19 booster dose. We used two generalized linear models (crude and adjusted) of the Poisson family with logarithmic link function to estimate the factors associated with not having received a booster dose against COVID-19. We estimated crude (cPR) and adjusted (aPR) prevalence ratios with their respective 95%CI. We used a statistical criterion for the adjusted regression model (variables with a p value < 0.05 were included in the crude model). We evaluated the possible collinearity of the associated factors included in the final adjusted model.

2.7. Ethical issues

This study did not require the approval of an ethics committee since we analyzed a secondary database. This database collected data without identifiers, which ensures the protection of the confidentiality of the survey participants. Respondents gave informed consent prior to completing the survey. Access to the survey database was obtained with permission from the University of Maryland.

3. Results

3.1. Characteristics of the study sample

We analyzed a sample of 154,841 adults from 20 LAC countries. We found that 51.7% (n = 87,754) were women, 21.7% (n = 33,635) were between 25 and 34 years old, 42.4% (n = 60,213) had a secondary or pre-university education, 82.2% (n = 130,740) lived in a city; 59.8% (n = 89,117) reported food insecurity, and 78.8% (n = 121,046) reported economic insecurity. Additionally, 39.2% (n = 62,341) and 44.3% (n = 68,891) reported having anxious and depressive symptoms, respectively; 56.4% (n = 83,717) reported having no comorbidities, 43.9% (n = 68,203) had had COVID-19 at some point, and 33.7% (n = 46,459) reported not having received a COVID-19 booster vaccine (Table 1). The countries with the highest prevalence of not receiving a booster dose were Venezuela (66.6%) and Bolivia (49.5%), while the Latin American countries with the highest prevalence of receiving a booster dose were Chile (92.6%) and Uruguay (88.1%) (Fig. 2 and Supplementary Material).

3.2. Bivariate analysis according to not having received the booster vaccine against COVID-19

We found statistically significant differences in the bivariate analysis between the independent variables and not having received the COVID-19 booster vaccine, except for being employed (p = 0.345) (Table 2).

3.3. Factors associated with not having received the booster vaccine against COVID-19

The adjusted statistical regression model showed a higher prevalence of not having received the COVID-19 booster vaccine among people aged 65–74 years (aPR = 1.23; 95%CI: 1.02–1.48; p = 0.029), 55–64 years old (aPR = 1.82; 95%CI: 1.49–2.22; p < 0.001), 45–54 years old (aPR = 2.33; 95%CI: 1.88–2.89; p < 0.001), 35–44 years old (aPR = 3.06; 95%CI: 2.44–3.84; p < 0.001), 25–34 years old (aPR = 3.95; 95% CI: 3.12–5.01; p < 0.001) and 18–24 years old (aPR = 4.86; 95%CI: 3.81–6.20; p < 0.001) compared to those aged 75 and over. We found a lower prevalence of not having received the booster vaccine in female (aPR = 0.89; 95%CI: 0.87–0.92; p < 0.001) and non-binary participants (aPR = 0.76; 95%CI: 0.60–0.97; p = 0.025) compared to the male gender group. Compared with having a postgraduate educational level, having a university (aPR = 1.27; 95%CI: 1.21–1.32; p < 0.001), secondary or pre-university education (aPR = 1.39; 95%CI: 1.32–1.47; p <

Table 1
Characteristics of the study population (n = 154,841).

Characteristics	n	%[a]	95%CI[a]
Gender			
Male	66,827	48.1	47.4–48.9
Female	87,754	51.7	50.9–52.4
Non-binary	260	0.2	0.17–0.23
Age (years)			
18 - 24	17,636	15.4	14.7–16.2
25 - 34	33,635	21.7	21.1–22.3
35 - 44	35,110	20.1	19.8–20.4
45 - 54	30,628	18.9	18.6–19.2
55 - 64	24,552	12.6	12.1–13.2
65 - 74	11,095	9.5	9.0–10.2
75 years or older	2,185	1.7	1.5–1.9
Area of residence			
City	130,740	82.2	79.0–85.1
Town	14,839	11.3	9.1–13.9
Village or rural area	9,262	6.5	5.6–7.4
Educational level			
Primary school or less	12,384	8.8	7.6–10.2
Secondary school – pre-university	60,213	42.4	41.2–43.7
University	58,541	35.6	33.9–37.3
Postgraduate	23,703	13.2	12.2–14.2
Employment			
No	61,475	42.3	41.0–43.6
Yes	93,366	57.7	56.4–59.0
Comorbidities			
None	83,717	56.4	55.3–57.4
1 to 2	62,811	38.7	38.0–39.5
Greater than or equal to 3	8,313	4.9	4.5–5.3
History of COVID-19			
No	86,638	56.1	54.7–57.4
Yes	68,203	43.9	42.6–45.3
Food insecurity			
No	65,664	40.2	38.8–41.5
Yes	89,117	59.8	58.5–61.2
Economic insecurity			
No	33,795	21.2	20.6–21.9
Yes	121,046	78.8	78.1–79.4
Anxiety symptoms			
No	92,500	60.8	59.9–61.6
Yes	62,341	39.2	38.4–40.1
Depressive symptoms			
No	85,950	55.7	55.0–56.5
Yes	68,891	44.3	43.5–45.0
Having received a booster			
Yes	108,382	66.3	63.7–68.7
No	46,459	33.7	31.3–36.3

95%CI: 95% confidence intervals.
[a] Weighted percentages according to survey complex sampling.

0.001) or having a primary level or less (aPR = 1.31; 95%CI: 1.22–1.40; p < 0.001) was associated with a higher prevalence of not having received the booster vaccine. In addition, compared to having three or more comorbidities, having one to two comorbidities (aPR = 1.09; 95% CI: 1.03–1.16; p = 0.003) or not having any comorbidities (aPR = 1.21; 95%CI: 1.13–1.29; p < 0.001) was associated with a higher prevalence of not having received the COVID-19 booster vaccine. Likewise, living in a town (aPR = 1.09; 95%CI: 1.02–1.17; p = 0.012), having food insecurity (aPR = 1.10; 95%CI: 1.07–1.14; p < 0.001), depressive symptoms (aPR = 1.06; 95%CI: 1.04–1.09; p < 0.001) and having had COVID-19 (aPR = 1.24; 95%CI: 1.20–1.28; p < 0.001) were associated with a higher prevalence of not having received the booster vaccine. On the other hand, having symptoms of anxiety (aPR = 0.95; 95%CI: 0.92–0.98; p < 0.001) was associated with a lower prevalence of not having received the COVID-19 booster vaccine (Table 3).

4. Discussion

4.1. Main findings

This study aimed to assess the prevalence and factors associated with not receiving a booster dose of the COVID-19 vaccine. Our findings show that approximately one in three participants did not receive a booster dose. Being under the age of 75, having a college, high school or pre-university, and primary education or less, having no or fewer than three comorbidities, living in a town, being food insecure, having depressive symptoms, and having had COVID-19, were associated with a higher prevalence of not having received the booster dose. In contrast, being female or non-binary and having anxiety symptoms were associated with a lower prevalence of not having received the booster dose.

4.2. Prevalence of not having received a booster dose in LAC countries

As of March 27, 2022, 81.6% of the Chilean population and 62.9% of the Uruguayan population had received a booster dose [20]. On the other hand, the WHO reported that for that date, 2.3% and 9.9% of the population received a booster dose in Venezuela and Bolivia, respectively [3]. Although Chile and Uruguay lead the coverage of the booster dose [3], the difference in the percentages of the population receiving the booster vaccination in the present study could be due to the type of sample used in our research. While our study included the population that accessed a social network, the WHO reports include official data collected by governments [3].

The heterogeneity of booster dose coverage across countries is multifactorial and includes structural aspects of vaccination strategies [25]. However, differences in booster vaccination coverage among countries may also be explained by individual aspects regarding the perception of the booster dose. In Poland, the main reasons for not accepting the booster dose were side effects experienced after previous doses, the opinion that it is unnecessary, and uncertainty regarding its safety [13]. In Jordan, there were doubts about its usefulness, because according to the perception of the interviewees, the previous doses had been received a short time ago or that, with a history of infection, an additional dose was not necessary [14]. In China, confidence in the effectiveness of COVID-19 vaccines against SARS-CoV-2 and its variants and having previously received the vaccine influenced the need for a booster dose [16]. Although our study does not identify the reasons for the intention to receive a booster dose, it is clear that it is necessary to encourage the population to receive the booster vaccine, since in some LAC countries, the campaign for a fourth dose is already being reinforced [26,27]. In this sense, identifying the population groups or the characteristics of the population in which this dose is more or less accepted will allow the countries to individualize these campaigns.

4.3. Factors associated with not receiving a booster dose

Compared with persons under 75 years of age, all participants in lower age ranges had a lower probability of having received a booster dose, with the probability being lower when the respondent was younger. Similarly, compared with individuals with more than three comorbidities, those who had less than two or none were less likely to receive a booster dose. This is because most countries prioritized this dose in the population at risk; that is, the older adult population or those with more comorbidities [28,29]. However, it is likely that the perceived health of older adults also influences the likelihood of receiving a booster dose. In Poland, older adults who perceived better health status after the initial vaccination schedule were more likely to receive a booster dose [13].

Our results show that in people with anxiety symptoms there was a lower prevalence of not having received the booster dose. These results are similar to the intention of parents with symptoms of anxiety in LAC to vaccinate children and adolescents against COVID-19 in association with fear of the consequences that the infection may cause in their children [12]. In the same context, in adults, the fear of becoming ill or that a relative becomes seriously ill, was also associated with a greater probability of vaccination intention [11]. Although they are not comparable situations since our study did not evaluate the intention to be

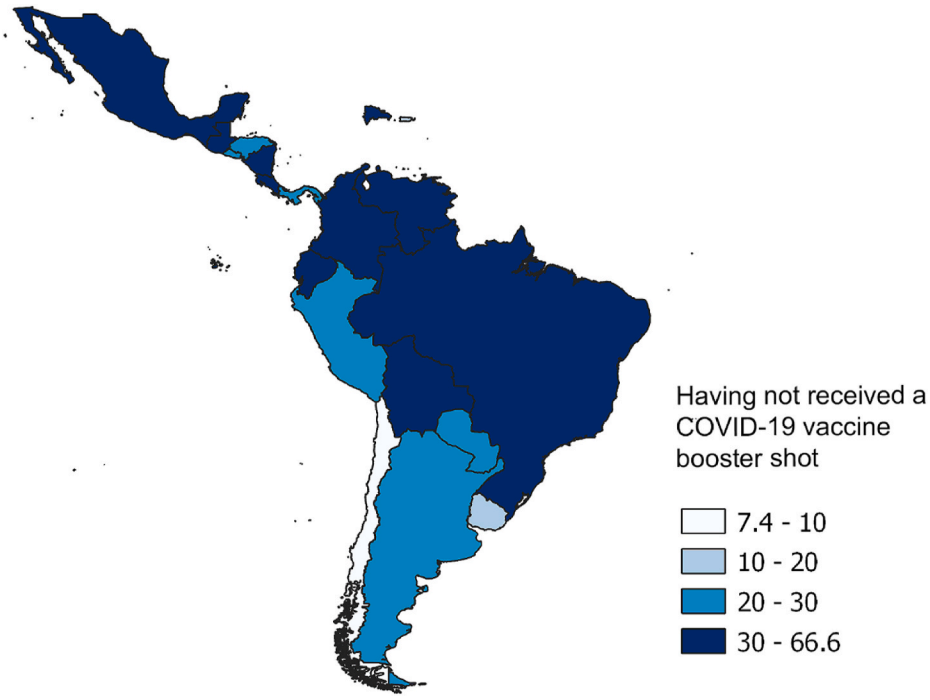

Fig. 2. Prevalence of not having received a COVID-19 vaccine booster in Latin America and the Caribbean countries.

vaccinated against COVID-19, but rather having received a booster dose, these results suggest that fear of the disease and its consequences still play an important role in the decision of some people to be vaccinated with a booster dose. In Denmark, vaccination intention was less frequent in groups that do not see COVID-19 as a threat to society [17]. In Italy, the intention to receive a booster dose was higher in those who had had a relative diagnosed with the disease [18], and in China, the same was true in the population that had a higher perception of susceptibility [15]. In people with anxiety, there is probably a greater intention to comply with the measures to prevent the disease due to the anxiety condition, which could explain their greater intention to receive the vaccine [30], even describing a greater intention to pay to receive the vaccine [31]. The aforementioned could explain a greater probability of receiving a booster vaccine in people with anxiety.

Our results showed that some conditions that were previously associated with a higher vaccination intention in LAC were associated with a higher prevalence of not having received the booster dose, such as having food insecurity, depressive symptoms, and having had COVID-19 [11,12]. These results could be explained by the indirect effects of a prolonged pandemic. This study was carried out when the countries were coming out of a wave of infection by the omicron variant of SARS-CoV-2, in which there was a lower number of deaths due to either less severity of the clinical symptoms or an increase in coverage of two doses worldwide [3,29]. This could give the impression that further measures against the pandemic are not necessary, since in parallel to this, many Latin American countries lifted some restriction measures [32]. In the case of people with depression, it is described that they are more likely to endorse false statements about COVID-19 and have half the likely to be vaccinated compared with those without depression, being proposed that a lack of positive interpretation bias or optimistic beliefs could conditionate those results mentioned above [33]. Additionally, there has been physical and mental exhaustion due to the restrictions related to the pandemic called “pandemic fatigue”, which causes people to decrease adherence to measures to prevent infection compared to the start of the pandemic [34,35].

As in the case of vaccination intention in children and adolescents, having a lower educational level was associated with not receiving a booster dose [13]. Likewise, although the two studies are not comparable because we did not evaluate vaccination intention, in China, a low educational level and low knowledge about COVID-19 were associated with a lower intention to receive the booster dose [15]. Our results may also be related to the infodemic which affects vaccination campaigns and impacts people regardless of educational level by the dissemination of erroneous information regarding vaccines [36,37]. This is relevant, because the intention to receive an additional dose is related to aspects such as doubts regarding the need, usefulness and safety of the booster. In this sense, in Denmark, individuals who did not perceive the advice of the health authorities as effective against the spread of the disease had lower acceptance of the booster dose [17].

Being female or non-binary was associated with a higher probability of having a booster dose, unlike previous studies reporting that the intention of receiving booster vaccination was greater in men in both the LAC region and worldwide [11,38]. While it has been described that woman are more exposed to anti-vaccine groups and that men are less susceptible to disease-related conspiracy theories [39–41], in the present study population this did not seem to influence the decision to receive the booster dose. Throughout the world, the participation of women in the fight against the pandemic has been important, with their collaboration with institutions performing effective and inclusive responses to COVID-19, from the highest decision-making levels to the provision of front-line services [6,42], thereby favoring the empowerment of women in health decision making. Although it has been described that "pandemic fatigue" affects women more than men [43], there are differences in both mental health problems and adherence to some community mitigation measures [21,22], a situation which has also been described in the non-binary population [44]. However, while these aspects were not evaluated in this study, they could influence the findings, and thus, more studies are required regarding the influence of gender on the decision to receive a COVID-19 booster dose.

4.4. Strengths and limitations

Our study has some limitations. First, because the respondents were users of a social network, information was only obtained from people with access to the internet and social networks, which could vary between the regions of the countries evaluated or the rural populations.

Table 2
Prevalence of not having received booster according to the characteristics of the study population.

Characteristics	Not having received booster						
	Yes			No			P value[b]
	n	%[a]	95%CI[a]	n	%[a]	95%CI[a]	
Gender							**<0.001**
Male	45,725	64.3	61.9–66.6	21,102	35.7	33.4–38.1	
Female	62,486	68.1	65.4–70.7	25,268	31.9	29.3–34.6	
Non-binary	171	65.5	56.3–73.7	89	34.5	26.3–43.7	
Age (years)							**<0.001**
18–24	7,704	42.6	39.9–45.5	9,932	57.4	54.5–60.2	
25–34	19,735	55.3	52.1–58.4	13,900	44.7	41.6–47.9	
35–44	24,497	66.2	63.7–68.4	10,613	33.8	31.4–36.3	
45–54	23,966	75.0	72.7–77.3	6,662	25.0	22.7–27.3	
55–64	20,592	81.2	79.1–83.2	3,960	18.8	16.8–20.9	
65–74	9,989	87.9	85.8–89.8	1,202	12.1	10.2–14.2	
75 years or older	1,995	90.5	87.7–92.7	190	9.5	7.3–12.3	
Area of residence							**<0.001**
City	92,194	67.2	64.5–69.8	38,546	32.8	30.2–35.5	
Town	9,709	60.5	58.2–62.8	5,130	39.5	37.2–41.8	
Village or rural area	6,479	64.2	61.9–66.4	2,783	35.8	33.6–38.1	
Educational level							**<0.001**
Primary school or less	8,872	69.0	66.3–71.7	3,512	31.0	28.3–33.7	
Secondary school – pre-university	39,245	61.1	58.6–63.6	20,968	38.9	36.4–41.4	
University	41,111	67.0	64.1–69.8	17,430	33.3	30.2–35.9	
Postgraduate	19,154	79.0	76.9–81.0	4,549	21.0	19.0–23.1	
Employment							0.345
No	43,123	66.6	64.0–69.1	18,352	33.4	30.9–36.0	
Yes	65,259	66.0	63.4–68.5	28,107	34.0	31.5–36.6	
Comorbidities							**<0.001**
None	55,049	61.8	59.3–64.3	28,668	38.2	35.7–40.7	
1 to 2	46,588	71.3	68.8–73.6	16,223	28.7	26.4–31.2	
Greater than or equal to 3	6,745	77.8	74.9–80.3	1,568	22.2	19.7–25.1	
History of COVID-19							**<0.001**
No	64,702	70.4	67.8–72.9	21,936	29.6	27.1–32.2	
Yes	43,680	61.0	58.6–63.4	24,523	39.0	36.6–41.4	
Food insecurity							**<0.001**
No	48,569	71.0	68.6–73.2	17,095	29.0	26.8–31.4	
Yes	59,813	63.1	60.5–65.6	29,364	36.9	34.4–39.5	
Economic insecurity							**<0.001**
No	25,663	72.9	70.6–75.0	8,132	27.1	25.0–29.4	
Yes	82,719	64.5	61.8–67.1	38,327	35.5	32.9–38.2	
Anxiety symptoms							**<0.001**
No	66,516	68.2	65.7–70.6	25,984	31.8	29.4–34.3	
Yes	41,866	63.2	60.4–65.9	20,475	36.8	34.1–39.6	
Depressive symptoms							**<0.001**
No	63,011	70.0	67.7–72.2	22,939	30.0	27.8–32.3	
Yes	45,371	61.6	58.6–64.5	23,520	38.4	35.5–41.4	

95%CI: 95% confidence interval.
P-values <0.05 are in bold.
[a] Weighted percentages according to survey complex sampling.
[b] Calculated by Chi2 test of independence with Rao Scott correction for complex sampling.

Then, this could overestimate the prevalence's found in this study. Second, the variables included, and their definition are subject to the pre-established definition of the parent survey and there could be relevant variables not included in our analysis. Third, the data was obtained by self-reporting, and thus, there may be underreporting of information. Fourth, causality among the variables evaluated cannot be established due to the cross-sectional design of the study. Fifth, the measurements used to assess food and economic security were not validated, however, they provide relevant information to the study. Sixth, we do not have the frequency of non-response, which is relevant in the context of an online survey, and this may induce bias to our results due to the frequency of user rejection in the survey, as well as the possibility of occurrence of voluntary response bias. Despite these limitations, the sample size was large with national representation in various countries of the continent that can help understand the study subject.

5. Conclusions

In conclusion, one in three participants did not receive a booster dose. The countries with the highest prevalence of not having received a booster dose were Venezuela and Bolivia. Being under 75 years of age, having the lowest level of education, having fewer than three comorbidities, living in a town, having food insecurity, depressive symptoms, and having had COVID-19 were associated with a higher prevalence of not having received the booster dose. In contrast, being female or non-binary and having anxiety symptoms were associated with a lower prevalence of not having received the booster dose. The results of this study suggest the need to develop booster vaccination campaigns with a greater focus on gender and to prioritize messages and content according to population subgroups to increase the receipt of booster doses.

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Table 3
Factors associated with not having received a booster in adults from Latin America and the Caribbean.

Characteristics	Crude model			Adjusted model		
	cPR	95%CI	P value	aPR	95%CI	P value
Gender						
Male	Ref.			Ref.		
Female	0.89	0.87–0.92	**<0.001**	0.89	0.87–0.92	**<0.001**
Non-binary	0.97	0.76–1.22	0.768	0.76	0.60–0.97	**0.025**
Age (years)						
75 years or older	Ref.			Ref.		
65–74	1.28	1.05–1.53	**0.014**	1.23	1.02–1.48	**0.029**
55–64	1.97	1.61–2.41	**<0.001**	1.82	1.49–2.22	**<0.001**
45–54	2.62	2.11–3.25	**<0.001**	2.33	1.88–2.89	**<0.001**
35–44	3.55	2.82–4.46	**<0.001**	3.06	2.44–3.84	**<0.001**
25–34	4.70	3.71–5.96	**<0.001**	3.95	3.12–5.01	**<0.001**
18–24	6.03	4.70–7.72	**<0.001**	4.86	3.81–6.20	**<0.001**
Area of residence						
City	Ref.			Ref.		
Town	1.20	1.12–1.30	**<0.001**	1.09	1.02–1.17	**0.012**
Village or rural area	1.09	1.02–1.17	**0.008**	1.02	0.96–1.08	0.572
Educational level						
Postgraduate	Ref.			Ref.		
University	1.57	1.50–1.65	**<0.001**	1.27	1.21–1.32	**<0.001**
Secondary school – pre-university	1.85	1.75–1.96	**<0.001**	1.39	1.32–1.47	**<0.001**
Primary school or less	1.48	1.37–1.58	**<0.001**	1.31	1.22–1.40	**<0.001**
Employment						
Yes	Ref.			Not included[a]		
No	0.98	0.95–1.01	0.251			
Comorbidities						
Greater than or equal to 3	Ref.			Ref.		
1 to 2	1.29	1.21–1.38	**<0.001**	1.09	1.03–1.16	**0.003**
None	1.72	1.59–1.85	**<0.001**	1.21	1.13–1.29	**<0.001**
History of COVID-19						
No	Ref.			Ref.		
Yes	1.32	1.27–1.37	**<0.001**	1.24	1.20–1.28	**<0.001**
Food insecurity						
No	Ref.			Ref.		
Yes	1.27	1.23–1.31	**<0.001**	1.10	1.07–1.14	**<0.001**
Economic insecurity						
No	Ref.			Not included[b]		
Yes	1.31	1.27–1.35	**<0.001**			
Anxiety symptoms						
No	Ref.			Ref.		
Yes	1.16	1.12–1.19	**<0.001**	0.95	0.92–0.98	**<0.001**
Depressive symptoms						
No	Ref.			Ref.		
Yes	1.28	1.25–1.31	**<0.001**	1.06	1.04–1.09	**<0.001**

cPR: crude prevalence ratio; aPR: adjusted prevalence ratio; 95%CI: 95% confidence interval.
Prevalence ratios and confidence intervals were calculated taking into account the complex sampling of the survey.
P-values <0.05 are in bold.
[a] Not included due to not having a statistically significant association in the crude model.
[b] Not included due to collinearity with food insecurity.

Authors' contributions

All authors made substantial contributions to the study's conception and design, analysis, and interpretation.

Ethical approval

We analyzed a secondary database without identifiers and participants gave informed consent prior to answering the survey. Then, the integrity of the participants was not compromised, and this study is exempt from an institutional review board ethical approval. We obtained the data by signing a research data use agreement with the University of Maryland. We downloaded the data without identifiers.

CRediT authorship contribution statement

Diego Urrunaga-Pastor: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Daniel Fernandez-Guzman:** Conceptualization, Methodology, Writing – original draft. **Brenda Caira-Chuquineyra:** Conceptualization, Methodology, Writing – original draft. **Percy Herrera-Añazco:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Vicente A. Benites-Zapata:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Guido Bendezu-Quispe:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

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