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COVID-19 Vaccine Booster Hesitancy among Hispanic Adults: The Puerto Rico Community Engagement Alliance (PR-CEAL) against COVID-19 Disparities

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Abstract: Hispanic/Latino communities have suffered a disproportionate burden due to the COVID-19 pandemic. Although Puerto Rico has one of the highest COVID-19 primary series vaccination rates nationwide, this estimate contrasts with the low uptake of booster doses (32.7%). This study aimed to assess health belief correlates of COVID-19 vaccine booster uptake. PR-CEAL recruited 787 participants via an online survey between December 2021 and January 2022. Sociodemographic characteristics and questions framed using the Health Belief Model were assessed. Analyses included adjusted Poisson regression models to estimate prevalence ratios (PR) of booster refusal. Overall, 22% of participants planned (10%) or refused (12%) the vaccine booster. Participants with lower income [PR=1.92; 95%CI=1.30, 2.84], in disagreement with vaccine benefits [PR=4.16; 95%CI=3.06, 5.64], and in agreement with booster concerns [PR=2.93; 95%CI=2.12, 4.04], efficacy [PR=2.76; 95%CI=2.00, 3.82], and safety [PR=2.97; 95%CI=2.15, 4.08] were significantly more likely to refuse the booster. Booster vaccination refusal was associated with lower perceived vaccine benefits and higher barriers among adults in Puerto Rico. Results informed CEAL team intervention strategies for public health campaigns to increase booster vaccine uptake.

Keywords: COVID-19; booster; vaccine uptake

1. Introduction

From March 2020 through February 14, 2023, 442,788 confirmed cases of COVID-19 and 5,759 deaths were reported in Puerto Rico (PR) [1], a US territory primarily composed of Hispanic. Nine months after the promotion of education strategies for the mitigation and prevention of the spread of the virus (December 2020), vaccines became available in PR for a select group of the population; the remainder of the population gained access to the vaccines in early 2021. The primary series vaccination rate of the COVID-19 vaccine in PR was approximately 86.3% [2] and was one of the highest in the United States [3]. However, in terms of booster completion, this extraordinary accomplishment was not duplicated. According to the PR Department of Health (PRDH), only 34.6% of the population have received the booster dose recommended by the Centers for Disease Control and Prevention (CDC) [4,1]. Several studies have discovered that booster doses have not been accepted to the same degree that the primary series of the vaccine has [5,6,7].

Vaccine hesitancy is a major public health problem, especially given the magnitude of the COVID-19 pandemic [5]. For the Hispanic population, compared with non-Hispanic whites, a high uptake for the primary series and a remarkably lower rate for booster uptake was documented [8]. It is of primary concern that Hispanics have lower rates of booster uptake compared to non-Hispanic

whites, despite the former's disproportionate burden of COVID-19 compared to the latter's as observed during the pandemic [8]. In the study of Baker and colleagues, it was documented that Hispanics had higher rates of deaths caused by COVID-19 than did non-Hispanic whites [8].

In addition to the influences of social and environmental factors on booster vaccine uptake, the beliefs and attitudes of the population of interest may also have played a part in the low booster vaccination rate. Multiple studies have documented the unwillingness of some individuals to receive both the COVID-19 vaccine primary series and the booster dose [9,10]. Qin and colleagues revealed that the primary reasons given for refusing the booster vaccine were the complicated vaccination process (e.g., long waiting lines and difficulties obtaining appointments) and uncertainty about the safety and effectiveness of the vaccine [10].

It is important to understand the perceptions and attitudes at the population level to develop efficient strategies to address vaccine hesitancy. To this end, the health belief model (HBM) has been used recently in many studies about vaccinations for COVID-19 and other illnesses, such as influenza [9–11]. The HBM is composed of a series of constructs that include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [11]. According to the results of Qin and colleagues (2022), those who perceived themselves to have a low susceptibility to COVID-19 were more likely to refuse the booster dose than were their counterparts who perceived themselves as having a greater level of susceptibility [10]. An earlier study by our team showed that the factors perceived susceptibility, vaccination benefits, barriers, and cues to action were associated with the unwillingness of some Puerto Rican adults to receive a COVID-19 vaccine [9]. Based on these findings, we aimed to assess the health-belief correlates of COVID-19 booster uptake, doing so using data collected as part of the PR Community Engagement Alliance (PR-CEAL) initiative.

2. Materials and Methods

2.1. Puerto Rico-Community Engagement Alliance

In the past 2 years, the PR-CEAL has led efforts to address COVID-19 health disparities, misinformation, and mistrust of the vaccination process (including the booster vaccine).

2.2. Study Design

Along with our CEAL partners, nationwide, we have made efforts to develop and implement a single COVID-19 survey that could be used across multiple populations. Among the emerging indicators that informed the design of the survey were general sociodemographic information, social determinants of health, COVID-19 prevention behaviors, testing behaviors, perceived trusted sources of information about COVID-19, and general perceptions of COVID-19. Important sources of data included the results of several clinical trials. The first version of the survey was developed in October 2021. Due to the dynamic nature of the pandemic and since the implementation of the vaccine, a second version of the common survey has been developed (December 2021); this version took into consideration a given respondent's intention to get a COVID-19 booster vaccine, the prevalence of chronic conditions in that individual, whether he or she had received the influenza vaccine, his or her self-perceived mental health, and that individual's screening practices for cancer and other common diseases in PR. Using the HBM as reference, our team added several questions to the second version of the CEAL common survey. These questions examined beliefs, behaviors, and the impact of the pandemic on adults residing in Puerto Rico [10].

After the completion of the survey design, in-person participant recruitment started on December 30, 2021, and consisted of visiting supermarkets and community settings on the island. This recruitment initiation date was before the spread of the Omicron variant. After this new variant of COVID-19 was reported in PR, the team adapted a new recruitment strategy that used only online recruitment. The team used different platforms, including Facebook, Instagram, and email blasts directed at academic groups, to invite individuals to complete the online survey. The inclusion criteria for participation in our study were being 18 years old or older, a resident of PR, and able to answer the questionnaire in Spanish.

The Institutional Review Board (IRB) of the University of PR Medical Sciences campus approved the study (IRB protocol number: 6050220). Each participant who finished the survey received a $30 gift card, which was sent via certified mail upon completion of the questionnaire.

2.3. Measurements

2.3.1. Main outcome variables

Booster acceptance was assessed with the question "Do you intend to get a booster shot?" as established in the CEAL common survey. Response options were "I already got the booster," "I will get it as soon as possible," "I am going to wait to see how it affects others," "I have no intention to get the booster soon, but I could sometime in the future," and "not at all." All the participants who answered, "I already got the booster" were considered to be accepting of it. The participants who used any other response were considered to be refusing to accept the booster. Beliefs about the COVID-19 booster vaccine were assessed using the HBM constructs defined by Wong, et al. We examined the following 5 constructs: *perceived susceptibility* (My chance of getting COVID-19 in the next few months is great; I am worried about the likelihood of getting COVID-19; and Getting COVID-19 is currently a possibility for me), *perceived severity* (Complications from COVID-19 are serious; I will be very sick if I get COVID-19; and I am afraid of getting COVID-19), *perceived benefits* (A booster dose is a good idea because it makes me feel less worried about catching COVID-19; and Getting the booster will decrease my chance of getting COVID-19 or its complications), *perceived barriers* (I worry that the possible side effects of the COVID-19 booster vaccine would interfere with my usual activities; I am concerned about the efficacy of the COVID-19 booster vaccine; and I am concerned about the safety of the COVID-19 booster vaccine), and *cues to action* (I will take the booster only if I am given adequate information about it; and I will take the COVID-19 booster only if the vaccine is taken by many in the public).

The sociodemographic characteristics collected included age, sex, education level, annual income, ethnicity, health insurance, and marital status. The variables that were included here were similar to those of other studies, which had found that they—said variables—influence the thoughts and beliefs of people [9,10]. For the analysis, age, education level, income, and marital status were grouped for convenience. We assessed religiosity with 1 item that asked each respondent about the importance of religion in his or her life, and the answer options ranged from *not important* to *very important.*

2.4. Statistical analysis

A chi-square or Fisher's exact test was used to assess the associations between sociodemographic characteristics, HBM constructs, and booster-vaccine acceptance. Poisson regression models with robust variance were used to estimate the prevalence ratios and 95% confidence intervals (CIs) for each outcome of interest. The models were adjusted based on bivariate analysis significance for income, health insurance, marital status, and the importance of religion. All the statistical analyses were performed using Stata version 17 (StataCorp LLC, College Station, TX, USA).

3. Results

A total of 787 participants were included in this analysis. Table 1 shows the demographic characteristics of the participants. The majority (72.2%) were women, and 71.7% had a college degree or greater. The mean (and standard deviation) age of participants was 38.6 (±14.1) years. The vast majority (96.5%) of the participants self-identified as Puerto Rican, 46.9% were single, and 31.1% indicated that religion was very important for them. In terms of income, 54.5% of participants reported having an annual income lower than $40,000. Regarding COVID-19 booster vaccine outcomes, 78% reported already having gotten the booster, and 22% either had refused the booster or would get it as soon as possible.

Table 1. Sociodemographic and booster acceptance.

Characteristic	Frequency (%)	Refusal	Acceptance	p-value
Education level				0.255
High school diploma or less	57 (7.4)	15 (26.3)	42 (73.7)	
GED, some college, associate degree	160 (20.9)	40 (25.2)	119 (74.8)	
Bachelors, masters, and/or doctoral degree(s)	550 (71.7)	110 (20.0)	439 (80)	
Age (years)				0.278
Mean (SD)	38.6 (14.1)	-------		
≤30	278 (35.7)	61 (20.8)	233 (79.2)	
31−40	259 (33.2)	48 (28.2)	122 (71.8)	
41−50	242 (31.1)	26 (19.9)	105 (80.1)	
Marital status				0.053
Married, living with partner	356 (45.6)	90 (25.4)	265 (74.6)	
Divorced/separated, widowed	425 (54.4)	83 (19.6)	341 (80.4)	
Sex				0.663
Male	215 (27.8)	45 (21.0)	169 (79.0)	
Female	557 (72.2)	431 (77.5)	125 (22.5)	
Importance of religion				0.070
Not important	195 (25.1)	32 (16.5)	162 (83.5)	
Somewhat important	185 (23.8)	42 (22.8)	142 (77.2)	
Important	398 (51.1)	99 (24.9)	299 (75.1)	
Income				0.007
≤$40,000	374 (54.5)	95 (25.5)	278 (74.5)	
>$40,000	312 (45.5)	53 (17.0)	259 (83.0)	
Health insurance				0.049
No	746 (96.0)	11 (36.7)	19 (63.3)	
Yes	31 (4.0)	160 (21.5)	585 (78.5)	

Income and having health insurance were statistically significantly associated with booster refusal (p<0.05). Marital status, the importance of religion, and most recent health check achieved marginal significance. In general, almost all the HBM constructs were associated with booster refusal, except for the following: "My chance of getting COVID-19 in the next few months is high," "Getting COVID-19 is currently a possibility for me," and "I will be very sick if I get COVID-19"; these all achieved statistical significance in bivariate analysis (p>0.05) (Table 2).

Table 2. Health belief model and booster acceptance.

HBM construct	Refused	Accepted	p-value
Perceived susceptibility			
My chance of getting COVID-19 in the next few months is high			0.348
Agree	81 (20.6)	312 (79.4)	
Disagree	91 (23.4)	298 (76.6)	
I am worried about the likelihood of getting COVID-19			<0.01
Agree	107 (17.6)	501 (82.4)	
Disagree	65 (37.6)	108 (62.4)	
Getting COVID-19 is currently a possibility for me			0.225
Agree	110 (20.7)	420 (79.3)	

Disagree	62 (24.6)	190 (75.4)	
Perceived severity			
The complications from contracting COVID-19 are serious			<0.01
Agree	127 (18.1)	574 (81.9)	
Disagree	45 (55.6)	36 (44.4)	
I will be very sick if I get COVID-19			0.236
Agree	55 (19.6)	225 (80.4)	
Disagree	117 (23.3)	385 (76.7)	
I am afraid of getting COVID-19			<0.01
Agree	76 (16.0)	400 (84.0)	
Disagree	95 (31.1)	210 (68.9)	
Perceived benefits			
The booster is a good idea because it makes me feel less worried about catching COVID-19			<0.01
Agree	68 (12.0)	500 (88.0)	
Disagree	105 (49.8)	106 (50.2)	
The booster will decrease my chances of getting COVID-19 or its complications			<0.01
Agree	86 (14.0)	529 (86.0)	
Disagree	87 (52.4)	79 (47.6)	
Perceived barriers			
I worry the possible side-effects of the booster would interfere with my usual activities			<0.01
Agree	119 (35.4)	217 (64.6)	
Disagree	54 (12.1)	392 (87.9)	
I am concerned about the efficacy of the COVID-19 booster			<0.01
Agree	121 (33.8)	237 (66.2)	
Disagree	52 (12.2)	373 (87.8)	
I am concerned about the safety of the COVID-19 booster			<0.01
Agree	118 (36.1)	209 (63.9)	
Disagree	55 (12.2)	397 (87.8)	
Cues to action			
I will take the COVID-19 booster only if I am given adequate information about it			<0.01
Agree	82 (73.9)	29 (26.1)	
Disagree	64 (94.1)	4 (5.9)	
Already got the booster	27 (4.5)	577 95.5)	
I will take the COVID-19 booster only if the vaccine is taken by many in the public			<0.01
Agree	30 (69.8)	13 (20.2)	
Disagree	112 (84.2)	21 (15.8)	
Already got the booster	31 (5.1)	575 (94.9)	

As shown in Table 3, those who were not worried about getting COVID-19 presented a prevalence ratio of 2.24 (95% CI: 1.61, 3.13) for booster refusal, after adjusting for the covariates. Those who did not recognize COVID-19 as a severe illness or who reported being afraid of COVID-19 (perceived severity construct) presented adjusted prevalence ratios of 3.49 (95% CI: 2.41, 5.05) and 1.99 (95% CI: 1.43, 2.76), respectively. In general, the participants who disagreed that getting the booster dose either made them feel less worried about COVID-19 or decreased their chances of getting COVID-19 presented higher booster-refusal prevalence ratios (adjusted prevalence ratio: 4.20, 95% CI: 3.00, 5.90; adjusted prevalence ratio: 3.67, 95% CI: 2.63, 5.14). Similarly, participants who perceived barriers such as being worried about side effects or the efficacy or safety of the booster

vaccine presented higher prevalence of booster refusal (adjusted prevalence ratio: 2.41, 95% CI: 1.70, 3.40; adjusted prevalence ratio: 2.47, 95% CI: 1.74, 3.51; adjusted prevalence ratio: 2.71, 95% CI: 1.91, 3.84).

Table 3. Poisson Regression Models.

HBM Construct	Refused to get COVID-19 booster dose			
	Crude Prevalence Ratio (95% CI)	p-value	Adjusted Prevalence Ratio (95% CI)	p-value
Perceived susceptibility				
My chance of getting COVID-19 in the next few months is high				
Disagree	1.14 (0.84, 1.53)	0.407	1.06 (0.76, 1.47)	0.763
I am worried about the getting COVID-19				
Disagree	2.14 (1.57, 2.91)	<0.001	2.24 (1.61, 3.13)	<0.001
Getting COVID-19 is currently a possibility for me				
Disagree	1.19 (0.87, 1.62)	0.284	1.17 (0.83, 1.64)	0.382
Perceived severity				
The complications from contracting COVID-19 are serious				
Disagree	3.07 (2.18, 4.31)	<0.001	3.49 (2.41, 5.05)	<0.001
I will be very sick if I get COVID-19				
Disagree	1.19 (0.86, 1.64)	0.296	1.28 (0.90, 1.82)	0.173
I am afraid of getting COVID-19				
Disagree	1.95 (1.44, 2.64)	<0.001	1.99 (1.43, 2.76)	<0.001
Perceived benefits				
Getting the booster is a good idea because doing so will make me feel less worried about catching COVID-19				
Disagree	4.58 (3.06, 5.64)	<0.001	4.20 (3.00, 5.90)	<0.001
Getting the booster will decrease my chances of getting COVID-19 or suffering from 1 or more of its complications				
Disagree	3.75 (2.78, 5.05)	<0.001	3.67 (2.63, 5.14)	<0.001
Perceived barriers				
I worry that the possible side effects of the booster would interfere with my usual activities				
Agree	2.92 (2.12, 4.04)	<0.001	2.41 (1.70, 3.40)	<0.001
I am concerned about the efficacy of the COVID-19 booster				
Agree	2.76 (1.99, 3.82)	<0.001	2.47 (1.74, 3.51)	<0.001
I am concerned about the safety of the COVID-19 booster				
Agree	2.97 (2.15, 4.08)	<0.001	2.71 (1.91, 3.84)	<0.001
Cues to action				

I will take the COVID-19 booster only if I am given adequate information about it

Disagree	1.27 (0.92, 1.77)	0.146	1.26 (0.88, 1.82)	0.207
Already got the booster	0.061 (0.04, 0.09)	<0.001	0.063 (0.04, 0.10)	<0.001
I will take the COVID-19 booster only if the vaccine is taken by many in the public				
Disagree	1.21 (0.81, 1.81)	0.360	1.31 (0.82, 2.08)	0.254
Already got the booster	0.073 (0.04, 0.12)	<0.001	0.09 (0.05, 0.15)	<0.001

4. Discussion

Despite the lower population estimates of booster vaccination rates in PR, our results indicate that booster-vaccine acceptance was high in this sample. This is consistent with recent studies that have documented high booster-vaccine acceptance or high intention to get the vaccine in their sample members [6,12]. Nevertheless, the acceptance of the booster dose against COVID-19 has faced several barriers, including misinformation and beliefs regarding and attitudes towards COVID-19 and preventive measures, which have resulted in a high percentage of people who are not current with their vaccines.

Similar to other studies [10], our study found a strong and significant association between beliefs about and attitudes towards the COVID-19 booster vaccine and booster hesitancy. In general, subjects who had lower perceived susceptibility and/or severity of COVID-19 were more likely to refuse the booster. Similarly, those who did not perceived the benefits of getting the booster dose, presented a higher hesitancy towards booster vaccination than did those whose perceptions of the benefits of booster vaccination were high. In this study, having self-perceived barriers was a strong indicator of booster vaccination. Additionally, with these results, the need for people to trust in the healthcare process becomes more than evident. As was the case with our study, Qin and colleagues (2022) found that concerns about the safety and effectiveness of the booster are closely related to vaccine hesitancy [10].

Despite the compelling findings obtained, this study had some limitations that merit discussion. Due to the emergence of the Omicron variant in December 2021, we changed the study design methodology from being a face-to-face to an online survey, leading to potential selection bias in our sample. This bias might be the reason for our finding that booster acceptance was as high as it was compared to what can be seen in the statistics released by the PRDH. The population explored in our study was not intended to be representative of the Puerto Rican population: we recruited a lower proportion of men than women. We also saw differential participation in terms of income levels and education, in that the majority of the participants reported having annual incomes lower than $40,000 and having a bachelors, masters, and/or doctoral degree. Finally, there are some limitations that are inherent to the HBM, which are that the model does not consider behaviors that are habitual (e.g., continuous preventive action) and may influence the decision-making process, and it assumes that everyone has access to equal amounts of information on the disease of interest.

With the results described herein, we have been able to develop evidence-based interventions through our outreach project in different communities, thus providing information about the COVID-19 vaccine; in addition, it is through these interventions that we have begun to address the myths about and the realities of the vaccine and have provided information on protection from and the prevention of COVID-19. One of the recommendations that can be made after seeing these results is that public health personnel and concerned government need to pay more attention to educating communities about emerging health issues at the state level. In addition, it is necessary to identify common vaccine-related myths before they become a problem.

5. Conclusions

Our study found that 22% of participants were unwilling to receive the booster doses of any of the COVID-19 vaccines. Based on the HBM model, and even with our high booster acceptance, the study was able to identify strong predictors of unwillingness. People having low confidence in the vaccine and who perceive that they are at low risk of getting COVID-19 are more likely to refuse the

booster. In addition, those participants who perceived higher benefits in relation to the booster dose presented higher acceptance of the vaccine. More and better education is necessary if we are to increase confidence in the COVID-19 booster vaccines.

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