Are Patients who are Diagnosed with Hypertension or Diabetes more likely to Receive the COVID-19 Booster? Data from PR-CEAL's Community Survey Tool

Valeria V. Vidal-Vega, BS*; Hérmilis Berríos-Ortiz, MS†; Karelys Canales-Birriel, MPHE†; Vivian Colón-López, PhD, MPH†

Objective: Evaluate the relationship between diabetes and hypertension and COVID-19 booster uptake.

Methods: Members of the Community Outreach Group of the Puerto Rico Community Engagement Alliance Against COVID-19 Disparities (PR-CEAL) administered a survey at 229 community events between November 2021 and May 2023. Information on 2,145 participants' sociodemographic information and chronic disease diagnoses was gathered. Characteristics distributions were described using frequency and percentages. The associations between demographic factors and booster uptake were assessed using chi-squared analysis for categorical variables. Multivariate logistic regression models were used to estimate odds ratios (OR) with 95% confidence intervals (CI), adjusting for age, sex, education, and medical insurance, to investigate the relationship between hypertension and diabetes and booster uptake.

Results: Participants' mean age was 43.8 years. Most (80%) were women and had received a COVID-19 booster (84%). A high prevalence of hypertension (43%) and diabetes (33%) was observed in this study sample. Bivariate analyses showed a statistically significant association between receiving the booster and having hypertension or diabetes (p<0.05). Adjusted multivariate analysis showed that participants with diabetes were 3% more likely to have the booster than those without diabetes (OR=1.03, 95% CI: (1.01-1.05), p<0.05). No significant association was found between hypertension and booster uptake in the adjusted multivariate analysis (OR=1.01, 95% CI: (0.99-1.03), p=0.13).

Conclusion: Insights from this study can inform future vaccination campaigns through improved awareness and prevention strategies by targeting vulnerable populations in Puerto Rico.

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Key words: Booster uptake, COVID-19, Hypertension, Diabetes, Puerto Rico

Walubita et al., 2021, describes a "perfect storm" where having a chronic disease, being 65+, and being Black or Hispanic compound to increase risk of severe illness/ death from COVID-19, exacerbating race-, age-, and chronic disease-related disparities in the United States (1). This is especially concerning in Puerto Rico (PR), where one in five residents is over 65, the 10th highest rate worldwide (2). Approximately 81% of COVID-19-related deaths occur in this age group (3). Moreover, PR is mostly Hispanic and has a high chronic disease burden, especially diabetes and hypertension (4), which are more prevalent among PR Hispanics than other racial/ethnic groups in the US (5). These diseases increase risk of severe COVID-19 (6). PR's vaccination strategies must target high-risk populations least likely to be vaccinated; therefore, we must assess who is getting vaccinated.

The COVID-19 booster reduces complications and mortality in high-risk groups (7). However, the PR Department of Health reported that as of February 2023, only 34.6% of the population's "up-to-date" with the vaccine (the monovalent booster at the time). The "up-to-date" criteria then changed, requiring the bivalent booster; currently, only 1.74% of PR is compliant (8). As of July 2023, 2,452,290 PR residents were missing the second dose and/ or updated booster (9).

To customize vaccination strategies for PR's unique challenges, we analyzed survey data to assess the association of hypertension and diabetes with booster uptake.

Materials and Methods

PR-CEAL

The PR Community Engagement Alliance Against COVID-19 Disparities (PR-CEAL) formed in February 2021 in response to NIH's effort to conduct urgent research to prevent and educate on COVID-19. PR-CEAL's Community Outreach Group (COEG) develops and collaborates in community activities to address disparities, misinformation, and mistrust surrounding COVID-19 vaccination.

Community Survey Tool

The community survey tool is a 5-minute, anonymous, online questionnaire that captures sociodemographics, vaccine uptake, and health practices data. Questions included whether the participant

*University of Puerto Rico Río Piedras Campus, Faculty of Natural Sciences, Department of Biology, San Juan, Puerto Rico; †University of Puerto Rico Comprehensive Cancer Center, Cancer Control and Population Sciences Division, San Juan, Puerto Rico

Address correspondence to: Vivian Colón-López, PhD. University of Puerto Rico Comprehensive Cancer Center, PMB 711, 89 De Diego Ave., Suite 105, San Juan, PR 00927-6346. Email: vivian.colon@upr.edu

had diabetes, hypertension, and/or the current COVID-19 booster; response options were yes/no. Parts of the survey were adapted from the Behavioral Risk Factor Surveillance System (BRFSS) Spanish survey. The BRFSS, established by the CDC, is a state-based system of surveys that collect information about health risks and healthcare access, serving as a powerful tool for building health-promotion activities. It has yielded similar results to other surveys, proving its reliability and validity (10, 11). Our survey was adapted as the CDC updated booster recommendations.

The survey was implemented at 229 community events across PR between November 2021 and May 2023. COEG members approached attendees, inviting them to participate. Those who verbally consented and were eligible (Spanish speaker, 18+, PR resident) completed the survey on a tablet, self-reporting age, sex, education, insurance, COVID-19/influenza vaccination, COVID-19 screening, and chronic diseases.

We studied the monovalent vaccine, the CDC-approved booster at that time. The bivalent vaccine was recommended later in the study; due to timing, this sample size was too small to study. Studying the monovalent booster still provides useful insight on uptake. In the future, we can compare the two boosters. This survey is still used and now includes the bivalent booster.

This protocol was approved by the University of Puerto Rico Comprehensive Cancer Center's Institutional Review Board (Protocol #202307110) and the University of Puerto Rico Río Piedras Campus (Protocol #2223-138).

Statistical analysis

In total, 2,006 surveys were included in the analysis, constituting those eligible who agreed to participate and completed the survey. Univariate analyses were performed to describe sociodemographics: frequency distributions and percentages for categorical variables; summary measures (mean and standard deviation) for quantitative variables. Bivariate (chi-square) analyses measured associations between sociodemographic factors and uptake. Multivariate logistic regressions measured associations between uptake and diabetes/hypertension after adjusting for age, sex, education, and health insurance. These potential confounders have been associated with intent to receive the COVID-19 vaccine (12).

Results

Initial sample size was 2,145 participants; 139 were excluded due to missing information. The final sample was 2,006. Participants' mean age was 43.8±16.5 years, 79% were women, 84% had received a COVID-19 booster, 55% had taken some university courses, and 50% had government health insurance (Table 1). The covariates education, health insurance, and age were associated with booster uptake (p<0.05); sex was not (p=0.158).

In the overall sample, hypertension prevalence was 43%; diabetes prevalence was 33%. Booster uptake was 86% among participants with hypertension and 89% among participants with diabetes (Figure 1). Bivariate analyses showed significant associations between vaccine uptake and hypertension and diabetes (p<0.05 for each disease).

In multivariate analyses that adjusted for age, sex, education, and health insurance (Table 2), hypertension was not associated with COVID vaccine uptake [OR=1.01, 95% CI: (0.99-1.03), p=0.13]. Diabetes was significantly associated with uptake in which participants with diabetes were 3% more likely to have the booster than those participants without this diagnosis [OR=1.03, 95% CI: (1.01-1.05), p<0.05].

Discussion

The CDC recommends that people with chronic diseases receive the COVID-19 booster. Results showed a high prevalence of hypertension (43%) and diabetes (33%), consistent with previous studies indicating high burden of these conditions in PR. Because these conditions increase the risk of severe COVID-19 (6), it is crucial to examine uptake rates in this large population.

Age, health insurance, and education were associated with uptake; sex was not. After adjusting for these covariates, we found that those with diabetes were more likely to have the booster than those without, while those with and without hypertension were

Table 1. Description of the study sample and bivariate association between sociodemographic characteristics and COVID-19 booster uptake (n=2,006).

Characteristics	Frequency (%)	Booster Uptake		
	Total	Yes** n=1,676 (84.0)	No** n=330 (16.0)	p-value*
*Sex***				
Male	410 (20.4)	352 (21.0)	58 (17.6)	0.158
Female	1,596 (79.6)	1,324 (79.0)	272 (82.4)	
*Age (years)***				
Mean ± Standard Deviation	43.8 ± 16.5	--------		
18–24	300 (14.9)	226 (13.5)	74 (22.4)	<0.001
25–34	220 (11.0)	171 (10.2)	49 (14.9)	
35–44	466 (23.2)	390 (23.2)	76 (23.0)	
45–54	439 (21.9)	378 (22.6)	61 (18.5)	
55+	581 (29.0)	511 (30.5)	70 (21.2)	
*Education level***				
High school diploma or less	433 (21.6)	378 (22.5)	55 (16.7)	0.003
Some university courses	1,101 (54.9)	892 (53.3)	209 (63.3)	
College degree	471 (23.5)	405 (24.2)	66 (20.0)	
*Health insurance***				
Government	1,002 (50.0)	806 (48.2)	196 (59.4)	<0.001
Medicare	460 (23.0)	406 (24.3)	54 (16.4)	
Private	482 (24.0)	417 (24.9)	65 (19.7)	
Uninsurance or other	59 (3.0)	44 (2.6)	15 (4.5)	

* P value derived from the chi-square test for each characteristic in relation to booster uptake.
** Percent presented in parenthesis.
*** Sex: 0 missing values. Age: 0 missing values. Education level: 1 missing value. Health insurance: 3 missing values.

Figure 1. Self-reported prevalence of COVID-19 booster vaccination among individuals with Hypertension and Diabetes: PR-CEAL 2024.
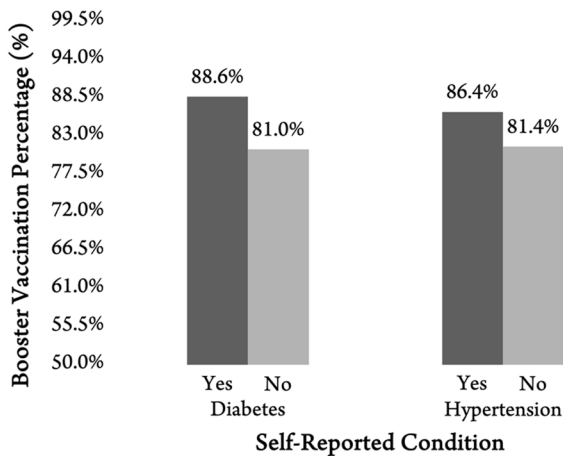
Chi-squared analysis showed a significant association of hypertension (p=0.003) and diabetes (<0.001) with booster uptake.

Table 2. Logistic regression analysis between hypertension and diabetes diagnosis and booster uptake (n= 2,006).

	Model 1	Model 2	Model 3
Hypertension	1.02 (1.00-1.04) p<0.05	1.01 (0.99-1.03) p=0.12	1.01 (0.99-1.03) p=0.13
Diabetes	1.04 (1.02-1.05) p<0.05	1.03 (1.01-1.04) p<0.05	1.03 (1.01-1.05) p<0.05

Model 1: OR crude (95% CI)
Model 2: OR adjusted for age (95% CI)
Model 3: OR adjusted for sex, age, education, and health insurance (95% CI)

equally likely to have the booster. In May 2022, the booster was recommended by the Advisory Committee on Immunization Practices (ACIP) for the immunocompromised 12 years and over and everyone 50 and older (18). This may have encouraged participants with diabetes and other chronic illnesses to get the booster.

Similar to other studies, age was associated with uptake (p<0.001). In another study, 82.8% of older participants were willing to receive the booster (13). This is good news for vaccination efforts targeting the elderly, especially those with comorbidities. Regarding education, our results were consistent with prior literature showing an association between education and uptake (14, 15, 16).

Hypertension was not associated with uptake, while diabetes was: individuals with diabetes were 3% more likely to have the booster than those without diabetes. Given recent studies showing that diabetes patients are three times more likely to die from or experience severe COVID-19, it makes sense that they

take precautions (17). A similar or higher booster uptake in high-risk groups is beneficial for public health. A Washington, D.C. study, however, found that people without chronic conditions were 1.4 times more likely to be vaccinated than those with chronic conditions (16). It is important to consider differences in location, population, and other contextual factors when designing vaccination strategies. For PR, with its high chronic disease burden, our findings that hypertension and diabetes patients demonstrate similar or higher uptake are encouraging. It suggests that campaigns and medical providers have conducted successful outreach to these patients. Ensuring that people with health conditions have equal access to vaccines is critical since they are more susceptible to severe illness or complications.

One study limitation is that our survey underwent multiple updates to align with evolving guidelines, which resulted in missing data for variables not in earlier survey versions. Moreover, self-reported data can introduce social desirability bias, the tendency to overreport or underreport what participants see as favorable or unfavorable, respectively, which could result in an inflated uptake rate and deflated diabetes and hypertension rates. Additionally, participants may sometimes misremember their medical history (recall bias). To mitigate possible biases from collecting data at health fairs, where attendees may be more health-conscious and thus more inclined to be vaccinated, recruitment also included supermarket visits. Despite limitations, because targeted campaigns are so important for encouraging vaccination, our results still offer important information about our populations of interest.

Efforts like PR-CEAL's are crucial in assessing disparities in PR, where a "perfect storm" of diabetes, hypertension, an older Hispanic population make Puerto Ricans extra vulnerable to COVID-19. We hope this and future studies will help tailor vaccination strategies to specific populations, especially these high-risk groups, ultimately increasing vaccine uptake and reducing COVID-19 severity and mortality.

Resumen

Objetivo: Evaluar la relación entre hipertensión y diabetes y la vacuna de refuerzo del COVID-19. Métodos: El Grupo de Alcance Comunitario de la Alianza de Participación Comunitaria contra las Disparidades del COVID-19 de Puerto Rico administró una encuesta en 229 eventos entre noviembre 2021 y mayo 2023. Recopiló información sobre características sociodemográficas y enfermedades crónicas de 2,145 participantes. Las características se describieron utilizando frecuencias y porcentajes. Los factores asociados con la dosis de refuerzo se evaluaron utilizando análisis de chi-cuadrado para variables categóricas. Los modelos de regresión logística multivariable estimaron la razón de probabilidades (OR) con intervalos de confianza (IC) de 95%, ajustando por edad, sexo, educación y seguro médico. Resultados: La edad media de los participantes fue de 43.8 años. La mayoría (80%) eran mujeres y habían recibido una dosis de refuerzo de la vacuna contra el COVID-19 (84%). Se observó una alta prevalencia de hipertensión (43%) y diabetes (33%) en esta muestra de estudio. Los análisis bivariados mostraron una asociación estadísticamente significativa entre recibir la dosis de refuerzo y tener hipertensión

o diabetes (p<0.05). El análisis multivariado ajustado mostró que los participantes con diabetes tenían un 3% más de probabilidades de haber recibido la dosis de refuerzo que aquellos sin diabetes (OR=1.03, IC 95%: (1.01-1.05), p<0.05). No se encontró una asociación significativa entre la hipertensión y la recepción de la dosis de refuerzo en el análisis multivariado ajustado (OR=1.01, IC 95%: (0.99-1.03), p=0.13). Conclusión: Los hallazgos aportan en las campañas de vacunación futuras a través de mejores estrategias de conciencia y de prevención para las poblaciones vulnerables en Puerto Rico.

Acknowledgments

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