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Short communication

Underserved population acceptance of combination influenza-COVID-19 booster vaccines

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Abstract

Recent data indicates increasing hesitancy towards both COVID-19 and influenza vaccination. We studied attitudes towards COVID-19 booster, influenza, and combination influenza-COVID-19 booster vaccines in a nationally representative sample of US adults between May and June 2021 (n = 12,887). We used pre-qualification quotes to ensure adequate sample sizes for minority populations. Overall vaccine acceptance was 45% for a COVID-19 booster alone, 58% for an influenza vaccine alone, and 50% for a combination vaccine. Logistic regression showed lower acceptance among female, Black/African American, Native American/American Indian, and rural respondents. Higher acceptance was found among those with college and post-graduate degrees. Despite these differences, our results suggest that a combination vaccine may provide a convenient method of dual vaccination that may increase COVID-19 vaccination coverage.

1. Introduction

COVID-19 vaccine acceptance has varied over time in the months prior to authorization of a vaccine. In June 2020, 75.5% of U.S. adults reported being “very or somewhat likely” to accept a COVID-19 vaccine, [1] but in September 2020, only 51% of U.S. adults would “definitely or probably” get a vaccine to prevent COVID-19 [2]. There are significant disparities in vaccine acceptance by race and ethnicity. Early in the pandemic, 65% of White U.S. respondents were likely to get a COVID-19 vaccine when available, compared to only 22% of Black or African Americans [3].

After six months of vaccination efforts, actual uptake falls in the middle of prior estimates of acceptance, and uptake among racial and ethnic groups varies. As of June 3, 2021, the U.S. Centers for Disease Control and Prevention (CDC) reported that 52% of U.S. adults (≥18 years of age) were fully vaccinated, with 63% having received at least one dose [4]. The limited data on smaller minority populations (i.e., Pacific Islander, Native American/Alaska Native) nonetheless suggest racial and ethnic disparities, with proportions of vaccinated population higher than their population proportion among Non-Hispanic White, Non-Hispanic American Indian/Alaska Native and Asian groups, and the opposite among Non-Hispanic Black and Hispanic/Latino groups [5]. Further, over the first six months of the pandemic, there was a decrease in COVID-19 and influenza vaccination [6]. In that study, decreased vaccine intention correlated with lower trust in media, [6] which is very concerning given low trust in media by minority groups [7]. For these reasons, although influenza vaccination rates have been much higher over the past two years, [8] and influenza infections have been low (in part from higher vaccination, and in part from COVID-19 public health precautions [9,10]), there is concern that influenza vaccination rates will decrease over this season.

Additional concerns related to disparities in COVID vaccine acceptance pertain to disparities in disease risk: the groups experiencing the severest consequences from the disease are typically less likely to accept vaccination [11].

Combination influenza-COVID-19 vaccines are being developed, [12,13] but to date public acceptance of such a vaccine is unknown. Given the relatively low acceptance rate of the influenza vaccine, and flattening acceptance of COVID-19 vaccines, it may be combination vaccines are less acceptable than either vaccine alone. In that event, it will be important to give the public a choice of vacci-
nations to avoid driving down rate. Alternatively, it may be that higher familiarity with the influenza vaccine, combined with potentially higher urgency of a COVID-19 booster, leads to higher acceptance of a combination vaccine. In that event, combination vaccines may offer a synergistic benefit, increase uptake of each. The objective of this study is to determine the acceptability of a combination influenza–COVID-19 vaccine (combination) compared to influenza or COVID-19 vaccines alone, in a nationally representative sample of U.S. adults that includes large oversamples of racial and ethnic groups often underrepresented in such surveys.

2. Material and methods

The African American Research Collaborative (AARC) is an organization dedicated to bringing an accurate understanding of African American civic engagement to the public discourse. AARC developed a survey and conducted a national mixed-mode (telephone and online) poll of U.S. minority adults from May 7 – June 7, 2021. Unlike other widely-used public opinion surveys about COVID-19 vaccine attitudes (e.g., the Kaiser Family Foundation’s COVID-19 Vaccine Monitor, the Centers for Disease Control and Prevention’s National Immunization Surveys, etc.), the AARC poll included large and nationally representative samples of racial and ethnic minorities using sampling techniques designed to recruit minority respondents from all parts of the country and living in diverse geographic contexts. Survey methodology is described in detail elsewhere (www.covidvaccinepoll.com). Briefly, pre-stratification randomized quota sampling was used as a starting point to generate nationally representative samples of White and minority-group populations, and post-stratification weights were added to bring the resulting sample into balance with known census demographic estimates for each racial and ethnic group in the sample. BSP Research (https://bspresearch.com/) conducted the surveys, asking respondents about their vaccine intentions.

Acceptance of the flu vaccine was measured by asking participants, “Do you plan to get the flu vaccine this year?” (yes, no, don’t know/unsure). Acceptance of an annual COVID-19 vaccine was measured by asking participants, “Some medical professionals think COVID-19 vaccines may need to be taken annually, similar to the seasonal flu vaccine. Would you say…” (I would definitely take an updated COVID-19 vaccine once per year, I might take an updated COVID-19 vaccine each year [if depends], I would NOT take an updated COVID-19 vaccine each year). Acceptance of a combination COVID– flu vaccine was measured by asking participants, “Would you be willing to take a combination COVID-Flu vaccine as one shot every year to protect yourself from both COVID-19 and influenza?” (yes, no, don’t know/unsure). We patterned these survey items after those used in other polls (see, e.g., the Kaiser Family Foundation COVID-19 Vaccine Monitor Dashboard; https://www.kff.org/coronavirus-covid-19/dashboard/kff-covid-19-vaccine-monitor-dashboard/). Comparing survey items that have different response categories is very common in the social sciences. That said, to aid with cross-item comparability, we use only the extreme “affirmative” response categories as unambiguous indicators of vaccine acceptance.

Reaching demographic minority populations is difficulty, leading to low and unequal response rates in modern survey research [14,15]. To overcome this challenge, we relied on pre-stratification quotas to achieve large and representative subsamples of demographic minority groups [16]. This sampling approach requires random selection within strata, but ensures large and near representative sample sizes for key demographics, including gender; race/ethnicity; age; geography (urban, suburban, rural); immigrant status (native born, foreign born, undocumented); education; and political ideology. To further encourage diverse participation, the study was offered in English, Spanish, Chinese, Korean, and Vietnamese. Survey responses were powered to ensure a margin of error under 4%. Statistical analysis was completed to 95% confidence using Stata (version 16) software.

Descriptive statistics were used to describe the dependent variables, theoretically-central predictors, and control variables. Logistic regression analysis was used to evaluate characteristic traits of those likely to accept a given vaccination, and we derived odds ratios as the “quantities of interest” in these models. There is a table for each dependent variable (influenza vs. COVID vs. combo vaccine acceptance). The first column records the independent variables, and the table entries tell us the impact of a given predictor on a particular dependent variable, holding other variables constant.

Some of the predictors are organized so that readers can see the specific categories comprising them. For example, the race/ethnicity variable has five categories: Latino/a/X, Black/African American, Asian American or Pacific Islander, Native American/American Indian, and White. Each category is its own separate predictor (in this case, we display the non-White categories and “White” is omitted, making it the reference category to which the other groups are compared).

We added the predictors incrementally. The first model only has race and ethnicity. The second model adds socioeconomic variables, all of which have been suggested to influence vaccine acceptance (partnership, [17] gender, [18] income, [19] education, [18] and geography/residency [20]). Likewise, the third model includes a person’s age [18] and their baseline willingness to receive vaccines [21] – predictors that are not only relevant to a person’s health and wellness overall but are also risk factors for COVID-19 severity. Below, we focus on the results from the “full models” (i.e., the models in the third column, with all the predictors added).

3. Results

Of the 12,887 respondents to the 2021 COVID-19 Vaccine Poll, more than half of the respondents are women, and the median age group is 35 to 59 years old (Table 1). The weighted demographic data are consistent with national demographic data reported from the Pew Research Center and the U.S. Census, within a margin of error of ± 4.0% for each racial and ethnic subgroup. Among respondents in our survey, the total percentage of those who have, will certainly, or will most likely take a COVID-19 vaccine alone is 45%, with a range of 37–53% across demographic subgroups. For an influenza vaccine alone, overall acceptance was 58%, with a demographic range of 52–69%. For a combination influenza-COVID-19 vaccine, overall acceptance was 50%, with a range of 44–61%, regardless of race or ethnicity. Table 1 also shows variation in respondents’ intent to take the COVID-19 vaccine, an influenza vaccine, and a hypothetical combination influenza-COVID-19 booster. Generally, acceptance is highest for and influenza vaccine and lowest for a COVID vaccine, with willingness to receive a combination vaccine falling between the others.

Tables 2 through 4 show the logistic regression models for our measures of vaccine acceptance. In all the models, the coefficients we report are odds ratios (ORs), accompanied by z-statistics in parentheses and using superscript symbols to denote statistical significance. The estimates are clustered by a respondent’s state of residence, in keeping with common survey sampling strategies and because geography introduces heteroskedasticity [22]. The models demonstrate racial and ethnic differences in people’s willingness to receive vaccine. Because we are primarily concerned with these group differences, we focus the discussion below on
results in the “full” models of each table (third column), which display the impact of race and ethnicity on vaccine acceptance, controlling for other factors.

For example, the odds ratios in third column of Table 2 for the predictor variables for Latino/a, African American, and Native American respondents are 0.67, 0.51, and 0.80, respectively and they are all statistically significant at the p < .10 level of lower. Since ratios below the value of 1 suggest a negative relationship between independent and dependent variables, Table 2 confirms that, taking other factors into account, these respondents are less acceptant of an influenza vaccine. However, respondents who are American Indian/Native American are no different than their White colleagues when it comes to vaccine acceptance (OR = 0.86, p > .10).

In full model in Table 3, we evaluate racial/ethnic differences in the acceptance of a COVID-19 vaccine. Here, the only statistically significant difference is between White and African American respondents (the odds ratio for the Black respondents’ predictor variable is 0.67, with a p-value of < 0.05). This demonstrates that, controlling for other factors, the African Americans who took our survey are less willing than their White colleagues to receive the COVID vaccine.

Table 4 contains the results for a hypothetical combination influenza + COVID-19 vaccine. Once again, African Americans are less accepting when compared to White respondents (OR = 0.60, p < .05).

4. Discussion

Our results suggest that COVID-19 vaccine acceptance among racial and ethnic groups is higher than reported in polling from May 24, 2021, [23] and consistent with CDC reports of actual vaccination percentage across all US adults [4]. While offering some hope for wider coverage, the persistence of demographic disparities in uptake speaks to the need for changing vaccination messaging.

Influenza vaccine acceptance is generally higher than pre-COVID influenza coverage, [24] and similar to the rates of the 2019–2020 flu season, which enjoyed much higher coverage than usual [8]. This is encouraging in the face of early indications that influenza vaccination intentions were declining [6]. However, given historic low acceptance of influenza vaccination, [25] it is important to remain vigilant with pro-vaccination health messaging, as pandemic-vaccination intentions may not persist into post-pandemic seasons.

Acceptance of a combination vaccine among minorities is higher than for COVID-19 alone, but lower than influenza alone. While no historical data are available for comparison, the fact that approximately half of the population is willing to accept a novel combination vaccine suggests that bundling new vaccines or boosters (like COVID-19) with highly accepted vaccines (like influenza) may be a convenient option to increase uptake of future novel vaccines among minorities.
Further study is warranted to investigate why combination vaccine acceptance falls between influenza and COVID-19. As some of those not accepting of a COVID-19 booster would accept a combination vaccine, presumably the long history of influenza vaccine safety allayed trepidations stemming from the newness of the COVID-19 booster. Similarly, it appears that fears about the COVID-19 booster drove some otherwise accepting of an influenza vaccine to not accept a combination vaccine. To avoid decreasing influenza vaccination in that group, it may be important to offer both the combination vaccine and the influenza vaccine alone.

For influenza, COVID-19 booster, and a combination vaccines, highest acceptance was among those with a college education (similar to previous reports on influenza [26] and COVID-19 vaccination [20]) and those living in urban areas (similar to previous reports on influenza [27] and COVID-19 [28]).
As a cross-sectional survey, our data may not be generalizable over time. Further, our data does not include reasons behind high and low intent; hence, other attitudes or beliefs may underlay disparities observed. Moreover, the non-experimental nature of this data source limits our ability to establish causal relationships the highlighted factors and outcomes. Strengths of our study include robust sampling, offering a 4% margin of error for minority groups that have limited data to date. By offering the survey in multiple languages, we increased the likelihood of generalizability to non-English-speaking adults.

Because our goal was to examine the presence of racial and ethnic group differences in vaccine acceptance, while additional analyses that explain why racial/ethnic group differences exist in vaccine acceptance and that consider the potential role of race and ethnicity as moderator variables have merit, such explorations adds that explain why racial/ethnic group differences exist in vaccine acceptance while additional analyses that explain why racial/ethnic group differences exist in vaccine acceptance and that consider the potential role of race and ethnicity as moderator variables have merit, such explorations are beyond the scope of the current paper.

5. Conclusions

The rapid development and wide distribution of vaccines for COVID-19 has been impressive. However, millions of people are still unvaccinated because of lack of access or persistent vaccine hesitancy, undermining the effectiveness of vaccines in controlling the pandemic. As mitigation efforts like masks, social distancing, and school and business closures are relaxed or retired, widespread vaccination is increasingly likely to minimize the emergence of COVID-19 mutations. As more contagious viral variants emerge, hospitalizations and deaths will continue to have a disproportionately high impact on people of color given historic disparities in health care access and quality. Further, vaccination among low-income workers and workers of color – who were disproportionately impacted by COVID-19 related job losses – is needed to facilitate their return to employment.

Despite previously documented COVID-19 and influenza vaccine hesitancy, combination influenza-COVID-19 booster vaccines would be moderately acceptable, and this approach could moderately increase COVID-19 vaccine uptake, but may also decrease influenza vaccine uptake. An optimal approach may therefore be to offer a combination vaccine first, and if refused offer individual influenza or COVID-19 boosters to accommodate those who will accept only one.

Author Contributions

RB conceived of the study. Authors RPL, RB, ECS, LZ, and AS designed the study. Authors RPL and RB analyzed and interpreted the data. RPL drafted the article. Authors RPL, RB, ECS, LZ, and AS critically revised the article for intellectual content, and gave final approval of the version submitted.

Funding

This work was supported by the Commonwealth Fund, the Robert Wood Johnson Foundation, and the WK Kellogg Foundation. Members of RWJF and WKKF funding organization provided consultation on survey development, but otherwise were not involved in research design, data collection, analysis, or interpretation. Commonwealth Fund staff named as co-authors participated in survey development and critical revision of the work, but were not involved in data collection, analysis, or interpretation. Funders were not involved in the decision to submit the article for publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The authors are grateful to the members of the African American Research Collaborative 2021 COVID group. Listed in alphabetical order by last name, the group includes Matt Barreto, Erica Bernal-Martinez, Ray Block Jr., Gayle Chacon, Annabelle De St. Maurice, Henry Fernandez, Ray Foxworth, Matt Hildreth, Robert

Table 4

Willing to take influenza / COVID-19 combination vaccine

| Model | Odds ratios (z-statistic) |
|-------|--------------------------|
| First Model: Racial/Ethnic Groups | 1.01 (0.099) |
| Second Model: Socio-demographic Factors Added | 0.84 (-1.82) |
| Third Model: Health-Related Predictors Added | 0.93 (0.80) |

Exponentiated coefficients, clustered by state; z statistics in parentheses.

Source: 2021 American COVID-19 Vaccine Poll. (We drop the constant terms from each model.).

*p < 0.05, **p < .01, ***p < .001. Bold number are statistically significant at the p < .05 level. Marginally significant differences are identified by *, where 0.50 ≤ p < 0.10, in order to identify relationships of interest for future studies.

As a cross-sectional survey, our data may not be generalizable over time. Further, our data does not include reasons behind high and low intent; hence, other attitudes or beliefs may underlay disparities observed. Moreover, the non-experimental nature of this data source limits our ability to establish causal relationships the highlighted factors and outcomes. Strengths of our study include robust sampling, offering a 4% margin of error for minority groups that have limited data to date. By offering the survey in multiple languages, we increased the likelihood of generalizability to non-English-speaking adults.

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References

[1] Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, et al. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 2021;27(2):225–8. https://doi.org/10.1038/s41591-020-1124-9.

[2] Tyson, A., C. Johnson, and C. Funk. U.S. Public Now Divided Over Whether To Get COVID-19 Vaccine. September 7, 2020: Available from: https://www.pewresearch.org/science/2020/09/17/u-s-public-now-divided-over-whether-to-get-covid-19-vaccine/.

[3] Cu, G., Block R, Gillespie S, Patel M, Keshaviah A, Hu XC, et al., Lack of trust appears to drive “racial” differences in COVID-19 vaccine confidence. Fam Med Community Health 2021; Under Revision.

[4] COVID-19 Vaccination in the United States. U.S. Centers for Disease Control and Prevention. https://covid.cdc.gov/covid-data-tracker/#vaccinations; 3 June 2021 [accessed 4 June 2021].

[5] Demographic Characteristics of People Receiving COVID-19 Vaccinations in the United States. U.S. Centers for Disease Control and Prevention. https://covid.cdc.gov/covid-data-tracker/#vaccination-demographic; 3 June 2021 [accessed 4 June 2021].

[6] Fridman A, Gerston R, Gneezy A, Capraro V. COVID-19 and vaccine hesitancy: A longitudinal study. PLoS ONE 2021;16(4):e0250123. https://doi.org/10.1371/journal.pone.0250123.

[7] The Personal News Cycle: A focus on African American and Hispanic consumers. 2014 September 16, 2014 November 17, 2021]. Available from: https://www.americanpressinstitute.org/wp-content/uploads/2014/09/Media_Insight_Rethinking-the-Digital-Divide-in-News-Consumption_FINAL.pdf.

[8] Lindley MC, Srivastav A, Hendrich M, Fisun H, Nguyen K, Pedraza O, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. Eur J Epidemiol 2020;35(8):775–9. https://doi.org/10.1007/s10654-020-00671-y.

[9] Malik AA, McFadden SM, Elbarake J, Omer SB. Determinants of COVID-19 vaccine acceptance among adults in four major US metropolitan areas and nationwide. Sci Rep 2021;11(1). https://doi.org/10.1038/s41598-021-00794-6.

[10] Keeter S. Evidence About the Accuracy of Surveys in the Face of Declining Response Rates. In: Vannette D, Krosnick J, editors. The Palgrave Handbook of Survey Research. Cham: Palgrave Macmillan; 2018. p. 19–22. https://doi.org/10.1007/978-3-319-54395-0_4.

[11] Czaja JL, Beyler A. Declining Response Rates in Federal Surveys: Trends and Implications (Background Paper). 2016, Mathematica Policy Research: Princeton. Available at: https://mathematica.org/publications/declining-response-rates-in-federal-surveys-trends-and-implications-background-paper.

[12] Barreto MA, Frasure-Yokley L, Vargas ED, Wong J. Best practices in collecting online data with Asian, Black, Latino, and White respondents: evidence from the 2016 Collaborative Multiracial Post-election Survey. Politics, Groups and Identities 2018;6(1):171–80. https://doi.org/10.1080/21565503.2017.1419433.

[13] Krupenkin M. Does Partisanship Affect Compliance with Government Recommendations? Polit Behav 2021;43(1):451–72.

[14] Joshi A, Kaur M, Kaur R, et al. Predictors of COVID-19 Vaccine Acceptance, Intention, and Hesitancy: A Scoping Review. Front Public Health 9(1152) (2021) https://doi.org/10.3389/fpubh.2021.698111.

[15] Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, et al. COVID-19 Vaccine hesitancy: The next challenge in the fight against COVID-19. Eur J Epidemiol 2020;35(8):775–9. https://doi.org/10.1007/s10654-020-00671-y.

[16] Cameron AC, Miller DL. Robust inference with clustered data. 2016:1-28. https://doi.org/10.1186/s12874-019-0801-1.

[17] Malik AA, McFadden SM, Elbarake J, Omer SB. Determinants of COVID-19 vaccine acceptance among adults in four major US metropolitan areas and nationwide. Sci Rep 2021;11(1). https://doi.org/10.1038/s41598-021-00794-6.

[18] Njugua, N., P. Ohm, B. Hill, P. Artiga S., Parker N. Latest Data on COVID-19 Vaccinations Race/Ethnicity. https://www.cdc.gov/coronavirus/covid-19/jour-nal-survey/late-study-on-covid-19-vaccinations-race-ethnicity/; 8 July 2021 [accessed 3 June 2021].

[19] Flu Vaccination Coverage. United States, 2018–19 Influenza Season. U.S. Centers for Disease Control and Prevention. https://www.cdc.gov/flu/fluview/coverage-1819estimates.htm; 26 September 2019 [accessed 4 June 2021].

[20] Nowak GJ, Caciottore MA, Len-Rios ME. Understanding and increasing influenza vaccination acceptance: insights from a 2016 national survey of U.S. adults. Int J Environm Res Public Health 15(4) (2018), 711. DOI: 10.3390/ijerph15040711.

[21] Luyck K, Simmonds KA, Lorenzetti DL, Drews SJ, Svenson LW, Russell ML. The association between influenza vaccination and socioeconomic status in high income countries varies by the measure used: A systematic review. BMC Med. Res. Methodol. 2019;19(1). https://doi.org/10.1186/s12874-019-0801-1.

[22] Bennett KJ, Bellinger JD, Probst JC. Receipt of Influenza and Pneumonia Vaccinations: The Dual Disparity of Rural Minorities: RECEIPT OF INFLUENZA AND PNEUMONIA VACCINATIONS. J Am Geriatr Soc (JAGS) 2010;58(10):1896–902. https://doi.org/10.1111/j.1532-5415.2010.03084.x.

[23] Murphy BP, Steventer N, Weller D, Zell E, Reynolds L, Toblin RL, et al. Disparities in COVID-19 Vaccination Coverage Between Urban and Rural Counties—United States, December 14, 2020-April 10, 2021. MMWR Recommend Rep 2021;70(20):759–64. https://doi.org/10.15585/mmwr.mm7020e3.