ORIGINAL RESEARCH

A Nationwide Survey on Adult Opinion Toward COVID-19 Vaccination: What We Learned in Four Years Compared to Real-World Data from the Centers for Disease Control

Payam Safavi Naeini, MD[1], Golsa Alizadeh, DDS[2], Andre B. Akhondi, MD[3] and Mohammad Madjid, MD, MS[3]

[1] Center for Cardiac Arrhythmias and Electrophysiology, Texas Heart Institute, Houston, TX
[2] School of Public Health, University of North Texas Health Science Center, Forth Worth, TX
[3] Division of Cardiology, Department of Medicine, David Geffen School of Medicine, University of California, Los Angeles (UCLA), Los Angeles, CA

Abstract

We conducted a random, nationwide telephonic survey of 1,007 US adults to investigate population opinion about upcoming COVID-19 vaccines in a cross-sectional survey of the US population in 2020, was conducted about four months before the first vaccine became available. Respondents' willingness to receive a COVID-19 vaccine was not statistically predictable by most baseline characteristics, including gender, age groups, having more than one risk factor, race, income, place of living (city, suburb, rural), and US region (East, South, Center, West). A weak association was observed between willingness to take the vaccine and educational level and ideology. The primary reasons for vaccine hesitancy included concerns about side effects, not believing in needing a vaccine, lack of efficacy, refusal of other vaccines, and not believing in the risk of COVID-19. Our predicted vaccination rate was very close to the real-world data obtained after the vaccines were made available. Our survey methodology is a valuable tool to estimate vaccine acceptance rates, identify vaccine hesitancies, and detect barriers to vaccination.

Background

The COVID-19 pandemic has included over 103 million confirmed cases in the US, with over 1,1 million fatalities.[1] Tremendous efforts rapidly developed multiple vaccines against this virus. Vaccine introduction over the past century has helped control many infectious diseases. However, adult vaccines are still under-utilized, even in high-risk populations.[2] We investigated opinions on the upcoming COVID-19 vaccines in a cross-sectional survey of the US population in 2020, about four months before the first vaccine became available. We had previously used this strategy to identify barriers to influenza vaccination in high-risk subjects.[2]

Methods

A random, nationwide telephonic survey of US adults (age ≥18 years) was conducted to assess attitudes and possible hesitancies toward receiving COVID-19 vaccines. The survey was conducted on August 28th and 29th, 2020, by John Zogby Strategies. This was described in a previous vaccine survey study,[2] and is briefly summarized.

Data Collection

A cross-sectional telephonic survey was conducted by John Zogby Strategies (JZS) to assess attitudes towards the COVID-19 vaccine among a representative sample of the US adult population.

The survey targeted 1,200 participants, drawn through a stratified random sampling technique from a JZS's panel of 15 million US adults. The panel aimed to be representative of US adults in demographics including: age, race, region, gender, with minimal weighting adjustments.

To minimize response bias, the survey instrument underwent rigorous pre-testing and piloting to ensure clarity, neutrality, and logical flow of questions.

Trained and qualified interviewers employed a computer-assisted telephone interview (CATI) instrument to collect data. The instrument consisted of standardized closed-ended and open-ended questions designed to assess attitudes towards the COVID-19 vaccine. Interviewers received rigorous training on survey protocol, question phrasing, and neutrality to minimize interviewer bias. Call attempts were made over multiple days and times to maximize response rate.

The overall sample margin of error was estimated +/- 3.5 percentage points, with potential for higher margins in smaller subgroups.

Data Quality and Management

Data quality control procedures were implemented throughout the study. Audio recordings of a random sample of interviews were reviewed to ensure adherence to protocol and interviewer neutrality. Data cleaning procedures included identifying and correcting inaccurate or missing responses. Double entry and consistency checks were conducted to minimize data entry errors.

Sample Characteristics and Margin of Error

The overall sample yielded a margin of error of +/- 3.5 percentage points. While acknowledging potential for higher margins of error in certain data subsets, efforts were made to minimize this through careful instrument design and pilot testing.

The overall response rate was 83.9% (1007 out of 1200 subjects). Non-response bias was assessed by comparing demographic characteristics of respondents to the full sampling frame and applying weighting adjustments where necessary. The final weighted sample closely resembled the US adult population in terms of key demographics.

We used an available fully de-identified database which was exempt from the institutional review board review.

Statistical Analysis

Descriptive statistics (frequencies and percentages) were used to summarize participant characteristics and attitudes towards the COVID-19 vaccine.

To measure the association between acceptance or rejection of a COVID-19 vaccine with different variables of the study, we calculated lambda by SPSS (Armonk, NY: IBM Corp). Lambda is an asymmetrical measure of association that is suitable for use with nominal variables. Lambda is a Proportional Reduction in Error (PRE) measure that allows us to predict how much knowledge about one variable can help us predict another variable.[3] Lambda ranges from 0.00 to 1.00. A lambda of 0 reflects no association between variables, and a Lambda of 1.00 reflects a perfect association.

Findings

A total of 1,007 (Female=514) subjects participated in this study. The average age was 32.9 ± 16.3 (range=18 to 84 years), and 560 subjects had at least one risk factor for severe COVID-19 (55.6%) (Table 1). Subjects were asked if they would take a COVID-19 vaccine with Likert options of definitely yes, probably yes, not sure, probably not, and definitely not.

Among respondents, 61.6% answered that they would (definitely:32.7% or probably:29%) receive a coronavirus vaccine, 24.6% indicated they would not (definitely: 15.2%,

probably: 9.4%) take a COVID-19vaccine, and 13.8% were not sure whether they would take it or not.

The willingness to receive a COVID-19 vaccine was not statistically predictable by most baseline characteristics, including gender, age groups, having >1 risk factor, race, income, place of living (city, suburb, rural), and US region (East, South, Center, West). However, a weak association was observed between willingness to take a COVID-19 vaccine with educational level and ideology (Education: $\lambda = 0.032$, Ideology: $\lambda = 0.025$, P<0.05). Progressives expressed the highest willingness to take the vaccine (83.3%), while the very conservatives expressed the lowest willingness to receive the vaccine (51.1%). Respondents with higher education had a higher desire to receive the vaccine, with 78.3% willingness in those holding a master's degree or higher.

Subjects who expressed an unwillingness to receive a vaccine (N=248) were asked about the reason(s) for their choice, which are listed in Table 2.

Almost half (48.3%) of the subjects who stated they would not take a COVID-19 vaccine were iin the high-risk patient group with at least one risk factor for complications (Table 1). The majority (58%) of subjects who expressed a willingness to receive a vaccine (N=621), had at least one risk factor for severe COVID-19 disease. The distribution of willingness to receive the vaccine was not significantly different based on the number of risk factors.

Discussion

In this national random survey of US adults, about four months before the COVID-19 vaccine became available, almost 61% of the respondents expressed a willingness to take a COVID-19 vaccine when it becomes available. According to the CDC data, by May 22, 2021, about 57.0% of persons aged ≥18 years had received at least one dose of the COVID-19 vaccine. This real-world data was very close to our predicted vaccination rate for the general population.[4] We did not find younger age as a risk factor for vaccine hesitancy, but the CDC reported a considerable difference in vaccine uptake between persons aged ≥65 years (80.0%) and persons aged 18–29 years (38.3%) in May 2021.[4] This difference could result from multiple factors, including earlier and wider vaccine availability to the elderly and the higher perceived disease risk in older subjects. However, we cannot rule out a potential error in the survey to detect this difference, and need to expand follow-up surveys to clarify this issue. We found that 15.2% definitely will not take the COVID-19 vaccine when it becomes available. This is close to the actual data in 2023 with about 12.2% of the population remains unvaccinated.[5] This provides evidence that the intervention to increase COVID-19 vaccine acceptance among people who had decided not to take the vaccine four months before vaccine availability was relatively unsuccessful.

The primary reasons for vaccine hesitancy included concerns about side effects, not believing in needing a vaccine, lack of

efficacy, overall vaccine refusal, and not believing in the risk of COVID-19.

Our study did not find gender or ethnicity significantly associated with vaccine hesitancy. This is not in line with actual data, as females and Asians have lower percentage of non-vaccination. We believe the survey had limited power to detect these differences in these sub-groups. Future studies must be adequately powered for such subgroup. Our survey also could not detect differences in vaccination based on income and place of living.

Controlling a pandemic like COVID-19 requires community mitigation strategies including non-pharmaceutical interventions (such as social distancing and effective hygiene methods) combined with increasing population immunization rates against the disease to achieve herd immunity.

The success of an immunization program depends on the mass availability of safe, effective, and affordable vaccines, along with the population's acceptance of these vaccines. Our survey methodology is a valuable tool to estimate vaccine acceptance rates, identify vaccine hesitancies, and detect barriers to vaccination. This method may be used in similar epidemic or pandemic situations to rapidly and accurately assess public opinion about a vaccine. We should improve subgroup sampling to achieve adequate numbers of respondents in sub-groups of interest. Vaccine development is a dynamic process with high fluidity. Serial surveys of the population can be valuable to assess changes in population opinion and help devise educational programs to increase subjects' knowledge and address their hesitancies.

Figure 1. The Willingness to Receive a COVID-19 Vaccine Based on the Number of Risk Factors*
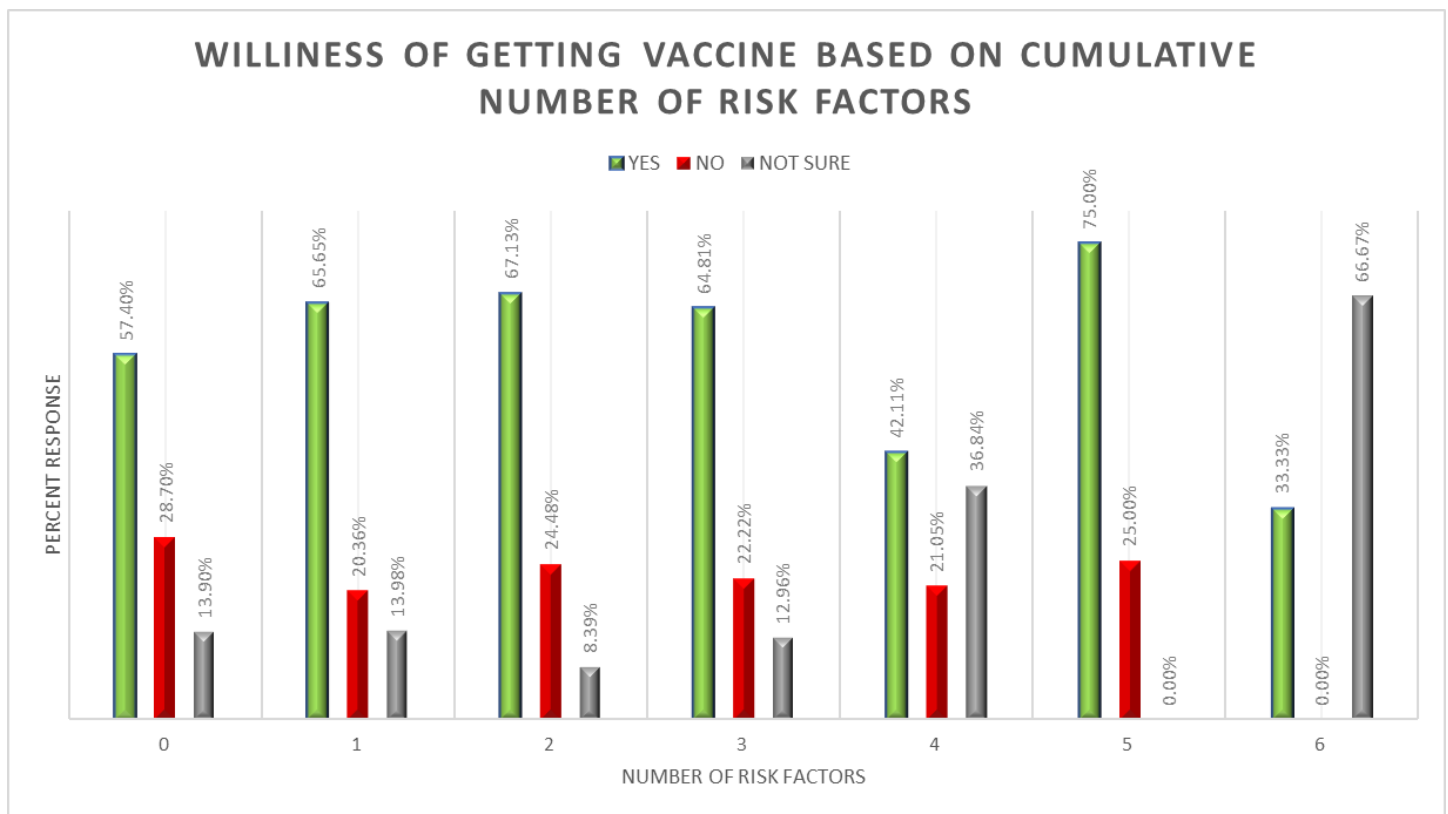
Risk factors included: High blood pressure, Heart disease, Diabetes, Chronic lung disease, Obesity, A weak immune system (because of disease or medication), Cancer, Chronic kidney disease, Stroke

Table 1: Baseline Characteristics and Prevalence of Self-Reported Risk Factors in Study Population

	Total N.	% of Total Population	Willingness to receive a vaccine		
			Yes	No	Not Sure
Age Group					
18-29	151	15.3%	62.9%	24.5%	12.6%
30-49	328	30.1%	57%	29.3%	13.7%
50-64	327	31.7%	60.2%	24.5%	15.3%
>65	201	22.9%	61.7%	24.6%	13.7%
Gender					
Male	493	49%	68%	18.5%	13.6%
Female	513	51%	55.6%	30.6%	48.6%
Race					
White	690	69.1%	62.6%	22.5%	14.9%
Hispanic	130	13%	62.3%	32.3%	5.4%
Black	120	12%	48.3%	30.8%	20.8%
Asian	30	3%	80%	10%	10%
Other	29	2.9%	75.9%	24.1%	0%
Risk Factors					
High blood pressure	356	35.4%	66.4%	18.6%	15%
Heart disease	46	4.6%	68.4%	13.6%	18.1%
Diabetes	172	17.1%	64.80%	18.9%	16.3%
Chronic lung disease	77	7.6%	52.9%	34%	13.1%
Obesity	128	12.7%	60.7%	19.4%	19.9%
Weak immune system	73	7.3%	52.9%	35.2	11.9%
Cancer	52	5.2%	65.6%	21%	13.4%
Chronic kidney disease	16	1.5%	61.3%	11%	27.7%
Stroke	20	1.9%	73.5%	21.8%	4.8%
No comorbidities	456	45.3%	58.1%	28.3%	13.6%
Place of living					
City	299	29.8%	64.9%	21.7%	13.4%
Suburb	469	46.7%	61.6%	24.1%	14.3%
Rural	236	23.5%	58.1%	29.2%	12.7%

Table 2: Reason(s) for Vaccine Hesitancy

I am afraid of vaccine side effects	(52.7%)
I never take a vaccine	(33%)
I am healthy and don't need a vaccine	(30.3%)
COVID-19 vaccine doesn't work	(15.5%)
The vaccine may cause infection	(26.6%)
COVID-19 disease is NOT dangerous	(13.3%)
I don't believe in COVID-19 virus	(10.1%)

REFERENCES

1. CDC COVID data tracker. Excess Deaths Associate with COVID-19. Retrieved on March 3, 2023. Available at: https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm.

2. **Madjid M, Alfred A, Sahai A, Conyers JL, Casscells SW**. Factors contributing to suboptimal vaccination against influenza: results of a nationwide telephone survey of persons with cardiovascular disease. *Tex Heart Inst J*. 2009;36(6):546-52. PMID: 20069079; PMCID: PMC2801927.

3. **Kvålseth TO**. Measuring association between nominal categorical variables: an alternative to the Goodman–Kruskal lambda. J of Applied Stat. 2017;45(6):1118-32. DOI:10.1080/02664763.2017.1346066

4. **Diesel J, Sterrett N, Dasgupta S, Kriss JL, Barry V, Vanden Esschert K, Whiteman A, Cadwell BL, Weller D, Qualters JR, Harris L, Bhatt A, Williams C, Fox LM, Meaney Delman D, Black CL, Barbour KE**. COVID-19 Vaccination Coverage Among Adults - United States, December 14, 2020-May 22, 2021. *MMWR Morb Mortal Wkly Rep*. 2021 Jun 25;70(25):922-927. doi: 10.15585/mmwr.mm7025e1. PMID: 34166331; PMCID: PMC8224863.

5. CDC National Center for Immunization and Respiratory Diseases. COVID-19 Vaccination Coverage and Vaccine Confidence Among Adults. Retrieved on March 3, 2023, available at: https://www.cdc.gov/vaccines/imz-managers/coverage/covidvaxview/interactive/adults.html.