

Prevalence and Beliefs Associated with Vaccine Hesitancy Among Muslim-Americans: Pilot Study

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Prevalence and Beliefs Associated with Vaccine Hesitancy Among Muslim-Americans: Pilot Study

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Abstract

Background: Vaccine hesitancy hinders the management of preventable illnesses. Currently, there are gaps in public health research on vaccine hesitancy among Muslim-Americans.

Objective: We aimed to understand the extent of vaccine hesitancy among American-Muslims, and the factors for health care decision making regarding vaccination.

Methods: Participants were recruited through Facebook group posts. Seventy-three participants completed the online Qualtrics survey. Sixty-three participants met the inclusion criteria. Participants' responses were collapsed into the following belief scores: political leaning, religiosity, trust in public institutions, and vaccine hesitancy.

Results: Participants who were older in age, had attained higher levels of education, employed, unmarried, and identified with the Sunni sect were less vaccine hesitant. Most participants (36.5%) were more likely to accept a vaccine if it had no reported safety issues. Participants were more likely to be hesitant about vaccines with safety concerns or poor efficacy.

Conclusions: Results both align with and contradict previous studies conducted in Muslim majority and religiously heterogeneous countries. This study found an association between Islamic sect and attitudes towards vaccines. Follow up studies are necessary to gauge a larger, more diverse population of Muslim-Americans. Based on this study's findings, healthcare professionals can better promote vaccines by addressing their patient's trust in public institutions.

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Original Manuscript

Short Paper

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Conclusions: Results both align with and contradict previous studies conducted in Muslim majority and religiously heterogeneous countries. This study found an association between Islamic sect and attitudes towards vaccines. Follow up studies are necessary to gauge a larger, more diverse population of Muslim-Americans. Based on this study's findings, healthcare professionals can better promote vaccines by addressing their patient's trust in public institutions.

Keywords: vaccine hesitancy; vaccines; Muslim health; Muslim-American

Introduction

Vaccine hesitancy refers to delaying vaccination, questioning their efficacy or expressing doubt in their safety [1]. Vaccine refusal is the complete rejection of vaccines [1]. Anti-vaccination sentiments are known to increase the proliferation and death rates of preventable illnesses, while also putting immunocompromised and nonvaccinated populations at risk. There have been studies, like those by Hossain et al. [2] and Sallam et al. in 2021 [3], that were conducted in Muslim majority countries. However, there is still no consensus on Muslim communities in religiously heterogeneous societies, like the United States. Such studies focus on Muslim-American subgroups. For example, Hearld & Budhwani [4] studied Muslim American women. Due to this research gap, this study aimed to provide a big picture understanding of vaccination trends in the Muslim community.

General Vaccine Hesitancy Trends in America

There are numerous associations in vaccine hesitancy and denial trends among Americans. Parents who believed strongly in vaccine adverse effects, distrusted institutions, had a feeling of helplessness, questioned vaccine efficacy, or desired bodily autonomy, were more likely to express vaccine hesitancy or outright deny them for their children [5]. University students from the west coast were more likely to accept a vaccine if they perceived that a vaccine-preventable disease

caused immense physical suffering or had a family member who contracted the illness in the past [6]. Americans who distrusted public institutions, like the CDC, were older in age, childless and less educated, and were more likely to be vaccine hesitant [7]. In 2020, 6% of parents were hesitant against routine childhood vaccines and 25.8% were hesitant against flu vaccines [8]. Low efficacy and the potential risk of side effects were cited as the most important factors for avoiding vaccines [8]. Parents of lower socioeconomic status, Hispanic heritage and fewer years of education were more likely to be hesitant [8].

General Vaccine Hesitancy in Muslims

Most studies on vaccine hesitancy among Muslims were conducted in Muslim majority countries. For example, 96.1% [9] and 80% [10] of Saudi parents supported vaccination in 2021 and 2019, respectively. Ninety-two percent [11] and 88.4% [12] of Malaysian parents supported vaccination in 2020 and 2017, respectively. Pakistani parents in Taliban controlled areas were 23% to 39% less likely to vaccinate their children compared to parents in non-Taliban controlled areas [13]. 68.4% of Nigerian mothers accepted vaccines [14]. Some studies combined data from multiple countries, such as Owoaje et al. [15], who analyzed vaccine hesitancy trends in Afghanistan and Nigeria. And 18 Arab countries had aggregated vaccine acceptance rates of 29.4% for COVID-19 and 30.9% for influenza immunizations in 2021 [3]. Other studies contained samples from countries with Muslim minorities, such as 61% of the children in a Muslim-dominated area of Ethiopia were receiving regular vaccinations [16].

Knowledge Gaps

There is no strong consistency on vaccine hesitancy trends in Muslim communities living in religiously heterogeneous societies, like those in the United States and the United Kingdom [17]. Therefore, most information about western Muslims is found in secondary sources. For example, in 2017, there was a highly publicized outbreak of measles in the Somali-Muslim diaspora in Minnesota. Public health officials cited the increasing anti-vaccine sentiments within the community as the primary cause of the outbreak [18]. Vaccine hesitancy studies in religiously heterogeneous countries typically cast a wide net. For example, 65% of Irish and 69% of British people accepted vaccines in 2021 [19]. Unfortunately, religion was not studied in this sample, so it's unclear if there were any religious associations with vaccine sentiments.

Themes

In past studies, there were several factors that influenced Muslim parents' willingness to vaccinate their children, such as religious prohibitions [20], parental experience [3], level of trust within public institutions [21], and political affiliations [19]. For example, some Malaysian parents were concerned about vaccine ingredients, considering how certain vaccines utilize pork byproducts during production and consuming pork products is forbidden in the Islamic tradition [22].

Methods

Study Design

We designed a cross-sectional, quantitative study. Participants completed an online survey on the Qualtrics platform; they were convenience and snowball sampled. Written informed consent to be involved with this study and publish this paper was obtained from all subjects. The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of Texas in Tyler (IRB #2022-030 on May 12, 2022). Data collection began in May of 2022 and was completed 2 months later in July.

Questionnaire Tool

The survey was divided into 4 major sections, which is outlined by the number of questions in (Table 1). Four belief groups utilized Likert scales, with each choice assigned a point value, on a scale of 1 to 5. These questions were grouped together, and their points combined to create composite scores. In this way, every participant received one composite score for each of the following variables: religiosity, vaccine hesitancy, trust in healthcare institutions, and political ideology. Health belief scores were considered dependent variables. Generally, the higher the score, the stronger the belief. For example, a score of 5 for religiosity meant that the participant did not identify as a religious Muslim, whereas 25, which is the highest possible composite religiosity score, reflected an intense devotion.

The only exception to this rule was the political beliefs composite score, which analyzed the participant's political stance on a scale from extremely liberal to extremely conservative. For example, participants with a score of 30, the highest possible, identified as having very conservative political and social beliefs. (Table 2) is a classification scheme for each composite score to analyze different personal beliefs and values. Each score was determined by the number of questions that make up the composite score. Not all participants could answer the question that is denoted with a superscript (^a). It inquired about children, so child-free participants were scored 0 for this question. The questions that surveyed political beliefs were split into the political beliefs score and trust in public institutions score.

Table 1. Types of survey questions

Survey Section	Number of Questions
Demographics	
	11
Religion	
	7
Political Beliefs	
	10
Health Beliefs	
	14

Table 2. Description of composite scores in belief category

Score Name	Min	Max	# Q's	Question Number
Religiosity				
	6	30	6	13, 14, 15, 16, 17, 18
Vaccine Hesitancy				
	7	40	8	32, 33, 35, 36, 37, 38, 39 ^a , 40
Trust in Public Institutions				
	6	30	6	25, 26, 27, 28, 30, 31
Political Beliefs				
	6	30	6	19, 20, 21, 22, 23, 24

Participant Selection

A target sample size of 43 was determined from the following parameters:

- Study Group Design: One study group vs. population

- Primary endpoint: dichotomous
- Anticipated incidence: 70% known population, 50% study group
- Alpha (α): 0.05
- Power: 0.80 (Beta (β) = 0.20)

Participants were required to be at least 18 years of age, identify as a Muslim, and live at least 5 years in the U.S. at the time of completing the survey. Since there are immigrants to the United States who view themselves as Muslim, it was necessary to set a limit on what this study defines as “American.” Immigrants need a few years to acclimate and identify as a member of their new country, so it was necessary to have a set minimum amount of time to establish how well someone identifies with their residence. The inclusion criterion of 5 years was selected since the naturalization process requires that all eligible applicants for citizenship live in the country for at least 5 years [23].

The participants were recruited through 10 Muslim oriented Facebook groups. The participants were encouraged to further spread information about the study to other individuals who meet the inclusion criteria. Selection of the Facebook groups was more deliberate, because targeted recruitment could ensure a lower chance of acquiring survey responses from excluded groups. Thus, groups with larger memberships and more current page activity were chosen over those that did not have these qualities.

Analysis

All data analysis was completed on the IBM SPSS Statistics 28 software. First, descriptive statistics were obtained for the following demographic factors: age, gender, race, highest level of education completed, employment status, total combined household income before taxes, marital status, number of children under the age of 18, Islamic sect, political views, source of healthcare information, and factors for vaccine hesitancy. Normalcy was scrutinized. When a demographic variable was skewed, it was transformed into a normal distribution. The four belief scores were calculated for each participant. The belief scores and the COVID-19 vaccination status were analyzed using T-tests and linear regression testing to determine if there are associations with the demographic variables. Additionally, correlation was conducted with continuous output variables. Finally, multiple regression analyses were conducted using the bivariate significant values for each score. The unadjusted model was created using the “Enter” preset while the adjusted model utilized the “Backwards” preset.

Results

In mid-April of 2022, a pilot study was conducted on 5 individuals, regardless of their ability to meet the inclusion criteria. After IRB approval, the website link to the survey was disseminated online to Facebook groups. Data collection began in May of 2022 and was completed 2 months later. Seventy-three responses were received. Sixty-five met the required inclusion criteria. The 8 participants who did not meet the inclusion criteria were not included in the final data analysis. Since 43 participants were sought, the extra responses meeting the inclusion criteria increased this requirement by 51% (65/43).

Belief Score Distributions

The distribution of the vaccine hesitancy scores is shown in (Figure 1). (Table 3) lists the mean and standard deviation (SD) of all belief scores. The skewness of each belief score is as follows: -0.045 for religiosity, +0.269 for political leaning, +0.645 for trust in public institutions, and -1.192 for vaccine hesitancy. More participants with higher feelings of vaccine hesitancy were represented in the study. Thus, the data was logarithmically transformed into a normal distribution using the

following equation:

$$Y (\text{transformed vaccine hesitancy score}) = \text{SQRT} (40 - \text{vaccine hesitancy score})$$

The transformed data was skewed -0.337. The transformed variable was used for statistical testing and the transformed distribution is seen in (Figure 2).

Table 3. Means and standard deviations (SD) of belief scores

Belief Score	Min	Max	Mean	SD
Religiosity	6	30	17.55	6.22
Political Beliefs	6	24	14.18	4.47
Trust in Public Institutions	8	26	15.58	3.72
Vaccine Hesitancy	16	40	33.03	5.50

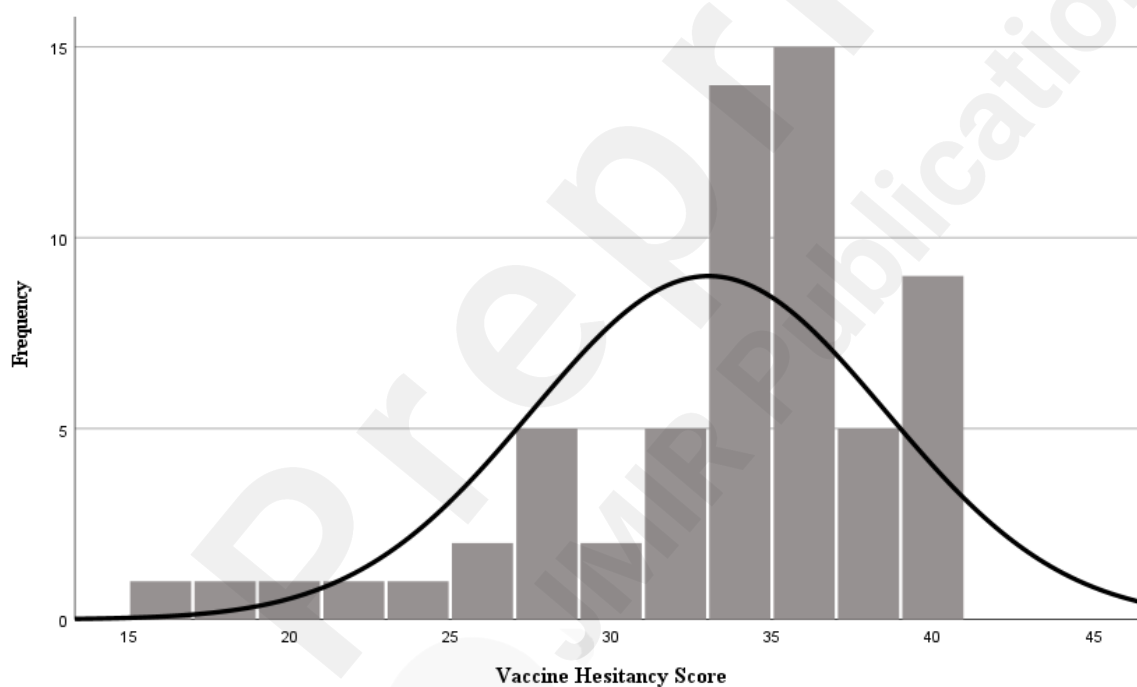


Figure 1. Distribution of Vaccine Hesitancy Scores

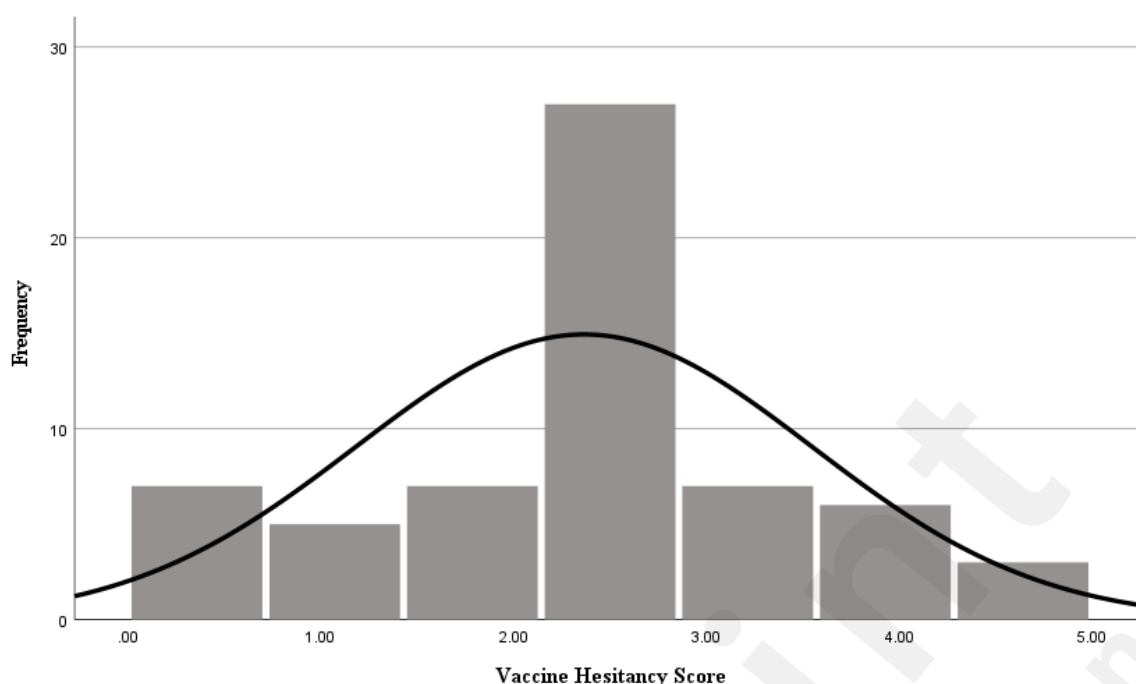


Figure 2. Distribution of Transformed Vaccine Hesitancy Scores

Demographics & Bivariate Analysis on Belief Scores

Demographic variables were regrouped or transformed for analysis. Their frequencies and *P*-values by association to the belief scores are listed in (Table 4). Forty-five participants (71.4%) identified as female, and 17 (27.0%) as male. One (1.6%) selected a gender identity of “other;” however, this person did not specify their gender identity. Because there was only 1 participant who did not identify as either male or female, and their response patterns were unusual, this participant’s responses were not included in any further analysis and in (Table 4).

The average age of participants was 32.0 ± 10.8 years. The median age was 28.5 years. The youngest participant was 19 years old and the oldest was 71 years old. Age was associated with trust in public institutions and vaccine hesitancy.

Fifty participants (80.6%) identified as Asian, six (9.7%) as white or Caucasian, two (3.2%) as Middle Eastern, two (3.2%) as mixed race, and one (1.6%) identified as Black or African American. One participant (1.6%) selected “other,” but did not specify a racial identity. Asian race was associated with trust in public institutions.

Thirty-two participants (51.6%) attained a graduate or doctoral degree, 24 (38.7%) had a bachelor’s degree, four (6.5%) had some post-secondary education but no degree, one (1.6%) had a high school diploma or equivalent, and one (1.6%) had an associate degree. Education was associated with trust in public institutions and vaccine hesitancy.

Participants reported their combined household income before taxes in 2021. The average income was \$121,383.87 and the median was \$88,500. The minimum income reported was \$0 and the maximum income was \$1,500,000. In examining the distribution, income was left skewed by +6.28, with more participants reporting lower incomes. Two data points with an income of \$0 were removed from the transformed dataset, because a logarithm of 0 is 0. One data point with an income of \$1,500,000 was removed from the transformed dataset, because it was a strong outlier and worsened the skewness to +0.24.

Thirty-two participants (50.8%) were employed or self-employed, seven (11.1%) were not employed

and not looking for work, four (6.3%) were not employed and are currently looking for work, two (3.2%) were retired, 17 (27%) were currently students, and one (1.6%) was unable to work. Employment status was associated with trust in public institutions and vaccine hesitancy. Thirty-two participants (51.6%) were married and 25 (40.3%) were single and never married. Three participants (4.8%) were in a relationship and not married, two (3.2%) were divorced. Marital status was associated with vaccine hesitancy. Twenty participants (32.3%) reported having children under the age of 18 in their household while 42 participants (67.7%) did not.

Forty-nine participants (79.0%) identified as Sunni, six (9.7%) were Shia, four (6.5%) were Sufi, and three (4.8%) did not associate with any sect of Islam. Religious sect was associated with vaccine hesitancy; Sunnis were less hesitant of vaccines than non-Sunnis.

Thirty-five participants (55.6%) receive most of their healthcare information from a licensed healthcare professional, 18 (28.6%) obtained it online, three (4.8%) utilized print media, one (1.6%) utilized radio, and one (1.6%) utilized television. Five (8.1%) reported they used “other” sources. They received most information from scholarly sources, like peer reviewed journals, or clinical resources, like UpToDate.

Sixty-one participants (96.8%) received at least one dose of the COVID-19 vaccine, while two (3.2%) did not. Participants indicated their most important factor in receiving a vaccine. Twenty-three (36.5%) were more willing if a vaccine had no safety issues. Eight (12.7%) were more willing if a vaccine did not cause potential allergies. Six (9.5%) if a vaccine was free or low cost. Four (6.3%) were more willing if a vaccine had no potential for causing autism or any other illness. Four (6.3%) if vaccines had no pork based or non-Halal ingredients. Four (6.3%) were more willing because someone close to them had an illness. Two (3.2%) were more willing because the people around them were receiving vaccines.

Of the 12 participants (19%) selected “other” as their most important factor for receiving a vaccine, 4 were more willing if the vaccine “actually prevented the disease,” 3 if there was proven scientific research and evidence for a vaccine, 2 if a vaccine had no side effects and 2 if they knew a vaccine could protect other people. One participant reported there was not one factor but rather many factors that affected their decision, and one participant reported they would get any vaccine recommended by their healthcare provider.

Additionally, participants reported on their most important reason for avoiding a vaccine. Fifteen participants (23.8%) were less likely to attain a vaccine if it had other safety issues not listed in the survey. Fifteen (23.8%) were less likely if they knew a vaccine was less efficacious, eight (12.7%) if a vaccine had a potential for causing autism or any other illness. Seven (11.1%) selected “other” important factor for avoiding a vaccine. Seven (11.1%) were less likely if a vaccine caused potential allergies, six (9.5%) if a vaccine was expensive, five (7.9%) if a vaccine contained pork-based or non-Halal ingredients, and four (6.5%) who reported they had no reasons for avoiding a vaccine.

Table 4. Bivariate analyses of demographic groupings

		N (%)	P-value & (Mean)			
			Religiosity	Politics	Trust	Hesitancy ^c
Sex		62 (100.0%)	.289	.468	.560	334
	Male	17 (27.4%)	(19.82)	(16.29)	(15.24)	(2.39)
	Female	45 (72.6%)	(16.69)	(13.38)	(15.84)	(2.35)

Age (years)			.907	.107	.063 ^a	.012 ^b
	Under 28.5 years	31 (50.0%)	(16.52)	(12.97)	(14.87)	(2.49)
	Over 28.5 years	31 (50.0%)	(18.58)	(15.39)	(16.48)	(2.24)
Racial Identity			.347	.333	.065 ^a	.908
	Asian	50 (80.6%)	(17.90)	(14.44)	(15.52)	(2.32)
	Non-Asian	12 (19.4%)	(16.08)	(13.08)	(16.33)	(2.56)
Education Level			.479	.866	.066 ^a	.029 ^b
	Graduate/ Doctorate Degree	32 (51.6%)	(18.38)	(14.78)	(15.66)	(2.06)
	No Graduate Degree	30 (48.4%)	(16.67)	(13.53)	(15.70)	(2.69)
Employment Status			.654	.125	.019 ^b	.011 ^b
	Employed/ Self-Employed	31 (50.0%)	(16.34)	(14.25)	(15.97)	(2.35)
	Not Employed	31 (50.0%)	(18.83)	(14.10)	(15.37)	(2.39)
Marital Status			.486	.600	.335	<.004 ^b
	Married	32 (51.6%)	(19.47)	(15.72)	(16.22)	(2.48)
	Not Married	30 (48.4%)	(15.50)	(12.53)	(15.10)	(2.25)
Children			.602	.262	.598	.388
	Yes	20 (32.3%)	(19.85)	(15.80)	(17.25)	(2.25)
	No	42 (67.7%)	(16.45)	(13.40)	(14.93)	(2.42)
Sect			.354	.262	.585	.057 ^a
	Sunni	49 (79%)	(17.71)	(14.45)	(15.61)	(2.35)
	Non-Sunni	13 (21%)	(16.92)	(13.15)	(15.92)	(2.43)
COVID-19 Vaccine			.266	.435	.276	.410
	Yes	60 (96.8%)	(17.67)	(14.20)	(15.77)	(2.30)
	No	2 (3.2%)	(14.00)	(13.50)	(13.00)	(4.23)

^aP-value < α , $\alpha = 0.10$

^bP-value < α , $\alpha = 0.05$

^cTransformed data

Correlation Analyses

Because age and income were continuous variables, an additional correlation analysis was completed between their untransformed values and each of the belief scores. (Table 5) is the parametric Pearson correlation and (Table 6) is the non-parametric Spearman correlation. There is a significant positive Pearson correlation of age, household income, and religiosity score with the political beliefs score. Also, there is a significant positive Spearman correlation of age and religiosity score with the

political beliefs score, income with religiosity score, and trust score with vaccine hesitancy. Because Spearman correlations are less sensitive to large outliers in either tail of the sample, there is a loss of statistical significance between income level with the religiosity score and political score. The greatest correlation is +.593 between the religiosity score and the political beliefs score.

Table 5. Parametric Pearson correlations

		Income	Religiosity Score	Political Score	Trust Score	Hesitancy Score ^c
Age						
	Correlation	-.006	.142	.342 ^b	.176	.033
	P-value	.960	.272	.007	.171	.801
Income						
	Correlation	---	.240 ^a	.289 ^b	.205	-.123
	P-value	---	.061	.023	.110	.343
Religiosity Score						
	Correlation	---	---	.593 ^b	.171	-.056
	P-value	---	---	<.001	.183	.666
Political Score						
	Correlation	---	---	---	.012	.114
	P-value	---	---	---	.924	.380
Trust Score						
	Correlation	---	---	---	---	-.223 ^a
	P-value	---	---	---	---	.082

^aCorrelation is significant at the 0.10 level (2-tailed)

^bCorrelation is significant at the 0.05 level (2-tailed)

^cTransformed data

Table 6. Non-parametric Spearman correlation

		Income	Religiosity Score	Political Score	Trust Score	Hesitancy Score ^c
Age						
	Correlation	.109	.150	.286 ^b	.172	-.080
	P-value	.401	.244	.024	.182	.534
Income						
	Correlation	---	.090	.088	-.071	.021
	P-value	---	.489	.496	.582	.869
Religiosity Score						
	Correlation	---	---	.587 ^b	.155	-.040
	P-value	---	---	<.001	.230	.756
Political Score						
	Correlation	---	---	---	-.075	.095
	P-value	---	---	---	.561	.462

Trust Score						
	Correlation	---	---	---	---	-.233 ^a
	P-value	---	---	---	---	.069

^aCorrelation is significant at the 0.10 level (2-tailed)

^bCorrelation is significant at the 0.05 level (2-tailed)

^cTransformed data

Multiple Regression Analyses

Because none of the demographic variables were statistically significant, no multiple regression analyses were completed on the religiosity and political beliefs scores. An independent samples T-test was performed between the religiosity and political beliefs score and COVID-19 vaccination status, which is listed on (Table 4).

Trust in Public Institutions

(Table 7) and (Table 8) show the multiple regression findings. (Table 7) displays Model 1, which compared the trust score with the statistically significant variables from the bivariate analysis. Model 2 is in (Table 8), which compares the trust score with the statistically significant variables and the other belief scores. In Model 1, participants older than 28.5 years were more likely to have higher trust scores. In Model 2, participants with lower vaccine hesitancy scores were more likely to have higher trust scores, controlling for the six other independent variables. Age ceased to be important in Model 2. The R^2 of Model 1 was .063, which means that 6.3% of the variability in trust was explained by the four demographic variables. The R^2 of Model 2 was .174, which means that 17.4% of the variability in trust was explained by the four demographic variables plus the three other health belief scores.

Table 7. Multiple regression of trust score with Model 1

	Unadjusted ^a		Adjusted ^b	
	B ^d	P-value	B	P-value
Age	1.702	.089 ^c	1.613	.088 ^c
Racial Identity	.607	.639	---	---
Education Level	.506	.647	---	---
Employment Status	-.646	.518	---	---

^aEnter preset

^bBackwards preset

^cP-value < α , $\alpha = 0.10$

^dSlope

^eDashed line represents no significant values after 4 regression iterations.

Table 8. Multiple regression of trust score with Model 2

	Unadjusted ^a		Adjusted ^b	
	B ^d	P-value	B	P-value
Age	7.507	.066 ^c	---	---
Racial Identity	.834	.504	---	---
Education Level	1.282	.251	---	---

Employment Status	-1.182	.245	---	---
Religiosity Score	.179	.071 ^c	---	---
Political Score	-.157	.261	---	---
Hesitancy Score	-.758	.073 ^c	-.701	.082 ^c

^aEnter preset

^bBackwards preset

^cP-value < α , $\alpha = 0.10$

^dSlope

^eDashed line represents no significant values after 7 regression iterations.

Vaccine Hesitancy Score

(Table 9) shows Model 1, which compared the hesitancy score with the statistically significant variables from the bivariate analysis. (Table 10) shows Model 2, which compared the trust score with the statistically significant variables and the other belief scores. According to Model 1 and Model 2, participants with a graduate or a doctorate degree were more likely to have higher hesitancy scores. This finding contradicts that of the T-test during bivariate analyses. Moreover, Model 2 showed that participants with higher trust scores were more likely to have lower vaccine hesitancy scores, controlling for all other variables. The R^2 of Model 1 was .102, which means that 10.2% of the variability in vaccine hesitancy was explained by the five demographic variables. The R^2 of Model 2 was .179, which means that 17.9% of the variability in vaccine hesitancy was explained by the five demographic variables plus the three other health belief scores. Finally, an independent samples T-test was performed between the vaccine hesitancy score and whether a participant received at least one dose of the COVID-19 vaccine, which is listed on Table 4. This did not show an association.

Table 9. Multiple regression of hesitancy score with Model 1

	Unadjusted ^a		Adjusted ^b	
	B ^c	P-value	B	P-value
Age	-.282	.416	--- ^f	---
Education Level	.631	.056 ^c	.625	.036 ^d
Employment Status	-.094	.767	---	---
Marital Status	-.398	.243	---	---
Sect	.159	.667	---	---

^aEnter preset

^bBackwards preset

^cP-value < α , $\alpha = 0.10$

^dP-value < α , $\alpha = 0.05$

^eSlope

^fDashed line represents no significant values after 5 regression iterations.

Table 10. Multiple regression of hesitancy score with Model 2

	Unadjusted ^a		Adjusted ^b	
	B ^c	P-value	B	P-value
Age	.637	.670	--- ^f	---
Education Level	.775	.023 ^c	.628	.032 ^d
Employment Status	-.121	.718	---	---

Marital Status	-.208	.577	---	---
Sect	.237	.518	---	---
Religiosity Score	-.018	.586	---	---
Political Score	.046	.304	---	---
Trust Score	-.077	.071 ^c	-.071	.071 ^c

^aEnter preset

^bBackwards preset

^cP-value < α , $\alpha = 0.10$

^dP-value < α , $\alpha = 0.05$

^eSlope

^fDashed line represents no significant values after 7 regression iterations.

Discussion

The goals of this study were to determine the factors that influenced vaccine hesitancy among Muslim-Americans and give healthcare providers a clear picture of how to address vaccine hesitancy with their Muslim patients, by learning about its prevalence and the socioeconomic factors that contribute to it. It was hypothesized that vaccine hesitancy in Muslim-Americans follows anti-vaccination trends within the United States.

Demographic Factors

As age increased, vaccine hesitancy decreased, as confirmed by some studies [19, 28, 34, 35, 36] and contradicted by others [31, 32, 33]. More educated participants were less vaccine hesitant, which was supported by the multiple regression analysis. Similar relationships were found in some studies [3, 28, 35, 36] but contradicted in others [37]. Employed participants were less vaccine hesitant, which aligned with some previous research [28, 29] and not in others [30]. Furthermore, previous studies have reported that unmarried participants were more vaccine hesitant [28, 29, 36] which contradicts the findings of this study and others [31]. Lastly, participants who identified as Sunni were less vaccine hesitant than those who were non-Sunni. No other study was found to have discussed hesitancy trends among Muslim sects, so this study was the first of its kind to determine statistically significant differences in vaccine acceptance between Sunnis and non-Sunnis. Ideally, more research will be conducted in the future to further elucidate the connection between sect and hesitancy.

Belief Scores

Religiosity

Income had a positive correlation with religious beliefs. There is no recent data on the connection between high income and stronger religious adherence compared with the findings of this study. In the last Religious Landscape Survey by the Pew Research Center from 2014, participants with higher incomes were less likely to attend religious services, have strongly associated beliefs in their faith or even align themselves with a particular religion [43]. So, the findings of this study do not correspond with general trends between socioeconomic status and the extent of religious belief. Additionally, participants with stronger religious beliefs favored more right leaning political, economic, and social ideologies. This finding is unsurprising as Americans with stronger religious leanings tend to follow conservative civic ideologies [44].

Political Beliefs

Older age and higher income correlated with more conservative ideology in this study. While adults tend to have stable political beliefs over time, those who transition in their beliefs as they age are

more likely to go from left leaning to right leaning [45].

Trust in Public Institutions

Participants were less likely to accept vaccines if they perceived that the institutions associated with them were not trustworthy or did not have the best interests for the public. This was supported in the multiple regression analysis and other studies [5, 7, 21, 26, 27, 44].

Unusual Findings

One association contradicted itself. Increased trust in public institutions and more education were associated with less vaccine hesitancy, but more education was not associated with higher trust scores. In an ideal scenario, more education would lead to more trust in public institutions and less vaccine hesitancy. The inconsistency of this study may be caused by the transformed vaccine hesitancy score data. When the independent samples T-test was completed with untransformed data, there was a positive association between trust in public institutions and more education; however, the association became negative when untransformed vaccine hesitancy was analyzed with trust scores and education level.

Considerations, Limitations & Strengths

Online surveys with convenience sampling allow researchers to cast a wide net to attain participants with very little effort for recruitment. However, they pose problems with information validation. Also, some responses with large outliers in reported income and age were most likely inaccurate. If a participant had at least one response that was an extreme outlier (± 3 standard deviations from the mean) or showed abnormal reporting patterns, all their responses were removed from the data analyses. This explains why only 62 participants were included in the final analysis, despite 65 participants meeting the inclusion criteria. Moreover, participants were asked about their opinions on vaccines for themselves, not for others, so there may be differences between how a person views vaccines for themselves or for someone else.

Additionally, the survey was not distributed as widely as intended. Twenty-five Facebook groups were selected for distribution; however, only 10 disseminated the survey. This discrepancy was due to a few reasons. First, many Muslim-oriented Facebook groups are private and did not allow posts from non-members. Second, some groups deleted the marketing script and the link to the survey, because the posts were considered spam. Third, group administrators were often unresponsive to requests to post the marketing script or share information about the survey. Lastly, the Facebook groups that posted about the study were dominated by South Asian and Sunni Muslims. To put this in context, only 1.6% of survey participants identified as Black or African American, but they make up 20% of Muslim population in America [46]. Also, the sample size was smaller than similar studies on vaccine hesitancy. However, the calculated minimum sample size for this study was 43, so the acquired 62 responses was higher than the smallest necessary sample.

There may have been a more representative sample if Facebook advertisements were utilized, but this would have introduced new limitations. First, advertisements are not free. They are billed by Facebook's parent company, Meta, based on how many people are exposed to the advertisement message. Advertisers can set cost limits and specify the demographics they are trying to reach, but this is not a perfect guarantee that someone in the inclusion criteria will start a survey. Moreover, advertising costs do not include the time that goes into creating and managing surveys, and the miscellaneous funds necessary to conduct studies, such as participant incentives. Second, there are high rates of survey attrition [47]. Unfortunately, Qualtrics did not provide completion data for this study's survey, so an adequate comparison cannot be made.

Even so, there may be sampling bias. The lead author of this study is a South Asian Muslim woman, who shared the survey on her personal social media profiles, of which comprised mostly of followers from South Asian, Sunni and healthcare backgrounds. The lead author also distributed the study through her medical school's internal email system. Thus, educated individuals with the means of accessing reliable health information resources, primary care physicians and healthcare services were overrepresented. These discrepancies most likely impacted the findings of this survey because there are significant associations between education level and trust in public institutions with vaccine hesitancy.

With respect to the findings of this study, there was a possibility that the multiple regression underestimated the effects of racial identity on vaccine hesitancy. Participants volunteered to share their opinions, so there may be recall bias, a Hawthorne effect, or incorrect recollections. To offset these limitations, the study had several analytical strengths. First, skewed variables were transformed into a normal distribution. Second, while the independent samples T-tests compared the means of the belief scores, the multiple regressions reduced the effect of confounding variables. Lastly, the multiple regression models compared demographic and confounding variables. A proposed future study would aim to improve the diversity of the sample and the sample size.

Conclusions

Overall, public health scientists must have compassion and empathy when engaging the public on vaccination. Healthcare is a deeply personal choice that reflects one's background, personal history, and beliefs. While it's easy to express frustration at those who harbor anti-vaccination sentiments, it's important to remember that all people are pulled by their own biases and conflicts of interest. Thus, it is necessary to have a sense of optimism and remain proactive in developing people's trust in vaccines.

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Conflicts of Interest

None declared.

Abbreviations

CDC: Centers for Disease Control and Prevention

U.S.: United States of America

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