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Prevalence and beliefs associated with vaccine hesitancy among Muslim-Americans

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PREVALENCE AND BELIEFS ASSOCIATED WITH VACCINE HESITANCY AMONG

MUSLIM-AMERICANS

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Abstract

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MUSLIM-AMERICANS

Marina Ali

Thesis Chair: William Sorensen, Ph.D.

The University of Texas at Tyler

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Background. Vaccine hesitancy hinders the eradication of preventable illnesses. Furthermore, there are gaps in public health research on vaccine hesitancy among Muslims in heterogenous societies.

Objective. This study aimed to determine whether socioeconomic demographics, political beliefs and trust in public institutions were associated with vaccine hesitancy beliefs. Additionally, two models were applied to determine which factors had the strongest influence in rejecting vaccines.

Method. Participants were recruited through Facebook group posts. Seventy-three responses were received. Sixty-three responses met the inclusion criteria and were included in the final analysis. Participants rated their opinions on political beliefs, religious practices, trust in institutions and vaccines. Answers were compiled into the following belief scores: political leaning, religiosity, trust in public institutions, and vaccine hesitancy.

Results. From bivariate analysis, participants who were older in age, attained higher levels of education, were employed, were not married, and identified with the Sunni sect were less

vaccine hesitant. From multiple regression analysis, participants with higher education levels and trust in public institutions were the least likely to express vaccine hesitancy. No belief score had a significant correlation with vaccine hesitancy. Most participants (36.5%) were more likely to receive a vaccine it had no potential safety issues. Moreover, they were hesitant with vaccines if they had safety concerns or had poor efficacy.

Discussion. Results both align with and contradict previous studies in Muslim majority and religiously heterogenous countries. This study is the first of its kind to find an association between Islamic sect and proclivity 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, vaccine, vaccines, Muslim, Muslim-American, Muslim health

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Chapter 1

Introduction

Vaccine hesitancy, or the delay or refusal of vaccines, is a growing problem around the world (Chen & Whitehead, 2021). Anti-vaccination sentiments are known to increase the proliferation and death rates of preventable illnesses, while also putting immunocompromised and nonvaccinated populations at risk. Unfortunately, thorough researched data is scant on this subject for Muslims. There have been studies, like those by Hossain et al. (2021) and Sallam et al. (2021), which were conducted in Muslim majority countries. However, there is still no consensus on Muslim communities in religiously heterogenous societies, like the United States. Such information is scattered and very limited in scope. For example, Hearld and Budhwani (2020) focused on Muslim women in the United States who were recruited through social media. They found that 72% of their sample obtained an influenza vaccine while only 38% received at least one dose of the human papilloma virus (HPV) vaccine series.

While these findings contribute to a better understanding of Muslim women's vaccine hesitancy, they exclude the other half of the American Muslim community and only focus on two vaccines. Because of Hearld and Budhwani's study design, it is difficult to determine large scale prevalence rates for vaccine hesitancy in general and across multiple types of vaccines. Additionally, they only study whether someone is vaccinated or not. However, there are a multitude of reasons why someone cannot receive a vaccine but may still desire to receive one (Lin et al., 2020). Since there is a gap in the literature for vaccine hesitancy trends among Muslims in religiously heterogenous societies, my study aims to collect both specific and general information. There must be a big picture understanding of vaccination trends as well as smaller details about underlying factors that influence the Muslim community.

The main goals of my study were to 1) understand what factors influence vaccine hesitancy in American Muslim communities and 2) give healthcare providers the tools to deter vaccine hesitancy among their Muslim patients. I wanted to learn about its prevalence and determine if socioeconomic status contributes to it. Additionally, I hypothesized that vaccine hesitancy in American Muslim communities follow the broader picture of anti-vaccination sentiments within the country. For example, those with less education, of lower socioeconomic status, identify as more religiously conservative, and more distrustful of public institutions are more vaccine hesitant.

In all, this type of research is very important, because it is necessary to learn about specific health concerns that disproportionately affect different groups of people. The following chapter will examine published literature about this subject.

Chapter 2

Literature Review

A wide assortment of search engines and databases were utilized to find the most relevant papers for this study. These included PubMed, ScienceDirect, Ovid, Google Scholar, and Academic Search Elite. Access to the databases were provided through the University of Texas (UT) in Tyler and Kansas City University libraries. The following keywords were used to search for research papers: "Muslim vaccine hesitancy", "Islamic community vaccine hesitancy", "vaccine hesitancy," "COVID vaccine Muslim", and "COVID-19 vaccine Muslim." Studies that were over five years old were scanned, but not fully read as they most likely contained old information that may not reflect the current climate surrounding vaccine hesitancy in Muslim communities. Nonetheless, they provided useful background and historical context for the researcher on vaccination.

General Vaccine Hesitancy Trends in America

Since the creation of vaccines in the 18th century, their efficacy, safety, and epidemiology have been rigorously tested. With the popularity of anti-vaccination movements in the 20th century, there have been an explosion of public health data on the long-term societal consequences of vaccination, or the lack thereof. However, there were not many recent, peer-reviewed papers that study the prevalence of anti-vaccine sentiments for all of America. These studies analyzed hesitancy using different quantitative metrics and study designs, which hindered the comparison of one paper's findings to another. Also, there was an emphasis on specific demographic groups, but there was no comparison on the prevalence of anti-vaccine sentiments among them to understand big picture trends within the wider population. Moreover, with the advent of the coronavirus disease of 2019 (COVID-19), hesitancy studies on other major

vaccines, like those for measles, influenza, and human papilloma virus (HPV) declined.

Regardless, these studies were good starting points to establish patterns of behavior.

For example, for a study completed before the COVID-19 pandemic, Gidengil et al. (2019) reported that American parents who believed strongly in vaccine adverse effects, distrusted institutions, felt helplessness, questioned vaccine efficacy, or desired bodily autonomy, were more likely to express vaccine hesitancy or would outright deny them for their children. Johnson et al. (2019) reported that 13% of college students at a university on the west coast were vaccine hesitant. Students 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. Dysband, Hall and Carson (2019) discovered that compared to all other healthcare professions students, nursing students were more likely to be vaccine hesitant and scored the lowest in vaccine knowledge tests. Guadiana, Kavanagh and Squarize (2021) assessed vaccine hesitancy among dental professionals in Michigan by their willingness to vaccinate their patients. They found that 30% of their sample were either opposed or unsure about administering vaccinations, citing potential malpractice or liability concerns as the most common reason.

Justwan et al. (2019) found that Americans who distrusted public institutions, like the Centers for Disease Control and Prevention (CDC) and the government, were older in age, were childless and less educated, and were more likely to be vaccine hesitant. Furthermore, there has been a plethora of hesitation studies on parents to vaccinate their children. Kempe et al. (2020) surveyed parents on their willingness to vaccinate their children. Six percent were hesitant against routine childhood vaccines and 25.8% were hesitant against flu vaccines, with the risk of side effects and low effectiveness as the most important factor for avoiding them. They also found that parents of lower socioeconomic status, Hispanic heritage and fewer years of education

were more likely to be hesitant. This supports the findings of Mesch and Schwirian (2019) who

reported that those with fewer years of education and older age were more likely to obtain an

Ebola vaccine for themselves. Unfortunately, contradictory findings are not uncommon in

vaccine hesitancy surveys (Kempe et al., 2020). Even older studies, like Dubé, Vivion and

MacDonald (2015); Freed et al. (2015); Shui, Weintraub and Gust (2006); Smith et al. (2004);

and Smith et al. (2011) reported conflicting findings between parental age, years of education,

race, and socioeconomic status. Because of the many inconsistencies in vaccine hesitancy

findings, it is necessary for more research to be conducted in this field.

General Vaccine Hesitancy in Muslims

Most studies on vaccine hesitancy among Muslims were conducted in Muslim majority

countries. For example, Alqahtani et al. (2021) and Alsubaie et al. (2019) surveyed Saudi

Arabian parents, of which 96.1% and 80%, respectively, supported vaccination. Kalok et al.

(2020) and Mohd et al. (2017) had similar results, with 92% and 88.4% of Malaysian parents,

respectively, supporting vaccination. Martinez-Bravo and Stegmann (2021) showed that

Pakistani parents in Taliban controlled areas were 23% to 39% less likely to vaccinate their

children compared to parents in non-Taliban controlled areas. Ogbuabor and Chime (2021)

surveyed Nigerian mothers, of whom 68.4% accepted vaccines. Some studies combined data

from multiple countries, such as Owoaje et al. (2020) who analyzed vaccine hesitancy trends in

Afghanistan and Nigeria. Sallam et al. (2021) studied 18 different Arab countries and aggregated

all the data into vaccine acceptance rates of 29.4% for COVID-19 and 30.9% for influenza

immunizations. Other studies contained samples from countries with Muslim minorities, such

Tefera et al. (2018), who found that 61% of the children in a Muslim-dominated area of Ethiopia

were receiving regular vaccinations.

Knowledge Gaps

Unfortunately, there was no strong consensus on vaccine hesitancy trends in Muslim communities living in religiously heterogenous societies, like those in the United States and the United Kingdom (Memish et al., 2019). Therefore, most information about Muslims in western countries was mainly found in secondary sources. For example, in 2017, there was a highly publicized outbreak of measles in the Somalian-Muslim immigrant diaspora in Minnesota. Public health officials cited the increasing anti-vaccine sentiments within the community as the primary cause of the outbreak (Dyer, 2017). Vaccine hesitancy studies in religiously heterogeneous countries typically cast a wide net, as in the case of Murphy et al. (2021). Their study had vaccine acceptance rates of 65% in Ireland and 69% in the United Kingdom, but there was no breakdown of these numbers by demographics. Such studies did not focus solely on Muslims, since their researchers aimed for a representative sample from their diverse population.

Themes

There were several themes that resonated across the papers. These factors significantly influenced Muslim parents' willingness to vaccinate their children, such as religious prohibitions (Padmawati, 2019), parental experience (Sallam et al., 2021), level of trust within public institutions (Khan et al., 2020), and political affiliations (Murphy et al., 2021). For example, parents in Taliban-influenced areas of Pakistan distrusted foreign health officials and vaccinations once they learned that the Central Intelligence Agency (CIA) used a polio vaccination campaign to capture Osama bin laden (Martinez-Bravo & Stegman, 2021). Also, 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 (French, 2019).

COVID-19

Overview

According to the most recent information from health authorities, the first cases of COVID-19 were reported from Wuhan, China in early January 2020 (AJMC Staff, 2021). What began as a confounding mystery, eventually spiraled into a global pandemic, with 756 million confirmed cases and over 6.8 million deaths globally by February 2023 (WHO, 2023). This illness caused widespread devastation in every aspect of human civilization and every country on Earth has reported COVID-19 cases (Murphy et al., 2021). In addition to the loss of human life, the pandemic cost an estimated $16 trillion in lost gross domestic product (GDP), healthcare costs, long-term health impairment costs, and mental health impairment costs (Cutler & Summers, 2020). Unfortunately, only 13 billion vaccine doses have been administered, and at least 2 to 3 doses are necessary for effective immunity (WHO, 2023). Approximately 50% to 80% of the population must be vaccinated to benefit from herd immunity (Erzurum, 2021), but by February 2023, this has not been achieved with the COVID-19 vaccine.

Vaccine Hesitancy Trends

Because of the pandemic, there have been an influx of research into vaccine hesitancy. Lin et al. (2020a) and Pan et al. (2021) are systematic reviews comprised of research papers with samples from around the world. The main difference between the two was Pan et al.'s focus on parental attitudes towards vaccinating children whereas Lin et al. (2020a) analyzed more broadly to include any paper on COVID-19 vaccine hesitancy. Unfortunately, the reviews did not delve into specific hesitancy rates for all papers, but they discussed themes, many of which were similar between them. From both, individuals who mistrusted public institutions and/or believed in conspiracy theories, were more hesitant of COVID-19 vaccines.

Furthermore, Freeman et al. (2020) and Lin et al. (2020b) reported that unemployed and unmarried individuals were more likely to be vaccine hesitant, which contradicts Dror et al. (2020), who found that unemployed individuals were less likely to be hesitant. Wang et al. (2021) found that people who were unmarried were more hesitant towards COVID-19 vaccines. Interestingly, both papers found conflicting information about age. Palamenghi et al. (2020), Kwok et al. (2021) and Wang et al. (2021) reported that hesitancy increased with old age, while Detoc et al. (2020), Freeman et al. (2020), Murphy et al. (2021), Fisher et al. (2020), and Al-Mohaithef and Padhi (2020) reported the opposite trend.

For COVID-19 vaccine hesitancy rates in Muslim populations, the best data came from studies in Muslim majority countries. Al-Mohaithef and Padhi (2020) found that 64.7% Saudi Arabians were willing to vaccinate, and Salali and Uysal (2020) reported that 69% of their Turkish sample were accepting of vaccines. Hossain et al. (2021) show that 53.8% of Bangladeshis desired COVID-19 vaccines. Harapan et al. (2020) found that 93.3% of Indonesians would consent to a 95% effective vaccine, but only 67.0% consented to a 50% effective vaccine. Wong et al. (2020) found gradations, with 48.2% of Malaysians definitely intending to receive the vaccine, 29.8% of the sample with probable intent, and 16.3% with a possible intent.

Saudi Arabian Muslims who were married and employed by government organizations were more likely to accept COVID-19 vaccines (Al-Mohaithef & Padhi, 2020). Overall, even with the information collected from the COVID-19 pandemic, there was a gap in the literature for vaccine hesitancy trends in Muslim communities from countries with religious diversity.

Contradictions & Considerations

Almost all the papers randomly sampled people in a single or a few countries, and did not limit their studies to Muslims only, except for Ahmed et al. (2018) and Hamdi (2018). It should be noted that within the literature search, there were contradictory findings. For example, Kabir et al. (2021) concluded that Muslims from all socioeconomic backgrounds in Bangladesh were more likely to get the COVID-19 vaccine if it were free. This contradicts the conclusions from Sabahelzai (2019), in which wealthy Sudanese people were less likely to obtain any kind of vaccine if it were free. Discrepancies in vaccine hesitancy trends were expected from country to country as there are cultural norms that dictate health behaviors, but there was not enough information from other Muslim communities to show if the difference originated from culture, socioeconomic status, or something entirely different.

Additionally, most data were on Asian and Middle Eastern Muslims; there were not enough studies on African Muslims and none on indigenous, Central American, and South American Muslims. Thus, the review summaries hold a strong bias for some cultures and not others. Because Islamic culture differs greatly from country to country, it was imperative to investigate as many kinds of Muslims as possible. The strong biases for certain sects, ethnicities and socioeconomic backgrounds potentially skews how public health and medical professionals should approach vaccine hesitancy with Muslim patients. There are lasting consequences to creating and implementing policies based on inaccurate information.

The next chapter will outline the methods for my research.

Chapter 3

Materials and Methods

Study Design

This was a cross-sectional, quantitative study. Participants completed an online survey on the Qualtrics platform.

Questionnaire Tool

The survey was divided into 4 major sections, which is outlined by the number of questions in **Table 1**. The full questionnaire can be found in **Appendix A**. 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. Half of the political belief questions lean towards a conservative ideology while the other half lean towards a liberal ideology. **Table 2** is a classification scheme for each composite score to analyze different personal beliefs and values. The minimum score was the smallest composite score possible, while a maximum score was the

highest. 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 an asterisk (*). For

those who do not have children, their score for this question is 0. 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	Minimum	Maximum	# Questions	Questions
Religiosity	6	30	6	13, 14, 15, 16, 17, 18
Vaccine Hesitancy	7	40	8	32, 33, 35, 36, 37, 38, 39*, 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 sample size of 43 was determined using a sample size calculator by Kane (2019) from

the following study design 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)

The calculated sample size was only a target for the minimum number of valid responses. Ideally, there would be more than 43 responses, as it was crucial to find as many participants as possible. The larger the sample size, the more variability in the data.

Generally, studies that analyze vaccine hesitancy collect data through surveys completed by a sample (Ahmad, 2022; Lin, 2020; Cooper, 2021; Pan, 2021). From the literature review in Chapter 2, there was a knowledge gap for vaccine hesitancy trends among Muslim-Americans. While there were papers from Muslim majority countries, like Alqahtani et al. (2021) for Saudi Arabia, or from heterogenous societies with Muslim populations, like Freeman et al. (2020) for the United Kingdom, there were almost none exclusively focusing on Muslim-Americans. Thus, this study analyzed vaccine hesitancy trends and beliefs of Muslim adults living in America.

Subjects had to meet all the following requirements to participate: be at least 18 years of age, identify as a Muslim, and have lived at least 5 years in the United States at the time of completing the survey. Because children do not make decisions about their own health, they were not included in the study. Also, 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 (U.S. Citizenship and Immigration Services, 2019).

The participants were recruited through preselected Muslim oriented Facebook groups (see **Appendix D** for the list of groups). **Appendix B** was the recruitment flyer that was posted online; it included a link to the survey. This flyer was also posted by the author through "word of

mouth" among her physical social networks, personal Twitter profile, personal Instagram page, and personal Facebook profile. The participants were encouraged to further spread information about the study to other individuals who meet the inclusion criteria. Even though participants were convenience and snowball sampled, selection of the Facebook groups was more deliberate, because targeted recruitment can 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.

Timeline

In mid-April of 2022, a pilot study was conducted on 5 individuals, regardless of their ability to meet the inclusion criteria. This was a test run of the Qualtrics survey to solve any unforeseen technical or research related problems. The Institutional Review Board (IRB) review documents were submitted in April of 2022 and accepted in May of 2022. After IRB approval, the website link to the survey was disseminated online to 10 Facebook groups. Data collection began in May of 2022 and was completed 2 months later in July. Finally, data was aggregated in August of 2022 and analyzed until February of 2023. The thesis was defended in March of 2023. In total, 73 responses were received, with 89% meeting the inclusion criteria.

Analysis

The Qualtrics software collected participants' survey responses during the data collection phase. At the completion of this stage, the data was downloaded as a Microsoft Excel document. The data spreadsheet was uploaded into the IBM SPSS Statistics 28 software, where all the statistical analyses were completed. 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. Additionally, descriptive statistics were be obtained for Islamic sect, political views,

source of healthcare information, and factors for vaccine hesitancy. Normalcy was scrutinized

and when a demographic variable was skewed, it was transformed to yield more normal

measures. The four belief scores were calculated for each participant. The belief scores and the

response to Question #34 were output variables. They were analyzed using T-tests and linear

regression testing to determine if there are associations between demographic variables and each

metric. Additionally, correlation was conducted with the 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.

Ethics

The UT Tyler IRB approved this study on May 12, 2022 (IRB #2022-030 in **Appendix**

E). Consent was obtained by participants on the first page of the questionnaire: once they

selected the option, "yes, I choose to participate in this study." The consent statement is shown in

Appendix C. Because the Excel document with questionnaire responses contained personal

information, they were stored in a password protected computer. The Excel file was encrypted,

and password protected for added security.

Chapter 4

Results

At the conclusion of the data collection period, a total of 73 responses were received. Sixty-five

met the required inclusion criteria. Eight did not meet the inclusion criteria and were not

included in the final data analysis. According to sample size analysis, 43 participants were

originally sought. The extra responses meeting the inclusion criteria increased this requirement

by 51% (65/43).

Belief Score Distributions

The distribution of the calculated belief scores are as follows: religiosity in **Figure 1**,

political leaning in **Figure 2**, trust in public institutions in **Figure 3** and vaccine hesitancy in

Figure 4. **Table 3** lists the mean and standard deviation (SD) of the 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 Y (transformed vaccine hesitancy score) = SQRT

(40 – vaccine hesitancy score) and showed a skewness of -0.337. The transformed variable was

used for statistical testing and the transformed distribution is seen in **Figure 5**.

Table 3: *Means and Standard Deviations (SD) of Belief Scores*

Belief Score	Minimum	Maximum	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
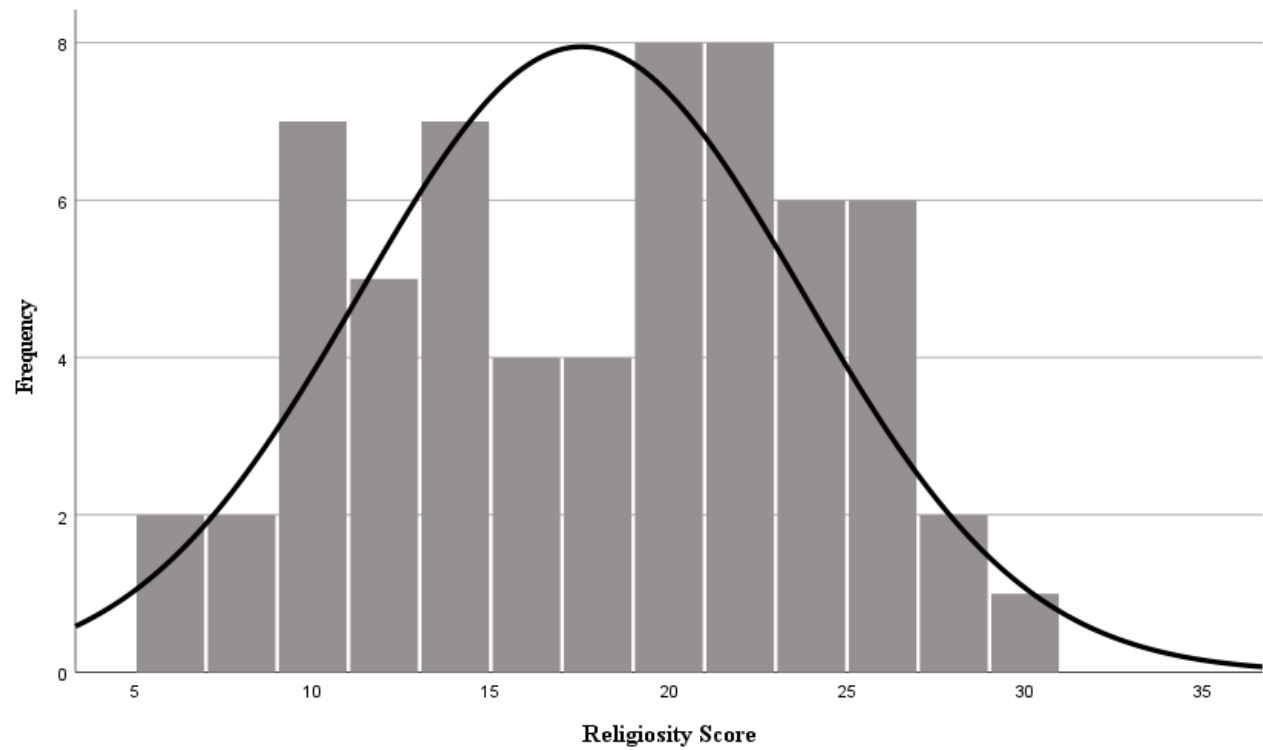
Figure 1: *Distribution of Religiosity Scores*
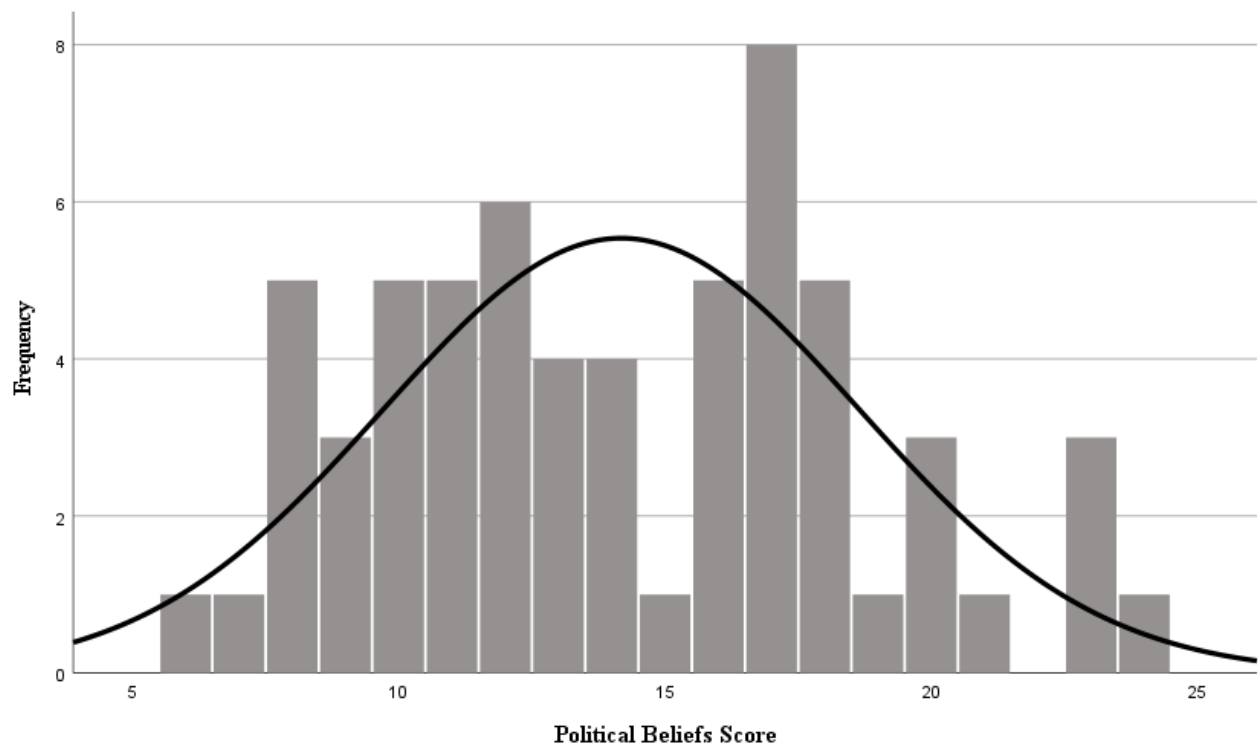
Figure 2: *Distribution of Political Beliefs Scores*
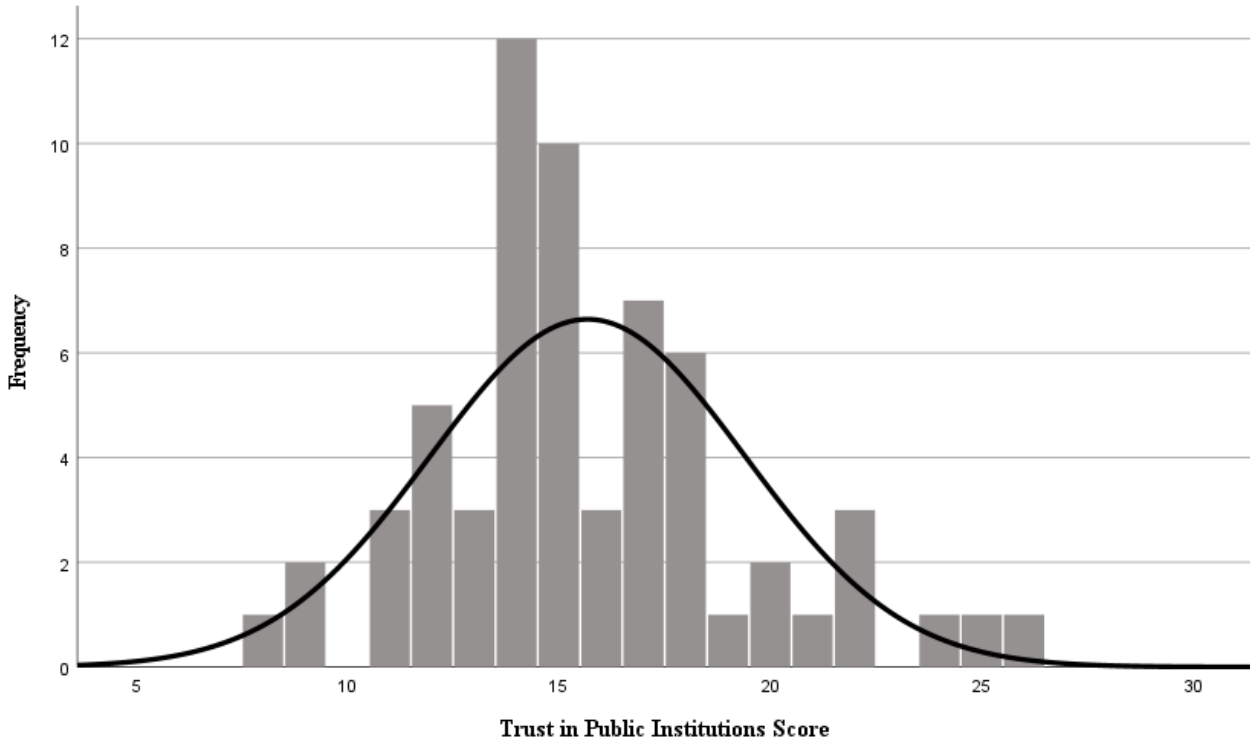
Figure 3: *Distribution of Trust in Public Institutions Scores*
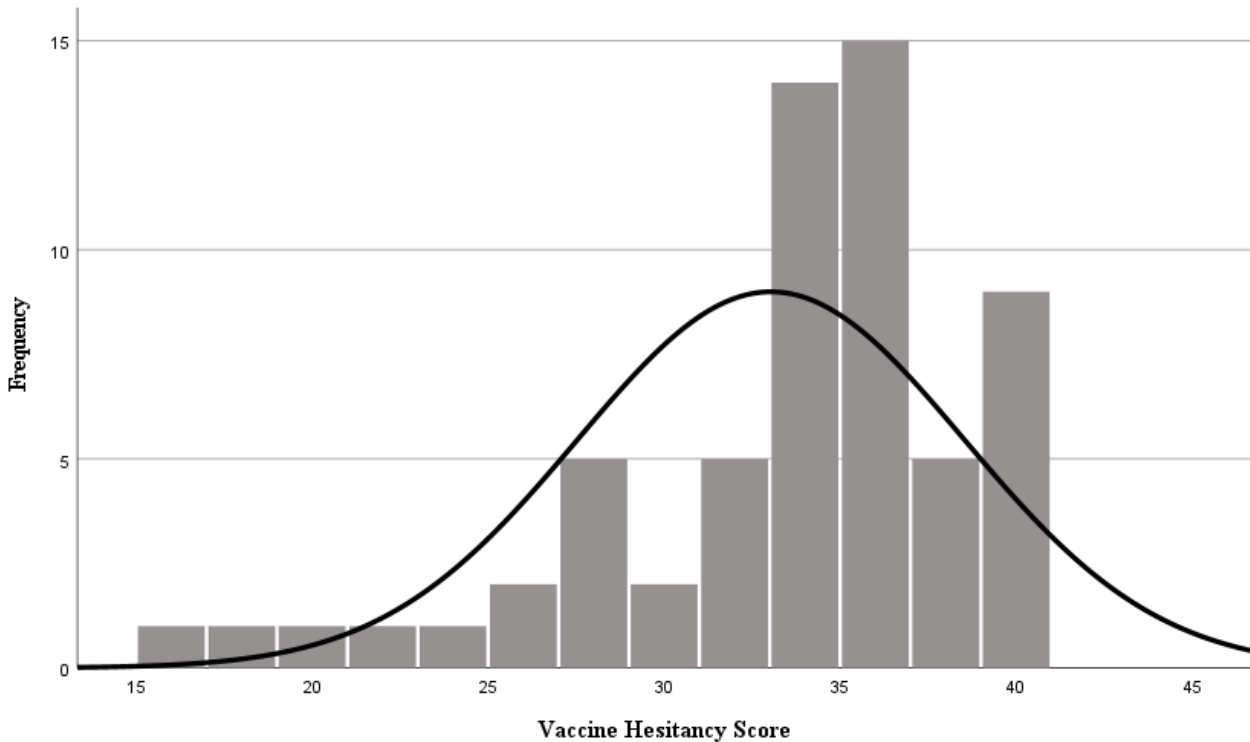
Figure 4: *Distribution of Vaccine Hesitancy Scores*
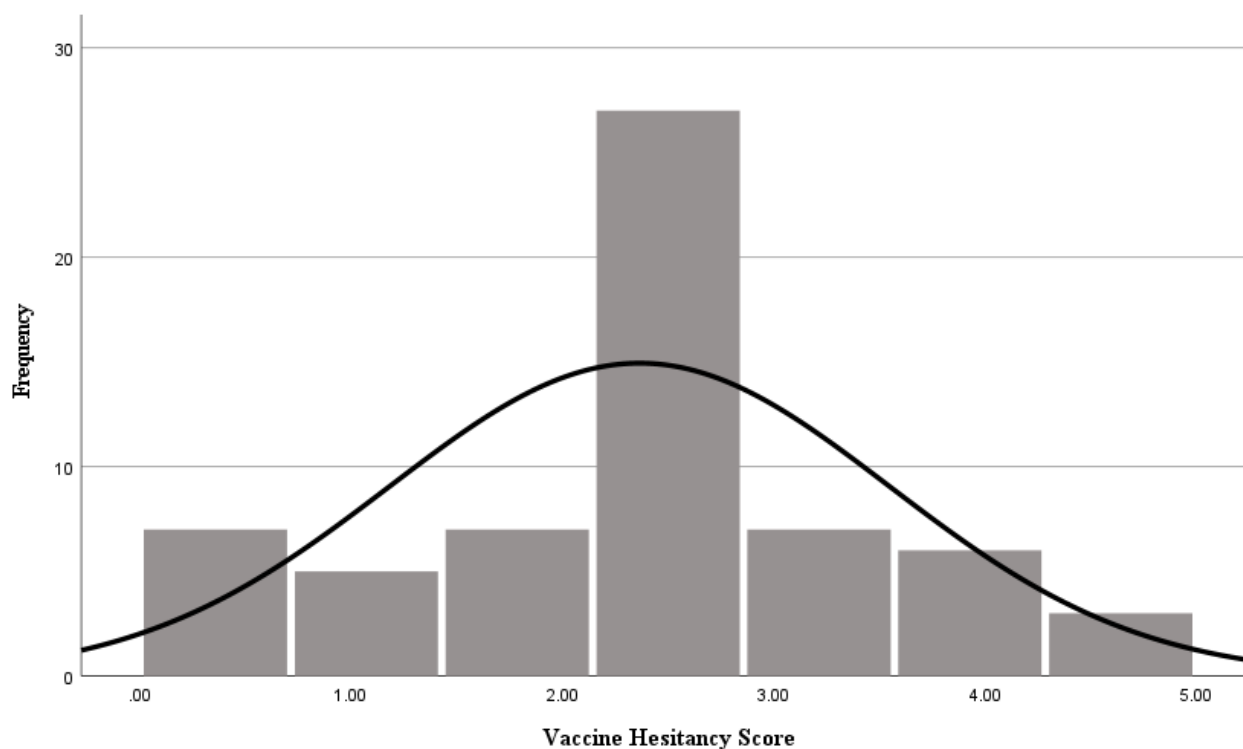
Figure 5: *Distribution of Transformed Vaccine Hesitancy Scores*

Demographics & Bivariate Analysis on Belief Scores

Demographic variables were regrouped or transformed to enhance analysis. Their frequencies and P-values by association to the belief scores are listed in **Table 4**.

Gender

Forty-five participants (71.4%) identified as female, and 17 participants (27.0%) identified as male. One participant (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**. Gender had no associations to religiosity, political beliefs, trust in public institutions or vaccine hesitancy, because there were no statistically significant P-values in bivariate analysis.

Age

The average age of participants was 32.0 years with a standard deviation of 10.8 years. The median age was 28.5 years. The youngest participant was 19 years old and the oldest was 71 years old, with a range of 52 years. For further analysis, age was regrouped into 2 categories based on the median: Under 28.5 years and over 28.5 years. Both groups contain 31 participants (50.0%). Age was associated with trust in public institutions and vaccine hesitancy because these scores yielded statistically significant P-values in bivariate analysis. Participants over 28.5 years were less vaccine hesitant and more trusting of public institutions than those who are younger. Comparison of group means are found in **Figure 6** for the trust score and **Figure 7** for the hesitancy score.
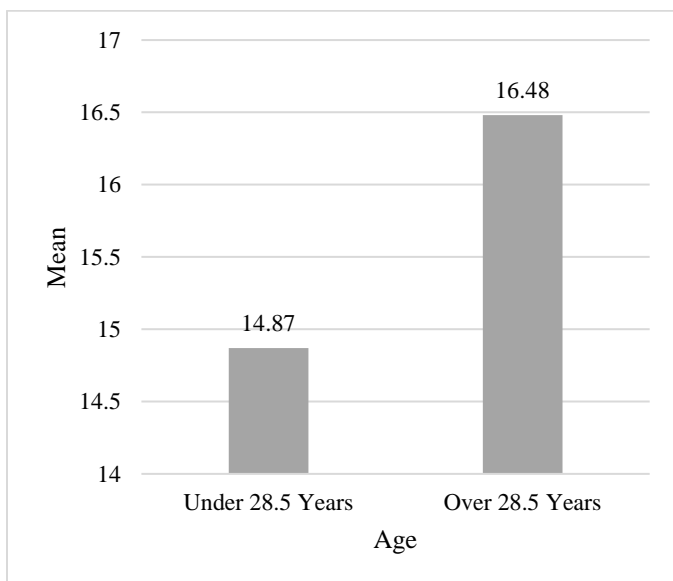
Figure 6: *Comparison of Mean Trust Scores Between Age Groups*
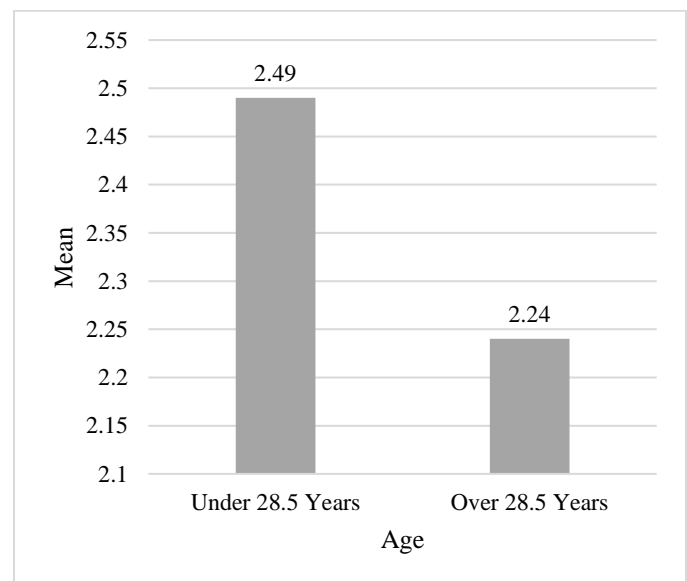
Figure 7: *Comparison of Mean Hesitancy Scores Between Age Groups*

Racial Identity

Fifty participants (80.6%) identified as Asian. Six participants (9.7%) identified as white or Caucasian. Two participants (3.2%) identified as Middle Eastern. Two participants (3.2%)

identified as mixed race. One participant (1.6%) identified as Black or African American. One

participant (1.6%) selected "other," but did not specify a racial identity. For further analysis,

racial identity categories were regrouped into 2 categories: Asian, and non-Asian (12

participants, 19.4%). The non-Asian category contains all participants who did not identify as

Asian on the survey. Race was associated with trust in public institutions because the trust score

yielded a statistically significant P-value in bivariate analysis, thus Asian participants were more

trusting of institutions.

Education

Participants indicated the highest level of education attained at the time of completing the

survey. Thirty-two participants (51.6%) attained a graduate or doctoral degree. Twenty-four

participants (38.7%) attained a bachelor's degree. Four participants (6.5%) received some post-

secondary education but no degree. One participant (1.6%) attained a high school diploma or

equivalent. One participant (1.6%) attained an associate degree. For further analysis, the

education level categories were regrouped into 2 categories: graduate degree, and no graduate

degree (30 participants, 48.4%). The no graduate degree category contains all participants who

have not attained a graduate or doctoral degree. Education was associated with trust in public

institutions and vaccine hesitancy because these scores yielded statistically significant P-values

in bivariate analysis. Participants with a graduate or doctorate level degree were less vaccine

hesitant and less trusting of public institutions than those who have less education. Comparison

of group means are found in **Figure 8** for the trust score and **Figure 9** for the hesitancy score.

Figure 8: *Comparison of Mean Trust Scores Between Education Level Groups*

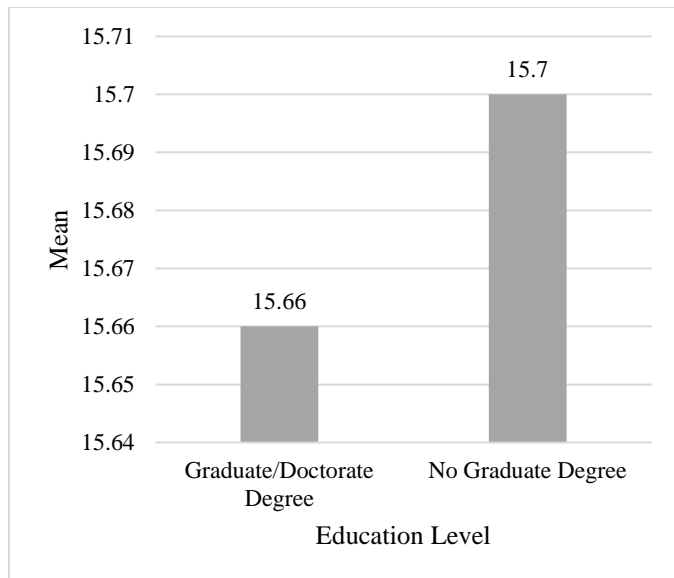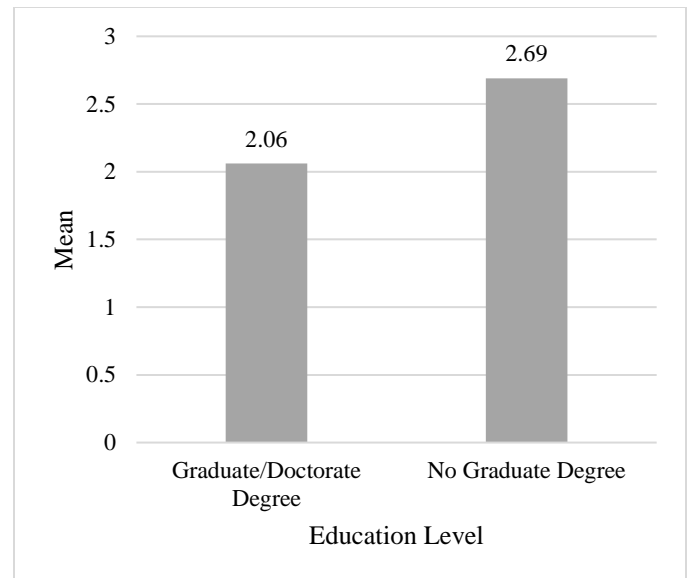
Figure 9: *Comparison of Mean Hesitancy Scores Between Education Level Groups*

Household Income

Participants reported their combined household income before taxes in 2021. The average income was $121,383.87. The median income was $88,500. The minimum income reported was $0 and the maximum income was $1,500,000, with a range of $1,500,000. For further analysis, household income was regrouped into 2 categories based on the median: Under $88,500 and over $88,500. Both groups contain 31 participants (50.0%). Next, in examining the distribution, income was skewed to the left by +6.28, with more participants reporting lower incomes represented in the study. 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. had no associations to religiosity, political beliefs, trust in public institutions or vaccine hesitancy. Income had no associations to religiosity, political beliefs, trust in public institutions or vaccine hesitancy, because there were no statistically significant P-values in bivariate analysis.

Employment Status

Thirty-two participants (50.8%) were employed or self-employed. Seven participants (11.1%) were not employed and not looking for work. Four participants (6.3%) were not employed and are currently looking for work. Two participants (3.2%) were retired. Seventeen participants (27%) were currently students. One participant (1.6%) was unable to work. For further analysis, the employment status categories were regrouped into 2 categories: employed or self-employed, and unemployed (30 participants, 48.4%). The unemployed category contains all participants who did not identify as employed or self-employed. Employment status was associated with trust in public institutions and vaccine hesitancy because these scores yielded statistically significant P-values in bivariate analysis. Employed or self-employed participants were less vaccine hesitant and more trusting of public institutions than those who were not. Comparison of group means are found in **Figure 10** for the trust score and **Figure 11** for the hesitancy score.
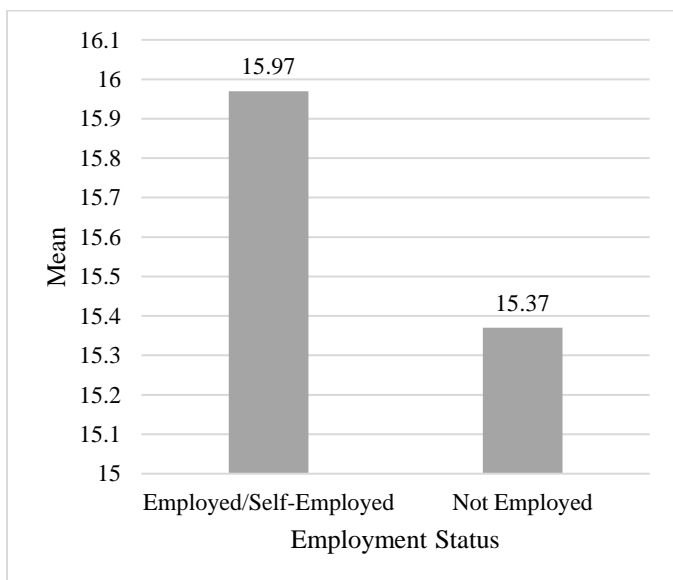
Figure 10: *Comparison of Mean Trust Scores Between Employment Status Groups*
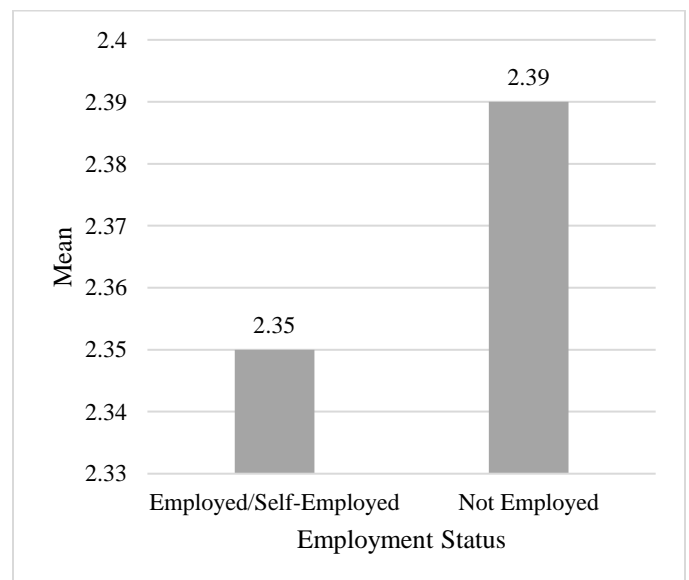
Figure 11: *Comparison of Mean Hesitancy Scores Between Employment Status Groups*

Marital Status

Thirty-two participants (51.6%) were married. Twenty-five participants (40.3%) were single and never married. Three participants (4.8%) were in a relationship and not married. Two participants (3.2%) were divorced. For further analysis, the marital status categories were regrouped into 2 categories: married, and unmarried (30 participants, 48.4%). The unmarried category contains all participants who were not married at the time of completing the survey. Marital status was associated with vaccine hesitancy because the hesitancy score yielded a statistically significant P-value in bivariate analysis. Unmarried participants were less vaccine hesitant than those who were married.

Children & Offspring

Twenty participants (32.3%) reported having children under the age of 18 in their household while 42 participants (67.7%) did not. Having children had no associations to religiosity, political beliefs, trust in public institutions or vaccine hesitancy, because there were no statistically significant P-values in bivariate analysis.

Religious Sect

Forty-nine participants (79.0%) identified as Sunni. Six participants (9.7%) identified as Shia. Four participants (6.5%) identified as Sufi. Three participants (4.8%) did not associate with any sect of Islam. For further analysis, the religious sect categories were regrouped into 2 categories: Sunni, and non-Sunni (13 participants, 21.0%). The non-Sunni category contains all participants who did not identify with the Sunni sect. Religious sect was associated with vaccine hesitancy because the hesitancy score yielded a statistically significant P-value in bivariate analysis. Sunnis were less hesitant of vaccines than non-Sunnis.

Health Information Sources

Thirty-five participants (55.6%) receive most of their healthcare information from a licensed healthcare professional. Eighteen participants (28.6%) obtained most of their healthcare information online. Three participants (4.8%) utilized print media, 1 participant (1.6%) utilized radio, and 1 participant (1.6%) utilized television as the source of the majority of their healthcare information. Five (8.1%) participants reported they used "other" sources; they received most information from scholarly sources, like peer reviewed journals, or clinical resources, like UpToDate.

Vaccination

Sixty-one participants (96.8%) received at least one dose of the COVID-19 vaccine, by the end of data collection, July 2022, while 2 (3.2%) did not. Participants reported on their most important factor in receiving a vaccine. Twenty-three participants (36.5%) were more willing if a vaccine had no safety issues. Eight participants (12.7%) were more willing if a vaccine did not cause potential allergies. Six participants (9.5%) were more willing if a vaccine was free or low cost. Four participants (6.3%) were more willing if a vaccine had no potential for causing autism or any other illness. Four participants (6.3%) were more willing if vaccines had no pork based or non-Halal ingredients. Four participants (6.3%) were more willing because someone close to them had an illness. Two participants (3.2%) were more willing because the people around them were receiving vaccines.

Twelve participants (19%) selected "other" as their most important factor for receiving a vaccine. Four of these participants reported they were more willing if the vaccine "actually prevented the disease." Three of these participants were more willing if there was proven scientific research and evidence for a vaccine. Two of these participants were more willing if a

vaccine has no side effects. Two participants were more willing 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. 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 participants (23.8%) were less likely if they knew a vaccine was less

efficacious. Eight participants (12.7%) were less likely if a vaccine had a potential for causing

autism or any other illness. Seven participants (11.1%) selected "other" important factor for

avoiding a vaccine. Seven participants (11.1%) were less likely if a vaccine caused potential

allergies. Six participants (9.5%) were less likely if a vaccine was expensive. Five participants

(7.9%) were less likely if a vaccine contained pork-based or non-Halal ingredients. Four of these

participants reported they had no reasons for avoiding a vaccine. Lastly, as seen in **Table 4**, there

were no associations between the four belief scores and COVID-19 vaccination in bivariate

analysis.

Table 4: *Independent Samples T-Test P-values and Means of Demographic Groupings*

	Descriptive N (%)	P-value & (Mean)			
		Religiosity	**Politics**	**Trust**	**Hesitancy[a]**
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*	.012**
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*	.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*	.029**
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**	.011**
Employed/Self-Employed	32 (51.6%)	(16.34)	(14.25)	(15.97)	(2.35)
Not Employed	30 (48.4%)	(18.83)	(14.10)	(15.37)	(2.39)
Income		.406	.610	.184	.280
Under $88,500	31 (50.0%)	(17.35)	(13.74)	(15.48)	(2.37)
Over $88,500	31 (50.0%)	(17.74)	(14.61)	(15.87)	(2.36)
Marital Status		.486	.600	.335	<.004**
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*
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)

*P-value < α, α = 0.10
**P-value < α, α = 0.05
a. Transformed data

Correlation

Because age and income were continuous/interval variables, an additional correlation analysis was completed between their untransformed values and each of the belief scores. **Table 5** displays the parametric Pearson correlation and **Table 6** contains the non-parametric Spearman correlation. There is a statistically significant positive Pearson correlation of age, household income, and religiosity score with the political beliefs score. Also, there is a statistically 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 a positive .593 between the religiosity score and the political beliefs score. This shows that, on average, as participants become more religious, they tend to lean towards conservative beliefs.

Table 5: *Parametric Pearson Correlation*

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

*Correlation is significant at the 0.10 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)
a: Transformed data

Table 6: *Non-Parametric Spearman Correlation*

		Income	Religiosity Score	Political Score	Trust Score	Hesitancy Score[a]
Age	Coefficient	.109	.150	.286**	.172	-.080
	P-value	.401	.244	.024	.182	.534
Income	Coefficient	---	.090	.088	-.071	.021
	P-value		.489	.496	.582	.869
Religiosity Score	Coefficient	---	---	.587**	.155	-.040
	P-value			<.001	.230	.756
Political Score	Coefficient	---	---	---	-.075	.095
	P-value				.561	.462
Trust Score	Coefficient	---	---	---	---	-.233*
	P-value					.069

*Correlation is significant at the 0.10 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)
a: Transformed data

Multiple Regression

Religiosity Score

The religiosity score was analyzed against the participants' age, gender, racial identity, education level, employment status, household income, marital status, the presence of children in the home, and religious sect using independent samples T-tests. Because none of these values were statistically significant, no multiple regression analysis was completed on religiosity score. An independent samples T-test was performed between the religiosity score and whether a participant received at least one dose of the COVID-19 vaccine, which is listed on **Table 4**.

Political Beliefs Score

The political beliefs score was analyzed against the participants' age, gender, racial identity, education level, employment status, household income, marital status, the presence of children in the home, and religious sect using independent samples T-tests. Because none of

these values were statistically significant, no multiple regression analysis was completed on the

political beliefs score. An independent samples T-test was performed between the political

beliefs score and whether a participant received at least one dose of the COVID-19 vaccine,

which is listed on **Table 4**.

Trust in Public Institutions Score

        The trust in public institutions score was initially analyzed against the participants' age,

gender, racial identity, education level, employment status, household income, marital status, the

presence of children in the home, and religious sect using independent samples T-tests. The

significant relationships from **Table 4** were used for multiple regression analysis; **Table 7** shows

the findings of the multiple regression. Model 1 compares the trust score with the participants'

racial identity, education level, employment status, and age. Again, these variables were chosen

as they were statistically significant in the bivariate analysis. Model 2 compares the trust score

with the participants' racial identity, education level, employment status, age, religiosity score,

vaccine hesitancy score, and political beliefs score.

        According to Model 1, participants older than 28.5 years were more likely to have higher

trust scores. According to 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 1was .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 and the three other health belief scores. Finally, an independent samples T-test was

performed between the trust in public institutions score and whether a participant received at

least one dose of the COVID-19 vaccine, which is listed on **Table 4**.

Table 7: *Multiple Regression of Trust Score with Two Models*

	Unadjusted[§]		Adjusted[‡]	
	B	P-value	B	P-value
Model 1				
Age	1.702	.089*	1.613	.088*
Racial Identity	.607	.639	---	---
Education Level	.506	.647	---	---
Employment Status	-.646	.518	---	---
Model 2				
Age	7.507	.066*	---	---
Racial Identity	.834	.504	---	---
Education Level	1.282	.251	---	---
Employment Status	-1.182	.245	---	---
Religiosity Score	.179	.071*	---	---
Political Score	-.157	.261	---	---
Hesitancy Score	-.758	.073*	-.701	.082*

--- Model 1: No significant values after 4 regression iterations.
--- Model 2: No significant values after 7 regression iterations.
*P-value < α, α = 0.10
**P-value < α, α = 0.05
B: Slope
§ = Enter preset
‡ = Backwards preset

Vaccine Hesitancy Score

The vaccine hesitancy score was initially analyzed against the participants' age, gender, racial identity, education level, employment status, household income, marital status, the presence of children in the home, and religious sect using independent samples T-tests. The significant relationships from **Table 4** were used for multiple regression analysis; **Table 8** shows the findings of the multiple regression. Model 1 compares the hesitancy score with the participants' marital status, education level, religious sect, employment status, and age. Again, these variables were chosen as they were statistically significant in the bivariate analysis. Model

2 compares the hesitancy score with the participants' marital status, education level, religious

sect, employment status, age, religiosity score, trust score, and political beliefs score.

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

and 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.

The next chapter discusses these findings in light of the published literature concerning

these issues.

Table 8: *Multiple Regression of Hesitancy Score with Two Models*

	Unadjusted[§]		Adjusted[‡]	
	B	P-value	B	P-value
Model 1				
Age	-.282	.416	---	---
Education Level	.631	.056*	.625	.036**
Employment Status	-.094	.767	---	---
Marital Status	-.398	.243	---	---
Sect	.159	.667	---	---
Model 2				
Age	.637	.670	---	---
Education Level	.775	.023*	.628	.032**
Employment Status	-.121	.718	---	---
Marital Status	-.208	.577	---	---
Sect	.237	.518	---	---
Religiosity Score	-.018	.586	---	---
Political Score	.046	.304	---	---
Trust Score	-.077	.071*	-.071	.071*

--- Model 1: No significant values after 5 regression iterations.
--- Model 2: No significant values after 7 regression iterations.
*P-value < α, α = 0.10
**P-value < α, α = 0.05
B: Slope
§ = Enter preset
‡ = Backwards preset

Chapter 5

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

The findings of this study both affirm and contradict previous research. In the independent samples T-test, age, education level, employment status, marital status and sect were statistically significant demographic factors that influenced vaccine hesitancy. As age increased, the vaccine hesitancy decreased, as confirmed by Detoc et al. (2020); Freeman et al. (2020); Murphy et al. (2021); Fisher et al. (2020); and Al-Mohaithef and Padhi (2020). In addition, this contradicted the findings of Palamenghi et al. (2020); Kwok et al. (2021); and Wang et al. (2021), who found that vaccine hesitancy increased as age increased. Participants with more attained education had lower levels of vaccine hesitancy than those with less education, like Freeman et al. (2020); Sallam et al. (2021); Fisher et al. (2020) and Al-Mohaithef and Padhi (2020). This was supported by the multiple regression analysis. These findings contrast with those of Salali and Uysal (2020).

Employed participants were less vaccine hesitant than those who were unemployed, which is similar to what was reported by Freeman et al. (2020) and Lin et al. (2020b). However, this is the opposite of Dror et al.'s (2020) findings. Furthermore, Freeman et al. (2020); Lin et al. (2020b); and Al-Mohaithef and Padhi (2020) reported that unmarried participants were more

hesitant to vaccines, which contradicts the findings of this study; Wang et al. (2021) confirms

this study as well. Lastly, participants who identified as Sunni were less vaccine hesitant than

those who were non-Sunni. Other articles that discussed hesitancy trends among Muslim sects

were not found during the literature review, so this study is 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 future to further elucidate the connection between

sect and hesitancy.

Belief Scores

Religiosity

Income had a positive correlation to participants' religious beliefs in a Pearson

correlation analysis. There is no recent data from other studies on the connection between high

income and stronger religious adherence to compare with the findings of this study. In the last

Religious Landscape Survey by the Pew Research Center in 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 (Smith, 2014). Thus, the findings of this

study do not correspond with wider trends socioeconomic status and the extent of religious

belief. It is recommended that more research is conducted on the connection between income

level and religiosity among the American population at large and within specific demographic

groups. Additionally, the religiosity score had a positive correlation with the political beliefs

score in the Pearson and Spearman analyses. This showed that 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 (Levin & Bradshaw, 2022).

Political Beliefs

Age had a positive Pearson and Spearman correlation to the political beliefs score. This was expected, as older people tend to hold more right leaning beliefs than younger people. Income had a positive Pearson correlation to political beliefs; thus, participants with higher incomes held conservative political, economic, and social views. This is also not surprising. 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 (Peterson et al., 2020).

Trust in Public Institutions

Trust in public institutions had negative Pearson and Spearman correlations to vaccine hesitancy, which was supported in the multiple regression analysis. This finding is supported by Levin and Bradshaw (2022); Gidengil et al. (2019); Justwan et al. (2019); Khan et al. (2020); Lin et al. (2020a) and Pan et al. (2021). Participants in these studies 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. Generally, it is not feasible to expect someone to commit to an action if they fear it and have no compelling reason to engage with it.

Overall, while all the data in the study either supported or contradicted the findings of the literature review, there was one peculiar association that contradicted itself. Increased trust scores and levels of education were associated with less vaccine hesitancy. However, more education was not associated with higher trust scores. In an ideal scenario, all three of these metrics would align with their respective trends, where more education leads 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 scores 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. Because the survey was completed entirely online by anonymous participants, the

responses were taken at face value. Essentially, the data analyses and conclusions were based on

the goodwill of the participants. It was entirely possible that participants provided biased or

dishonest answers, but there was no way to verify this. There were hints that some responses

with large outliers in reported income and age were inaccurate. If a participant had at least one

response that was an extreme outlier ($\pm$ 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 analyses, despite 65 participants

meeting the inclusion criteria.

Additionally, the survey was not distributed as widely as intended. Twenty-five Facebook

groups were originally intended to share it; however, only 10 disseminated it. 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. Thus, the collected data was overrepresented by people from these

demographics. 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 (Mohamed &

Diamant 2020). On a similar note, the sample size was smaller than similar studies on vaccine

hesitancy. For example, Salali and Uysal (2020) utilized a sample size of 5,024. 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 (Schneider & Harknett 2022).

Unfortunately, Qualtrics did not provide completion data for this study's survey, so a comparison

cannot be made. Schneider and Harknett (2022) conducted a study to determine the efficacy of

Facebook surveys and found that 40% of participants started their survey but did not complete it.

Even so, the lead author of this study is a South Asian Muslim woman. The survey was

shared across her personal social media profiles, of which the majority of her followers and

friends identified as South Asians, Sunni and health professionals. The lead author also

distributed her study through her medical school's internal email system. Thus, there was an

overrepresentation of educated individuals with the means of accessing highly regarded health

information resources, primary care physicians and healthcare services. These discrepancies

most likely impacted the findings of this survey, because, as noted in Chapter 2, there are

significant associations between education level and trust in public institutions with vaccine hesitancy. For example, most participants (96.8%) received at least one dose of the COVID-19 vaccine, which is slightly more than the 92.1% of all American adults who have received at least one dose (CDC, 2022).

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. On a similar note, all studies that obtain data on participant opinions and voluntary information release run the risk of recall bias and incorrect recollections. Participants could have boosted certain variables based on implicit or intentional biases, such as the religiosity score and income. To offset these limitations, the study had several analytical strengths. First, certain scaled variables, like vaccine hesitancy, were skewed. In order to properly analyze them, it was necessary to transform the data into a normal distribution. Second, while the independent samples T-tests compared the means of the belief scores, the multiple regressions eliminated confounding variables. Lastly, multiple statical models were utilized in the multiple regression to compare the importance between demographic and confounding variables in assessing vaccine hesitancy.

In the future, if this study was reused, it would require a few changes in survey deployment. First, this study would utilize both in person and online recruitment. A good way to achieve physical participant recruitment is by approaching parishioners at multiple mosques in various metropolitan and suburban areas in the United States during or after a busy religious event, such as Ramadan dusk prayers or a biannual Eid prayer. This way, the researchers have access to a diverse array of Muslims. Since these are the most popular Islamic events, they are often attended by casual and nonpracticing Muslims, thereby attracting people of varying levels of religious belief. Second, this study must utilize more time prior to deploying the survey to

entice more Facebook group administrators and purchase social media advertisements. Meta is

the best, because they post their advertisements on all their products, like Facebook and

Instagram. These two major changes could improve the diversity of the sample.

Conclusions

Overall, when addressing vaccine hesitancy sentiments, it is necessary to develop clear

goals, objectives, and metrics for determining how people's views change (Strully et al., 2021).

Unfortunately, as with most behavioral health research, it is sometimes difficult to discern the

strength of a program or campaign on behaviors. Thus, public health scientists must approach the

study of vaccine hesitancy with caution and maintain clear standards of comparison.

Additionally, there must be a sense of compassion and empathy when thought leaders engage

with people about vaccines (Smith, 2017). Healthcare is a deeply personal choice, and how

people set about it reflects their background, personal history, and beliefs. While it is easy to

express frustration, annoyance and even disgust at those who harbor anti-vaccination sentiments,

public health scientists must not forget that all people are pulled by their own biases and conflicts

of interest. Thus, it is necessary to maintain a sense of optimism and remain proactive in

developing people's trust in vaccines.

Reflections

On a personal note, I gained valuable insight into research and public health from

completing this study. From prior research experience in high school and my undergraduate

studies, I was aware of the rigor and unremitting nature of conducting a scientific endeavor.

However, I was unprepared for the dynamic nature of studying trends and public opinions in

healthcare. Even though I had a plan and a method of attack for every part of the study, it was

necessary to constantly change my approach when implementing my ideas. Such is the nature of

studying people, their environment, their lives and how they attain their healthcare. So much of

public health is marred by systemic inequalities, disenfranchised groups and lack of funding;

thus, many of the inconsistencies of my study are a reflection of the human nature of healthcare

research.

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Appendix A. Survey Questions

1 Are you over the age of 18?
- Yes
- No

2 Do you identify as Muslim?
- Yes
- No

3 Have you resided in the United States for at least 5 years?
- Yes
- No

4 What is your age? (fill in the blank)

5 What is your gender?
- Male
- Female
- Non-binary / third gender
- Transgender
- Other (please specify) (fill in the blank)

6 What is your race?
- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Hispanic/Latino
- Other (please specify) (fill in the blank)

7 What is the highest level of school that you have completed or the highest degree you have received?
- Did not complete high school
- High school degree or equivalent (example: GED)
- Some college but no degree
- Associate degree
- Bachelor's degree
- Graduate degree or doctorate degree

8 Which of the following categories best describes your employment?
- Employed or self-employed
- Not employed and looking for work
- Not employed and NOT looking for work
- Retired
- Unable to work
- Student

9 What is your household's total combined income before taxes in 2021? (fill in the blank)
Just include numbers. You don't need to worry about the "$" sign or commas.

10 What is your marital status?
- Single and never married
- Married
- In a relationship, but not married
- Widowed
- Divorced

11 Do you have children in your household under the age of 18?
- Yes
- No

12 Which sect of Islam do you MOST identify with?
- Shia (including Ismaili, Saydi, Alavi, Dawoodi, etc.)
- Sunni (including Hanafi, Salafi, Wahhabi, etc.)
- Khariji (including Ibadi, etc.)
- Sufism (including Azeemiyya, Bektashi, Chisti, Qadiri, etc.)
- Other (please specify) (fill in the blank)

13 How often do you PRAY both at home and in public?
This includes praying by yourself and with others.
- Never
- Once or less than once per week
- Several times per week
- Once per day
- Multiple times per day

14 How often do you take part in RELIGIOUS SERVICES both at home and in public?
 Examples of religious services include listening to religious podcasts, attending Islamic funerals and weddings, watching religious programming on television or online, or attending sermons/khutbahs.
- Never
- Once or less than once per week
- Several times per week
- Once per day
- Multiple times per day

15 In general, to what extent do you trust your Islamic religious leaders on SPIRITUAL AND RELIGIOUS MATTERS?
- Not at all trusting
- Slightly trusting
- Moderately trusting
- Very trusting
- Extremely trusting

16 When you hear DOMESTIC ISSUES ADVICE from a religious leader, how likely will you follow their advice?
Example: personal advice, relationship advice, health advice, financial advice
- Not at all trusting
- Slightly trusting
- Moderately trusting
- Very trusting
- Extremely trusting

17 When you hear ISLAMIC ADVICE from a religious leader, how likely will you follow their advice?
- Not at all likely
- Slightly likely
- Moderately likely
- Very likely
- Extremely likely

18 When you hear HEALTH ADVICE from a religious leader, how likely will you follow their advice?
- Not at all likely
- Slightly likely
- Moderately likely
- Very likely
- Extremely likely

19 To what extent do you believe that the government should reduce regulations?
For example: laws on the economy, healthcare, crime, etc.
- Not at all
- Slightly
- Moderately
- Very
- Extremely

20 To what extent do you believe that the government should cut taxes and spend less money?
- Not at all
- Slightly
- Moderately
- Very
- Extremely

21 To what extent do you support the right to bear arms, or own guns?
- Not at all
- Slightly
- Moderately
- Very
- Extremely

22 To what extent do you support gay marriage?
- Extremely
- Very
- Moderately
- Slightly
- Not at all

23 To what extent do you support abortion?
- Extremely
- Very
- Moderately
- Slightly
- Not at all

24 To what extent do you believe that people with higher incomes should pay more taxes?
- Extremely
- Very
- Moderately
- Slightly
- Not at all

25 To what extent do you trust FEDERAL political leaders?
- Not at all trusting
- Slightly trusting
- Moderately trusting
- Very trusting
- Extremely trusting

26 To what extent do you trust LOCAL and STATE political leaders?
- Not at all trusting
- Slightly trusting
- Moderately trusting
- Very trusting
- Extremely trusting

27 To what extent do you believe that the government and its leaders have your best interest?
- Not at all
- Slightly
- Moderately
- Very
- Extremely

28 To what extent do you trust public institutions?
This includes public schools and universities, hospitals, community centers, social security centers
Examples: CDC, FDA, NSA, FBI, CIA, USDA, DEA, ICE
- Not at all trusting
- Slightly trusting
- Moderately trusting
- Very trusting
- Extremely trusting

29 Where do you obtain the majority of your healthcare information?
Pick just one.
- Licensed healthcare professional (primary care provider, specialist, etc.)
- Television
- Radio
- Online
- Print
- Other (please specify) (fill in the blank)

30 To what extent do you trust healthcare workers in general?
- • Not at all trusting
- • Slightly trusting
- • Moderately trusting
- • Very trusting
- • Extremely trusting

31 To what extent do you trust your primary care provider (PCP)?
A primary care provider is a doctor or healthcare professional who gives you regular medical care for treatments, preventing diseases or check up's. This does NOT include emergency room or urgent care visits.
PCP's are also known as family practitioners, family medicine providers, internal medicine providers or internists.
- • Not at all trusting
- • Slightly trusting
- • Moderately trusting
- • Very trusting
- • Extremely trusting

32 To what extent do you trust vaccines?
- • Not at all trusting
- • Slightly trusting
- • Moderately trusting
- • Very trusting
- • Extremely trusting
- • I don't have a family doctor or a personal doctor

33 How likely will you get ANY vaccine for yourself if you need one?
- • Not at all likely
- • Somewhat likely
- • Moderately likely
- • Very likely
- • Extremely likely

34 Have you received at least one dose of the COVID-19 vaccine?
- • Yes
- • No

35 If you needed a COVID-19 vaccine, how likely will you get one for yourself?
- • Not at all likely
- • Somewhat likely
- • Moderately likely
- • Very likely
- • Extremely likely

36 If you needed a FLU vaccine, how likely will you get one for yourself?
- Not at all likely
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely

37 If you needed a MEASLES vaccine, how likely will you get one for yourself?
- Not at all likely
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely

38 If you needed a SMALLPOX vaccine, how likely will you get one for yourself?
- Not at all likely
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely

39 If you have a child, how likely will you get a vaccine for your child?
- Not at all likely
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely
- I don't have a child

40 How likely will you encourage others around you to get vaccinated?
- Not at all likely
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely

41 What is the MOST important factor for you to GET a vaccine?
Pick just one.
- Doesn't cause potential allergies
- Not using pork-based or non-Halal ingredients
- Other people around me are getting vaccines
- Someone close to me got a disease
- No safety issues
- No potential for causing autism or any other illness/disease
- Low cost/free
- Other (please specify) (fill in the blank)

42 What is the MOST important factor for you to AVOID a vaccine?
Pick just one.
- Causes potential allergies
- Uses pork-based or non-Halal ingredients
- Other people around me are NOT getting vaccines
- Doesn't work
- Other safety issues
- Potential for causing autism or any other illness/disease
- High cost
- Other (please specify) (fill in the blank)

Appendix B. Recruitment Flyer

Assalamualaikum! My name is Marina Ali and I'm a student at the University of Texas in Tyler. I'm doing a research project about how Muslims in America feel about healthcare, politics, and vaccines. This is an opinion survey, and all responses are completely confidential. You don't have to share any of your contact information; I just want your honest opinions! To do this survey, you need to:
- identify as a Muslim
- have lived in the United States for at least 5 years
- be willing to give up about 20 to 25 minutes of your time to finish the survey

You can access the survey by clicking the link below:
https://uttyler.az1.qualtrics.com/jfe/form/SV_3WSduUwjBX1vmXc

After taking it, please share the link to the survey to any friends or family who meet the requirements. I would really appreciate it. Thanks!

If you have any questions or concerns, don't hesitate to direct message me or email me at (mali8@patriots.uttyler.edu).

Appendix C. Consent

THE UNIVERSITY OF TEXAS AT TYLER
Informed Consent (Online, Anonymous) to Participate in Research
Institutional Review Board #2022-030
Approval Date: 5/12/2022

You have been invited to participate in this study, titled, *Prevalence and Beliefs Associated with Vaccine Hesitancy Among Muslim-Americans*. The purpose of this study is to evaluate beliefs, attitudes and practices of Muslim-Americans about vaccinations, the healthcare system, politics and education. Your participation is completely voluntary, and if you begin participation and choose to not complete it, you are free to do so without any adverse consequences.

If you agree to be in this study, I will ask you to do the following thing:
- Answer all questions completely, honestly, and to the best of your abilities.
- It will take about 30 minutes to complete the survey.

There are no known risks to this study, other than perhaps becoming a little tired of answering the questions, or you may even become a little stressed when answering some of the questions. If this happens, you are free to take a break and return to the survey to finish it. Potential benefits to this study are: find out how healthcare providers can better serve Muslim patients, discover the issues that are most important to Muslim-Americans, and create healthcare systems that help Muslims better.

"I know my responses to the questions are anonymous. If I need to ask questions about this study, I can contact the principal researcher, Mrs. Marina Ali at mali8@patriots.uttyler.edu, or, if I have any questions about my rights as a research participant, I can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858."

"I have read and understand what has been explained to me. If I choose to participate in this study, I will click 'Yes' in the box below and proceed to the survey. If I choose to not participate, I will click 'No' in the box."

- YES, I choose to participate in this study.
- NO, I choose NOT to participate in this study.

Appendix D. List of Facebook Groups

Group Name	# Members	URL
FITNA - Feminist Islamic Troublemakers of North America Group	6,811	https://www.facebook.com/groups/feministfitna/
the little brown diary	33,804	https://www.facebook.com/groups/thelittlebrowndiary/
American Muslim Health Professionals (AMHP)	3,370	https://www.facebook.com/groups/2229359368/
Muslim Brotherhood	48,060	https://www.facebook.com/groups/1472299826400313/
Muslim Revert Sisters	15,267	https://www.facebook.com/groups/MuslimRevertSisters/
Muslim Moms of Arizona	931	https://www.facebook.com/groups/muslimmomsofaz/
National - Muslim Women's Professional Network Group	1,812	https://www.facebook.com/groups/174444507220214/
DMV Muslim Parents (DC, MD, VA)	610	https://www.facebook.com/groups/1145597872463873/
Muslims in Medicine	485	https://www.facebook.com/groups/488730528822329
Muslims of Long Island	5,524	https://www.facebook.com/groups/muslimsoflongisland

Total Number of Facebook Groups: 10

Appendix E. IRB Letter

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DATE: 05/12/2022

TO: Marina Ali, BS
        18800 Lina St.
         Apt. 707
        Dallas, TX 75287

SUBMISSION TYPE: **Exemption Submission**
PROTOCOL NUMBER: 2022-030
PROTOCOL TITLE: Prevalence and Beliefs Associated with Vaccine Hesitancy Among Muslim-Americans

IRB ACTION: **EXEMPT DETERMINATION**
APPROVAL DATE: 05/12/2022
EXPIRATION DATE: 05/11/2025
REVIEW TYPE: **Exempt Review**
_____

Thank you for your protocol submission for the above-referenced study. The UT Tyler Institutional Review Board has GRANTED YOUR EXEMPTION REQUEST based on:
 Exempt Category (2)Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:(i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;(ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or (iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

*This determination is for a three-year period beginning on **05/12/2022** and ending on **05/11/2025**. A progress report will be required prior to this end date if research is still ongoing.*

        Items Submitted for Review:
- *IRB Exemption Request Submission Form*
    - *Bibliography & References.docx (Other)*
    - *Human Subject Research Determination Form-2022-04-20-06-34.pdf (Investigator/Research Team CV or Resume)*
    - *Human Subject Research Determination Form-2022-04-20-06-34.pdf (Other)*
    - *Marketing Script (1).docx (Other)*
    - *Questions (1).docx (Other)*

Institutional Review Board Office
1100 East Lake Street, Suite 330, Box-14
Phone: 903-877-7632
Email: irb@uthct.edu

Research Team:
- Marina Ali, BS - Investigator
- William Sorensen, PhD - Co-Investigator

Responsibilities of the Principal Investigator

Research that is determined to be Exempt from IRB review is not exempt from ensuring protection of human subjects. The Principal Investigator (PI) is responsible for the following throughout the life of the research study:

- Ensure that all research personnel complete and maintain all institutional required training.
- Disclose to subjects that the activities involve research and that participation is voluntary during the informed consent process, and provide subjects with pertinent information ensuring that subjects voluntarily consent, unless the requirement of consent has specifically been waived by the IRB.
- Assure that subjects will be selected equitably so that risks and benefits of the research are justly distributed.
- Assure that the privacy of the subjects and the confidentiality of the research data will be maintained appropriately to ensure minimal risks to subjects.
- Closure Request: Upon completion, a Closure Request must be submitted to the IRB via IRBManager.
- Unanticipated Problems: Any unanticipated problems or complaints must be reported to the IRB immediately.
- Progress Report: A 3-year progress report must be submitted if the study will continue beyond the original determination period.
- Modifications: Modifications that affect the exempt category or the criteria for exempt determination must be submitted as a modification via IRBManager. All other changes to the research should be discussed with the IRB office prior to implementation for determination if a modification submission is required.

The UT Tyler IRB is organized, operates, and is registered with the United States Office for Human Research Protections according to the regulations codified in the United States Code of Federal Regulations at 45 CFR 46 and 21 CFR 56. The IRB operates under the following Federal Wide Assurance Number: 00009775

Any complaints or issues of non-compliance must be immediately reported to this office. If you have any questions or comments about this correspondence, please contact the IRB Office at **903-877-7632 or irb@uthct.edu**

Sincerely,

David Pearson, PhD
Chairman, Institutional Review Board

Biography

Marina Ali was born in Dhaka, Bangladesh. When she was five years old, she and her family immigrated to the United States. While she has lived in many different parts of the southeast, she calls Texas home. She currently resides in Dallas with her husband and cat. Marina earned her bachelor's degree in health sciences at the University of Texas in Tyler. During her time as an undergraduate, she became interested in vaccine hesitancy and Muslim health. Prior to starting and throughout her master's program, Marina worked as a medical scribe, medical assistant, and makeup artist.

Currently, Marina is a medical student at Kansas City University and hopes to use her background in health sciences in her future practice. In her free time, Marina works as a professional writer and magazine editor. Her hobbies include planning elaborate dinners for her friends and family, writing to her pen pels, and Pilates.