The relationship between Muslim religiosity and vaccine hesitancy in undergraduate

students of FCCU.

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Abstract:

There is a massive research gap in studies that examine adult vaccine hesitancy. This study examines religious beliefs that might affect the rate of vaccine hesitancy in university students present in FCCU through a quantitative method. This paper uses the theory of reasoned action and its extension in the view of planned behaviour to explain the nature of vaccine hesitancy. The theories explain that each step has a basis of intention, reward, and normative beliefs that influence a participant in the activity. The study was done with the permission of IRB at FCCU. The study's sample size was 160, with six responses being discarded while the sample was exclusively Muslim. The study used a Muslim religiously scale and the adult vaccine hesitancy scale created by the SAGE working group. The results showed a high rate of religiosity and a low rate of vaccine hesitancy. The data also showed increased confidence in governmental information and trust in healthcare professionals regarding vaccine information. This study concludes that there is no relation between religiosity and vaccine hesitancy as the results were not significant. The result has implications in furthering research on factors that might drive vaccine hesitancy in different population demographics.

Introduction:

Background:

As the Covid-19 pandemic rages on, one of the major solutions to this crisis is administering a vaccine that would quell the advance of the virus. Covid-19 was first reported in Wuhan, China, in early 2019 and is a severe acute respiratory syndrome coronavirus (Adhikari et al., 2020). This disease then spreads, causing a significant global economic, social, and humanitarian burden. Most of the responsibility falls on healthcare services trying to cope with the number of patients and staff needed to combat a pandemic. While protocols were set even before the pandemic, the issue was that training in these protocols was not readily available. As of February 25, 2021, there have been 428,511,601 global patients of Covid-19 and 5,911,081 cumulative deaths (WHO, 2022). In Pakistan, there are 1,503,873 patients and 30,096 cumulative deaths (WHO, 2022). However, the number is much higher. Pakistan does not have increased testing capabilities and has poor patient surveillance and tracking system.

There is no approved treatment for the Covid-19 virus (Cousins 2020). Moreover, there is a severe lack of effective treatment compared to the speed at which the virus spreads; the burden of this infection is exerted on the economy, trade, and infrastructure (Cousins 2020). This actuates an unprecedented need to create a vaccine that would be safe to administer and effective in a short period (Cousins, 2020). Albeit the spread of the virus was a public health concern, the decision to get vaccinated was to be made voluntarily in most parts of the world. Therefore, in parallel to vaccine development, another challenge that emerged was the possibility that a sizable percentage of the world population may become unwilling to get vaccinated even if it was available. Reasons behind the lack of willingness to take the vaccine can range from complacency, mistrust of the government and misinformation.

Pakistan has faced the brunt of the Coronavirus like most underdeveloped countries. The government has had numerous half-hearted lockdowns, and many voices have risen to demand more solutions. Pakistan is unique with the complexities regarding vaccine hesitancy. There is still some animosity against the government for the polio vaccine (Gostin, 2014). Religion also plays an integral part in this regard as well, especially in the wake of rumours being spread mainly through the social media that swine-deprived products used in the vaccine manufacturing process, which has influenced the more religious populace to resist the idea of being vaccinated (Khan et al., 2001). The study aimed to explore the impact of Muslim religious beliefs on vaccine hesitancy on Muslim undergraduate students. The hypothesis used in this study was that Muslim undergraduates with a higher level of religiosity would have greater vaccine hesitancy (Perveen et al., 2021). The study uses the Muslim religiosity scale created by Albelaikhi (1997) and the vaccine hesitancy scale created by Akel et al. (2021).

Conceptual Definitions:

Muslim religiosity:

Albelaikhi (1997) creates a working definition while creating his Muslim religiosity scale. According to him, Muslim religiosity agrees with the three major parts of Islam, which include belief, attitude, and practice. The belief factor is the acceptance of the significant teachings around Allah, the prophets, and the divine decree. Attitude is the opinion regarding issues that affect Islam, religious authority, and religious people, both positive and negative. The factor of practice gauges respondents' frequency of participation in activities that are part of the divine decree. For which there will be rewards in the afterlife.

Vaccine Hesitancy:

There has been no fixed definition of vaccine hesitancy before 2015. After which, the SAGE Working Group on Vaccine Hesitancy set forth to create their description of vaccine hesitancy which was adopted widely (MacDonald, 2015). The MacDonald (2015) definition states that vaccine hesitancy can delay accepting a vaccine or refusing it straight out. This definition also considers the vaccine being present widely. However, they also believe that vaccine hesitancy is more region, time, and culture-dependent. The model that influences vaccine hesitancy is called the "3Cs" (MacDonald, 2015). Complacency, convenience, and confidence are the "3Cs" (MacDonald, 2015).

Vaccination complacency occurs when the population believes that a disease has no real risk to their health. Hence, taking the vaccine is not essential (MacDonald, 2015). Vaccination convenience is dependent on the time and date of vaccine administration, as citizens would not take vaccines if they were not readily available (MacDonald, 2015). Other factors that come under the vaccine convenience umbrella are paying for the vaccine if a person can afford that vaccine and not having the means to travel to get vaccinated (MacDonald, 2015). Lack of trust in the vaccine's safety, health care systems, policymakers, and motivations diminish vaccine confidence (MacDonald, 2015).

Significance of Study:

During the Covid-19 period, there have been calls for massive vaccination drives for adults. However, there have been lower numbers of vaccinations, which in turn caused many countries to go back into lockdowns or extend the wave of infections that were already present as Akel et al. (2021) pointed out that this is a rather suitable time for a study of vaccine hesitancy among adults. This is important as previous studies consisted primarily of middle-aged adults allowing their children to be vaccinated or not. For a country like

Pakistan, this also poses another problem. It has a largely conservative Muslim population, which will use its religious beliefs on matters such as public health (Khan et al., 2020). It has contributed to the massive disobedience of government-mandated Covid-19 SOPs and led to several conspiracy theories regarding the Covid-19 pandemic (Khan et al., 2020).

Hence, this study looks at the impact of religiosity on vaccine hesitancy in Muslim Undergraduate students presently studying at FCCU.

Theoretical framework:

The Theory of Reasoned Action and its extension, the Theory of Planned Behaviour, are cognitive theories that offer an understanding of human behaviour in specific contexts (Heller et al., 2013). The basis of the Theory of Reasoned Action is with intention. The best way of seeing that a person will engage in an activity is to see if there is an intention to do so (Heller et al., 2013). These intentions are affected by a positive or negative perception. If a person perceives that activity will positively affect themselves, they will be more inclined to do it (Heller et al., 2013).

Further on, creating the theory of Planned Behaviour, with behavioural control to the model, added volitional control as necessary in how people make their intentions (Heller et al., 2013). Behaviour beliefs and attitudes are the outcomes that a person thinks they would get for doing the act. Normative beliefs and subjective norms are the views the individual puts on the significance of the action in the eyes of other members of society (Heller et al., 2013). Control beliefs and perceived behavioural control are the factors that affect the engagement in the activity of the action (Heller et al., 2013). The intention is the reasoning and strategy needed to commit an act (Heller et al., 2013).

Literature review:

Theory of Planned behaviour and Covid-19 vaccine hesitancy:

There has been much work recently regarding the theory of planned behaviour and Covid-19 vaccine hesitancy, specifically in how the theory applies to different modules. Specifically when it comes to vaccine administration, uptake, and fear of the vaccine. A study conducted in Pakistan that the three behavioural factors of the theory of planned behaviour, perceived infectability and fear of Covid-19 explained more than 50% of the variance in Covid-19 vaccination uptake (Ullah, Lin, et al., 2021). This indicates that a combination of the theory of planned behaviour and fear of covid could explain why the young Pakistani adults intended to get the vaccine (Ullah, Lin, et al., 2021). It also showed that the fear of Covid-19 was less potent than perceived behavioural control (Ullah, Lin, et al., 2021). The fear of the disease came from the perceived effect on the body. An individual's attitude to be vaccinated or not depends more on the perceived infectability of the vaccine (Ullah, Lin, et al., 2021). The perceived threat also makes the individual look inwards at their ability or the ability of the community to have the resources to overcome a disease (Ullah, Lin, et al., 2021).

Another study in Bangladesh was done based on the HBM model, the theory of planned behaviour and the 5C psychological model (Hossain et al., 2021). The writers wanted to see which of the following theories might be a better indicator of vaccination behaviour in a population. They found that the theory of planned behaviour had the highest level of predictability in the modal (adjusted $R^2=0.43$) (Hossain et al., 2021). A study in Iran corroborated with the findings of the previous studies. They also found that incorporating fear and perceived infectability of the Covid-19 in the theory of planned behaviour was seen to be effective in explaining the population's intention to get vaccinations (Yahaghi et al., 2021).

All the present evidence shows a mechanism to show how an individual's psychological factors might be associated with being administered the vaccine. The fear of Covid-19 may trigger an individual's psychological control over the vaccination uptake, attitude towards the vaccine, the subjective norm of the vaccination and perceived Covid-19 infectability (Yahaghi et al., 2021).

Vaccination and religion:

Approximately 90% of the countries in the world have adopted some level of vaccine hesitancy (Murphy et al., 2021). WHO has declared vaccine hesitancy as one of the ten significant threats to public health worldwide (Perveen et al., 2021)? The literature around vaccine hesitancy is somewhat helpful; nonetheless, it is relatively early to predict or understand the hesitation around the Covid-19 vaccine (Perveen et al., 2021). However, it is paramount that these kinds of studies happen, as they can be helpful to create education campaigns that will reduce vaccine hesitancy (Murphy et al., 2021).

The concern about vaccine hesitancy is that religiosity plays a valuable role in building vaccine hesitancy over time. The notion that" natural medicine" is better than "artificial medicine" shows that there is a significant debate on what people would prefer due to moral and philosophical reasons (Ullah et al., 2021). It is also associated with strong religious beliefs. Religious devotees have higher levels of vaccine hesitancy, as they would prefer to pray for healing rather than take medication (Garcia & Yap, 2021). They were embedding the idea into the next generation of devotees, creating a cycle of vaccine hesitancy due to religiosity and lack of knowledge (Garcia & Yap, 2021). Due to this, devotees are much more inclined to take alternative medications, vaccines, and treatments for their children, if it comes under the doctrine of their religion (Garcia & Yap, 2021).

On the other hand, significant leaders like the Pope have already pointed out their stance on the vaccine. Due to the use of cell lines from aborted foetuses in certain Covid-19 vaccines, the Church under the Pope has been steadfast in its rejection (Garcia & Yap, 2021). However, the instructions of *Dignitas Personae*, the practice of taking the vaccine was deemed 'moral' when three factors are true: that there are no ethically made vaccines available, there are issues in storage and transportation of the vaccine, and even if vaccines are available the choice of getting a specific vaccine is not up to the individual (Garcia & Yap, 2021). These problems do not occur in countries where Judaism and Buddhism are prevalent; hence, they largely accept the vaccine (Garcia &Yap, 2021).

Anti-vaccine misinformation and myths reached fever-pitch in 2011 when it was being circulated that those vaccines are being used to sterilize the Muslim female population (Ullah et al., 2021). Given that gelatine from porcine is haram, the vaccine, which might have gelatine, is also haram (Ullah et al., 2021). Another partial fact circulated at that time is that some vaccines are produced using porcine-based enzymes, making the vaccines haram for the general population (Ullah et al., 2021). It should be noted that views like these have been disclaimed by many religious leaders (Ullah et al., 2021). Given that there is no absolute transparency in how the vaccines are made and transported, views like these have an easier time taking hold of the general population (Ullah et al., 2021).

Wong et al. (2020) point out that in Malaysia, a Southeast Asian Muslim country, parents' opposition to the vaccine was so high that even having free HPV vaccines entice them. This was due to the reliance these parents have on traditional modes of healing for issues like cancer and vaccines, which are affected by the historical and cultural norms in their surroundings (Wong et al., 2020). These parents would prefer homemade herbal remedies and homoeopathy vaccines to artificially made medication. The 'local' aspect of their

medicine was necessary. They would trust local healers and their recommendations rather than being administered vaccines (Wong et al., 2020).

Whether a vaccine is halal or not is highly important in Muslim states. Religious teachers and preachers hold strong leadership positions in rural or illiterate communities; hence a non-halal vaccine would face much resistance in those areas (Wong et al., 2020). A non-halal material is only allowed under strict rules. The Ministry of health and local Islamic authorities in Malaysia hence created a strict guideline that must be followed by all parties concerning medication (Wong et al., 2020). Non-halal medicines will only be allowed if they meet the following requirements: there is no other alternative is present, the risk and benefit are informed to the patient, there is informed consent in the usage of the medication, and the drug will protect the patient from harm (Wong et al., 2020). Sarah is the basis of these guidelines, as non-halal materials can be taken if they will save a person's life, and there is no readily available alternative (Wong et al., 2020). Where there is no halal vaccine, the decision of what would be allowed is given to a country's fatwa committee (Wong et al., 2020). Even then, the difference in how certain sects permit and dismiss materials on their own specific rules makes it hard to take a nationwide decision.

For these reasons, religious representatives from Indonesia visited the Chinese factory where the Chinese Sinovac Covid-19 vaccine was made (Perveen et al., 2021). They conducted an audit, which resulted in the vaccine being declared halal, allowing it to be administered to the Muslim population in their country (Perveen et al., 2021).

A study was conducted in a university in Venezuela (Andrade, 2021) with a sample size of 265. Only 230 participants completed the survey based on the link between religiosity and vaccine hesitancy. The sample consisted of primarily Catholic and Protestant students, while

a small number of non-religious students were also present. The results show no link between religious beliefs and vaccine hesitancy. It is correlated with conspiracy theories around vaccines and acceptance of the theory of evolution.

Vaccine Hesitancy in Pakistan:

A non-Covid vaccination study in 2019 ranked Pakistan amongst the ten lowest countries in terms of acceptance of vaccines (Saeed Shah & Emont, 2021). The nature of the vaccine hesitancy can be shown by the following quotes, found in a study done by Zeker et al. (2020).
"If it is in my kismet [fate] written that I will get infected with the virus, then nothing can stop it. So, we must trust in Allah. Nothing will happen." (Zakar et al., 2020)
"Allah is not happy from us. This is a wrath of Allah. We need to give more sadaqah [spend money on poor to make Allah happy]." (Zakar et al., 2020)

A well-known columnist has already stated that the vaccine is a massive conspiracy against the Muslims, which in the end would allow the Jewish population of the world to be in power. (Khan et al., 2020). These vaccines would also include nano-chips controlled by malicious external actors through 5G networks (Khan et al., 2020). A former foreign minister of Pakistan accused the United States of creating the virus before using it as a weapon against the Chinese population (Khan et al., 2020). The Vaccine confidence project found that the anti-vaccine point of view has increased from 2% to 4% (Perveen et al., 2021). This is a familiar presence on social media in Pakistan, with a public narrative creating false narratives around the virus and creating vaccine hesitancy (Khan et al., 2020).

In 2011, the CIA found Osama bin Ladin in Abbottabad, Pakistan (Jaafari, 2021). They had disguised their operative as a polio vaccine administer under the guise of a Polio drive

(Jaafari, 2021). This risked the security of health workers later for polio and the Covid-19 vaccine, as previous polio drives have been dangerous in the northern area of Pakistan (Jaafari, 2021). This also has created a sense of dishonesty around the nature of a vaccine drive, creating more vaccine hesitancy in areas that have become hard to tackle (Jaafari, 2021).

It is primarily the large urban spaces that have been hit hard with the virus (Shoukat & Jafar, 2020). Due to the limited number of cases in rural areas of Pakistan, certain conspiracies around corona were highly prevalent (Shoukat & Jafar, 2020). These comments include:

"There is no coronavirus," (Shoukat & Jafar, 2020)

"Is the coronavirus a reality?" (Shoukat & Jafar, 2020)

"I have not seen any coronavirus infected person anywhere" (Shoukat & Jafar, 2020)

"Coronavirus cannot harm Muslims," (Shoukat & Jafar, 2020)

"What coronavirus can do to us?" (Shoukat & Jafar, 2020)

"Is the coronavirus a reality or conspiracy of America for selling vaccine and medicines?" (Shoukat & Jafar, 2020).

Due to the rural areas not having sizeable urban sprawl, they have had more minor cases of Covid-19, which have created a breeding ground for coronavirus-based conspiracy (Shoukat & Jafar, 2020). Even with SOPs being communicated by the government, religious leaders defy them openly and hold massive congregations (Perveen et al., 2021). While the government had much more success in closing other large establishments like schools, universities, markets, they could not effectively work with the religious leaders on a compromise and have left them to their own devices (Perveen et al., 2021).

There is a rather extensive discussion about the vaccination rate in Pakistan during the time of the vaccine being created and then administered. Pakistan is unique as it has a significant difference in ethnic population, and each region has a difference in ethnicity. As found in a study done by Chaudhary et al. (2021), the rates of acceptance of vaccine in Pakistan at 53% was higher than in Saudia Arabia (31.8%), Jordan (28.4%) and Kuwait (23.6%), where religion plays a significant role in the decisions of the people. However, it was much lower than countries like China, Indonesia and Malaysia, each country with >90% and other countries like Ireland (65%), UK (76%) or the US (57.6% - 68.6%), hence showing that Pakistan still has a gap to cover (Chaudhary et al., 2021). It should also be pointed out that this study was conducted at the Pakistan institute of medical sciences. Participants were rather well educated, from a privileged class, urban, and had medical knowledge. Hence the data could be skewed in their favour, and the percentage could be very different.

Another study done by Malik et al. (2021) targets Pakistan's healthcare workers. They were the first to get the vaccines and have medical knowledge through their profession. 70% of the participants that took the survey reported that they would indeed be vaccinated, while only 5.2% rejected the idea (Malik et al., 2021). However, 24.5 participants said they would wait for more information about the vaccine (Malik et al., 2021). The study also notes that the vaccine's acceptance increased with the respondent's age (Malik et al., 2021). This study also shows that religion plays a rather significant role in the rejection of vaccines, even in health care workers, as the components of the vaccines are thought to be against sharia law (Malik et al., 2021). However, other factors like prior covid exposure, vaccine effectiveness and side effects were more prominent in the study (Malik et al., 2021). However, the problem with the study done by Chaudary et al. (2021) is present in Malik et al.'s (2021) study, as they target a population with much better awareness and medical knowledge. It might not correctly

generalize the people and cannot give us an accurate image of vaccine hesitancy in Pakistan. While generalized studies, with diverse participants from different ethnicities and locales, have not been presented as Covid-19is an ongoing crisis.

Religion plays a large part in the decisions of Pakistanis when it comes to vaccination. This has been seen through how the government and NGOs that eradicate polio work with local religious leaders to destroy the myths around vaccines (Hussain et al., 2016). Their help has created a suitable space where vaccination is not harmed but allowed, especially in areas near other countries' borders (Hussain et al., 2016). There is a security issue that Pakistan has had to deal with many times in these areas. During the takeover of the Taliban, vaccines were banned, which caused an uptick in polio cases (Hussain et al., 2016).

The issues raised by the Malaysian people regarding the vaccine being halal are also present in Pakistan. The interpretation of a specific group of Muslim scholars has claimed that Islam does not allow vaccinations, as they are haram (Malik et al., 2021). Misinformation and hard-line religious views have already been recognized as a significant increase in the population's mistrust of vaccines (Perveen et al., 2021). The issue is not purely religious, too, given that many Pakistanis have refused the Chinese vaccines due to the myths around their effectiveness (Perveen et al., 2021).

Vaccine roll-out and vaccination inequality:

The roll-out of the vaccine was an issue, too, given the enormous inequality in Pakistan. Pakistan cannot create a locally made vaccine; hence it has signed a deal with a Chinese company to necessary their concentrate of vaccine, process it and brand it as PakVac (Asif Shahzad, 2021a). Most of the vaccines provided to Pakistan at the start were given by the

Chinese, who wanted to boost their diplomatic standing (Shah, 2020). 17500 Pakistani volunteers were chosen for China's CanSino vaccine tests (Mangi, 2021). Most of the doses in Pakistan currently are from China, as the COVAX alliance promised 45 million doses (Jalal Baig, 2021). Currently, only 1.2 million doses of western vaccine have been received under COVAX (Jalal Baig, 2021). China has already listed Pakistan as a 'priority' in the COVAX alliance and has pledged 100 million dollars to COVAX, which will increase the flow of Chinese vaccines in Pakistan (Tribune, 2021). The issue with Chinese vaccines is that the rate of effectiveness is much lower than its western counterparts, with Chinese vaccines being approximately 60-70% effective, while western vaccines are above 90% (Umair et al., 2021). To control the pandemic, more effective vaccines are needed to be available to the public. However, due to the reliance on China and Pakistan's place in the world, Chinese vaccines might prolong the pandemic in Pakistan due to their efficacy rate.

Pakistan was also one of the few countries that allowed the sale of vaccines to the general populace. This allowed pharmaceutical companies to sell imported vaccines. The government had set a fixed price for these vaccines (Perveen et al., 2021). The price for the vaccine in terms of dollars was 80, which was not affordable for most of the public, as it was four times higher than the price in the international market (Hassan, 2021). The cost of vaccination from private companies for a family of five in Pakistan is USD 400, making it unattainable for the lower class (Hassan, 2021). The Pakistani elite has used bribes and administrative powers to circumvent the vaccine roll-out system and secure it before the general populace (Perveen et al., 2021). This was brought to the forefront when a video leaked that the federal Ministry of Housing, Tariq Bashir Cheema, and his family were administered the vaccine in their home before a free vaccination drive had started in Pakistan (Dawn.com, 2021a).

The government has started to threaten action against vaccine-hesitant citizens. It has already made threats of blocking mobile phone numbers baring access to malls, offices, restaurants, and transport (Asif Shahzad, 2021b). However, it is tough to know if this has happened or not or how effective it has been in increasing the number of immunizations. On August 29, 2021, the government allowed booster shots to be administered to civilians willing to pay RS 1270 (Ikram Junaidi, 2021). The need for booster shots became apparent when countries did not approve Pakistani citizens who have taken the Chinese vaccines to enter their country; hence they must have a booster shot of a western vaccine (Ikram Junaidi, 2021). Many health officials have said that no studies have declared that mixing and matching vaccines is safe; hence, it can be dangerous to the person administering the booster shot (Ikram Junaidi, 2021).

Schools and universities were allowed to hold classes from October 31, 2021. Only students who had partial vaccinations were allowed to sit in the institutions (Dawn.com, 2021b). The fifth wave of a coronavirus entered Pakistan by the start of 2022, with the variant called Omicron, a faster variant of the virus (Syed Raza Hassan, 2022). Seventy million or 32% of the Pakistani population has already been fully vaccinated, with booster shots being authorized for over 30. At the same time, children aged 12 and above are provided vaccinations in their schools (Syed Raza Hassan, 2022).

Methodology

Research Question:

The research question of this study is:

1. What is the impact of religiosity on vaccine hesitancy in Muslim undergraduate students presently studying at FCCU?

Conceptual hypothesis:

Muslim undergraduate students with a higher level of religiosity will have more vaccine hesitancy.

Operationalization:

The first independent variable is Muslim religiosity. To measure this, we will be using the Muslim religiosity scale (hereinafter referred to as MRS), which quantifies and measures four basic tenets of religiosity: belief, attitudes, practice, and knowledge (Albelaikhi, 1997). The dependent variable of vaccine hesitancy will be measured through the adult vaccine hesitancy scale (hereinafter referred to as VHS) created by Akel et al.,

Operational Hypothesis:

Muslim undergraduate students who score higher on the Muslim religiosity scale (Albelaikhi, 1997) will also score higher on the adult vaccine hesitancy scale (Akel et al., 2021).

Variables:

Independent variable: Muslim religiosity

Dependent variable: Vaccine hesitancy

Control variables: Level of education, Gender, wealth class (categorized), Age of Participant, vaccination status of participant and family.

Research Design:

This research is a cross-sectional quantitative study. The data was collected as soon as the IRB gave permission.

Selection Criteria and Sample Size:

1. University students that are currently enrolled in the undergraduate program at FCCU Lahore

2. Muslim students

The sample size of this study was 160 participants.

Sampling Method:

For this study, the researcher used convenience sampling. There was no specific number of responses required from different departments at FCCU. The use of non-probability sampling delimits the inferential power of the study results; however, due to the situation with Covid-19 at the time of data collection, a probability-based sample necessitates the course of action taken. The University was officially open from November 1; there was a mixture of online and in-person data collection through google forms and printed questionnaires after discussions with the supervisor. In total, 150 questionnaires were completed by hand, of which six were discarded, while 16 were done online. The survey's question number 8 was used to ensure that only students who mark themselves as Muslims completed the study. If a student marks no to the question, they were sent to the exit section of the study, and their survey will not be counted when compiling data in the online form. Students were also contacted directly through email or WhatsApp when deemed necessary.

Target Data Collection:

The data for this study was collected through the google web application called google forms and in-person questionnaires. Online forms were automatically transferred into an excel sheet, which then was transferred to SPSS for analysis. The questionnaires done in person were processed manually by the researcher into SPSS before data analysis. A consent form

was attached to the survey, which the participants had agreed to before filling out the questionnaire. Respondents were not offered any reward or consideration for participating in the study.

Instrument:

The survey was divided into three sections and included 26 questions.

The first section included the socio-demographic characteristics of the respondents. The eight variables that the respondents were asked for were age (18-20, 21-23, 24+), Gender (Male, Female, prefer not to say), year of study (freshmen, sophomore, junior and senior), place of birth (Punjab, KPK, Sindh, GB and other, Baluchistan and ICT), Wealth class (Upper, Upper Middle, Middle, Lower-middle and lower class). Questions regarding Have you been vaccinated? (Yes, No), Is your immediate family vaccinated? (Yes, no), are you a Muslim? (Yes, no) were also added. The last three questions were essential to ask due to the nature of the study, as knowing the vaccination status and the religion of the participant was a vital point. The year of the study was measured on the American college system. A freshman is a student in their first year of undergraduate study. A sophomore, their second, junior student is in their third year. The senior student is in their fourth or last year.

The second section included eight questions from the MRS, added verbatim. The MRS measures four components of religiosity: belief, attitudes, and practice (Albelaikhi, 1997). Questions 9 and 10 measure practices, questions 11-13 measure beliefs, and questions 14-16 measure attitudes (Albelaikhi, 1997), as shown in table 1.1. A 5-point Likert scale was used, measuring strongly disagree, disagree, neutral, agree and strongly disagree.

Table 1.1

List of questions that were used in the following subscales

Subscales	Questions

Practice	I try hard not to miss praying on time
	If I could have a chance, I would read Quran everyday
Belief	I rely on Allah (God) in all my affairs
	I think this world would be a better place if all people believed in Islam and followed it
	I have no doubt that Islam is the only true religion
Attitudes	For science to be of service to humanity, it has to have religious restraints that regulate its steps
	Religious leaders have to be consulted about the important affairs of the nation
	The more Science advances in its discoveries, the clearer the truth of religious teachings becomes

The third section included ten questions from the VHS. The VHS by Akel et al. is a vaccine hesitancy scale explicitly developed for the use of adults (Akel et al., 2021), which was further divided into three subscales, protection, information, and effect subscale, as shown in table 1.2. A 5-point Likert scale was used, ranging from strongly disagree, disagree, neutral, agree, strongly agree. Later, Adult vaccine hesitancy was collapsed into three categories, Disagree, neutral and agree.

Table 1.2

List of questions that were used in the following subscales

Subscales	Questions
Protection	Vaccines are important for my health
	Vaccines are effective
	Getting vaccines is a good way to protect me from disease.
Information	Being vaccinated is important for the health of others in my community
	All routine vaccinations recommended by the government are beneficial
	The information I receive about vaccines from the government is reliable and trustworthy.
	Generally, I do what my doctor or healthcare provider recommends about vaccines for me.

Effect	New vaccines carry more risks than older vaccines
	I am concerned about serious adverse effects of vaccines.
	I do not need vaccines for diseases that are not common anymore.

To test the reliability, Cronbach Alpha tests were run on questionnaires. The test was run for the subscales of religiosity and vaccine hesitancy. They are shown in Tables 2.1 and 2.2, respectively.

Table 2.1

Cronbach alpha values for the subscales of religiosity

Scale	Items	α
Practice	2	.727
Belief	3	.885
Attitude	3	.753

Table 2.2

Cronbach alpha values for the subscales of vaccine hesitancy

Scale	Items	α
Protection	3	.761
Information	4	.740
Effect	3	.541

Further on, factor reduction analysis was done on the subscales of religiosity and vaccine hesitancy. They are shown in tables 3.1 and 3.2, respectively.

Table 3.1

Factor loadings for the subscales of religiosity

Items	Factor loading
Practice	

I try hard not to miss praying on time	.888
If I could have a chance, I would read Quran everyday	.888
Belief	
I rely on Allah (God) in all my affairs	.896
I think this world would be a better place if all people believed in Islam and followed it	.991
I have no doubt that Islam is the only true religion	.901
Attitude	
For science to be of service to humanity, it has to have religious restraints that regulate its steps	.806
Religious leaders have to be consulted about the important affairs of the nation.	.820
The more Science advances in its discoveries, the clearer the truth of religious teachings becomes	.830

Table 3.2

Factor loadings for the subscales of vaccine hesitancy.

Items	Factor loading
Protection	
Vaccines are important for my health	.858
Vaccines are effective	.886
Getting vaccines is a good way to protect me from disease.	.722
Information	
Being vaccinated is important for the health of others in my community	.797
All routine vaccinations recommended by the government are beneficial	.822
The information I receive about vaccines from the government is reliable and trustworthy.	.707
Generally, I do what my doctor or healthcare provider recommends about vaccines for me.	.697
Effect	
New vaccines carry more risks than older vaccines	.646
I am concerned about serious adverse effects of vaccines.	.787
I do not need vaccines for diseases that are not common anymore.	.730

Target Data Analysis:

Once the data was collected, it was analyzed through the SPSS software version 26. Descriptive statistics, MANOVA, and linear regression were conducted.

Ethics of Research:

The following measures were applied to ensure the study meets the ethical requirement of IRB at FCCU. The age of the sample would be above 18 years. A consent form document (Appendix A) would need to be filled out before attempting the survey, which informed the participants about the aim of the research, the risks present, if any, and points out that the data collected would be only used for this research alone. Participant psychological and physical wellbeing was not put at risk during the research condition. Data collected through google forms had no identifiable information like names, roll numbers, or email addresses of the respondents. The option of requiring emails to complete the study was disabled on google forms. The questionnaire was not time-sensitive, and the researcher was not present when the respondent filled out the survey. This study is not funded and has no budget.

Results

The hypothesis tested in the results Muslim undergraduate students with a higher level of religiosity will have more vaccine hesitancy. Due to the changing nature of the dataset and the pandemic, specific changes were made to the data before any analysis was performed. Due to the opening of FCCU from November 1, 150 responses were gathered in person, while 16 responses were gathered online through google forms. Data collection was closed on November 10, 2021, when sufficient responses were collected. The need for this was to speed up gathering data. Six of the in-person responses were discarded due to incomplete responses.

Tables 4.1, 4.2 and 4.3 consists of descriptive statistics ran on the data based on the sections made in the questionnaire. Table 4.1 consists of descriptive variables; Table 4.2 contains the frequencies of Muslim religiosity (independent variable). Table 4.3 includes the frequencies of the vaccine hesitancy scale (dependent variable). MANOVA ran where a single socio-demographic variable was tested against three dependent subscales to find significance in Table 5.1-5.4. After which, their variances were compared. Multiple independent variables subscales were used to test their combined and partial effect on one dependent subscale variable through Multivariate regression analysis, as seen in table 6.1- 6.3. A linear regression modal in table 6.4 was run to test religiosity as an independent variable against vaccine hesitancy as a dependent variable. At the same time, Statistical significance was placed at alpha value 0.05 for both regression models and MANOVA tests.

Descriptive Statistics:

Table 4.1

Frequency of socio-demographic variables used for the study

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Age				
18-20	42	26.3	26.3	26.3
21-23	102	63.7	63.7	90.0
24+	16	10	10	100
Gender				
Male	68	42.5	42.8	42.8
Female	89	55.6	56.0	98.7
Prefer not to say	2	1.3	1.3	100.0
Missing	1	.6		
Year of study				

Freshmen	15	9.4	9.4	9.4
Sophomore	29	18.1	18.1	27.5
Junior	54	33.8	33.8	61.3
Senior	62	38.8	38.8	100.0
Place of Birth				
Punjab	136	85.0	85.5	85.5
KPK	6	3.8	3.8	89.3
Sindh	5	3.1	3.1	92.5
GB and other	4	2.5	2.5	95.0
Baluchistan	8	5.0	5.0	100.0
Missing	1	.6		
Wealth class				
Lower	85	53.1	53.1	53.1
Middle	67	41.9	41.9	95.0
Upper	8	5.0	5.0	100.0
Are you vaccinated?				
Yes	160	100.0	100.0	100.0
No	0	0	0	0
Is your family vaccinated?				
Yes	141	88.1	88.1	88.1
No	19	11.9	11.9	100.0
Are you Muslim?				
Yes	160	100.0	100.0	100.0
No	0	0	0	0

The two main variables that were 100% in the yes, were the variables dealing with personal vaccination and if the participant was Muslim. 63.7% of the students were in the 21-23 category, while 26.3 and 10 per cent of the sample were in the 18-20 and 24+ category. At the same time, only 1 participant claimed to be in the 27-30 age bracket. Specifically, two variables had a narrow distribution. One of them was the place of birth; due to the survey

being administered in Lahore, based in Punjab, 136 of the participants were from Punjab out

of N=160. The variable describing the class of participants, 53.1% consisted of a lower class,

41.9% were middle class, and 5% were upper. 55% of the population were females, 42%

were female, while 1.3.% did not prefer to say. Students in the later stages of their education

were keen to do the survey, as 33.8% of the participants were Juniors and 38.8% of the

participants were seniors.

Table 4.2
Frequency of independent variable-based survey questions used for the study

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
I try hard to not miss praying on time				
Strongly disagree	23	14.4	14.4	14.4
Disagree	20	12.5	12.5	26.9
Neutral	49	30.6	30.6	57.5
Agree	38	23.8	23.8	81.3
Strongly agree	30	18.8	18.8	100.0
If I could have a chance, I would read Quran everyday				
Strongly disagree	8	5.0	5.0	5.0
Disagree	11	6.9	6.9	11.9
Neutral	33	20.6	20.6	32.5
Agree	61	38.1	38.1	70.6
Strongly agree	47	29.4	29.4	100.0
I rely on Allah (God) in all my affairs				
Strongly disagree	8	5.0	5.0	5.0
Disagree	7	4.4	4.4	9.4
Neutral	20	12.5	12.5	21.9
Agree	38	23.8	23.8	45.6
Strongly agree	87	54.4	54.4	100.0
I think this world would be a better place if all people believed in Islam and followed it				

Strongly disagree	12	7.5	7.5	7.5
Disagree	16	10.0	10.0	17.5
Neutral	37	23.1	23.1	40.6
Agree	35	21.9	21.9	62.5
Strongly agree	60	37.5	37.5	100.0

I have no doubt that Islam is the only true religion

Strongly disagree	9	5.6	5.6	5.6
Disagree	6	3.8	3.8	9.4
Neutral	18	11.3	11.3	20.6
Agree	26	16.3	16.3	36.9
Strongly agree	101	63.1	63.1	100.0

For science to be of service to humanity, it has to have religious restraints that regulate its steps

Strongly disagree	20	12.5	12.7	12.7
Disagree	26	16.3	16.5	29.1
Neutral	63	39.4	39.9	69.0
Agree	31	19.4	19.6	88.6
Strongly agree	18	11.3	11.4	100.0
Missing	2	1.3		

Religious leaders have to be consulted about the important affairs of the nation

Strongly disagree	22	13.8	13.8	13.8
Disagree	23	14.4	14.4	28.1
Neutral	43	26.9	26.9	55.0
Agree	44	27.5	27.5	82.5
Strongly agree	28	17.5	17.5	100.0

The more science advances in its discoveries, the clearer the truth of religious teachings become

Strongly disagree	10	6.3	6.3	6.3
Disagree	11	6.9	6.9	13.2
Neutral	29	18.1	18.2	31.4

Agree	50	31.3	31.4	62.9
Strongly agree	59	36.9	37.1	100.0
Missing	1	.6		

Table 4.2 presents the frequencies of the religiosity scale. The table shows that the participants scored high, with most respondents agreeing with the prompts. Three questions (I try hard to not miss praying on time, for science to be of service to humanity, it has to have religious restraints that regulate its steps and the more science advances in its discoveries, the clearer the truth of religious teachings become) were the only main questions that had any significant disagreement, with 40+ participants marking the disagree options. The belief subscale had a positive trend, where most of the responses were answered in the positive. The practice had a positive trend with 40%+ of positive responses. The attitude subscale had a mixed trend as one question (For science to be of service to humanity, it must have religious restraints that regulate its steps) had the most neutral responses (39.9%). In contrast, religious leaders who must be consulted about the important affairs of the nation had fewer positive responses (45%) than the more science advances in its discoveries, the clearer the truth of religious teachings become (68.5%). The comparison between the subscale shows that the belief subscale had the most positive responses, followed by the practice and attitude subscales.

Table 4.3
Frequency of dependent variable-based survey questions used for the study

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Vaccines are important for my health				
Disagree	2	1.3	1.3	1.3
Neutral	14	8.8	8.8	10.0
Agree	144	90.0	90.0	100.0
Vaccines are effective				

Disagree	1	.6	.6	.6
Neutral	26	16.3	16.3	16.9
Agree	133	83.1	83.1	100.0

Being vaccinated is important for the health of others in my community.

Disagree	1	.6	.6	.6
Neutral	7	4.4	4.4	5.0
Agree	152	95.0	95.0	100.0

All routine vaccinations recommended by the government are beneficial

Disagree	6	3.8	3.8	3.8
Neutral	24	15.0	15.0	18.8
Agree	130	81.3	81.3	100.0

New vaccines carry more risks than older vaccines

Disagree	46	28.7	28.7	28.7
Neutral	73	45.6	45.6	74.4
Agree	41	25.6	25.6	100.0

The information I receive about vaccines from the government is reliable and trustworthy.

Disagree	17	10.6	10.6	10.6
Neutral	51	31.9	31.9	42.5
Agree	92	57.5	57.5	100.0

Getting vaccines is a good way to protect me from disease.

Disagree	17	10.6	10.6	10.6
Neutral	51	31.9	31.9	42.5
Agree	92	57.5	57.5	100.0

Generally, I do what my doctor or healthcare provider recommends about vaccines for me.

Disagree	4	2.5	2.5	2.5
Neutral	25	15.6	15.6	18.1
Agree	131	81.9	81.9	100.0

I am concerned about serious adverse effects of vaccines.

Disagree	41	25.6	25.6	25.6

Neutral	45	28.1	28.1	53.8
Agree	74	46.3	46.3	100.0
I do not need vaccines for diseases that are not common anymore.				
Disagree	31	19.4	19.4	19.4
Neutral	38	23.8	23.8	43.1
Agree	91	56.9	56.9	100.0

Five (vaccines are important for my health, vaccines are effective, being vaccinated is important for the health of others in my community, all routine vaccinations recommended by the government are beneficial, generally, I do what my doctor or healthcare provider recommends about vaccines for me) variables have more than 80% agreement. Only one question (New vaccines carry more risks than older vaccines) has a significant number of neutral responses, at 45.6%. Only two questions (New vaccines carry more risks than older vaccines, I am concerned about serious adverse effects of vaccines) were answered with a disagree rate higher than 20%. The protection and information subscale had a positive trend, with both having a positive response rate of 57.5%+. The effect subscale had a mixed trend, where one question had more neutral responses (New vaccines carry more risks than older vaccines), and two questions (I am concerned about serious adverse effects of vaccines, I do not need vaccines for diseases that are not common anymore) had more positive responses. The comparison between the subscales shows that the protection subscale had the most positive responses, followed by the information and affect subscales.

MANOVA Tables:

MANOVA was done to compare the variance in the dependent variable subscales (protection, information, and effects subscale) when tested against the socio-demographic variables (age, gender, year of study, wealth class). Due to these tests, the effect of the socio-demographic

variables on the dependant variable would be studied. The importance of conducting these

tests is to look at the significance of the socio-demographic variables and then understand the

differences that there might be in the. Place of birth was not used in the test, as the

distribution was not normal, which is against the assumption of the MANOVA test data

(85.5% were from Punjab, while other categories had less than 5% responses each).

Table 5.1
One-way MANOVA of variance of dependent variables by the age of the participant.

Source	Dependent Variable	SS	Df	Mean Square	F	Sig	Partial Eta Squared
Age of Participant	Protection	3.564	2	2.122	2.122	.123	.026
	Information	.740	2	.197	.197	.821	.003
	Effect	7.211	2	2.355	2.355	.098	.029
Error	Protection	131.811	157	.840			
	Information	294.204	157	1.874			
	Effect	240.389	157	1.531			

There was an insignificant difference between the ages when considered jointly on the

variables of protection, information and effect subscale, Wilks Λ= .935, F (6,310) =1.766,

P=.106, partial η^2=.033. on any dependent subscale. When looked separately, Age of

participant had no significant effect on the protection subscale [F (2,157) = 2.122, p = .123,

η^2=.026], the Information subscale [F (3,156) = .345, p = .793], or the Effect subscale [F

(3,156) = 1.653, p = .179]. The level of significance was at p> .05.

Table 5.2
One-way MANOVA of variance of the dependent variable by gender of the participant

Source	Dependent Variable	SS	Df	Mean Square	F	Sig	Partial Eta Squared
Gender	Protection	4.719	2	2.360	2.821	.063	.035
	Information	7.221	2	3.611	1.958	.145	.024
	Effect	2.431	2	1.216	.774	.463	.010
Error	Protection	130.463	156	.836			

Information	287.722	156	1.844	
Effect	244.965	156	1.216	

There was an insignificant difference between the gender when considered jointly on the variables of protection, information and effect subscale, Wilks Λ= .953, F (6,308) =1.257, P=.277, partial η^2=.027. When looked separately, age of participant had no significant effect on the protection subscale [F (2,156) = 2.360, p = .063, η^2=.035], the Information subscale [F (2,156) = 1.958, p =.145, η^2=.024], or the Effect subscale [F (3,156) = .774, p = .463, η^2=.010]. The level of significance was at p> .05.

Table 5.3
One-way MANOVA of variance of dependent variables by year of study

Source	Dependent Variable	SS	Df	Mean Square	F	Sig	Partial Eta Squared
Age of Participant	Protection	2.732	3	.908	1.067	.365	.020
	Information	2.977	3	.992	.530	.662	.010
	Effect	7.484	3	2.495	1.621	.187	.030
Error	Protection	132.652	156	.850			
	Information	291.967	156	1.872			
	Effect	240.116	156	1.539			

There was an insignificant difference between the year of study when considered jointly on the variable's protection, information and effect subscale, Wilks Λ= .946, F (9,374.949) = .968, P=.466, partial η^2=.018. When looked separately, the year of study of participants had no significant effect on the protection subscale [F (3,156) = 1.067, p = .365, η^2=.020], the Information subscale [F (3,156) = .530, p = .662, η^2=.010], or the Effect subscale [F (3,156) = 1.621, p = .187, η^2=.030]. The level of significance was at p> .05.

Table 5.4
One-way MANOVA of variance of dependent variables by wealth class

Source	Dependent	SS	Df	Mean Square	F	Sig	Partial Eta

	Variable						Squared
Wealth class	Protection	.324	2	.162	.188	.828	.002
	Information	2.109	2	1.055	.565	.569	.007
	Effect	1.718	2	.859	.548	.576	.007
Error	Protection	135.051	157	.860			
	Information	292.834	157	1.865			
	Effect	245.882	157	1.566			

There was an insignificant difference between the ages when considered jointly on the variable's protection, information and effect subscale, Wilks Λ= .968, F (6,310) = .842, P=.538, partial η^2=.016. When looked separately, wealth class of participant had no significant effect on the protection subscale [F (2,157) = .188, p = .828, η^2=.002], the Information subscale [F (2,157) = .565, p = .569, η^2=.007], or the Effect subscale [F (2,157) = .548, p = .576, η^2=.007]. The level of significance was at p> .05.

Regression Tables:

Table 3.1
Regression analysis summary for Practice, belief and attitudinal subscale predicting protection subscale

Variable	B	95% Cl	β	T	P
(Constant)	7.87	[7.28, 8.46]		26.32	.000
Practice scale	-.003	[-.10,0.96]	-.007	-.059	.953
Belief scale	.075	[.001,.149]	.260	1.99	.047
Attitude scale	-.021	[-.09,.049]	-.066	-.58	.560

Note. R^2adjusted=.027. CI=Confidence level for B

The protection scale represented the dependent variable in the model, while practice, belief, and attitude subscales were the independent variables. The adjusted R square value is at .027, which shows that independent variables are explaining 2.7% of the variation in the dependent variable. The coefficients table shows that only the belief scale had a significant positive

relationship with the dependent variable (B = .075, p = .047). While the practice and attitude subscale were negatively related, the relationship was insignificant in both cases (p > .05).

Table 3.2
Regression analysis summary for Practice, belief and attitudinal subscale predicting information subscale

Variable	B	95% Cl	β	T	P
(Constant)	10.111	[9.232 10.989]		22.729	.000
Practice scale	.015	[-.133,.163]	.023	.200	.842
Belief scale	.067	[-0.43,.177]	.158	1.203	.231
Attitude scale	-.006	[-.110,.098]	-.013	-.114	.909

Note. R^2adjusted=.009. CI=Confidence level for B

The dependent variable was the information subscale in this model, while practice, belief, and attitude subscales were the independent variables. 0.9 of the variances in the dependent model could be attributed to the independent variables as R^2 =.009. The practice and belief subscales were positively related. The attitudinal scale was negatively associated with the information subscale; however, the relationship in all three cases was insignificant (p > .05).

Table 3.3
Regression analysis summary for Practice, belief and attitudinal subscale predicting Effects subscale

Variable	B	95% Cl	β	T	P
(Constant)	6.685	[5.868 7.502]		16.163	.000
Practice scale	-.031	[-.168,.107]	-.051	-.439	.661
Belief scale	.028	[-.074,.130]	.071	.538	.591
Attitude scale	-.026	[-.123,.071]	-.061	-.527	.599

Note. R^2adjusted=-.016. CI=Confidence level for B

This model's dependent variable was the effects subscale, while practice, belief, and attitude subscales were the independent variables. -1.6 of the variances in the conditional model could be attributed to the independent variables as R =-.016. The belief subscale was positively related. In comparison, practice and attitudinal subscale were negatively associated with the information subscale. However, the relationship in all three cases was insignificant (p > .05).

Table 3.4
Regression analysis summary for religiosity predicting vaccine hesitancy

Variable	B	95% Cl	β	T	P
(Constant)	24.863	[23.005 26.721]		26.432	.000
Religiosity scale	.029	[-. 032,091]	-.075	.942	.348

Note. R²adjusted=-001. CI=Confidence level for B

The dependent variable was vaccine hesitancy, a composite variable of the protection, information and affect subscale. Meanwhile, the independent variable was religiosity, a composite variable made of the practice, belief, and attitude subscale. The highest composite score for the religiosity scale is 40, while the lowest score is 8. The composite highest score for the vaccine hesitancy scale is 30, while the lowest score is 10. -0.1 of the variances in the religiously variable could be attributed to the independent variable as $R^2= -.001$. The religiosity scale was positively related to the dependent variable, but the relationship was insignificant (B= .029, p=.348).

The results show that the hypothesis tested in this study has been disproven, given that religiosity was high and vaccine hesitancy was low. The only subscale that had a significant positive effect in the regression modal was the protection subscale tested against the belief subscale (B = .075, p = .047) in table 6.1. The relationship could be interpreted as when participants have a firmer belief in the religion; they will have a higher vaccine hesitancy in this sample. The regression models did show that there would be a change in the variables based on the effect of the independent variable on the dependent variable. However, due to no significance of the results, it cannot prove the hypothesis. Further on in table 3.4, no correlation was found with the composite variable of Religiosity and Vaccine hesitancy. Additionally, MANOVA shows that none of the socio-demographic yield any significant result.

Discussion

The present study tested the hypothesis that religiosity would be positively related to vaccine hesitancy. Students scoring high on the religiosity scale will also score high on the vaccine hesitancy scale. However, the predictions were proven to be false. The data shows that religiosity in Muslim students is generally high in a liberal private institute like Forman Christian University. The belief subscale had the most positive results. Due to the high attitudinal subscale, the sample believes that science works with religion. This could show why this sample had a low rate of vaccine hesitancy.

The data shows a high level of confidence in the sample size for the information given by the government on vaccines. Most of the respondents trusted health care professionals to provide reliable information to the patients. They believed in the effectiveness and importance of a vaccine for preventing diseases. However, it should be noted that 46% of the participants were concerned about the adverse effect of vaccines. The results indicate that people have a degree of scepticism towards new vaccines, which can be mitigated by providing better information regarding the vaccine's side effects. The data showed that even though there have been large scale awareness campaigns regarding the vaccine, the participants still believed that newer vaccines might have adverse effects. The reason is the newness of the covid vaccine and the misinformation circulated in social media, which is unregulated.

The results can be explained through the theory this thesis is based on. The view of reasoned action and its later expansion into planned behaviour explain that participants decide based on normative behaviours. When the participant intends to be administered the vaccine, the significance of the act is high in society. In that case, they will partake in the vaccination process, regardless of other beliefs. These include religion in the case of the study.

Interestingly the findings revealed that even though the people were trusted in the information they received from the government and health professionals regarding the vaccine, they were still concerned about the adverse health effects of the vaccine. Furthermore, there is a high likelihood that the source of concern over the vaccine's negative health effects is not religion, as we found no direct relationship between religious beliefs and vaccine hesitancy.

This corroborates with the evidence provided by other writers on the link between the theory of planned behaviour and vaccine hesitancy. Perceived infectability of the Covid-19, together with the fear of the Covid-19 diseases, moves more of the population to be administered the vaccine (Ullah, Lin, et al., 2021). Hence, the vaccination process has subjective norms that people must adhere to. Given that they did perceive Covid-19 as a threat and that vaccination had a subjective norm to fulfil, it would lead to lesser vaccine hesitancy. Questions like being vaccinated are important for the health of others in my community, and vaccines are important for my health, showing that the vaccination process is both a personal and a communal process. Hence the individual perceives the threat is not just to themselves but also the community as they look at the resources at hand (Ullah, Lin, et al., 2021), which is why an individual might get a vaccine due to it becoming a subjective norm, which triggers a psychological effect (Yahaghi et al., 2021).

Complacency, convenience and confidence are the "3Cs' in the model presented by MacDonald (2015), which explains the factors that lead to vaccine hesitancy. This model can also be used to describe the results that were presented in this study. As administering the vaccine is a convenient process for the urban population of Lahore, and the confidence in healthcare professionals and government information was high; therefore, vaccine hesitancy

was found to be low among our sample.

Our results align with Andrade (2021), as he pointed out in his study of university students in Venezuela that there is no link between religiosity and vaccine hesitancy. The intensive nature of religion does not explain vaccine hesitancy; instead, it is how easily a religious group agrees with scientific facts (Andrade 2021). Given that this sample saw science as a part of Islamic ideas, they had low vaccine hesitancy. Andrade (2021) makes a valid point that the study of religious beliefs and vaccine hesitancy might move from religiosity to an analysis of conspiracy theories in specific religious groups regarding vaccines and then trace where those ideas originate.

The study's implications show that, given that COVID-19 is an ongoing pandemic and with the omicron variant being present, this sample would have near to no hesitation in getting the booster shot. This also shows that if there is another pandemic of this nature in the future, this sample would not have any delay in getting a new vaccine, even if there are myths and religious objections to the vaccines, as religiosity was not a factor in their decision, as seen through the sample having low vaccine hesitancy. Study also shows that governmental and healthcare-based information about the vaccine influenced the sample, which helped get vaccinated. This indicates that information provided by the government and health professionals is effective in dispelling disinformation and myths about the vaccine or reducing vaccine hesitancy. Hence counteracting the narrative that religious individuals would be averse to being administered the vaccine. The data also negates the points given by the media and the previous literature based on which this study was conducted that religious beliefs have a negative effect on vaccine hesitancy.

Given that the research on vaccine hesitancy found in adults regarding their vaccination is relatively low in number, this study could be seen as a starting point in understanding which part of the population might have a more significant level of vaccine hesitancy. Future researchers can conduct a more robust study on this issue by selecting a more representative sample through random sampling techniques. It is also worth noting that only 32% of the population has been fully vaccinated in Pakistan; hence the country is not entirely out of the pandemic yet (Syed Raza Hassan, 2022). A large population is vaccine-hesitant that has not been administered the vaccine. Preliminary research into vaccine hesitancy during the Covid-19 period has specifically been done on Pakistan's educational or medical institution level. A much more comprehensive and resourceful study needs to be done to see why such a large population of Pakistan has not been administered the vaccine. A greater study on the factors which lead them to have faith in their healthcare professionals and the governmental information around public health and pandemics could prove helpful to create robust public policies.

The generalizability of this study is low due to certain limitations. The sample was partially vaccinated as students were not allowed on campus if they had not been partially vaccinated as mandated by the government. The sample was selected from an urban population studying at a major private institution of higher education. Due to limitations presented by Covid-19, convenience sampling was used, limiting the generalizability, as the sample was not random. The sample size was not. It cannot explain the actions of upper-class students, students in public institutions, students living in rural areas, or students of different ethnicities. Neither can it explain the attitudes of students present in the other provinces. Hence the need for this study to be replicated in institutions in different regions and public institutions is high.

Conclusion

The literature review presented above gave us a mixed view of vaccine hesitancy. While in qualitative literature and content analysis of media, vaccine hesitancy was seen to be high in quantitative data presented above. Furthermore, the lack of research in this domain showed a massive gap in understanding what could be driving vaccine hesitancy in the Pakistani population. This study that a population that this sample presents, there is low rate of vaccine hesitancy, and that religious beliefs do not drive it. It also shows that this sample has a high level of religiosity. Science is seen as a part of religious beliefs rather than in contention with them, which disapproves of this study's hypothesis. However, the limitation of the sample size and its generalizability, coupled with the research gap present with the study of vaccine hesitancy, the need for replicating this study is high. While this study also shows the need to study different aspects of factors that drive vaccine hesitancy. Specifically, with this sample, a survey of why the sample has high trust in government information and healthcare professionals could yield significant results and further create better public policy.

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Appendices

Appendix A: Informed Consent form.

This letter is to inform you that this research aims to study the relationship between Muslim religiosity and vaccine hesitancy. The question we are trying to answer is that are students with higher Muslim religiosity going to be more vaccine-hesitant? The study is only being done with Muslim students at Forman Christian college university. The content of this study does not contain any element that might cause physical or psychological harm to the participant.

Your participation is voluntary, and at any time the participant feels uneasy, they can withdraw from the study. All data collected for this research is confidential and used for this study only, while your anonymity will always be maintained. This is non-funded research, and there are no compensation or rewards for participation.

Thank you for taking the time to do this survey.

Signature of Participant _____

Date _____

      Day/month/year

Appendix B: IRB certificate

FORMAN CHRISTIAN COLLEGE
(A CHARTERED UNIVERSITY)

INSTITUTIONAL REVIEW BOARD

<u>**IRB Approval Certificate**</u>

IRB Ref: IRB-310/10-2021

Date: 28-10-2021

Project Title: The relationship of Muslim religiosity and vaccine hesitancy in undergraduate students of FCCU.

Principal Investigator: Muhammad Salman Khan Niazi

Supervisor: Dr. Muhammad Vaqas Ali

Institutional review board has examined your project in IRB meeting held on 04-05-2021 and has approved the proposed study. If during the conduct of your research any changes occur related to participant risk, study design, confidentiality or consent or any other change then IRB must be notified immediately.

Please be sure to include IRB reference number in all correspondence.

Dr. Kauser Abdulla Malik HI,SI,TI
Chairman, IRB
HEC Distinguished National Professor (Biotechnology)
Dean Postgraduate Studies
Director, Research, Innovation & Commercialization (ORIC)
Forman Christian College (A Chartered University)
Lahore

Appendix C: Survey Questionnaire

Section 1:

S. No	Question	Option A	Option B	Option C	Option D	Option E	Option F
1	Age	18-20	21-23	24-26	27-30		
2	Gender	Male	Female	Other	Not prefer to say		
3	Year	Freshmen	Sophomore	Junior	Senior		
4	Place of birth	Punjab	KPK	ICT	Sindh	GB and other territories	Baluchistan
5	Wealth class	Upper	Upper-middle	Middle	Lower-middle	Lower	
6	Have you been vaccinated?	Yes	No				
7	Is your whole immediate family fully vaccinated?	Yes	No				
8	Are you a Muslim?	Yes	No				

Section 2: Items taken verbatim from Muslim religiosity scale (Albelaikhi, 1997).

S. No	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
9	I try hard not to miss praying on time					
10	If I could have a chance, I would read Quran everyday					
11	I rely on Allah (God) in all my affairs					
12	I think this world would be a better place if all people believed in Islam and followed it					
13	I have no doubt that Islam is the only true religion					
14	For science to be of service to humanity, it has to have religious restraints that regulate its steps					

15	Religious leaders have to be consulted about the important affairs of the nation					
16	The more Science advances in its discoveries, the clearer the truth of religious teachings becomes					

Section 3: These 10 items from the adult vaccine hesitancy are being used verbatim. However, there are changes to help them ground in the Pakistani geographical setting (Akel et al., 2021).

S. No	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
17	Vaccines are important for my health					
18	Vaccines are effective					
19	Being vaccinated is important for the health of others in me community.					
20	All routine vaccinations recommended by the government					

	are beneficial				
21	New vaccines carry more risks than older vaccines.				
22	The information I receive about vaccines from the government is reliable and trustworthy.				
23	Getting vaccines is a good way to protect me from disease.				
24	Generally, I do what my doctor or healthcare provider recommends about vaccines for me.				
25	I am concerned about serious adverse effects of vaccines.				
26	I do not need vaccines for diseases that are not common anymore.				