TESTING THE MEDIATING AND MODERATING FACTORS OF THE LINK BETWEEN RELIGIOSITY AND VACCINE HESITANCY: A QUANTITATIVE STUDY OF TURKISH MUSLIMS

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Abstract

This study aims to examine the link between religiosity and vaccine hesitancy and whether this relationship is mediated by trust in science and scientists. The sample consisted of 571 Turkish Muslims. The participants' average age was 38.09 years (SD=11.3). The participants were asked to provide their demographic information and complete measures of vaccine hesitancy, religiosity, and trust in science and scientists. The findings indicate that (a) there is a significant positive correlation between religiosity and vaccine hesitancy, (b) trust in science and scientists has a mediating role in the relationship between religiosity and vaccine hesitancy, and (c) age has a significant moderating effect on the relationship between religiosity and vaccine hesitancy. The findings suggest that the role of religiosity in vaccine hesitancy functions through trust in science and scientists.

Keywords: Vaccine hesitancy, trust in science, trust in scientists, religiosity, Turkish Muslims

Introduction

Discussions about vaccine hesitancy go back as far as vaccine history. Following the development of new vaccines during the recent worldwide COVID-19 pandemic, these discussions became a main research topic in almost every society. In this context, numerous studies have been conducted to address vaccine hesitancy from different perspectives and to determine its predictors.[1] Religion and/or religiosity have also been studied in relation to vaccine hesitancy. The literature shows that religiosity might have a negative or a positive influence on individuals' attitudes toward vaccines. For example, a study conducted in Poland revealed that religiosity is a significant and

[1] For a systematic meta-analysis and review, see Jeanette J. Rainey et al., "Reasons Related to Non-Vaccination and under-Vaccination of Children in Low and Middle Income Countries: Findings from a Systematic Review of the Published Literature, 1999–2009", *Vaccine* 29/46 (2011), 8215–8221; Judy Truong et al., "What Factors Promote Vaccine Hesitancy or Acceptance During Pandemics? A Systematic Review and Thematic Analysis", *Health Promotion International* 37/1 (2022), 1-13.

negative predictor of vaccine hesitancy (or anti-vaccine attitudes).[2] Two studies conducted in the US that explored the relationship between vaccine hesitancy and Christian nationalism concluded that there is a significant and negative association between the aforementioned variables.[3] However, some studies have shown that religiosity is a significant and positive predictor of vaccine confidence. According to a study conducted in the Philippines, clergymen can have a positive influence on people with regard to building vaccine trust.[4] Another study that analyzed publicly available data from 147 countries found that religiosity is significantly and strongly positively correlated with vaccine confidence.[5]

Nevertheless, according to research, religiosity is not a consistent predictor of vaccine hesitancy. One study of university students in Venezuela examined the link between vaccine hesitancy and religiosity and revealed that although vaccine hesitancy is significantly correlated with the acceptance of scientific theories (that is, evolution theory) and vaccine conspiracy theories, there is no significant correlation between vaccine hesitancy and religiosity itself.[6] These results also imply that trust in science (and scientists) and belief in conspiracy theories can be strong predictors of vaccine hesitancy.

Recent studies have revealed a correlation between vaccine hesitancy and trust in science or belief in conspiracy theories. According to these studies, vaccine hesitancy is significantly and negatively correlated with trust in science (and scientists), while it is significantly and positively correlated with belief in conspiracy theories.[7] This raises the question of whether religiosity or trust in

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2 Waldemar Wojtasik et al., "Religiosity and New Populism", *European Journal of Science and Theology* 17/5 (2021), 93–106.

3 Katie E. Corcoran et al., "Christian Nationalism and COVID-19 Vaccine Hesitancy and Uptake", *Vaccine* 39/45 (2021), 6614-6621; Andrew L. Whitehead - Samuel L. Perry, "How Culture Wars Delay Herd Immunity: Christian Nationalism and Anti-Vaccine Attitudes", *Socius* 6 (2020), 1-12.

4 Jose Ma W. Gopez, "Building Public Trust in COVID-19 Vaccines Through the Catholic Church in the Philippines", *Journal of Public Health* 43/2 (2021), 1-2.

5 Kimmo Eriksson - Irina Vartanova, "Vaccine Confidence Is Higher in More Religious Countries", *Human Vaccines & Immunotherapeutics* 18/1 (2022), 1-3.

6 Gabriel Andrade, "Vaccine Hesitancy and Religiosity in a Sample of University Students in Venezuela", *Human Vaccines & Immunotherapeutics* 17/12 (2021), 5162-5167.

7 Chiara Cadeddu et al., "Vaccine Hesitancy and Trust in the Scientific Community in Italy: Comparative Analysis from Two Recent Surveys", *Vaccines* 9 (2021),1-12; J.

science and belief in conspiracy theories are the determining factors in vaccine hesitancy. Very few studies have addressed this question. The only study that has examined religiosity, trust in science, and vaccine hesitancy together was conducted in the US and found that religiosity increases individuals' vaccine intention and trust in science.[8]

Although a majority of these studies were conducted in Western or Judeo-Christian countries, some studies have explored the predictors of vaccine hesitancy or the relationship between vaccine hesitancy and certain variables, such as religiosity and conspiracy theories, in Muslim countries. Similarly, these studies have generally found a positive correlation between vaccine hesitancy and belief in conspiracy theories and a negative correlation between trust in science, religiosity, and vaccine hesitancy.[9]

Considering the literature review above, it is possible to examine the relationships among vaccine hesitancy, religiosity, and trust in science and scientists. According to the study conducted by Chu et al., trust in science and scientist can be proposed as a mediator of the relationship between vaccine hesitancy and religiosity, both theoretically and empirically.[10] However, the literature review also revealed that only one study tested this proposition empirically. Furthermore, the study by Chu et al. was conducted with a Christian sample and proposed that religiosity mediated vaccine hesitancy and trust in science and scientists.

Milošević Đorđević et al., "Links Between Conspiracy Beliefs, Vaccine Knowledge, and Trust: Anti-Vaccine Behavior of Serbian Adults", *Social Science & Medicine* 277 (2021), 1-8; Daniel Seddig et al., "Correlates of COVID-19 Vaccination Intentions: Attitudes, Institutional Trust, Fear, Conspiracy Beliefs, and Vaccine Skepticism", *Social Science & Medicine* 302 (2022), 1-10.

8 James Chu et al., "Religious Identity Cues Increase Vaccination Intentions and Trust in Medical Experts Among American Christians", *Proceedings of the National Academy of Sciences* 118/49 (2021), 1-3.

9 Qamar Abbas et al., "Myths, Beliefs, and Conspiracies About COVID-19 Vaccines in Sindh, Pakistan: An Online Cross-Sectional Survey", *Authorea* (2021); Muhammad Subhan Arshad et al., "A National Survey to Assess the COVID-19 Vaccine-Related Conspiracy Beliefs, Acceptability, Preference, and Willingness to Pay among the General Population of Pakistan", *Vaccines* 9/7 (2021), 720; Veysel Bozkurt et al., "Factors Affecting Negative Attitudes towards COVID-19 Vaccines", *İnsan & Toplum* 13/1 (2023); Mohammad Bellal Hossain et al., "COVID-19 Vaccine Hesitancy among the Adult Population in Bangladesh: A Nationwide Cross-Sectional Survey", *PLOS ONE* 16/12 (2021), 1–19.

10 Chu et al., "Religious Identity Cues Increase Vaccination Intentions and Trust in Medical Experts Among American Christians".

On a theoretical and empirical basis, we propose that trust in science and scientists is a mediating variable between religiosity and vaccine hesitancy. Given the literature review above, it seems that compared to religiosity, trust in science and scientists might be a stronger predictor of vaccine hesitancy. Hence, it is likely that trust in science and scientists has a mediating role in the link between vaccine hesitancy and religiosity. However, another point needs to be stressed. The recent COVID-19 pandemic strongly affected people in all countries across the world. According to a report by UNICEF that covered 90 countries, the number of confirmed deaths from COVID-19 increased with age, and 78.6% of the deaths occurred among people over the age of 60.[11] Additionally, previous research has shown that older people tend to be confident in vaccines due to their anxiety about health. In other words, since older people are often highly vulnerable to diseases, they are also more concerned about their health, which leads them to get vaccinated.[12] In this context, it is expected that individuals' attitudes toward vaccines will change with age. On this basis, the current study proposes that age might be a moderator of the link between religiosity and vaccine hesitancy.

It would be helpful to briefly explain the unique understanding of health in Islam to better understand a Muslim sample. The Islamic understanding of health is built mainly upon the two pillars of the sacred texts of Islam, namely, the Qurʾān and ḥadīth, as well as philosophical writings and theological treaties. According to the Qurʾān and ḥadīths, human beings are created by Allah in the best possible form (*aḥsan taqwīm*) (Q 95/4), and the body is believed to be a trust (*amānah*) given by God. This belief is also linked to the belief that any illness and health is from God (Q 4/78). Thus, Muslim scholars have constructed a holistic understanding of health. In other words, since the body is a trust, Muslim scholars have treated physical,

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11 "COVID-19 Confirmed Cases and Deaths", UNICEF (2022).

12 Alison Bish et al., "Factors Associated with Uptake of Vaccination against Pandemic Influenza: A Systematic Review", *Vaccine* 29/38 (2011), 6472–6484; Gustavo S. Mesch - Kent P. Schwirian, "Social and Political Determinants of Vaccine Hesitancy: Lessons Learned from the H1N1 Pandemic of 2009-2010", *American Journal of Infection Control* 43/11 (2015), 1161–1165; Lynn B. Myers - Robin Goodwin, "Determinants of Adults' Intention to Vaccinate Against Pandemic Swine Flu", *BMC Public Health* 11/1 (2011), 15; Björn Rönnerstrand, "Social Capital and Immunisation Against the 2009 A(H1N1) Pandemic in Sweden", *Scandinavian Journal of Public Health* 41/8 (2013), 853–859.

spiritual, and mental disorders/ailments as a whole and have not addressed them separately. In addition, since the body (that is, physical, spiritual, and mental health) is a trust given by God, it is believed that both treating ailments and preventing them is a religious duty.[13]

This study tested the links between religiosity and vaccine hesitancy and whether these links are mediated by trust in science and scientists and moderated by age. While assessing religiosity, we focused on both social effect and practical dimensions to provide a more comprehensive and complex understanding of the relationships among religiosity, trust in science and scientists, and vaccine hesitancy. For similar reasons, we measured the variable of trust with two different dimensions, namely, trust in science and trust in scientists. Previous researchers have also evaluated vaccine hesitancy attitudes, including beliefs in conspiracy theories about vaccines (for example, "vaccines cause autism" and "vaccines contain harmful substances, such as mercury"), because they believe that this will allow them to measure participants' attitudes toward information about vaccines.

Based on the literature review, the following hypotheses are constructed:

H_1: There is a significant correlation between religiosity and vaccine hesitancy.

H_2: There is a significant correlation between religiosity and trust in science and scientists.

H_3: There is a significant correlation between trust in science and scientists and vaccine hesitancy.

H_4: Trust in science and scientists mediates the links between religiosity and vaccine hesitancy.

H_5: Age moderates the link between religiosity and vaccine hesitancy.

1. Method

1.1. Participants

The sample of this study consisted of 571 Turkish Muslim participants, of whom 299 (52.4%) were male and 272 (47.6%) were female. Their ages ranged from 18 to 78 years, with a mean age of 38.09

[13] Ali Ayten - Amjad M. Hussain, *Psychology and Islam* (İstanbul: M.Ü. İlahiyat Fakültesi Vakfı Yayınları, 2020), 100-103.

years (SD=11. 384). In terms of educational level, 20% of the participants were not educated at a university (N=114), while 80% of the sample had an undergraduate degree or higher (N=457). Table 1 shows the participants' characteristics.

Characteristics	n	%
Gender		
Female	272	47.6
Male	299	52.4
Education Level		
High school and below	114	20
Undergraduate and higher	457	80
Has he/she ever gotten infected with COVID-19?		
Yes	308	53.9
No	263	46.1
Vaccinated for COVID-19		
Yes	440	77.1
No	131	22.9
Lost a close relative due to COVID-19?		
Yes	144	25.2
No	427	74.8
The mean age of the participants	38.89 ± 11.38 (SD = 11.3)	

n = frequency, % = column percentage, SD = standard deviation

Table 1. Demographic characteristics for all respondents (N=571)

1.2. Measures

Background information: The participants were asked to indicate their sex, age, and educational status. In addition, they were asked whether they were vaccinated for COVID-19 and whether they were ill with COVID-19. If they were ill, they were asked how severe the disease was. Data were also requested on whether they had lost a close relative due to COVID-19.

Vaccine Hesitancy. The first main variable in the present study was vaccine hesitancy. The respondents' attitudes toward the vaccine were assessed with a scale of anti-vaccine beliefs (anti-vaccination)

developed by Wojtasik et al.[14] The participants responded to ten items (e.g., the system of universal and compulsory vaccinations is an instrument of control over society by the authorities). The score for each item ranged from 1 (I strongly disagree) to 5 (I strongly agree). All items in the scale were subjected to factor analyses. The scale accounted for 56.507% of the variance. The Kaiser-Meyer-Olkin (KMO) value was .922, and Bartlett's test of sphericity yielded x^2=3413.792 and p=.000. The Cronbach's alpha (α) of this scale was .905. These results show that the scale was acceptable and applicable. Table 2 shows the conformity analysis and more psychometric values.

Trust in Science and Scientists. Trust in science and scientists was measured with the "Instrument to Measure Trust in Science and Scientists".[15] This scale has 21 items. However, for this study, we applied Esen's and Alkış-Küçükaydın's versions, in which the number of items was reduced to 10 (e.g., scientific theories are trustworthy).[16] The scale consisted of a 5-point Likert-type scale (1= strongly disagree, and 5= strongly agree). In the current study, the Cronbach's alpha (α) value was found to be .785, which was suitable for the study.

Religiosity. One of the main variables of this study is religiosity. Since all participants were Muslim, we used Ayten's 9-item religiosity scale, which was developed to measure Muslim religiosity.[17] The scale consists of two dimensions. In the first dimension, religious consequences have four items, including the effect of religion on decision-making, social life, and eating and clothing (e.g., My religious beliefs influence what I wear). The second dimension concerns faith and practice. It measures beliefs about the existence of God, the frequency of prayer, the reciting of the Qur'an, and so on (e.g., I pray five times a day). The KMO value was .914, and Bartlett's test of sphericity yielded x^2=3552.018 and p=.000. The Cronbach's alpha (α) of the scale was .921 for this study.

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[14] Wojtasik et al., "Religiousity and New Populism".

[15] Louis Nadelson et al., "I Just Don't Trust Them: The Development and Validation of an Assessment Instrument to Measure Trust in Science and Scientists", *School Science and Mathematics* 114/2 (2014), 76–86.

[16] Seher Esen - Menşure Alkış-Küçükaydın, "Turkish Adaptation Study of the Trust in Science and Scientists Scale: Validity and Reliability Study", *Research on Education and Psychology* 6 (Special Issue) (2022), 57–68.

[17] Ali Ayten, "Kimlik ve Din: İngiltere'deki Türk Gençleri Üzerine Bir Araştırma", *Çukurova Üniversitesi İlahiyat Fakültesi Dergisi (ÇÜİFD)* 12/2 (2012), 101–119.

1.3. Procedure

This study was conducted in Turkey. The data were gathered between the 23rd of May 2022 and the 30th of May 2022 using Google Forms. The snowball sampling method was used, and the participants were mostly recruited from the authors' family members, friends, and coworkers. They were asked to complete the survey and received the link via online messages and social media posts.

2. Results

2.1. Factor Analyses of Anti-Vaccination Scale

The translation into Turkish of a ten-item anti-vaccine scale developed by Wojtasik et al. was conducted by the researchers to measure the participants' attitudes toward vaccines.[18] Following the data collection process, explanatory and confirmatory factor analyses were conducted to determine the reliability and factorial validity of the scale. These ten items were subjected to principal component factor analysis and accounted for 56.507% of the variance. The KMO parameter and Bartlett's test of sphericity were suitable for factor analysis (KMO = .922; x^2 = 3413.792; p = .000). The Cronbach's alpha values (α) were found to be satisfactory (.905). As a result of these analyses, the scale was determined to be applicable.

AMOS software was used for the confirmatory factor analyses. As a result of the confirmatory factor analyses based on the structural equation model, which makes it possible to include latent and observed variables in the analysis, the model fit indices were found to be in the acceptable range and statistically significant.

[18] Wojtasik et al., "Religiosity and New Populism".

Scale/Item	M	SD	Corrected Item-to Total R	α	Standardized Regression Weights
Vaccine Hesitancy	3.01	.760		.905	
Item 1	3.34	1.20	.584**		.424**
Item 2	4.00	1.06	.646**		.493**
Item 3	2.79	1.16	.749**		.616**
Item 4	3.15	1.10	.813**		.701**
Item 5	3.27	1.16	.800**		.703**
Item 6	2.60	.839	.789**		.842**
Item 7	2.61	.832	.774**		.802**
Item 8	2.88	.921	.766**		.815**
Item 9	2.59	.850	.777**		.824**
Item 10	2.84	1.11	.754**		.696**
Model Fit Statistics					
χ^2				135.396	
df				28	
χ^2/df				4.836	
GFI				.951	
AGFI				.903	
NFI				.961	
RFI				.937	
IFI				.969	
TLI				.949	
CFI				.968	
SRMR				.046	
RMSEA				.082	

Note: N: 571. ** Significant at .001 level.

Table 2. Descriptive Statistics, Reliability Statistics, and Confirmatory Factor Analytic Findings for the Vaccine Hesitancy Scale (VHS)

The chi-square test results for the model fit indices were significant (x^2 = 135.396, df = 28, p<.000). Additionally, the value of the minimum discrepancy function divided by degrees of freedom (chi-square divided by degrees of freedom) was within an acceptable range (x^2/df

= 4.836).[19] The goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), Tucker–Lewis index (TLI), comparative fit index (CFI), normed fit index (NFI), and incremental fit index (IFI) were found to be greater than .900 (GFI =.951; AGFI =.903; TLI =.949; CFI =.968; NFI =.961; IFI= .969). AGFI greater than .900 is an excellent fit according to Schermelleh-Engel, Moosbrugger, and Müller.[20]

Moreover, the root mean square error of approximation (RMSEA = .082) was within an acceptable range,[21] and the standardized root mean residual was less than .05 (SRMR = .046). Consequently, confirmatory factor analyses based on the structural equation model showed that the model fit indices were in the acceptable range and significant.[22]

2.2. Correlation Analyses for the Main Variables

Table 3 presents a correlation matrix of the study's three main variables. According to the findings, there was a significant positive correlation between religiosity and vaccine hesitancy (r=.138; p<.01). Furthermore, religiosity (r=-.101; p<.05) and vaccine hesitancy (r=-.563; p<.01) were negatively related to trust in science and scientists.

Variable	R	TS	VH
R (M=4.17; SD=.842; range=1-5)	1		
TS (M=3.18; SD=.573; range =1-5)	-.101*	1	
VH (M=3.01; SD=.760; range =1-5)	.138**	-.563**	1

Note: N= 571. R= Religiosity, TS= Trust in Science and Scientists, VH= Vaccine Hesitancy

**p<0.01

*p<0.05

Table 3. Correlation Matrix

[19] H. W. Marsh - D. Hocevar, "Application of Confirmatory Factor Analysis to the Study of Self-Concept: First- and Higher Order Factor Models and Their Invariance across Groups", *Psychological Bulletin* 97/3 (1985), 562-582.

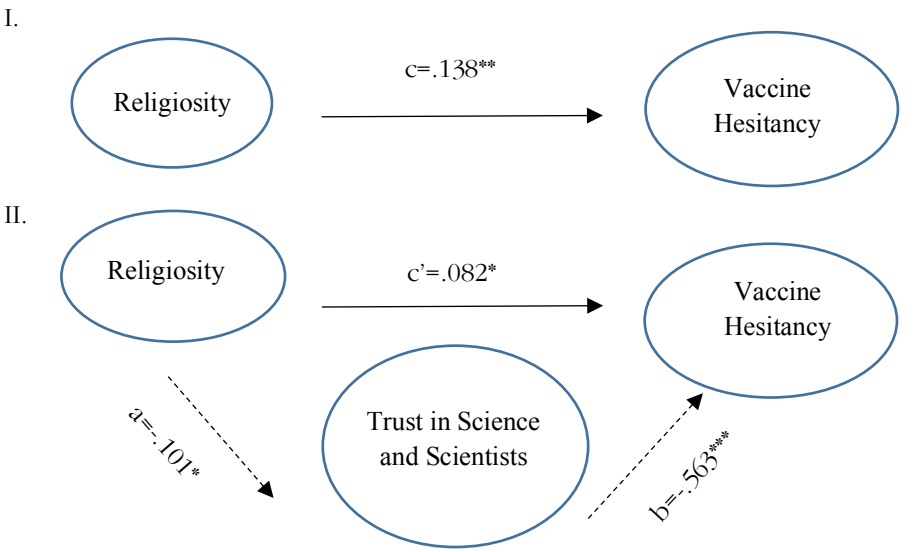
[20] K. Schermelleh-Engel et al., "Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures", *Methods of Psychological Research* 8/2 (2003), 23-74.

[21] M. W. Browne - R. Cudeck, "Alternative Ways of Assessing Model Fit", *Sociological Methods & Research* 21/2 (1992), 230-258.

[22] R. B. Kline, *Principles and Practice of Structural Equation Modeling* (New York: Guilford Press, 2011); Schermelleh-Engel et al., "Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures".

2.3. The Mediating Role of Trust in Science and Scientists

The present study examined the mediating role of trust in science and scientists in the relationship between religiosity and vaccine hesitancy. All three conditions to establish the mediating role of trust in science and scientists in the link between religiosity and vaccine hesitancy were met, as Baron and Kenny suggested.[23] Graph 1 shows that religiosity had a significant positive effect on vaccine hesitancy (c=.138**) and a negative effect on trust in science and scientists (a=-.101*) and that trust in science and scientists had a negative effect on vaccine hesitancy (b=-.563***). Graph 1 also shows that the effect of religiosity on vaccine hesitancy decreased to (c'=.082*) from (c=.138**) when trust in science and scientists was added as a mediator. Based on these findings, it can be concluded that trust in science and scientists partially mediates the relationship between religiosity and vaccine hesitancy.

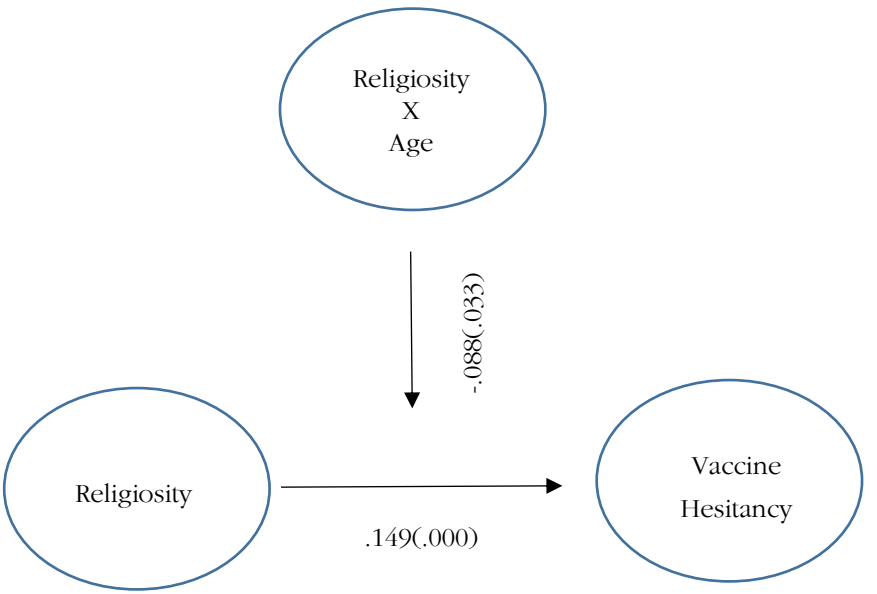


Graph 1. The mediating role of trust in science and scientists on the relationship between religiosity and vaccine hesitancy. Model I illustrates the direct effect of religiosity on vaccine hesitancy. Model II illustrates the mediating effect of trust in science and scientists. Note: *p<0.05; **p<0.01; ***p < .001

[23] R. M. Baron - D. A. Kenny, "The Moderator–Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations", *Journal of Personality and Social Psychology* 51/6 (1986), 1173-1182.

2.4. Moderation Test of Age between Religiosity and Vaccine Hesitancy

A moderation model was constructed to test the hypothesis of whether age moderates the relationship between religiosity and vaccine hesitancy. Multiple regression analysis was conducted to determine the effectiveness of the model. The independent variables were centered, and an interaction term of age and religiosity was calculated.[24] As shown in Graph 2, age had a significant moderating effect (p=.033) on the relationship between religiosity and vaccine hesitancy. When the interaction term was added to the equation (regression model), the direction of the relationship between religiosity and vaccine hesitancy changed to (-.088) from (.149). These findings reveal that while higher religiosity predicts greater vaccine hesitancy, the moderating role of age eliminates this relationship. As the participants' age increased, vaccine-hesitant attitudes decreased and vice versa.



Graph 2. Age as a moderator on the link between religiosity and vaccine hesitancy.

[24] Baron - Kenny, "The Moderator–Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations".

3. Discussion

The COVID-19 pandemic has led to ongoing debate and mistrust about vaccines. Studies on vaccine hesitancy and intention have revealed that there are a number of factors related to hesitant attitudes toward vaccines. For example, factors such as risk perceptions, ethnicity, gender, lack of information, and vaccine misinformation have been shown to affect vaccine hesitancy. According to the literature, it is safe to say that religiosity or belief in a higher power and trust have a noticeable and distinct place among these factors. The primary purpose of this study was to examine the link between vaccine hesitancy and religiosity and whether trust in science and scientists mediates the previously mentioned relationship among a sample of Turkish Muslims. Moreover, this study aimed to explore the moderating role of age in the link between religiosity and vaccine hesitancy.

Regarding the first research hypothesis (H_1), the findings indicate that there is a statistically significant and positive correlation between religiosity and vaccine hesitancy (see Table 3). These findings support the first research hypothesis. Furthermore, these findings are consistent with the findings of other studies. For instance, some studies conducted in different countries using diverse samples have concluded that there is a negative correlation between religiosity and vaccination intentions; that is, the more religious people are, the less they accept being vaccinated.[25] However, there are also data from studies that conclude that religiosity promotes a positive tendency toward vaccination.[26]

The findings of this study also support the second research hypothesis (H_2) concerning the link between religiosity and trust in science and scientists. The findings indicate that there is a statistically

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[25] Abbas et al., "Myths, Beliefs, and Conspiracies About COVID-19 Vaccines in Sindh, Pakistan: An Online Cross-Sectional Survey"; Miguel Pugliese-Garcia et al., "Factors Influencing Vaccine Acceptance and Hesitancy in Three Informal Settlements in Lusaka, Zambia", *Vaccine* 36/37 (2018), 5617-5624; G. Troiano - A. Nardi, "Vaccine Hesitancy in the Era of COVID-19", *Public Health* 194 (2021), 245-251.

[26] E. T. Mupandawana - R. Cross, "Attitudes Towards Human Papillomavirus Vaccination Among African Parents in a City in the North of England: A Qualitative Study", *Reproductive Health* 13/1 (2016); Tami Thomas et al., "The Influence of Religiosity and Spirituality on Rural Parents' Health Decision Making and Human Papillomavirus Vaccine Choices", *Advances in Nursing Science* 38/4 (2015), 1-16.

significant and negative correlation between religiosity and trust in science and scientists (see Table 3). These findings are compatible with other studies in the literature. Numerous studies conclude that an increasing level of religiosity predicts negative attitudes toward science.[27] On the other hand, certain studies have derived notable findings. For instance, O'Brien and Noy[28] found that religiosity is a stronger negative predictor of trust in science than religion itself. In a slightly broader study that drew upon data from 52 countries, Chan found that although religiosity is, on average, negatively associated with science, the results differ by country, and religion sometimes has a positive association with science.[29] More interestingly, Chan concluded that religiosity is unswervingly negatively associated with science only in Western countries.

Research Hypothesis H_3 regarding the link between vaccine hesitancy and trust in science and scientists is supported by the findings of the study. That is, there is a statistically significant and negative correlation between vaccine hesitancy and trust in science and scientists (see Table 3). Many previous studies have also demonstrated that trust in science and scientific authorities decreases negative attitudes toward vaccines.[30]

The findings of this study support the fourth research hypothesis, H_4, concerning the mediating role of trust in science and scientists on

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[27] Jonathon McPhetres - Miron Zuckerman, "Religiosity Predicts Negative Attitudes Towards Science and Lower Levels of Science Literacy", *PLOS ONE* 13/11 (2018), 1-20; D. A. Scheufele et al., "Religious Beliefs and Public Attitudes toward Nanotechnology in Europe and the United States", *Nature Nanotechnology* 4/2 (2009), 91-94.

[28] "Cultural Authority in Comparative Context: A Multilevel Analysis of Trust in Science and Religion", *Journal for the Scientific Study of Religion* 57/3 (2018), 495-513.

[29] Esther Chan, "Are the Religious Suspicious of Science? Investigating Religiosity, Religious Context, and Orientations Towards Science", *Public Understanding of Science* 27/8 (2018), 967-984.

[30] E. Dubé et al., "Vaccine Hesitancy: An Overview", *Human Vaccines & Immunotherapeutics* 9/8 (2013), 1763-1773; Matthew J. Hornsey et al., "Donald Trump and Vaccination: The Effect of Political Identity, Conspiracist Ideation and Presidential Tweets on Vaccine Hesitancy", *Journal of Experimental Social Psychology* 88 (2020), 1-8; Laura Rozek et al., "Understanding Vaccine Hesitancy in the Context of COVID-19: The Role of Trust and Confidence in a Seventeen-Country Survey", *International Journal of Public Health* 66 (2021), 1-9; Patrick Sturgis et al., "Trust in Science, Social Consensus and Vaccine Confidence", *Nature Human Behaviour* 5/11 (2021), 1528-1534.

the link between religiosity and vaccine hesitancy. As demonstrated in Graph 1, trust in science and scientists partially mediates the link between religiosity and vaccine hesitancy. The findings for the above four hypotheses might indicate that the increasing effect of religiosity on vaccine hesitancy is partially related to the link between religiosity and trust in science and scientists. Religiosity, therefore, increases vaccine hesitancy because it decreases trust in science and scientists. This might explain why religiosity increases questioning and distrust of scientific thinking and methods, and this hesitation about scientific methods results in increasing vaccine hesitancy. However, these findings also raise the question of whether there are other mediating factors in the link between religiosity and vaccine hesitancy.

As explained in the literature review above, a great deal of research has examined the relationship between religiosity and vaccine hesitancy/intentions, but studies that explain the underlying mechanism of this relationship are lacking in the literature. We found only a limited number of studies that investigated a mediating factor in the link between religiosity and vaccine hesitancy. For example, a study conducted by Olagoke et al. revealed that health locus of control (HLOC) partially mediates the link between religiosity and COVID-19 vaccination intention.[31] Furthermore, according to Ladini and Vezzoni, beliefs in COVID-19 conspiracy theories mediate the relationship between beliefs in divine immanence and vaccine hesitancy.[32] Finally, Plohl and Musil concluded that trust in science fully mediates the effect of religious orthodoxy on compliance with COVID-19 prevention guidelines.[33]

Finally, research Hypothesis H_5 concerning the moderating role of age on the link between religiosity and vaccine hesitancy is supported by the findings of the study. Age moderates the link between religiosity and vaccine hesitancy (see Graph 2). This means that as people age,

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[31] Ayokunle A. Olagoke et al., "Intention to Vaccinate Against the Novel 2019 Coronavirus Disease: The Role of Health Locus of Control and Religiosity", *Journal of Religion and Health* 60/1 (2021), 65-80.

[32] Riccardo Ladini - Cristiano Vezzoni, "When Believing in Divine Immanence Explains Vaccine Hesitancy: A Matter of Conspiracy Beliefs?", *Politics and Governance* 10/4 (2022), 168-176.

[33] Nejc Plohl - Bojan Musil, "Modeling Compliance with COVID-19 Prevention Guidelines: The Critical Role of Trust in Science", *Psychology, Health & Medicine* 26/1 (2021), 1-12.

they appear to become less hesitant toward vaccines, although religiosity predicts greater vaccine hesitancy. That is, age both moderates and limits the role of religiosity in vaccine hesitancy. These findings are partially consistent with the findings of the current study. In other words, most previous studies have revealed a negative correlation between age and vaccine hesitancy; that is, older people are less vaccine-hesitant than young people.[34] However, other studies have shown a positive correlation between age and vaccine hesitancy.[35]

In the literature, the latter findings are more limited than the former. This indicates that age is one of the main predictors of vaccine hesitancy. However, the findings of the current study concerning the moderating role of age on the link between religiosity and vaccine hesitancy are unique and supplement the gap in the literature. The decrease in vaccine hesitancy with increasing age can be explained by the relationship between age and health anxiety. Various studies in the literature have shown that there is a positive correlation between health anxiety and aging, which means that health anxiety increases with age.[36] On this basis, it can be inferred that older people are less

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[34] D. Allington et al., "Coronavirus Conspiracy Suspicions, General Vaccine Attitudes, Trust and Coronavirus Information Source as Predictors of Vaccine Hesitancy among UK Residents during the COVID-19 Pandemic", *Psychological Medicine* 53/1 (2023), 236-247; Anja Repalust et al., "Childhood Vaccine Refusal and Hesitancy Intentions in Croatia: Insights from a Population-Based Study", *Psychology, Health & Medicine* 22/9 (2017), 1045-1055; Hannah A. Roberts et al., "To Vax or Not to Vax: Predictors of Anti-Vax Attitudes and COVID-19 Vaccine Hesitancy Prior to Widespread Vaccine Availability", *PLOS ONE* 17/2 (2022), 1-19; Micah Skeens et al., "An Exploration of COVID-19 Impact and Vaccine Hesitancy in Parents of Pediatric Hematopoietic Stem Cell Transplant (HCT) Recipients", *Bone Marrow Transplantation* 57/4 (2022), 547-553.

[35] Nareman Aly Mohamed et al., "Moderating Effect of Psychological Antecedents and Conspiracy Mentality on COVID-19 Vaccine Hesitancy in a Sample of Egyptians", *Egyptian Journal of Health Care* 12/3 (2021), 1873-1886; Alessandro Siani et al., "Investigating the Determinants of Vaccine Hesitancy Within Undergraduate Students' Social Sphere", *Journal of Public Health: From Theory to Practice* 30/12 (2022), 2791-2799.

[36] Ehud Bodner et al., "Attitudes to Aging Mediate the Reciprocal Effects of Health Anxiety and Physical Functioning", *Psychology & Health* 38/2(2023), 190-208; R. El-Gabalawy et al., "Health Anxiety Disorders in Older Adults: Conceptualizing Complex Conditions in Late Life", *Clinical Psychology Review* 33/8 (2013), 1096-1105; James Lindesay et al., "Worry Content Across the Lifespan: An Analysis of 16- to 74-Year-Old Participants in the British National Survey of Psychiatric Morbidity 2000", *Psychological Medicine* 36/11 (2006), 1625–1633.

hesitant toward vaccines since they are worried about their health. Finally, according to the results of this study, this sample of Muslims had similar tendencies in comparison to the different religious traditions mentioned in the literature above with regard to vaccine hesitancy and trust in science and scientists.

Conclusion

Religiosity plays an important and effective role in different aspects of human life. As such, this study predicted that religiosity would be a significant factor in vaccine hesitancy. The findings of this study revealed that religiosity has a significant relationship with vaccine hesitancy. In addition, trust in science and scientists has been identified as a mediator of the link between religiosity and vaccine hesitancy, while age has been identified as a moderator of this link. The findings of this study correspond with the relevant literature and suggest that the process underlying the relationship between religiosity and vaccine hesitancy remains to be explored.

Research Limitations and Directions for Future Research

The findings of the current study show that the relationship between religiosity and vaccine hesitancy among Turkish Muslims is multifaceted and is mediated and moderated by many other variables. This study found that trust in science and scientists and age were mediating and moderating factors. In addition to these variables, variables such as personality, the type of religiosity (intrinsic, extrinsic, inquiry, etc.), and the style and place of religious education also affected the link between religiosity and vaccine hesitancy among Turkish Muslims. However, the mediating factor of trust in science and scientists in the current study seems to present a new dimension to explain how religiosity and vaccine hesitancy are related. It should be stressed that the mediating effect of trust in science and scientists in this study needs to be explored in further studies. In short, more comprehensive and nuanced analyses are needed to elucidate the links between the abovementioned variables.

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