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UDK: 316.64:614.47(497.5)"2019/2022"
061.25:316.647.8(497.5)"2019/2022"
316.642.3:[616.98:578.834(100)
Original research paper
Submitted: 12. 1. 2023.
Accepted: 23. 2. 2023.
DOI: https://doi.org/10.18485/rit.2023.21.39.1

INTERACTIVE EFFECT OF RELIGIOSITY AND INTERNET USE ON VACCINATION ATTITUDES[4]

Summary: *During the time of COVID-19 pandemic, vaccination attitudes have become one of the most important public health issues, while their determinants have also become a widely researched topic. The main goal of the paper is to explore the connection between religiosity, Internet use and vaccination attitudes, i.e. to determine possible interaction effect between Internet use and religiosity. In order to achieve the research goal, the authors compared the results from two surveys – one conducted on an online non-random sample of the Croatian general population (N = 822) in 2019 (before the pandemic) and the other conducted on a nationally representative online quota sample (N = 1.500) in 2022 (during the pandemic). The data were analyzed with hierarchical linear regressions, and the results showed that religiosity was a significant predictor of vaccine hesitancy both before and during the pandemic. Therefore, there seems to be a tension between science, as a secular ideology, and religion. The results also showed that before the pandemic Internet use was negatively correlated with vaccine hesitancy, probably indicating the positive correlation between the social integration and Internet use. The results from 2022 showed that there was an interactive impact of religiosity and Internet use, i.e. that the relationship between time spent on the Internet showed different signs among religious and non-religious persons. Namely, among the religious persons, those who spent more time on the Internet (one standard deviation above the average) had about one point higher vaccination conspiracy beliefs in comparison to the persons who spent less time on the Internet (one standard deviation below the average). Among the less religious persons the pattern was different – persons who spent more time on the Internet had one point lower result on the vaccination conspiracy scale. The results are framed within the general relations between religion and science/technology as partially competing worldviews, as well having in mind the theories of media effects and the social uses of media technologies.*

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4 This paper has been fully supported by Croatian Science Foundation under the project HRZZ IP-2019-04-7902.

Key words: *religiosity, vaccine conspiracy beliefs, media, Internet, health information.*

INTERAKTIVNI UTJECAJ RELIGIOZNOSTI I UPOTREBE INTERNETA NA STAVOVE O CIJEPLJENJU

Rezime: *Za vrijeme COVID-19 pandemije stavovi o cijepljenju postali su jedno od najvažnijih javnozdravstvenih pitanja, a njihove determinante također su postale široko istražena tema. Glavni je cilj ovoga rada istražiti povezanost religioznosti, upotrebe interneta i stavova o cijepljenju, odnosno utvrditi mogući učinak interakcije između upotrebe interneta i religioznosti. Kako bi postigli cilj istraživanja, autori su usporedili rezultate dvaju istraživanja – jednog provedenog na online neslučajnom uzorku opće hrvatske populacije (N = 822) 2019. godine (prije pandemije) i drugog provedenog na nacionalnoj razini na reprezentativnom online kvotnom uzorku (N = 1.500) u 2022. godini (tijekom pandemije). Podaci su analizirani hijerarhijskim linearnim regresijama, a rezultati su pokazali da je religioznost bila značajan prediktor neodlučnosti oko cjepiva i prije i tijekom pandemije. Stoga se čini da postoji napetost između znanosti, kao sekularne ideologije, i religije. Rezultati su također pokazali da je prije pandemije upotreba interneta bila u negativnoj korelaciji s oklijevanjem prema cijepljenju, što vjerojatno ukazuje na pozitivnu korelaciju između društvene integracije i upotrebe interneta. Rezultati iz 2022. godine pokazali su da postoji interaktivni utjecaj religioznosti i upotrebe interneta, odnosno da odnos između vremena provedenog na internetu ima različite predznake među religioznim i nereligioznim osobama. Naime, među religioznim osobama, oni koji su provodili više vremena na internetu (jedna standardna devijacija iznad prosjeka) imali su za oko jedan bod veća uvjerenja o zavjerama vezanim za cijepljenje u odnosu na osobe koje su provodile manje vremena na internetu (jedna standardna devijacija ispod prosjeka). Kod manje religioznih osoba obrazac je bio drugačiji – osobe koje su više vremena provodile na internetu imale su jedan bod slabiji rezultat na ljestvici vjerovanja u zavjere u području cijepljenja. Rezultati su uokvireni unutar općih odnosa između religije i znanosti/tehnologije kao djelomično konkurentskih svjetonazora, kao i imajući na umu teorije medijskih učinaka i društvene upotrebe medijskih tehnologija.*

Ključne riječi: *religioznost, vjerovanja u teorije zavjere o cijepljenju, mediji, internet, zdravstvene informacije.*

Introduction

Vaccine hesitancy during COVID-19 health crisis in Croatia, as in other countries, proved to be a complex and multidimensional phenomenon (Pavić et al., 2022). Given that the crisis was very sudden and included astonishingly rapid development of new vaccine types suited for COVID-19 disease, some amount of hesitancy was observed not only among general population but even among healthcare workers in Croatia (Miškulin et al., 2022). Among other significant predictors, religiosity is often suggested as one of the sources of vaccine hesitan-

cy and negative vaccination attitudes. Indeed, some studies conducted both before and during the COVID-19 pandemic suggest a positive correlation between religiosity and vaccine hesitancy (Andrade, 2022; Imdad et al., 2013; Schelton et al., 2013; Siani et al., 2021), even though there are also studies who failed to find the connection (Rutjens and van der Lee, 2020; Williams, Rice and O'Leary, 2021). However, we cannot fully understand the relationship between religion and vaccine hesitancy without a deeper consideration of the general relationship between science and religion, which should be embedded in the previous theoretical approaches and research. Therefore, we need to situate the discussion about the relationship between religiosity and vaccine hesitancy within the general discussion of the possible relationships between science and religion. Additionally, the relationship between religion and vaccination attitudes could be context-dependent, i.e. the relationship could be different in different societies, which could be hidden by the fact that most research comes from the U.S.

Barbour (1997) divided the attitudes on the relationship between science and religion into four different categories. The first one comprises those who think that religion and science are in a perpetual tension, since they represent mutually incompatible worldviews. The second view states that religion and science are not in conflict since they deal with different issues – science with natural things, and religion with spiritual and moral issues (e.g., Gould, 1997). In words of Galileo Galilei – science teaches how heavens move, while religions teach how to enter the heaven. The third position is similar to the second one, given that it states that religion and science are compatible since they approach the world with complementary perspectives – science answers how thing happen, while religion explains why they happen as they happen. And finally, the fourth position states that science and religion are somewhat ideologically different, but they should make an effort to enter into a mutual dialog and share ideas and perspectives which can benefit both. More specifically, Evans and Evans (2008) distinguished between the three types of studies of the relationship between science and religion: the symbolic epistemological conflict studies, the symbolic directional influence studies, and the social-institutional studies. The first type assumes that there is an epistemological conflict between them, i.e. that they contain opposing truth claims about the world. These studies are enshrined in the views that secularization can be equated with rationalization, with science bringing about new worldview which replaces the magical world of religion. The symbolic directional influence studies are more nuanced, and often claim that specific religions can advance science, such as the famous „Merton Thesis" which states that modern Protestantism gave a significant contribution towards the development of modern science in the Western world (Merton, 1970/1938; Shapin, 1988). And finally, Evans and Evans propose that the most fruitful approach is to consider science

and religion as two institutions which sometimes, but not necessarily, fight for power and legitimacy over various social and moral issues.

Research studies show that the relationship between religiosity and science attitudes are various and inconsistent. An overview of the studies, conducted by McPhetres, Jong and Zuckerman (2021) show that the majority of studies conducted in the U.S. show lower support for science among more religious persons. For instance, McPhetres and Zuckerman (2018) found that those general measures of religiosity are negatively associated with science knowledge, which was partially mediated by an association between religiosity and negative attitudes toward science. Ellison and Musick (1995) found that conservative Christians in the U.S. are more often sceptical about the benefits of science and explained it by their biblical literalism, theological orthodoxy, and beliefs related to the ubiquity of sin, while Gauchat (2008) confirmed the link through science knowledge, religious faith and social context of religious persons. Rios et al. (2015) even found that that religious persons' awareness of the negative societal stereotypes about the scientific competence of religious persons may be partially responsible for the underperformance and underrepresentation of religious persons in scientific fields. However, there are countries in which the studies show negative or null correlation, or religiosity is (not) connected with some type of science attitudes. For example, Chan (2018) analyzed the data from 52 countries, collected within World Values Survey research program, and found that religiosity in all countries was negatively correlated with trust in scientific authority. However, the connection of religiosity and the other orientations towards science (confidence in science, faith in science, views on the moral effects of science, and interest in scientific knowledge) was uneven. Williams et al. (2013) also confirmed that some science domains seem to be more controversial to religious persons than the other. Moreover, Baker (2012) determined that a relatively small proportion of American adults perceive incompatibility between science and religion. Furthermore, even though scientists are more secular than the general populations in their countries, they often consider themselves as religious and do not consider science to be in conflict with religion, mainly due to their non-overlapping domains (Ecklund and Scheite, 2007; Ecklund et al., 2016; Gross and Simmons, 2009).

The first goal of this paper is to compare the relationship between religiosity and vaccination attitudes before and during the COVID-19 pandemic. By doing that, we can conclude whether the relationship between religiosity and vaccine hesitancy existed before the pandemic, or whether it can be related to the positions taken on the vaccination issue of the religious authorities in Croatia during the pandemic and the specifics of the COVID-19 pandemic and related vaccines. The second goal of the paper is to test whether the impact of the Internet on

the vaccination attitudes is different for religious and non-religious persons, and whether this relationship changed during the pandemic. Namely, Internet and social media are often listed as one of the important causes of vaccine hesitancy, both before and during the COVID-19 pandemic, given that anti-vaccination contents represent a large part of all vaccination related content which can be found on the Internet (Davies, Chapman and Leask, 2002; Evroni and Caplan, 2017), thus making it a "Postmodern Pandora's box" of anti-vaccination misinformation (Kata, 2010). This research goal was aimed at testing the possibly polarizing effects of the Internet, and the differences in their amount before and after the pandemic, given that we assumed that religiosity would be a significant predictor of vaccine hesitancy. In this sense, religiosity was just a proxy for anti-vaccination attitudes. In order to achieve both research goals, in this paper authors comparatively analyzed the results of two online surveys, one conducted before, and the other during the still existing COVID-19 pandemic.

Sample and methodology

The data from the 2019 study were collected on a non-probability sample by means of an online survey (N=822). Namely, a convenience sample was used, wherein the respondents were recruited through various personal channels, mains using the snowball method. As such, the sample widely diverged from the characteristics of the Croatian population, most vividly in the case of the educational level, given that highly educated respondents were overrepresented in the sample. More details about the sampling procedure can be found in Pavić (2019). The data in the 2022 study were collected on a nationally representative online panel (N=1.500), i.e. a quota sample that matched the Croatian population in terms of gender, education and residential status (regional distribution and residence size). The data collection was conducted by a public opinion polling company with a long experience in conducting online panel research.

As control variables, in both studies gender (female-male), level of education and age (in years) were used. In the 2019 study, education was measured on a scale ranging from 1 (elementary school or less) to 6 (graduate school or more), while in the 2022 study the scale ranged from 1 (elementary school or less) to 5 (postgraduate level) was employed. The difference between the two scales is related to the more specific measurement of the secondary level which was used in the 2019 study. Namely, in the 2022 study all secondary schools were put in the same category, while in the 2022 study they were divided into grammar schools and professional schools.

As for the substantial variables which were part of our research, in the 2019 study, religiosity was measured on a 1-6 scale, while in the 2022 study a 1-10 scale was used. In the 2019 study, the overall time spent on the Internet was mea-

sured as an open-ended question, i.e. responded entered their estimate of the time spent on the Internet as precise as possible. In the 2022 the same variable was measured on a scale ranging from 1 (less than half an hour) to 13 (more than 10 hours). As a measure of vaccine hesitancy, a vaccine conspiracy scale designed by Shapiro et al. (2016) was used in both studies. The Croatian version of the scale was used in previous research (Pavić and Šuljok, 2022), with solid metrical characteristics (validity and reliability). The scale comprises seven items measured on a Likert scale. The scale in the 2019 study ranged from 1 (not agree at all) to 5 (completely agree), while in the 2022 study the scale ranged from 1 (not agree at all) to 7 (completely agree). Some examples of the scale items are: "The data about vaccine safety are often fabricated" and "Pharmaceutical companies hide the dangers of vaccination". The overall result on the scale was obtained by adding the items. Therefore, in the 2019 study the overall result ranged from 7 to 35, while in the 2022 study it ranged from 7 to 49.

The variables used in the both studies are shown in the Table 1 (2019) and Table 2 (2022). As can be noted, women are overrepresented in the 2019 sample, given that they comprise 62.25 of the sample. The average educational level on a 1 to 6 scale was 4.72, resulting from the fact that 47.6% of the respondents had a graduate degree. We can also note that the average age was about 39 years, while the average result on the religiosity scale was 3.06, the respondents spent on average about 3.60 hours on the Internet, while the average results on the scale that measured searching for health information on the Internet was 3.02. And finally, the average results on the vaccination conspiracy scale

Table 1. Sample variables (2019)

Variable	Mean	Standard deviation
Gender	1.38 (37.8% male; 62.2% female)	0.49
Age (in years)	38.82	10.04
Education	4.72	1.29
Religiosity (1-6)	3.06	1.68
Internet use (time)	3.60	2.77
Health information Internet	3.02	1.03
Vaccination conspiracy beliefs	16.33	9.10

From the Table 2, we can note that the sample from the 2022 study was much more balanced when it comes to gender and educational level. Religiosity is similar as in the 2019 study, while this mainly also goes for the time spent on

the Internet. Namely, even though the absolute number for the amount of time spent on the Internet is higher in the 2022 study, we have to bear in mind that this variable was measured on a different scale, i.e. that the average amount of time spent on the Internet was about 3 hours. We can also note that the average conspiracy beliefs are higher in the 2022 study, even when we take into account the difference in scaling. However, given that the samples were widely different, we cannot conclude that the average conspiracy beliefs rose during the COVID-19 pandemic.

Table 2. Sample variables (2022)

Variable	Mean	Standard deviation
Gender	1.50 (49.7% male; 50.3% female)	
Age (in years)	42.61	13.10
Education	2.53	0.91
Religiosity (1-6)	5.33	2.93
Internet use (time)	5.85	2.28
Vaccination conspiracy beliefs	26.86	12.03

In order to gain the overall insight into the bivariate relationships between the study variables, in the following tables Pearson correlations are stated. We can note that vaccination conspiracy beliefs were positively correlated with female gender and religiosity, while negative correlation existed with level of education and time spent on the Internet.

Table 3. Intercorrelation matrix (2019)

Variables	Gender	Age	Education	Religiosity	Internet use (time)	Vacc. consp.
Gender	1	0.06	0.04	-0.24**	0.24**	-0.24**
Age	0.06	1	0.04	-0.08*	-0.14**	-0.06
Education	0.04	0.04	1	-0.07*	0.02	-0.23**
Religiosity	-0.24**	-0.08*	-0.07*	1	-0.18**	0.35**
Internet use (time)	0.24**	-0.14**	0.02	-0.18**	1	-0.22**
Vacc. consp.	-0.24**	-0.06	-0.23**	0.35**	-0.22**	1

Gender: Female = 0, Male = 1;
*p < .05, **p < .01

In the next table, intercorrelation matrix from the research conducted in 2022 is presented. We can see that the correlation of vaccination conspiracy beliefs with religiosity, education and gender have the same direction as in the 2019 study, while age appeared as a significant negative predictor, which was not the case in 2019. Contrary to the results from 2019, time spent on the Internet was not a significant predictor.

Table 4. Intercorrelation matrix (2022)

Variables	Gender	Age	Education	Religiosity	Internet use (time)	Vacc. consp.
Gender	1	0.16**	-0.02	-0.15**	-0.01	-0.08**
Age	0.16**	1	0.08**	-0.04	-0.26**	-0.13**
Education	-0.02	0.08**	1	-0.03	-0.02	-0.08**
Religiosity	-0.15**	0.04*	-0.03	1	-0.07**	0.21**
Internet use (time)	-0.01	-0.26**	-0.02	-0.07**	1	-0.01
Vacc. consp.	-0.08**	-0.13**	-0.08**	0.21**	-0.01	1

Gender: Female = 0, Male = 1;
*p < .05, **p < .01

After the correlation analysis, we conducted a hierarchical regression analysis, with gender, age, education, religiosity and Internet use as predictors, and vaccination conspiracy beliefs as the criterion variable. In the second model, we also added the interaction of religiosity and Internet use as one of the predictors. All the variables were grand-mean centred in order to avoid the potential problems associated with multicollinearity, especially given that the interaction factors are used as predictors in the regression analysis. It can be seen that gender, education, religiosity and Internet use were significant predictors, with the same direction as in the correlational table.

Table 5.
Hierarchical linear regression with vaccination conspiration attitudes as criterion variable (2019)

	Model 1			Model 2		
Variable	B	SE B	β	B	SE B	β
Gender	-2.14**	0.63	- 0.11	- 2.14**	0.63	- 0.11
Age (in years)	- 0.04	0.03	- 0.05	- 0.04	0.03	- 0.05

Education	- 1.18**	0.19	- 0.20	- 1.18**	0.19	- 0.20
Religiosity	1.51**	0.18	0.28	1.51**	0.18	0.28
Internet use (time)	- 0.47**	0.11	- 0.14	- 0.46**	0.11	- 0.14
Religiosity X Internet use				0.01	0.06	0.00
R^2		0.20			0.20	
Adjusted R^2		0.20			0.20	
R^2 – change		0.20			0.00	
F for change in R^2		41.75**			0.10	

Gender: Female = 0, Male = 1;
*p < .05, **p < .01

In the next table we can observe the same model from the year 2022. As in the former case, all variables were grand-mean centred as well. We can note here that, contrary to the 2019 results, Internet use was not a significant predictor; however the interaction between religiosity and Internet use was significant. Other predictors showed the same direction as in the correlational analysis.

Table 6.
Hierarchical linear regression with vaccination conspiration attitudes as criterion variable (2022)

	Model 1			Model 2		
Variable	B	SE B	β	B	SE B	β
Gender	-0.74	0.62	0.03	- 0.70**	0.62	0.03
Age (in years)	- 0.11**	0.02	- 0.12	- 0.11**	0.02	- 0.12
Education	- 0.83*	0.33	- 0.06	- 0.87**	0.33	- 0.07
Religiosity	0.81**	0.10	0.20	0.80**	0.10	0.20
Internet use (time)	- 0.15	0.14	- 0.03	- 0.13	0.14	- 0.03
Religiosity X Internet use				0.11*	0.05	0.06
R^2		0.06			0.07	
Adjusted R^2		0.06			0.06	
R^2 – change		0.06			0.01	
F for change in R^2		20.40**			6.04*	

Gender: Female = 0, Male = 1;
*p < .05, **p < .01

In order to make sense out of the interaction effect, we probed the interaction by setting religiosity at the values of one standard deviation below the average,

the average, and one standard deviation above the average. The results show that the relationship between time spent on the Internet shows different signs among religious and non-religious persons. For instance, among the religious persons (with the result on the religiosity scale one standard deviation above the average) of the average age and educational level, persons who spent more time on the Internet (one standard deviation above the average) have about one point higher vaccination conspiracy beliefs in comparison to the persons who spend less time on the Internet (one standard deviation below the average). Among the less religious persons the pattern is different – persons who spend more time on the Internet have one point lower result on the vaccination conspiracy scale.

Discussion and conclusions

The results of our study show that religiosity was positively connected with vaccine hesitancy both before and during the COVID-19 pandemic. Therefore, we can conclude that the connection cannot be related to the contingent factors, such as the reaction of the religious hierarchy of the Catholic Church in Croatia during the COVID-19 pandemic, or the specific circumstances of the COVID-19 pandemic. Namely, the relationship between religiosity and vaccine hesitancy cannot be explained by the specific context of the development of the COVID-19 vaccines, such as their development speed, or other possible ethical issue that might have arisen, such as the issue of human freedom to refuse vaccination. In other words, there seems to be a long-standing tension between secular (science) and religious sources of authority. Evans and Evans (2008:99) put forward the general idea about the relationship between science and religion in which they „…are conflicting over differential interests, not differential notions of truth, and therefore the content of the symbol systems in each group is not important to the analysis. These conflicts are won by the group that obtains greater power and resources". In the case of vaccination debate, it is quite obvious that the "skirmishes" between science and religion are about institutional and symbolical power, and not about truth claims. Evans (2011), by analyzing American General Social Survey data, confirmed that religious persons seek out scientific knowledge in equal amount as non-religious ones. However, they are more sceptical about scientists' moral agenda, i.e. they believe that the rising scientific influence in the public affairs is not acceptable. Even in the cases of seemingly epistemological conflicts, as in the cases of the Calvinist belief in predestination (Ruijs et al., 2012), or in the Catholic (and generally Christian) reluctant acceptance of vaccines which use aborted human tissue cells (Jones, 2022; Maher, 2002; Pontifical Academy for Life, 2005), the conflict is about morality and not about truth claims. This conclusion is supported by the findings of Kuru et al. (2022), who demonstrated that only a small minority of religiously affiliated persons are

of the opinion that there is a conflict between vaccination and their religious beliefs. However, in reality, they are more often opposed to vaccination due to their "philosophical" beliefs, such as that God is the one who has the ultimate impact on the health outcomes, not the medical science or medical doctors. This tension, which essentially can be boiled down to the question of who is "more powerful", science or religion, is confirmed in other research which dealt with health outcomes (for instance, Browne et al., 2015; Sporton and Francis, 2001). Even though belief in God's impact on health outcomes can have positive consequences in other health behavior domains, such as alcohol drinking (Karvinen and Carr, 2013), it seems that it can exert opposite consequences in other domains, such as vaccination decisions. Moreover, Baker, Perry and Whitehead (2020) established that negative attitudes towards science of religious Americans are largely mediated through the so-called Christian nationalism, as an ideology which posits exclusivist vision of Christianity as the dominant moral order, thus making its adherents feel threatened by challenges to the epistemic authority brought about by science and scientists. These results are also confirmed by a study using World Values Survey data, wherein religious exclusivism was the strongest predictor of choosing religion over science (Lee, 2022).

Therefore, in Croatia, as in the U.S. (for a discussion, see Perry, Whitehead and Grubbs, 2020), the entire vaccine hesitancy issue can be framed more as a culture war than as a conflict over substantive issues regarding safety, efficiency or morality of vaccines. As Holton (1992) suggests, in some social contexts anti-science attitudes are best understood by putting them into the frame of the long struggle over the knowledge legitimacy which is embedded into the very concept of modernity. Naturally, this does not imply that all sorts of vaccine hesitancy are necessarily anti-scientific in their root cause.

As for the interaction effect found in the 2022 study, it can be probably explained by the polarizing effect of the Internet. In other words, more religious persons, who are more likely to be vaccine hesitant, probably selectively search for the information and associate with the persons with the similar attitudes. The same goes for less religious persons, thus making them less vaccine hesitant when the Internet use becomes more intensive. This effect is probably not related to the religion/religiosity as such, but points to the general conclusion that people selectively use the Internet, making its effect on vaccine hesitancy contingent upon their previous attitudes towards vaccines. Such conclusion is in accord with the results of Mønsted and Lehmann (2022), who confirmed that the debate around COVID-19 vaccines is highly polarized, in that the persons with similar attitudes over the issue prefer to interact with each other. More generally, the results also confirmed theoretical ideas about „echo chambers" (Cinelli et al., 2021) and "filter bubbles" (Pariser, 2011) which can be found on the Internet. Both phenomena

contribute to social polarization, especially over sensitive issues, thus discrediting social optimism present in the early stages of the development of the Internet.

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