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# Protected by Faith? Religion and COVID-19 Vaccination Uptake among Young Adults in Germany

## Durch den Glauben geschützt? Religion und COVID-19 Impfverhalten unter jungen Erwachsenen in Deutschland

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**Abstract:** While religion has been widely discussed as a barrier to COVID-19 vaccination, the link between religiosity and vaccination behavior remains underexplored, especially in secular societies and for actual vaccination instead of intentions. This study examines whether and how religiosity is associated with COVID-19 vaccination uptake in Germany, using data from the CILS4EU-DE study, collected from March 2022 onward. Multiple-group structural equation models show that higher religiosity is associated with lower vaccination uptake, but only among Muslims. Although feelings of divine protection do not directly explain this link, they are indirectly associated with lower vaccination uptake by fostering conspiracy beliefs. These findings highlight the need for context-sensitive theorizing on religion as a determinant of health behavior.

**Keywords:** Religiosity; Feelings of Divine Protection; COVID-19 Vaccination Uptake; 3C Model of Vaccine Hesitancy; Germany.

**Zusammenfassung:** Religion wurde häufig als Hindernis für die COVID-19 Impfbereitschaft diskutiert. Jedoch ist der Zusammenhang zwischen Religiosität und Impfverhalten bislang wenig erforscht – insbesondere in säkularen Gesellschaften und für tatsächliches Impfverhalten anstelle von Impfabichten. Die vorliegende Studie analysiert Daten der CILS4EU-DE Studie, welche ab März 2022 erhoben wurden,

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um den Zusammenhang zwischen Religiosität mit COVID-19 Impfverhalten in Deutschland zu untersuchen. Mithilfe von Strukturgleichungsmodellen und unter Berücksichtigung verschiedener Religionsgruppen zeigt sich, dass höhere Religiosität mit geringerer Impfanahme verbunden ist, jedoch ausschließlich bei Muslimen. Ein Gefühl göttlichen Schutzes erklärt diesen Zusammenhang nicht direkt. Es steht jedoch indirekt mit geringerer Impfanahme in Verbindung, da es mit stärkerem Verschwörungsglauben einhergeht. Die Ergebnisse unterstreichen die Notwendigkeit einer kontextsensitiven Theoriebildung zur Erklärung religiöser Einflüsse auf Gesundheitsverhalten.

**Schlagworte:** Religiosität; Gefühl göttlichen Schutzes; COVID-19 Impfanahme; 3C Modell der Impfskepsis; Deutschland.

## 1 Introduction

In March 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic (WHO 2020). As COVID-19 cases surged worldwide, governments implemented measures, such as social distancing to curb the virus's spread. Within a short period, the first COVID-19 vaccination was approved for the EU market in December 2020. Despite a generally successful vaccination rollout, a significant proportion of the adult population remains voluntarily unvaccinated – approximately 22% in Germany (Robert Koch Institut 2024, as of 08 July 2024). Although the COVID-19 pandemic is now under control, understanding why some individuals refuse the vaccine remains crucial. These personal decisions have societal consequences by undermining efforts to control not only COVID-19 but also other infectious diseases.

Studies from the United States suggest that religiosity can contribute to lower vaccination intentions (e.g., DiGregorio et al. 2022; Olagoke et al. 2021). However, findings from more secular societies remain limited. Germany offers

a useful case in this regard: While 26 % of Germans identify as religiously unaffiliated and only 14 % of Christians report that religion is central to their lives, in the U.S. the corresponding figures are 19 and 68 %, respectively (Pew Research Center 2015; Evans 2018). This positions Germany as a markedly secular context in which to test the relevance of religiosity for public health behavior.

We acknowledge that the religious landscape in Germany differs substantially from that in the U.S., including historically institutionalized church-state relations and a more coordinated role of religious organizations in health campaigns. While U.S.-based studies offer a useful point of departure, our focus is not on comparing countries but on testing whether mechanisms identified in more religious societies also apply to secular ones – and how they may differ. So far, only one study has systematically explored religiosity and COVID-19 vaccination in Germany (Seddig et al. 2022) but it focused on intentions rather than actual behavior.

Addressing this gap, we investigate the relationship between religiosity and COVID-19 vaccination uptake in Germany. We define religiosity in its private internal form, using individuals' strength of religious importance (Voas 2007; Barrett et al. 2007) and further include comparisons by religious group membership. Unlike most prior research, we focus on actual vaccination behavior, based on data collected after universal vaccine access was established in March 2022 (Bundeszentrale für gesundheitliche Aufklärung 2022; Paul-Ehrlich-Institut 2022). This distinction is crucial given the well-documented gap between intentions and behavior (Sheeran 2002; Orbell & Sheeran 1998).

Although our dependent variable is based on self-reports rather than direct observation, it provides a meaningful proxy for actual vaccination behavior. By 2022, logistical and structural barriers to vaccination in Germany were largely eliminated, so that differences in uptake likely reflect motivational and attitudinal factors rather than access constraints. This distinction matters because religiosity may shape intentions and actual vaccination differently: while some religious norms could encourage vaccination through moral or community-oriented motives, others – such as beliefs in divine protection or skepticism toward institutions – might hinder the translation of intentions into action. By focusing on reported vaccination uptake, we therefore capture the behavioral outcome of these competing influences more directly.

This distinction is also theoretically meaningful. While intentions capture general attitudinal support for vaccination, actual behavior reflects whether individuals translate these intentions into action. Even when vaccines are readily available, psychological and social factors – such as moral ambivalence, institutional trust, or perceived divine protec-

tion – may prevent follow-through. Thus, religiosity may influence both stages, but not necessarily to the same extent: it may shape intentions through value orientations, and behavior through trust- or confidence-related mechanisms.

Given the limited research in more secular contexts, we ask: *To what extent is religiosity associated with individuals' COVID-19 vaccination uptake in Germany?* If such a link exists, understanding the mechanisms behind it is essential – not only for refining theoretical models of health behavior but also for developing effective, group-sensitive public health strategies. So far, explanatory factors such as belief in divine influence (DiGregorio et al. 2022), conspiracy beliefs (Allington et al. 2021), and authoritarian attitudes (Murphy et al. 2021) have primarily been studied in isolation and in relation to vaccination intentions rather than behavior. Aside from Seddig et al. (2022), at least to our knowledge, no studies have examined these factors as mediators of actual COVID-19 vaccination uptake. We therefore further ask: *What mechanisms explain the link between religiosity and individuals' COVID-19 vaccination uptake in Germany?* To explore underlying mechanisms, we use the 3C model of vaccine hesitancy (SAGE Working Group 2014; MacDonald & SAGE Working Group 2015) as our guiding framework.

This study contributes to the growing literature on religion and public health during pandemics by offering a theoretically grounded account of how religiosity may hinder – or in some cases promote – COVID-19 vaccination uptake through multiple, distinct pathways.

## 2 The Link Between Religiosity and COVID-19 Vaccination Uptake

Religion – here understood as religious affiliation in terms of religious group membership – and religiosity – defined as individuals' multidimensional enactment of religious contents, including strength of religious identification and religious importance, religious beliefs, and religious behavior (e.g., religious service attendance or praying) (Voas 2007), have been identified as social determinants of public health (Idler 2014a) and individual health behavior (Idler 2014b; Idler & Patton 2014). Religiosity has been described as 'Janus-faced' in its effects on health (Kranz et al. 2023). On one side, it promotes healthier behaviors, such as reduced alcohol consumption, greater physical activity, and safer sexual practices, by offering meaning, social support, and moral guidance (Koenig 2012; Koenig et al. 2012; Hackney & Sanders 2003). On the other side, religiosity has been associated with a reduced capacity to assess and mitigate infection risks (Kranz et al. 2023; Gervais & Norenzayan 2012; Pennycook et al. 2016).

With regard to COVID-19 vaccination, previous research suggests that the negative effects of religiosity may prevail. Although most world religions do not oppose vaccination (Grabenstein 2013), studies in the U.S., the U.K., and across countries have found that lower COVID-19 vaccination intentions among more religious and spiritual individuals (DiGregorio et al. 2022; Olagoke et al. 2021; Murphy et al. 2021; Zarzeczna et al. 2023; Enea et al. 2023; Martens & Rutjens 2022). It is important to note that findings of these studies refer to multiple dimensions of religiosity – including individuals’ conceptualization of God as a higher power; religiosity as a scale of organizational, non-organization and intrinsic religiosity items; religious beliefs; strength of individuals’ self-identification as religious or spiritual. The link to COVID-19 vaccination seems to extend to religion (i.e., religious group membership), per se. Lahav et al. (2022) found lower vaccination among religious individuals compared to the unaffiliated (with the exception of Buddhists). Interestingly, Christian-majority countries report lower vaccination rates than Muslim, Buddhist, Hindu, or secular-dominated countries (Trepanowski & Drajzkowski 2022). Additionally, religiosity has been linked to reduced adherence to other pandemic-related behaviors, such as social distancing (Kranz et al. 2023).

That said, not all findings point in the same direction. Some studies report no significant link between religiosity and COVID-19 vaccination intentions (Freeman et al. 2022; Kilic et al. 2021; Sherman et al. 2021). However, these tend to focus on very specific aspects of religiosity, such as ‘God being close to oneself’ or that ‘illness is a punishment from God’.

A key limitation of most existing research is its focus on vaccination intentions rather than actual uptake. While intentions are predictive to some extent (Ajzen 1991), they explain only 19 to 38 % of the variance in observed health behavior (Orbell & Sheeran 1998; Sniehotta et al. 2014; Sutton 1998). This established ‘intention-behavior gap’ (Sheeran 2002) suggests that intentions alone are insufficient for understanding COVID-19 vaccination behavior.

Taken together, existing studies show that religiosity can influence vaccine uptake intentions, though results are mixed and largely drawn from highly religious societies. Research on actual vaccination behavior, especially in more secular countries such as Germany, remains scarce.

### 3 Theory and Hypotheses

To conceptualize the mechanisms through which religiosity may influence COVID-19 vaccination uptake, we draw on the 3C model of vaccine hesitancy (SAGE Working Group

2014; MacDonald & SAGE Working Group 2015). Although the model originates from psychology and public health, we employ it here as an organizing framework to systematically link sociological and psychological mechanisms – such as trust, belief systems, and social embeddedness – to the behavioral dimensions of complacency, confidence, and convenience. This approach allows us to integrate sociological and behavioral explanations in a structured way without equating the model itself with a comprehensive theory of religion or health. We focus on religiosity in its private internal form – using individuals’ strength of religious importance (Voas 2007; Barrett et al. 2007). Although non-private external forms of religiosity such as religious service attendance can also be linked to vaccination behavior, many religious institutions had been closed for official religious service in earlier times of the COVID-19 pandemic in Germany – making individuals’ service attendance a sub-optimal measure in this case. Internal forms of religious behavior such as frequency of praying often vary conceptually between religious groups (e.g., Muslims versus Christians). Since we compare COVID-19 vaccination uptake between individuals belonging to different religious groups, we chose strength of religious importance as more ‘universal’ measure of religiosity.

Based on the 3C framework, we formulate specific hypotheses corresponding to each of the three C dimensions. Given the predominance of research showing a negative relationship between religiosity and COVID-19-related health behavior, we first hypothesize *that more religious individuals in Germany are less likely to be vaccinated against COVID-19 (H1)*.

#### 3.1 COVID-19 Vaccination Uptake – The 3C Model

The World Health Organization explains vaccine hesitancy through the 3C Model, which identifies *complacency*, *confidence*, and *convenience* as its core determinants (SAGE Working Group 2014). Vaccine hesitancy is defined as a delay in acceptance or refusal of vaccines despite the availability of services, influenced by contextual and vaccine-specific factors (MacDonald & SAGE Working Group 2015).

*Complacency* arises when individuals perceive the risks of vaccine-preventable diseases as low, reducing the perceived need to vaccinate. *Confidence* refers to trust in vaccine efficacy and safety, the reliability of health services, and the motivations of policymakers. *Convenience* relates to structural conditions such as accessibility, affordability, and the appeal of vaccination services (SAGE Working Group 2014). The model offers a practical yet robust framework,

widely endorsed for tailoring communication strategies and policy interventions to address vaccine hesitancy in diverse settings.

### 3.2 Mechanisms Explaining the Link between Religiosity and COVID-19 Vaccination Uptake

Building on the 3C model of vaccine hesitancy, we identify mechanisms corresponding to each C that we expect to explain how religiosity relates to COVID-19 vaccination uptake.

#### 3.2.1 Complacency

Complacency is likely influenced by individuals' perceived susceptibility to a COVID-19 infection and severity of the disease (Rosenstock 1966). We propose two mechanisms by which religiosity may shape complacency:

*Feelings of Divine Protection.* Beliefs in divine protection refer to the idea that a higher power actively intervenes in one's life to guard against harm (Wu & Cutright 2018; Bader & Froese 2005). Although shaped by general religiosity, this belief can be viewed as conceptually distinct (Froese & Bader 2008; Greeley 1993; Greeley 1991), as also expressed by the God Locus of Health Control scale (Wallston et al. 1999). It may reduce perceived vulnerability to COVID-19 and thereby weaken the motivation to vaccinate. U.S. examples like "Jesus is my vaccine" illustrate this view (Beyerlein et al. 2021; DiGregorio et al. 2022; Perry et al. 2020). Prior studies show that stronger divine protection beliefs correlate with lower risk perception and reduce COVID-19 vaccination uptake (Upnieks et al. 2022; DiGregorio et al. 2022). We thus hypothesize *that more religious individuals report stronger feelings of divine protection (H2<sub>a</sub>), which in turn are associated with a lower COVID-19 vaccination likelihood (H2<sub>b</sub>).*

*Health Consciousness.* We define health consciousness as the degree to which individuals think about and engage with their health. Religiosity may be associated with two forms of health consciousness, which we operationalize as health satisfaction and health worries. Although not mutually exclusive, we treat them as separate constructs to capture different aspects of how individuals relate to their health.

*Health Satisfaction.* Religious individuals often experience greater mental and physical health, for instance: lower depression rates (Koenig 2012), higher life satisfaction (Lim & Putnam 2010), reduced cardiovascular risks, and greater longevity (Larson & Larson 2003; Levin & Vanderpool 1992). These outcomes are attributed to religions' psychological,

social, and behavioral factors (Koenig 2012; Seybold & Hill 2001), such as stress coping, meaning-making, and healthy lifestyle norms (e.g., Sedikides & Gebauer 2013; Sibley & Bulbulia 2012; Hill & Butter 1995). Although the relationship may be reciprocal, we follow the dominant view that religiosity tends to enhance health and life satisfaction (Witter et al. 1985; Lim & Putnam 2010). In the context of COVID-19, higher health satisfaction may reduce perceived vulnerability and increase concerns about vaccine side effects (Rosenstock 1966; SAGE Working Group 2014), leading to reduced vaccine intentions (Allington et al. 2021; Seddig et al. 2022). We therefore hypothesize *that more religious individuals report higher health satisfaction (H3<sub>a</sub>), which in turn is associated with a lower COVID-19 vaccination likelihood (H3<sub>b</sub>).*

*Health Worries.* Conversely, religious lifestyles may also foster vigilance and concern about health, particularly in the face of a global pandemic. Moral norms and self-discipline associated with religion can promote proactive self-care (Koenig 2012), potentially heightening health-related worries. According to the Health Belief Model, such worries may increase perceived susceptibility and severity, thereby encouraging vaccination (Rosenstock 1966). We thus expect *that more religious individuals report stronger health-related worries (H4<sub>a</sub>), which in turn are associated with a greater COVID-19 vaccination likelihood (H4<sub>b</sub>).*

#### 3.2.2 Confidence

Confidence concerns trust in vaccine safety, health system, and authorities. Two concepts are particularly relevant in explaining religiosity's influence on this dimension:

*Conspiracy Beliefs.* Conspiracy theories are a "[...] set of false beliefs in which an omnipresent and omnipotent group of actors are believed to work together in pursuit of malevolent goals" (Swami & Furnham 2014: 221; Swami 2012). Religiosity is often associated with a higher endorsement of conspiracy beliefs, often rooted in science skepticism and anti-intellectualism (Jasinskaja-Lahti & Jetten 2019; Laverghetta et al. 2007). Conspiracy theories erode vaccine confidence by offering alternative narratives that frame health authorities as deceptive, diminish the legitimacy of expert knowledge, and undermine public trust (SAGE Working Group 2014; Jennings et al. 2021; Allington et al. 2021; Seddig et al. 2022). We hypothesize *that more religious individuals hold stronger conspiracy beliefs (H5<sub>a</sub>), which in turn are associated with a lower COVID-19 vaccination likelihood (H5<sub>b</sub>).*

*Authoritarianism.* Right-wing authoritarianism (RWA) combines deference to authority, moral rigidity, and hostility towards outgroups (Altemeyer 1983, 1988). Religiosity is often positively associated with RWA (Johnson et al. 2011;

Altemeyer & Hunsberger 1992), but the effect of authoritarianism on vaccine uptake is complex. When authorities are viewed as legitimate and strong, authoritarianism may enhance confidence and compliance. However, if institutional actors are seen as weak or illegitimate, authoritarian attitudes may decrease confidence and vaccination uptake (Murphy et al. 2021). In the 3C framework, authoritarianism may hence increase or decrease vaccination uptake, depending on how institutional authority is perceived. We hypothesize that more religious individuals report stronger authoritarian attitudes ( $H6_d$ ). Based on competing theoretical expectations, we propose two alternative hypotheses regarding their effect on COVID-19 vaccination uptake:  $H6_b$  posits that authoritarian attitudes promote vaccination uptake, while  $H6_c$  suggests that it inhibits it.

### 3.2.3 Convenience

Convenience refers to practical and informational access to vaccination services (Kour et al. 2022; SAGE Working Group 2014). Structural barriers such as bureaucratic complexity, limited transportation, or missing information can inhibit vaccine uptake – especially when individuals face language barriers or lack the social resources to navigate health systems. Prior research suggests that such barriers are more common among immigrant-origin populations, particularly when German is not spoken at home or when families are only weakly embedded in majority-institutional networks (Blau et al. 1982; Haug 2007; Kour et al. 2022).

In this context, language exposure within the household can serve as a relevant proxy for informational access and health system familiarity – even among second- or third-generation immigrants. Individuals growing up in linguistically enclosed environments may have fewer opportunities to access health information or navigate digital and bureaucratic systems related to vaccination. We therefore examine whether speaking a second language at home mediates the link between religiosity and vaccine uptake among immigrant-origin respondents.

Religious practice may further interact with convenience mechanisms. Individuals who actively participate in minority religious communities – such as Muslim, Orthodox Christian, or other non-majoritarian groups – may be more likely to rely on close-knit, ethnically or religiously homogeneous networks. These networks often offer strong bonding capital, but limited bridging capital to health-related institutions and mainstream information channels (Martin et al. 2003; Maliepaard & Schacht 2018). We do not claim this applies to all minority religious groups uniformly, but rather that such mechanisms are plausible under certain

conditions, especially when community life is spatially concentrated or linguistically isolated.

To ensure that any association between religiosity and vaccine hesitancy is not merely due to lower convenience, we control for immigrant background, religious participation, and explore the mediating role of home language. We thus test whether reduced informational access among more religious individuals contributes to lower vaccine uptake.

We therefore hypothesize that among individuals with an immigrant background, those who are more religious are less likely to be vaccinated against COVID-19 due to reduced informational access (measured via home language) and religious social embeddedness ( $H7$ ).

## 4 Methods

### 4.1 Data and Participants

We use data from the German part of the “Children of Immigrants Longitudinal Survey in Four European Countries” (CILS4EU-DE) (Kalter et al. 2016, 2019, 2024a). This is a fully standardized panel study on the integration of young people with and without an immigrant background. The study started in the year 2010 in four countries, Germany, England, the Netherlands, and Sweden, targeting students in grade 9 (around 14 years old) at regular schools. Schools with a higher share of immigrants were oversampled to ensure comparable numbers of students with and without an immigrant background. Data collection is conducted via postal, web, and telephone interviews. For Germany, currently, data from nine waves, and one wave on the COVID-19 pandemic are available.

For our data analysis, we rely on data from the COVID-19 wave (field start in April 2020, Soigné et al. 2024a), wave eight (field start in March 2020, Soigné et al. 2024b), and wave nine (field start in March 2022, Soigné et al. 2024c) which fall in the time-span of the COVID-19 pandemic. We use the data in a cross-sectional format (total  $N = 3,341$ ), excluding non-religious respondents ( $N = 906$ ) and those with missing values on the religious group variable ( $N = 101$ ), the weighting variable ( $N = 24$ ) and those with missing values on the COVID-19 vaccination status ( $N = 40$ ) and time point, if vaccinated ( $N = 189$ ).<sup>1</sup> This results in a final sample size of 2,081 respondents with a mean age of around 26 years.

<sup>1</sup> Note that for the measure of religiosity, we also include respondents who did not participate in wave 8 but participated in the subsequent wave 9 and wave COVID ( $N = 15$ ).

## 4.2 Measures

*COVID-19 vaccination uptake* was included in wave nine and measured with two items. First respondents were asked ‘Are you vaccinated against COVID-19?’ (yes/no). Due to the timing of the survey, this question was asked at a timepoint when the COVID-19 vaccine was already largely available in Germany (Bundeszentrale für gesundheitliche Aufklärung 2022; Paul-Ehrlich-Institut 2022), hence reflecting actual decisions for or against receiving a vaccination. Second, for those who received a COVID-19 vaccination, the time point of the first vaccination (month and year) was assessed ‘When was your first vaccination? Month, Year’.

As only 7.59 % of our sample remain entirely unvaccinated (after excluding those with missings on the vaccination time point), we constructed a binary variable (0/1) measuring whether respondents received the COVID-19 vaccination before August 2021 ‘1’ or after August 2021 or never as ‘0’. On the 7<sup>th</sup> of June 2021, the vaccination prioritization was lifted in Germany and enough vaccination became available to offer everybody above the age of 18 a COVID-19 vaccination appointment until the end of July 2021 (Bundesgesundheitsministerium 2023). At the 28<sup>th</sup> of July 61,1 % of the general adult population in Germany had received a minimum of one vaccination dose and 50,2 % had the full vaccination protection (Bundesgesundheitsministerium 2023). Choosing August 2021 as a cut-off point, we hence capture vaccination decisions based on ideological and voluntary reasons (for which we expect religiosity to be the most influential) instead of decisions based on a perceived need to receive a vaccination for retaining access to the public life (e.g., the ‘3-G Rule’).

*Religious group membership* was included in wave eight with the question: ‘What is your religion?’. We summarized different religious persuasions into four overarching groups: *non-religious*, *Catholics*, *Protestants*, and *Muslims* as the smaller religious groups and subgroups were too small for trustworthy analyses (see Table A1 for an overview).

*Religiosity* was measured with one item about the importance of religion in respondents’ life which was included in wave eight: ‘How important is religion to you?’ Reverse coded: ‘Very important’ (4) to ‘Not at all important’ (1). Missings on this item make up 0.72 %.

*Feelings of divine support* was measured in wave nine with one item asking respondents how much they agree or disagree with the following statement: ‘I benefit in my life from the protection of a higher power’. Answer categories are recorded on a 5-point scale, reverse coded ranging from (5) ‘Strongly agree’ to (1) ‘Strongly disagree’ (5.43 % missing values).

*Health satisfaction* was measured in the COVID-19 questionnaire via the question ‘On a scale from 1 to 10 where 1

is very unsatisfied and 10 is very satisfied, how satisfied are you with your own health’ (0.43 % missing values).

*Health worries* was also measured in the COVID-19 questionnaire via the question: ‘Are you more or less worried about the following things since the beginning of the Corona pandemic? Your own health’. Reverse-coded answers to this question range from (5) ‘Far more worried’ to (1) ‘Far less worried’ (0.58 % missing values).

*Conspiracy beliefs* was measured with three items, included in the wave nine questionnaire. ‘How strongly do you agree or disagree with each of these statements? 1) The coronavirus (COVID-19) was intentionally created and spread throughout the world by a government or organization. 2) A small secret group of people is responsible for all important decisions in world politics. 3) Groups of scientists manipulate, falsify or suppress evidence in order to deceive the public.’ Answers were measured on a 5-point scale, reverse coded from (5) ‘Strongly agree’ to (1) ‘Strongly disagree’. Missing values range from 3.36 to 4.66 %. We combined the four items into a reflexive factor (higher values indicate stronger conspiracy beliefs), which showed a good internal consistency:  $\alpha = 0.86$  (Cortina 1993).

*COVID-19-specific authoritarianism* was measured with three items, from the COVID-19 questionnaire. ‘How much do you agree or disagree with each of these statements? 1) During the Corona pandemic, we need a strong leader who ensures our safety. 2) It is important now to follow the measures of the German Federal Government without questioning them. 3) People who do not follow the protective measures of the German Federal Government should be reported to the police immediately.’ Answers were measured again on a 5-point scale, reverse coded from (5) ‘Strongly agree’ to (1) ‘Strongly disagree’. Missing values range from 0.91 to 3.08 %. We measured authoritarianism as a reflexive factor ( $\alpha = 0.58$ ), where higher values indicate stronger authoritarian attitudes. Both conspiracy beliefs and authoritarianism were included in a measurement model (see ‘measurement model’).

We control for gender (male/female), education (low/medium/high), parental ISEL, immigrant background (non-migrant, first-generation, second-generation), and religious service attendance (never to every day), which studies showed to be connected to both religiosity and COVID-19 vaccination intentions/uptake (e.g., Allington et al. 2021; Upenieks et al. 2022). Missing values on all variables were imputed using multiple imputation in Mplus version 8.5 (Muthén, L.K. & Muthén, B.O. 1998–2017). Table 1 provides an overview of all variables in the analysis.

**Table 1:** Overview of all variables included in the analysis, by religious group membership.

	Range	N	Catholics (N = 797)		Protestants (N = 841)		Muslims (N = 308)		Others (N = 135)	
			Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
<i>Dependent variable</i>										
COVID-19 vaccination before August 2021	0/1	2,081	.75	-	.78	-	.42	-	.49	-
<i>Predictor</i>										
Importance of religion	1–4	2,066	1.97	.75	1.97	.83	3.32	.77	3.05	.97
<i>Mediators</i>										
Feelings of divine protection	1–5	1,968	2.78	1.20	2.70	1.23	3.65	1.30	3.77	1.14
Health satisfaction	1–10	2,072	7.68	2.12	7.41	2.08	7.50	2.37	7.54	2.50
Health worries	1–5	2,069	3.42	.86	3.46	.77	3.67	1.22	3.43	.96
<i>Conspiracy beliefs</i>										
Coronavirus was intentionally created	1–5	2,011	1.83	1.13	1.73	1.13	2.76	1.29	2.26	1.25
Small secret group makes all important decisions	1–5	1,984	1.95	1.13	1.87	1.09	3.12	1.28	2.46	1.41
Groups of scientists manipulate evidence	1–5	1,990	2.23	1.30	2.10	1.29	3.24	1.30	2.60	1.45
<i>Authoritarianism</i>										
Need for strong leader	1–5	2,020	3.67	1.10	3.55	1.17	3.75	1.17	3.56	1.18
Follow coronavirus measures without questioning	1–5	2,062	2.93	1.16	2.98	1.13	3.38	1.23	3.00	1.10
Report coronavirus rule breakers	1–5	2,017	3.11	1.17	3.13	1.18	3.11	1.19	2.61	1.07
<i>Control variables</i>										
Female	0/1	2,081	.60	-	.59	-	.64	-	.46	-
<i>Education</i>										
Low	0/1	2,074	.04	-	.05	-	.18	-	.11	-
Medium	0/1		.26	-	.23	-	.23	-	.34	-
High	0/1		.69	-	.72	-	.59	-	.55	-
Parental ISEI	13.24–88.96	2,068	50.26	18.71	53.92	19.83	31.39	15.56	46.99	20.43
<i>Immigrant Generation</i>										
No-immigration background	0/1	2,062	.85	-	.91	-	.05	-	.45	-
1 <sup>st</sup> Generation	0/1		.03	-	.01	-	.15	-	.22	-
2 <sup>nd</sup> Generation	0/1		.12	-	.08	-	.81	-	.33	-
Religious service attendance	1–5	2,055	1.77	.61	1.68	.68	2.06	1.03	2.58	1.20

Note: Weighted means and stand deviations are displayed.

### 4.3 Measurement Model

To validate factor structures and measurement invariance of the two reflexive factors across the three religious groups, we applied multiple-group confirmatory factor analysis in Mplus. Note that we do not incorporate the group of religious ‘Others’ in the measurement model as this group is only included in the test of the first hypothesis, due to low sample sizes (see the analysis section for further detail). We used Robust Maximum Likelihood (MLR) as an estimator and applied model modifications that yielded an improved model fit. The measurement model showed a good model fit ( $\chi^2(33) = 51.23$ , RMSEA = .029, CFI = .981, TLI = .974, SRMR = .048; Byrne 1994) and indicated partial scalar measurement invariance, allowing for

comparisons of the latent factors across religious groups (Table A2).

Except for the item *need for a strong leader*, factor loadings were above .50 for both factors across all four groups (Table A3). As this item is a theoretically important indicator and the smallest factor loading is not far from .50, we nevertheless included it in the factor of authoritarianism – but test this operationalization in a robustness analysis. *Conspiracy beliefs* shows a good reliability ( $\rho > .80$ ). For *authoritarianism*,  $\rho$  indicates possible measurement error ( $\rho < .70$ ), highlighting the importance to conduct structural equation modelling (SEM), which allows incorporating measurement errors in the model. Model comparisons confirmed the factors to be distinct concepts (Table A4).

## 4.4 Analysis

To test our hypotheses, we performed Multiple Group Structural Equation Modeling (MGSEM) in Mplus, with religious group membership as the grouping variable. Since Mplus does not allow to incorporate sampling weights in a logistic SEM, we estimated linear probability models, which have been shown to produce almost identical results in outcomes and significance for binary variables (e.g., Hellevik 2009).

First, we test the direct link between religiosity and COVID-19 vaccination (Table 2). In this analysis we first pool across the four religious groups of Protestants, Catholics, Muslims, and Others to get an impression on the general importance of religiosity for COVID-19 vaccination (Model A to D), before estimating group specific effects of religiosity (Model E). Second, we add each mediator separately before finally estimating a full mediation model including all mediators and their relationships. We exclude the group of religious ‘Others’ (N=135) from the mediation analyses, due to the small sample size and conceptual ambiguity of the religious group make-up. We use the full mediation model for interpretation of our mediating hypotheses, which showed an acceptable model fit (Tables A9-A12:  $\chi^2(258) = 420.69$ , RMSEA = .031, CFI = .918, TLI = .881, SRMR = .046; Byrne 1994).

The control variables were included in all models as predictors of the dependent variable as well as the mediators. To enable comparisons of the associations across religious groups, we constrained the effects of all control variables, apart from religious service attendance, to equality across the groups.<sup>2</sup> All models were fitted with the MLR estimation.

## 5 Results

### 5.1 Descriptive Findings

As can be seen in Table 1, COVID-19 vaccination rates differ by religious group membership. While the highest vaccination rate is found among Protestants (78%), only 42% of Muslim respondents have received a COVID-19 vaccination prior to August 2021. Descriptive results indicate that this might be explained by the level of religiosity. Among the four groups, Muslims show the highest levels of religiosity

<sup>2</sup> We abstained from constraining the effect of religious service attendance to equality since it can have very different meanings across certain groups such as Muslims compared to Catholics or Protestants.

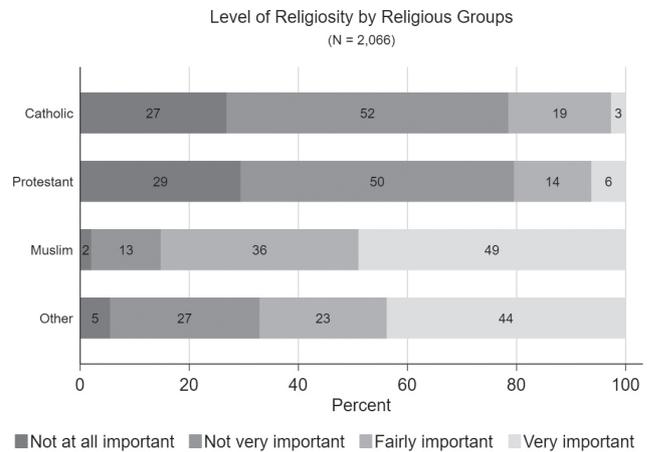


Figure 1: Differences in levels of religiosity, by religious group membership.

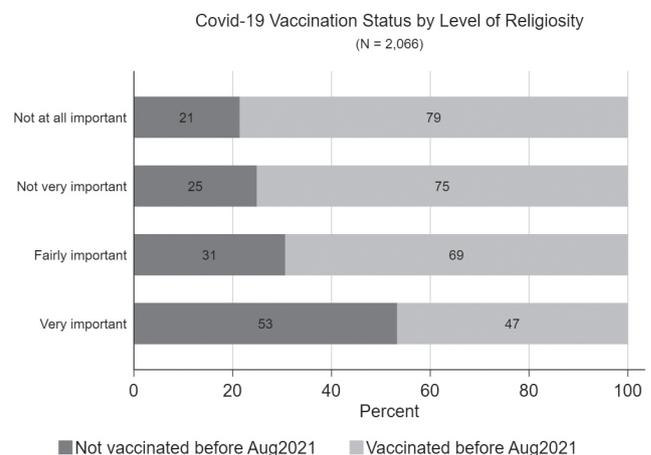


Figure 2: Covid-19 vaccination status by different levels of religiosity.

(Table 1:  $mean = 3.32$ ;  $SD = 0.77$  and Figure 1). In turn, the lowest vaccination rate is found among individuals who state that religion is very important in their life (Figure 2).

### 5.2 Structural Model

#### 5.2.1 H1: Direct Link between Religiosity and COVID-19 Vaccination

Table 2 displays the direct relationship between religiosity and COVID-19 vaccination. In line with H1, we find that pooled across all four religious groups, higher levels of religiosity are associated with a lower likelihood of having received a COVID-19 vaccination prior to August 2021 (Model A:  $b = -.161$ ,  $SE = .034$ ,  $p < .001$ ). This religiosity effect is consistent across different sets of control variables (Models B and C). As expected, higher levels of education are linked to

an increased likelihood of being vaccinated against COVID-19, while particularly second-generation immigrants exhibit a lower likelihood of being vaccinated compared to those without an immigrant background. Religious service attendance is decoupled from COVID-19 vaccination (Models C, D, E).

Interestingly, when distinguishing by religious affiliation (Models D and E), religiosity only seems to matter for COVID-19 vaccination uptake among Muslims (Model E:  $b = -.289, SE = .082, p < .001$ ) and religious Others (Model E:  $b = -.461, SE = .152, p < .001$ ). For both groups, these comparatively lower levels of COVID-19 vaccination uptake seem not to be solely driven by their immigrant background (as might be suggested by Figure A1 for Muslims), since immigrant background is no longer significantly associated with vaccination once religious affiliation is included (Models D and E).

**5.2.2 H2-H6: Mediation Analysis**

Figures 3 to 5 display the full multi-group mediation model separately for each religious group (see also Tables A5-A7). As expected in H2<sub>a</sub>, religious individuals report stronger feelings of divine protection across all four religious groups ( $b_{\text{Religiosity-DivineProtection} | \text{Protestants}} = .495, SE = .044, p < .001$ ;  $b_{\text{Religiosity-DivineProtection} | \text{Catholics}} = .293, SE = .066, p < .001$ ;  $b_{\text{Religiosity-DivineProtection} | \text{Muslims}} = .207, SE = .097, p < .05$ ) – with the strongest association appearing for Protestants. Yet, contrary to H2<sub>b</sub>, these feelings are not connected to lower COVID-19 vaccination uptake. Different to H3 and H4, both health satisfaction and health worries are decoupled from religiosity and COVID-19 vaccination across all groups apart from Catholics, where higher levels of health satisfaction are linked to lower COVID-19 vaccination uptake ( $b_{\text{HealthSatis.-Vaccination} | \text{Catholics}} = -.135, SE = .050, p < .001$ ) but not religiosity.

As expected in H5<sub>b</sub>, conspiracy beliefs reduce vaccination uptake across all religious groups ( $b_{\text{ConspiracyBeliefs-Vaccination} | \text{Protestants}} = -.371, SE = .055, p < .001$ ;  $b_{\text{ConspiracyBeliefs-Vaccination} | \text{Catholics}} = -.418, SE = .063, p < .001$ ;  $b_{\text{ConspiracyBeliefs-Vaccination} | \text{Muslims}} = -.234, SE = .118, p < .05$ ) – but do not seem to be fostered by individuals’ level of religiosity as such (H5<sub>a</sub>). Yet, interestingly, conspiracy beliefs seem to be heightened by feelings of divine protection ( $b_{\text{DivineProtection-ConspiracyBeliefs} | \text{Protestants}} = .123, SE = .060, p < .05$ ;  $b_{\text{DivineProtection-ConspiracyBeliefs} | \text{Catholics}} = .237, SE = .075, p < .01$ ;  $b_{\text{DivineProtection-ConspiracyBeliefs} | \text{Muslims}} = .178, SE = .079, p < .05$ ) and partially mediate the significant negative link between religiosity and COVID-19 vaccination uptake found among Muslims via this direction. Lastly, even though authoritarian attitudes appear to be heightened by health worries ( $b_{\text{HealthWorries-Authoritarianism} | \text{Protestants}} = .228, SE = .061, p < .001$ ;  $b_{\text{Health-$

**Table 2:** Linear regression model for COVID-19 vaccination before August 2021, (Beta (S.E.)), N = 2,081.

	Model A	Model B	Model C	Model D	Model E
	Direct	Direct	Direct	Direct	Direct
Religiosity	-.161*** (.034)	-.113** (.035)	-.128** (.042)	-.095* (.044)	-
Religious affiliation (ref. Protestants)					
Catholics	-	-	-	-.026 (.037)	-
Muslims	-	-	-	-.111** (.043)	-
Others	-	-	-	-.088* (.040)	-
Group-specific religiosity effects					
Rel.*Protestants	-	-	-	-	-.062 (.055)
Rel.*Catholics	-	-	-	-	-.021 (.066)
Rel.*Muslims	-	-	-	-	-.289*** (.082)
Rel.*Others	-	-	-	-	-.461** (.152)
Controls					
Female	.000 (.034)	-.001 (.034)	.001 (.034)	-.002 (.035)	-.003 (.037)
Education (ref. Low)					
Middle	.220* (.089)	.205* (.089)	.201* (.089)	.195* (.092)	.190* (.094)
High	.361*** (.089)	.354*** (.089)	.348*** (.090)	.341*** (.092)	.338*** (.095)
Parental ISEI	.082* (.034)	.047 (.037)	.046 (.037)	.033 (.037)	.030 (.038)
Generation (ref. No-immig.)					
First	-	-.082** (.030)	-.081** (.030)	-.052 (.032)	-.023 (.017)
Second	-	-.124*** (.035)	-.122** (.035)	-.073* (.040)	-.057* (.030)
Service attendance	-	-	.024 (.043)	.029 (.043)	.008/ .319/ (.059)/ (.202)

Note: \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ , † $p < .10$ . Standardized regression coefficients are reported.

$b_{\text{Worries-Authoritarianism} | \text{Catholics}} = .275, SE = .087, p < .01$ ;  $b_{\text{HealthWorries-Authoritarianism} | \text{Muslims}} = .380, SE = .102, p < .001$ ), they are decoupled from both religiosity and COVID-19 vaccination uptake (H6).

Conclusions about mediating effects do not change when estimating models separately for each mediator

(Figure A2 to A6). Interestingly, while immigrant background remains decoupled from COVID-19 vaccination uptake across all religious groups also in the full mediation model, it seems to be an important predictor of conspiracy beliefs, which are found to be higher among second-generation immigrants, as compared to those without an immigrant background ( $b_{2\text{ndGen.} \sim \text{ConspiracyBeliefs} | \text{Protestants}} = .090, SE = .032, p < .01$ ;  $b_{2\text{ndGen.} \sim \text{ConspiracyBeliefs} | \text{Catholics}} = .107, SE = .038, p < .01$ ;  $b_{2\text{ndGen.} \sim \text{ConspiracyBeliefs} | \text{Muslims}} = .111, SE = .040, p < .01$ ). As seen in the direct link model, religious service attendance stays disconnected from COVID-19 vaccination uptake across all four religious groups (opposed to H7). We additionally explored whether speaking a second language at home – used here as a proxy for minority language use – mediates the relationship between religiosity and vaccination uptake among Muslims. Results indicate no significant mediation effects (neither in the single nor the full mediation model), suggesting that language use does not explain the observed link in our data (opposed to H7). These results are reported in Appendix Table A9 as robustness checks.

To further investigate different motives for vaccination hesitancy, we applied a different operationalization of our dependent variable – using months since respondents' first vaccination (Table 3). For that only vaccinated respondents are included in the analysis ( $N = 1,804$ ) since only those were asked about their vaccination date. Among Muslims (and Protestants) religiosity is linked to later vaccination update ( $b_{\text{Muslims}} = .184, SE = .07, p < .1$ ) – although only marginally significantly (likely due to smaller sample sizes). This indicates that for Muslims, belief-based mechanisms connected to complacency may not be the main driver behind vaccination hesitancy since these should primarily influence whether and not so much at what time-point one gets vaccinated.

Taken together, our findings provide partial support for H1, with religiosity being linked to lower COVID-19 vaccination uptake among Muslims but not Protestants or Catholics. However, this association is not explained by any of the five hypothesized mediators, leading us to reject H2<sub>b</sub>, H3<sub>a/b</sub>, H4<sub>a/b</sub>, H5<sub>a</sub>, and H6<sub>a/b</sub>. Furthermore, the significantly lower COVID-19 vaccination uptake among more religious Muslims does not appear to stem primarily from reduced access to vaccination information, as neither immigrant background, religious service attendance nor second language usage significantly predict vaccination uptake in this group – leading us to reject H7.

Instead, our analysis reveals an unexpected indirect pathway: feelings of divine protection partially explain lower vaccination uptake among more religious Muslim individuals by fostering conspiracy beliefs. However, substantial portions of the religiosity-vaccination association

remain unexplained, suggesting that additional mechanisms not captured in our current model contribute to this relationship.

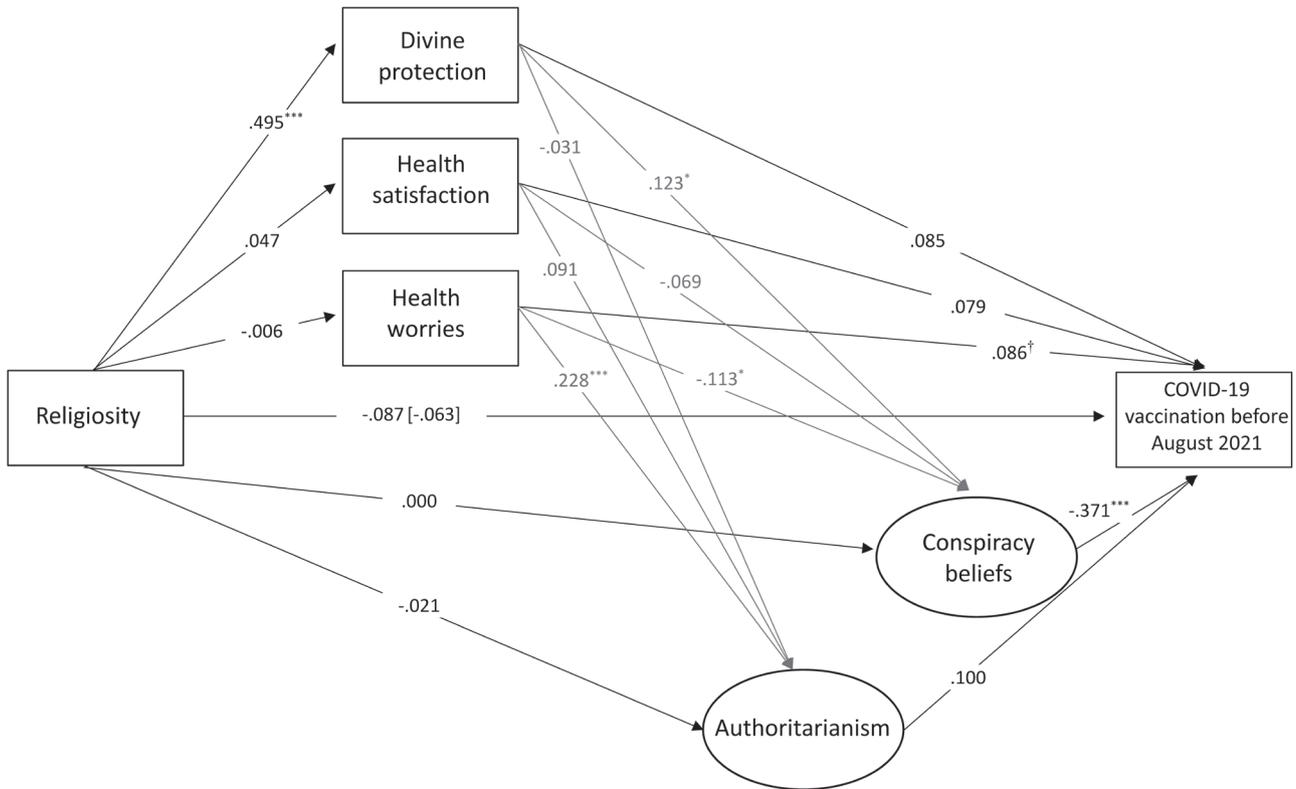
**Table 3:** Linear regression model for month since COVID-19 vaccination, by religious group membership (Beta (S.E.)),  $N = 1,804$ .

	Protestant N = 798	Catholics N = 755	Muslims N = 251
	Direct	Direct	Direct
Religiosity	.092 <sup>†</sup> (.056)	.035 (.064)	.184 <sup>†</sup> (.097)
<i>Controls</i>			
Female	.088* (.035)	.098* (.039)	.089* (.035)
Education (ref. low)			
Middle	-.101 (.092)	-.119 (.108)	-.106 (.096)
High	-.162 <sup>†</sup> (.094)	-.186 <sup>†</sup> (.108)	-.184 <sup>†</sup> (.107)
Parental ISEI	-.027 (.037)	-.029 (.039)	-.022 (.030)
Generation (ref. No-immig.)			
First	-.014 (.018)	-.028 (.035)	-.054 (.072)
Second	-.020 (.030)	-.027 (.040)	-.031 (.046)
Service attendance	-.016 (.059)	-.012 (.072)	-.091 (.128)

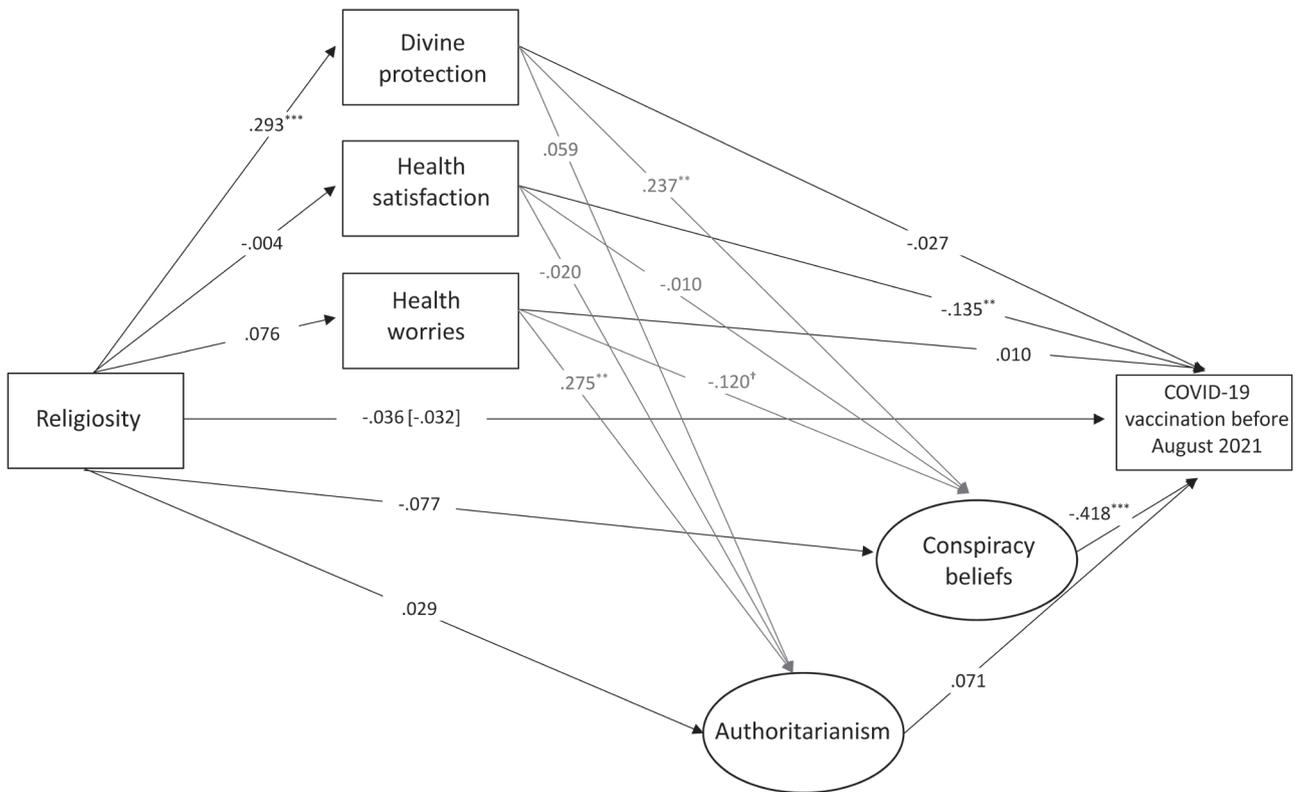
Note: \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ , <sup>†</sup> $p < .10$ . Standardized regression coefficients are reported.

### 5.2.3 Additional Analyses

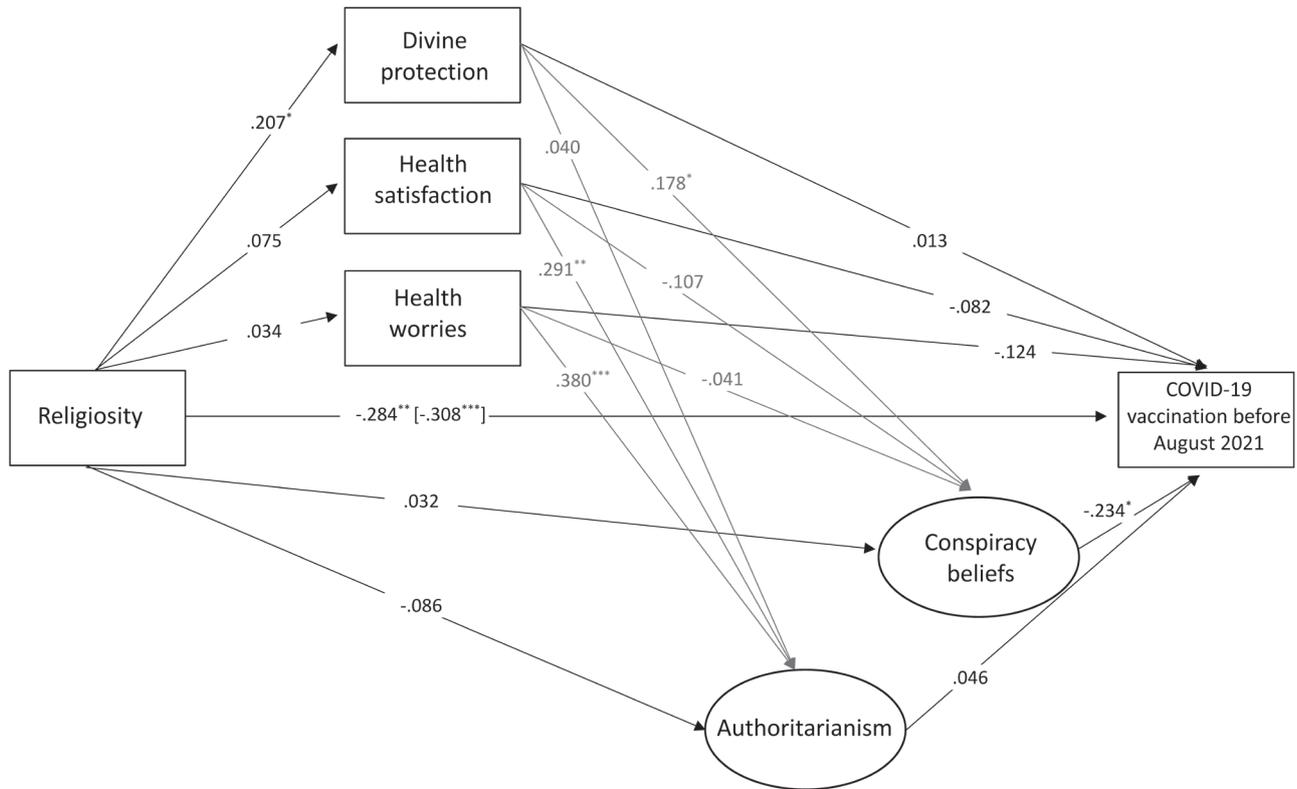
We conducted four additional analyses to test the robustness of our findings. First, we used bootstrapping instead of MLR for our mediation links. This alternative estimation method did not result in any significant changes in our findings (Table A10 to A12). Second, we re-estimated the mediation model without a multi-group set-up. This analysis shows that averaged across all three religious groups, religiosity remains negatively connected to COVID-19 vaccination uptake. Religiosity is still connected to stronger feelings of divine protection, and these feelings continue to be significantly associated with increased conspiracy beliefs. Conspiracy beliefs further remain the strongest predictor of COVID-19 vaccination uptake (Table A13). Third, due to the low factor loading of the authoritarianism item *need for a strong leader*, we re-estimated the full mediation models



**Figure 3:** Visual representation of the full mediation model for **Protestants** (N=841). Note: Grey paths indicate relationships between mediators, that were included in model but not hypothesized about. \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ , † $p < .10$ . Standardized regression coefficients are reported.



**Figure 4:** Visual representation of the full mediation model for **Catholics** (N=797). Note: Grey paths indicate relationships between mediators, that were included in model but not hypothesized about. \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ , † $p < .10$ . Standardized regression coefficients are reported.



**Figure 5:** Visual representation of the full mediation model for **Muslims** (N=308). Note: Grey paths indicate relationships between mediators, that were included in model but not hypothesized about. \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ , † $p < .10$ . Standardized regression coefficients are reported.

with a scale instead of the reflexive factor of authoritarianism, excluding this item. Results indicate that with this alternative measurement, authoritarianism remains decoupled from both religiosity and COVID-19 vaccination uptake (Figure A7 to A9). Lastly, instead of contrasting respondents vaccinated before August 2021 with those afterwards or never vaccinated, we re-estimated the regression model for all vaccinated (at any time point) versus all never vaccinated respondents, including also those respondents with missing values on their vaccination time point (Table A14). While the directions of the effects remain very similar, the previously significantly link between religiosity and COVID-19 vaccination for Muslims is no longer significant. This is however likely attributable to the very low variation in COVID-19 vaccination uptake (only 7% of all respondents never received a COVID-19 vaccination).

## 6 Discussion

Although the COVID-19 pandemic is now largely under control, understanding the factors that influence vaccine hesitancy remains vital for public health and societal cohesion. Using the World Health Organization's 3C model of

vaccine hesitancy –*complacency, confidence, and convenience* (SAGE Working Group 2014) – this study examined whether and how religiosity relates to COVID-19 vaccination uptake in Germany. Previous research has mainly focused on vaccination intentions and studied highly religious contexts such as the U.S. This study tests the link between religiosity and actual vaccination uptake in a more secular setting. Three main findings emerge:

First, in Germany the classic measure of religiosity is associated with lower COVID-19 vaccination uptake – but only among Muslims. No such relationship was observed for Catholics and Protestants. The general direction of this pattern aligns with prior studies that linked higher religiosity to reduced vaccination intentions (e.g., Olagoke et al. 2021; Zarzeczna et al. 2023), and it extends these findings to behavior. However, the inconsistent effects across religious groups contrast with studies reporting overall lower vaccination among religious individuals (Lahav et al. 2022) or in Christian-majority countries compared to Muslim-majority ones (Trepanowski & Drązkowski 2022). Though the latter operates at the macro-level. Our findings thus support the idea that the role of religiosity is context-sensitive, playing less of an overarching societal role for vaccination in more secular societies where it seems to matter only for specific ‘religious’ groups.

This variation across religious groups highlights the importance of disaggregating religious traditions. As theorized, Muslims' comparatively lower vaccination rates could stem from structural barriers linked to ethnically homogeneous social networks with strong bonding but low bridging social capital (Esser 1986; Haug 2007). Yet, we found that for Muslims the 'effect' of religiosity persists after controlling for immigrant background, religious participation, and second language usage (i.e., *convenience*-related factors). This suggests that for this group, lower vaccination uptake may rather stem from higher general levels of religiosity in this group (see our descriptive findings). Among Catholics and Protestants, by contrast, religion may be more nominal in the German context – particularly among younger individuals – and thus less likely to shape health behavior.

Second, none of our 3C measures – taken alone – explains the negative relationship between religiosity and COVID-19 vaccination uptake. Within the *complacency* dimension, the three hypothesized mediators (feelings of divine protection, health satisfaction, health worries) were not consistently linked to vaccination uptake. Also, religiosity was unrelated to health satisfaction and health worries, contradicting previous findings that linked religiosity to greater perceived health and life satisfaction (e.g., Koenig 2012; Witter et al. 1985). This suggests that in a global health crisis such as COVID-19, religiosity might not be a central driver of individuals' health perceptions. Although feelings of divine protection were strongly associated with religiosity, they did not directly reduce vaccination uptake, in contrast to U.S.-based studies (DiGregorio et al. 2022; Upenieks et al. 2022).

Within the *confidence* dimension, conspiracy beliefs, but not authoritarian attitudes, were predictive of lower vaccination uptake, in line with Seddig et al. (2022) but contrary to Murphy et al. (2021). However, religiosity was not significantly associated with conspiracy beliefs – as opposed to expectations based on prior research (Jasinska-Lahti & Jetten 2019).

Third, we find tentative evidence that in Germany, feelings of divine protection – as a special form of religious beliefs – may not reduce vaccine *complacency* directly, but by fostering conspiracy beliefs (i.e., *confidence*), which then predict lower vaccination uptake. This pattern appears across all religious groups, suggesting that in secular contexts, religious worldviews may operate less by directly discouraging vaccination, and more by undermining confidence in science and governmental institutions (Jasinska-Lahti & Jetten 2019).

Several limitations should be noted. First, our sample shows relatively little variation in COVID-19 vaccination uptake, with only about 7% unvaccinated. While this re-

flects a general success of the German vaccination campaign, it limits our explanatory power regarding the influence of religiosity. To address this, we compared those vaccinated early onwards (i.e., before August 2021) to those vaccinated later or not at all. By doing so, we capture more ideologically motivated choices rather than those taken out of merely practical reasons. Nonetheless, especially among Catholics and Protestants, the majority of respondents remained vaccinated with the measure. As a result, we cannot rule out that the absence of a religiosity effect among these groups may partly reflect a ceiling effect. Furthermore, the question on COVID-19 vaccination did not specify whether being vaccinated meant to have received one or two (the full protection at this time) dosages. Respondents may thus differ in their interpretation of this question, with some indicating 'yes' when having received one dosage, while others might indicate 'yes' only if they have a full vaccination protection.

Second, our study focused on a specific age group of young adults (approximately 26 years old). This cohort is particularly interesting because vaccination rates have been lower among younger individuals (RKI 2024), but their vaccination uptake was critical to curbing the spread of the virus and for protecting older populations. Additionally, our sample is biased toward individuals with higher educational backgrounds compared to the general German population. As our results have indicated, vaccination uptake is higher among better-educated individuals. Although we controlled for education, this bias may, thus, still have led to an underestimation of the religiosity 'effect'. Future research could, hence, replicate this analysis with a more diverse sample in terms of age and education to better understand the link between religiosity and COVID-19 vaccination in the German context.

Another limitation of this study concerns the role of religious institutions and their public stance on COVID-19 vaccination. For instance, major Christian churches in Germany explicitly recommended vaccination to their members, potentially acting as counterweights to vaccine skepticism within their communities. Likewise, Muslim organizations and imams may have promoted vaccination, although empirical evidence on the scope and impact of such endorsements remains scarce. Our study focuses on individual-level religiosity and does not account for potential moderating effects of institutional guidance. Future research should examine how the positions and public communication of religious organizations interact with individual religious beliefs to shape vaccination behavior – especially in relation to trust in authority.

Additionally, the operationalization of authoritarianism in our study could be subject to interpretive ambiguity.

For example, the notion of a “strong leader” or references to “protective measures” can evoke different associations depending on respondents’ political, religious, or cultural frames. This could explain the moderate reliability score of our authoritarianism index and suggests a need for more nuanced instruments that distinguish between deference to secular vs. religious authority, or between public health norms and generalized social control.

Finally, our study is cross-sectional due to the timing of the data collection for the mediator variables (with feelings of divine protection measured in wave 9 and the other mediators measured in the COVID wave). This deviation in measurement does not allow for time-lagged estimations of the relationships between the mediators and the dependent variable, inhibiting us from drawing causal conclusions. While it is less likely that COVID-19 vaccination uptake influences religiosity, the directionality between the mediators and vaccination may be reversed or reciprocal. Hence, it would be beneficial for future research to examine mechanisms underlying the relationship between religiosity and COVID-19 vaccination uptake using longitudinal data.

Despite these limitations, our study contributes to the literature by shedding light on the role of religiosity for COVID-19 vaccination in more secular environments and for actual vaccination uptake instead of intentions. Our findings indicate that religiosity can affect vaccination behavior through distinct belief-related pathways – most notably through feelings of divine protection and associated mistrust in authorities – highlighting its continued relevance for public health even in secular societies.

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## Data Note

This study used the scientific use files of the full versions of the CILS4EU-DE datasets from wave 8, waveCOVID, and wave 9:

- Kalter, Frank, Irena Kogan, and Jörg Dollmann. 2024. Children of Immigrants Longitudinal Survey in Four European Countries – Germany (CILS4EU-DE) – Full version. Data file for on-site use. GESIS Data Archive, Cologne, ZA6655 Data file Version 7.0.0, doi:10.4232/cils4eu-de.6655.7.0.0.

For the technical reports refer to:

- Soiné, Hannah, Lena Arnold, Jörg Dollmann, Victoria Kerzner, Leonie Kriegel and Markus Weißmann. 2024. Children of Immigrants Longitudinal Survey in Four European Countries – Germany. Technical Report. Wave 8 – 2020, v7.0.0. Mannheim: Mannheim University.
- Soiné, Hannah, Lena Arnold, Jörg Dollmann, Leonie Kriegel and Markus Weißmann. 2024. Children of Immigrants Longitudinal Survey in Four European Countries – Germany. Technical Report. COVID-19 Supplementary Survey – CILS4COVID – 2020, v7.0.0. Mannheim: Mannheim University.
- Soiné, Hannah, Lena Arnold, Jörg Dollmann, and Markus Weißmann. 2024. Children of Immigrants Longitudinal Survey in Four European Countries – Germany. Technical Report. Wave 9 – 2022, v7.0.0. Mannheim: Mannheim University.

The full version of the data is available for on-site use within the facilities of the Secure Data Center (SDC) of the GESIS Data Archive for the Social Sciences. A reduced version of the data can be requested from the GESIS Data Archive for the Social Sciences for download.

Do-Files used for all analyses of the present study are available on ‘Archivierung BASIS’: <https://doi.org/10.7802/2975>.

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