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Religion, beliefs, trust, and COVID vaccination behavior among rural people in Malawi

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Abstract

This study investigates the religious and other beliefs related to the corona/COVID-19 pandemic and how they are related to covid risk perceptions, trust in COVID vaccines, and how these are affected by the religious beliefs, religious affiliations, trust in authorities, generalized trust, and how these affect vaccine demand/vaccine hesitancy. The study took place in rural areas in six districts in Central and Southern Regions of Malawi during April-May 2022 towards the end of the fourth wave of the pandemic that was dominated by the omicron variant of the virus, through personal interviews of 835 subjects. The study revealed five religious beliefs associated with the pandemic and one non-religious belief that vaccination would lead to infertility in women. This belief (14% of the sample) and the belief that vaccination leads to a triple-six mark from the Devil (33% of the sample) were strongly negatively associated with trust in the vaccine and the trust in the vaccine had a strong impact on the demand for vaccine/vaccine hesitancy. In addition, certain religious groups were associated with more of these pandemic-related beliefs, lower trust in the vaccines, and lower vaccine demand/stronger vaccine hesitancy. Trust in politicians, health personnel, and generalized trust contributed to stronger trust in vaccines. It may be important to address both the beliefs and some of the religious groups and their leaders to promote vaccine demand and reduce vaccine hesitancy.

Keywords: COVID-19, rural population, religion, beliefs, trust, vaccination behavior.

JEL codes: I12; I15; I18.

1. Introduction

The World Health Organization declared the corona/COVID-19 endemic as a pandemic on 11 March 2020. The corona/COVID-19 pandemic spread globally in early 2020 with enormous effects on people and public efforts to get the pandemic under control and minimize the damages. Scientifically and

statistically, we may regard this pandemic as a natural shock and experiment that hit the world. Religious theology and beliefs tend to favor the notion that the pandemic hit the world for a reason (Isiko 2020). Some conspiracy theories claim that the pandemic is man-made or fake and should not be taken seriously (Jennings et al 2021; Wirawan et al. 2021). People's degree of association with scientific, religious, or conspiracy theories related to the pandemic varies across countries and may influence the public's trust in their governments and health personnel and the degree to which people adjust their behavior according to restrictions imposed by governments or to behavioral recommendations for self-protection such as vaccination, use of face masks, handwashing, social distancing, and so on.

Individuals and societies have been on a steep learning curve trying to adapt to the rapidly changing conditions during the spread of the virus which also has changed its behavior through multiple mutations over time.

Poor people in developing countries may be among the most vulnerable and least capable to protect themselves against infections and serious sickness during the pandemic due to poor access to vaccines and limited capacity to adopt other protective measures. This study investigates how rural people in one of the poorest countries in the world, Malawi, have related to this new threat, their formation of expectations about the risks involved, how their religions and reasoning combined with information disseminated by public authorities, have interacted and influenced their beliefs related to the pandemic, and how the level of trust in authorities and their recommendations have resulted in behavioral responses and varying degrees of compliance with the recommendations.

Holden et al. (2022) used data from a random sample of university students from Malawi to assess how religion influenced the demand for vaccination and use of protective facemasks during the corona/COVID-19 pandemic and found that certain religious affiliations and beliefs had a strong influence on pandemic-related protective behavior. This study uses data from a rural sample of 836 respondents, based on personal interviews, from six districts in Central and Southern Regions of Malawi to assess how religion and a set of beliefs, mostly of religious origin, influence trust in vaccines and vaccination demand. Furthermore, the study investigates whether trust in authorities in form of politicians, health personnel, and religious leaders, and general trust, measured with an incentivized trust experiment, influences trust in vaccines and thereby demand for vaccines.

Most early studies of the pandemic's influence on the public have used online surveys to access data. However, in poor countries in Africa, such as Malawi, the rural populations are not accessible through such online surveys. This is also an important reason for the lack of pandemic-related studies in rural areas in Africa, and for the existing knowledge gaps about the behavioral responses in such areas. Our study, which used personal interviews, therefore contributes to filling this gap.

We aim to answer the following research questions: RQ1): To what extent are there religious and other non-scientific beliefs associated with the corona/COVID-19 pandemic in Malawi? RQ2): To what extent do these beliefs vary across religious affiliations? RQ3): Are COVID risk perceptions influenced by religious affiliation and religious and infertility beliefs? RQ4): How do these beliefs influence (correlate with) the trust in vaccines? RQ5): How is trust in vaccines influenced by or correlated with the trust in political leaders, health personnel, and religious leaders, and with generalized trust? RQ6): How do these beliefs and trust influence the demand for vaccination against corona infection/COVID-19?

The answers to these research questions may be important for the success of public efforts to control the pandemic and protect people's health in Malawi. The answers may also give important insights into how knowledge and beliefs about the pandemic can cause unwanted behavior that can be a threat to individuals' health and the health of others.

Our study provides new evidence on the extent of public trust and religious beliefs related to the pandemic's influence on behavior related to the COVID-19 pandemic in a sample of difficult-to-access subjects in rural Malawi. The study finds that five specific religious beliefs associated with the pandemic are widespread. Some of these are more common in some religious congregations and the number of such beliefs also varies significantly across religious congregations. Some of the beliefs were found to strongly influence the demand for vaccines. Especially, women who believed that vaccination would lead to infertility in women were less likely to get vaccinated and were more likely to be vaccine-hesitant.

The paper is structured as follows. In part 2 we present the research design. Part 3 elaborates on how religion tends to construct its logic around pandemics and that may influence the behavior of those who associate themselves with these religions and religious beliefs. Part 4 outlines our conceptual framework and specifies the hypotheses we investigate in this study. Part 5 presents descriptive statistics from our sample, followed by the estimation strategy in part 6. The estimation results are presented in part 7 and these are discussed with the hypotheses and relevant literature in part 8 before we make some tentative conclusions.

2. Research design and data

2.1. Sampling

The data are from a stratified random sample from six districts in the Central (Kasungu and Lilongwe) and Southern (Machinga, Zomba, Chiradzulu, and Thyolo) regions of Malawi. The household sample used is a sample that has been used for panel data analyses and collaborative research by the Norwegian University of Life Sciences (NMBU) and the Lilongwe University of Agriculture and Natural

Resources (LUANAR) (Lunduka 2010; ++). The earlier studies utilizing this sample have focused on agricultural production, land tenure, and food security since the first survey round in 2006, with follow-up surveys in 2009, 2012, and 2015/16. The 2022 survey round is the first round to focus on health issues and religion. We, therefore, do not think that the repeated earlier survey rounds have had any influence on the findings in this study. To get a good representation of household members of different ages the current survey tried to interview up to four persons per household as interviewing the household head only, as done in earlier survey rounds, would result in a less representative sample concerning age distribution and possibly gender as most household heads are male. This age and gender representation were necessary for this study because these groups would vary significantly in their religious affiliation, beliefs, and trust, and hence result in varying COVID vaccination behavior that wouldn't be generalized by interviewing only the household head.

Table 1. Sample characteristics

Variable	Obs	Mean	Std. Dev.	Min	Max
Female	836	0.59	0.49	0	1
Age	836	38.39	18.99	14	90
Birth_rank	836	3.46	2.39	1	15
General trust[1] (experimental)	836	0.32	0.27	0	1

Note:[1]General trust is measured as the share the subject decides to share in the trust game out of the maximum endowment the subject can decide to keep for her/himself.

2.2. Survey and experimental instruments

We designed a survey instrument that focused on collecting data from sample rural households on their demographic characteristics (family characteristics, ethnicity, religion, and personal interests), their knowledge about the corona pandemic, their perceptions related to the pandemic, vaccination and infection status of the household members, personal behavior in response to the pandemic, and their perceptions about the behavior of other members in their village related to the pandemic.

Following Holden and Tilahun (2021), we used a binary step-wise version of the trust game (Berg et al., 1995) with a within-subject design where the household members in each case were offered 1000 MK (five 200 MK notes) that they could retain themselves or invest (either 0, 200, 400, 600, 800, or 1000) in another randomly selected unknown person. The respondents were asked how much they would be willing to invest when the other person; a) is an unknown person within their village (ingroup); b) is an unknown person in another village of the same district (outgroup). The researchers triple the amount invested before it is given to the other person (trustee), who is free to return any amount to the trustor. The strategy method was used to obtain pre-committed amounts to be returned given varying amounts received as trustees. All sampled household members played the roles of trustor as well as a trustee. One of the games with the ingroup or the outgroup member was randomly drawn to become real. Details on the experimental instrument are given in the Appendix.

2.3. Training, pilot testing, and implementation

A total of 23 research assistants were hired and trained for these experiments. The training started with a briefing on the experiments and an expected overview of the assignment by the research team. This was followed by question-by-question training on the experimental tool using a paper-based questionnaire. The research assistants were also taken through the programmed electronic versions of the tool which used survey solutions. Next were role plays of the experiments where the research assistants worked in pairs in turns with one playing the role of the interviewer and the other one as the interviewee. This helped to highlight key issues regarding both the tool and the programming which was adequately addressed before going for pretesting. The pretesting was conducted in Lilongwe in an area not sampled for the experiments. The pretesting was followed by a debriefing where observations on the data collection tools were presented. This information was once again used to revise the experimental tool and the programming. The actual implementation of the experiments followed after being satisfied with the tool and the understanding of the research assistants. The research assistants were assigned different responsibilities where one was responsible for overall coordination and assigning of subjects to experimenters, two were recorders, two were assigned to distributing beads, and two were assigned data entry for questions that did not use Computer-Assisted Personal Interviews (CAPI) while 16 were involved in actual interviews with household members.

The first step of the implementation of the experiments involved the identification and verification of the panel households. This process was necessary considering that the last survey with the households took place six years ago (in 2016) and there was likely to be attrition. Attrition was expected due to the movements of some households from their villages, the death of some household members, and the selling of the land among other reasons. From the 350 households that were interviewed in 2015/16, 335 households were verified of which others were a direct replacements of those that were interviewed in the earlier surveys. Replacement was done where either the household head died (or moved) and we found a new household head or the entire household moved and a new household took over the land that was being used by the moving household. From the verified household, a maximum of four adult members were sampled to participate in the experiments. We defined adult members as those aged 15 and above. We assumed that such an age group would be able to understand household issues and be able to respond to our questions. This is also in line with the definition in Malawi where ages of 15 and above are considered productive age groups (Malawi Government, 2019).

The sampled household members were then assigned to the research assistants. A maximum of 16 household members were assigned to 16 enumerators at a time. The enumerators were provided with a table and two chairs, one for the enumerator and the other for the respondent. This was done to minimize errors during the games.

3. Religion and pandemics: A literature review

A broader review of how religion and pandemics are related is in order as pandemics tend to influence people's religious activity and religions may influence how people reason and behave when experiencing pandemics. The extent of such reactions may vary with how religious people are and their type of religion. We start by reviewing some of the recent evidence from around the world to facilitate some comparisons with our case study in Malawi.

Corcoran et al. (2022), based on a random sample of adults in the U.S. found that over half of the respondents have engaged in pandemic-related prayer, and about a fifth had taken other religious steps related to the pandemic. Corcoran et al. assess whether the religious responses to the pandemic are substitutes or complements to the medically recommended responses. In another study in the U.S. in April-May 2020, Beyerlein et al. (2021) found that the majority of their sample of adults believed that God would protect them from COVID-19 infection. They found that those who believed that God used the pandemic as a way to tell humanity to change and provide protection to believers, were strengthened in their belief by the pandemic. They also found that Black Protestants were more likely to have this belief.

Religion and superstitious beliefs may help people accept crisis outcomes and give meaning and reason to why adverse events hit a specific person or persons at a specific point in time (Evans-Pritchard 1976; Malinowski 1992: 1948; Freud 2010: 1927). Clifford Geertz (1993) argued that chaos and suffering produce crises of meaning that generate more systematic beliefs to guide people in their suffering.

Religion has a strong position in most African countries, including Malawi. Holden et al. (2022) found that religion also plays an important role among university students in Malawi. In a random sample of 764 university students, they found that 10% of the subjects considered prayer as to most important device to protect themselves against COVID-19 whereas prayer was pitted against the other standard recommended practices to protect oneself, like the use of facemasks, handwashing, social distancing, and avoiding crowded places. They also found that 30% of the students belonged to the Seventh Day Adventist and Pentecostal congregations and these were less likely to use facemasks in church and were less likely to have tried to or gotten vaccinated. Here we will search the literature to provide deeper insights into the religious reasoning behind these kinds of behavioral responses.

The first issue is the fundamental freedom of worship that to varying degrees has been affected during the pandemic by restricting public gatherings, including in churches. In some countries, such as Uganda, a country where 98% of the population declares to belong to a specific religion, president Museveni introduced early public sanctions in form of a lockdown already on March 18th, 2020 that included the prohibition of prayer services in all places of worship (Male 2020). While there was some resistance

among religious groups, most of them obeyed the government-imposed sanctions in this emergency context in Uganda. In other African countries, such as Tanzania, president Magufuli declared spiritual warfare against the pandemic and organized a three-day national prayer to protect against the pandemic (Kirby et al. 2020). In Malawi religious leaders also resisted closing places of worship during the pandemic.

Second, a quite common religious belief is that the pandemic is a punishment used by God to punish those who have committed sins (Isiko 2020). Isiko reports examples of religious clerks in Uganda that think that the pandemic is sent to punish non-believers and sinners. These problems were considered to be much worse in Western countries than in Africa so they did not think they were at risk of being punished. The logic is that God is the source of disasters and pandemics and they are caused by the sinful behavior of humans, and the best response to this is to pray and worship God. Some of the worse sins were considered to be homosexuality, corruption, and the refusal to worship God (Isiko 2020). The fact that many more deaths due to the pandemic were recorded in Europe and America was considered proof of this theory. The God obeying Africans were considered safe as God would protect them and therefore protective measures, such as the use of face masks, avoiding handshakes, handwashing, and social distancing, were less necessary. This theology also indicated that vaccines were elusive and that God is above wisdom and science (Kyarikunda, interview reported by Isiko, 2020). The view above seemed to identify the pandemic as a temporary punishment that would go away after the sinful had been punished.

The next belief is going further and associating the pandemic with the end of days (doomsday or apocalyptic prophecies). This belief may therefore be associated with more pessimistic beliefs about the future on earth. In Uganda, this belief was strengthened by the recent occurrence of other calamities such as the HIV/AIDs disease, the civil war in Northern Uganda, Cholera and Ebola outbreaks, and locust attacks (Isiko 2020).

A fourth belief is associating the pandemic with the Devil rather than with God. Pentecostal pastors in Zimbabwe declared spiritual warfare against the pandemic which was seen as a force of evil, similar to what the president of Tanzania did. Also in Uganda, the state brought religious leaders from many Christian congregations as well as Muslims, orchestrated by the Minister of Health, to have a national prayer combining science and religion in the fight against the pandemic (Isiko 2020).

Religion and religious beliefs may also be associated with attitudes toward vaccination against corona/COVID-19 (Lahav et al. 2021; Marti et al. 2017; Neumann-Böhme et al. 2020). Most religious leaders support vaccination, however. Pope Francis suggested that it is everybody's moral obligation to get vaccinated as it protects not only the individual's life but also the life of others (McElwee 2021). However, there are cases reported where some religious leaders preach that their congregations should not get the vaccine as it may cause homosexual tendencies and can control the mind, and some have

been influenced by conspiracy theories (Galang 2021). In the U.S. there was a group of evangelical Christians that stated that the vaccine was a mark of the Devil based on the Book of Revelation (Galang 2021). These types of beliefs can lead to vaccine hesitancy and the World Health Organization (WHO) has listed vaccine hesitancy among the top ten threats to global health in 2019 (WHO 2019).

In Israel it was found that ultra-Orthodox Jews refused to take the vaccine for two reasons; they were concerned about fertility risks and they mistrust the government (Lahav et al. 2021). Over time they were gradually becoming more willing to take the vaccine after experiencing high infection rates (Rosen et al. 2021). In the U.S. in May-June 2020 31% of a surveyed sample was against taking the vaccine (Callaghan et al. 2020). A global review at the end of 2020 found that the average vaccine acceptance was about 70% but with lower levels in Africa, the Middle East, and Russia (Sallam 2021). A study in Pakistan revealed that illiterate people were more likely to believe the conspiracy theory that the vaccine would lead to infertility among Muslims.

4. Conceptual framework

3.1. Behavioral decision theory

We start from an agent-based decision-theoretic framework allowing for bounded rationality. Individuals are regarded as largely rational when making important decisions that are likely to affect their current and future welfare, given their knowledge, information, beliefs, preferences, social norms, and resources. Still, they may make decision errors, may rely on wrong information (fake news), have limited capacity to understand and absorb available information, and rely more on people they trust when making their decisions. They also have a limited ability to judge risk probabilities and tend to overweigh low probabilities. Religious beliefs may also strongly influence their subjective probability judgments. Religious affiliations and beliefs may therefore have a strong influence on individual behavior and shape preferences as well as social norms of behavior. Religious beliefs may also influence the interpretation of new information about the pandemic and reasoning around the pandemic and its causal interpretations. Social norms may influence or constrain their behavior because human beings are social animals that are influenced by other human beings and by public regulations and norms of behavior. General trust and trust in authorities and institutions may also matter for the degree of compliance with public regulations and recommendations given by authorities. The demand for corona/COVID-19 vaccination may therefore be influenced in ways illustrated in the stylized conceptual framework in Figure 1.

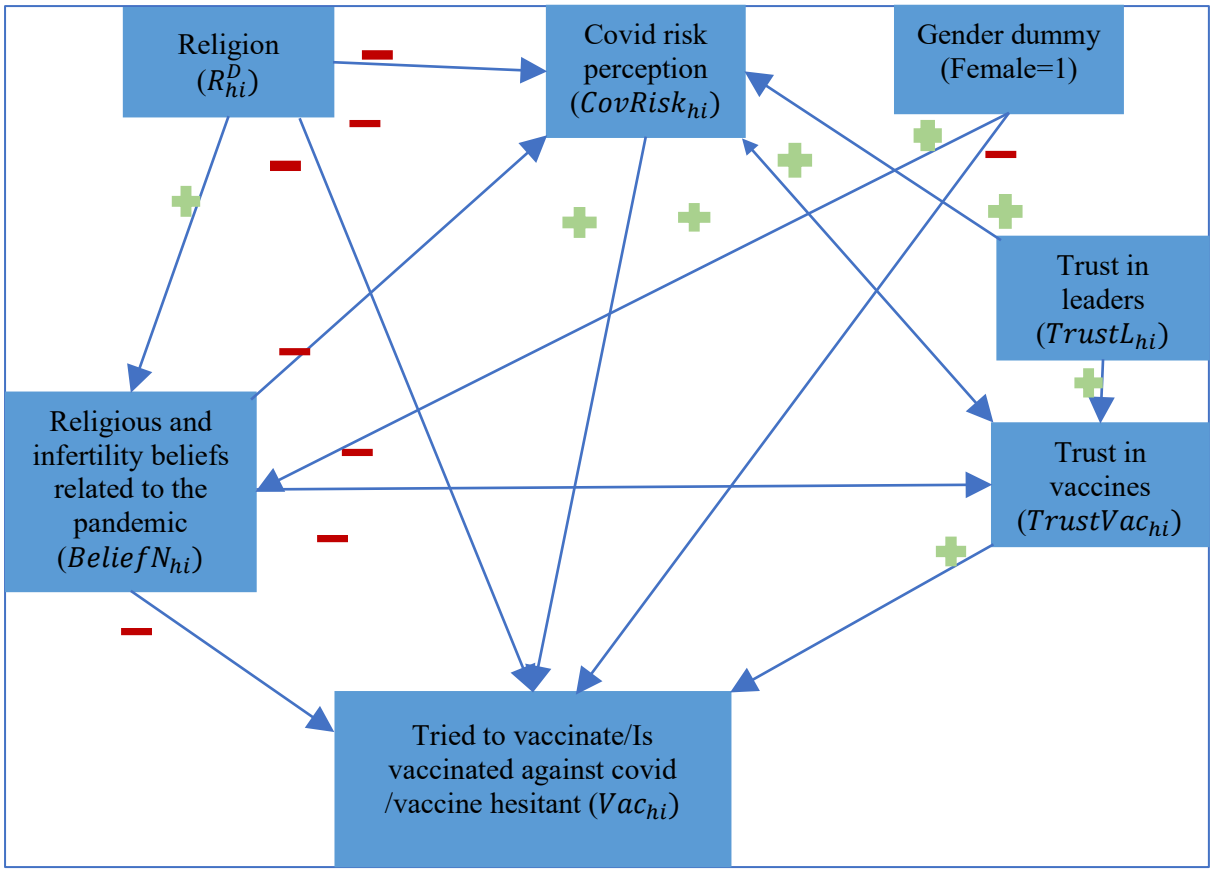

Figure 1. Conceptual model (simple flow diagram with key variables of interest)

Based on our research questions and our conceptual model, we will test the following hypotheses. Related to RQ3: *Are COVID risk perceptions influenced by religious affiliation and religious and infertility beliefs?* we hypothesize:

H1a. Religious beliefs reduce corona/COVID-19 risk perceptions among strong believers as the pandemic is seen as a punishment for not having the right belief/not being religiously active.

H1b. High trust in authorities (politicians, health personnel) related to information about the pandemic is associated with higher corona/COVID-19 risk perceptions.

Related to our research question RQ4): *How do the religious and infertility beliefs associated with the pandemic influence the trust in vaccines?* we hypothesize:

H2. Trust in vaccines is reduced by religious beliefs, especially beliefs that vaccination is associated with the devil and with infertility among women.

Related to our research question RQ5): *How is trust in vaccines influenced by or correlated with the trust in political leaders, health personnel, religious leaders, and with generalized trust?* we hypothesize:

H3a. Trust in vaccines is higher among those that have higher trust in politicians and health personnel and among those exhibiting higher general trust.

H3b. Trust in religious leaders is ambiguously associated with trust in vaccines and varies systematically across religious groups.

Finally, related to our research question RQ6): *How do these beliefs and trust influence the demand for vaccination against corona infection/COVID-19?* we hypothesize:

H4a. Trust in vaccines strongly influences the demand for vaccination/vaccine hesitancy.

H4b. Religious and infertility beliefs influence the attitudes towards corona/COVID-19 vaccination and reduce the likelihood that subjects get vaccinated.

H4c. Females who believe that vaccination can cause infertility among women are particularly reluctant to vaccinate themselves against COVID-19.

Given this framework and the hypotheses, we next inspect the key variables of interest before we present the estimation strategy.

5. Descriptive statistics

Table 2 presents the frequency of five different religious beliefs associated with the corona/COVID-19 pandemic. We see that these five beliefs are held by 25-50% of the sample. Most striking is that 51% of the sample associated the pandemic with the end of days (doomsday) prediction. 35% consider it to be a punishment by God for people's sins. 32% believe that those who pray are immune to COVID-19. 27% think that the coronavirus/COVID-19 comes from the Devil to take those with no faith in God. 33% believe that the COVID-19 vaccine imposes a triple six sign (a sign of the Devil among apocalyptic Christian groups).

The sixth belief in Table 2 does not, as far as we know, have a religious origin. With close to 14% believing that the COVID vaccine makes women infertile, this belief is less widespread than the religious beliefs we investigated but still, it may have a substantial impact on vaccination behavior which we will look into. The belief does not have any scientific basis as far as we know (Do COVID-19 vaccines affect menstruation and fertility? | Gavi, the Vaccine Alliance).

Finally, Table 2 shows that 8% are agnostic about their religious beliefs and about 25% do not believe in any of them. Overall, this shows that religion plays a potentially strong role related to the pandemic and whether people will listen to scientific advice related to vaccination and the use of other protective measures.

Table 2. Religious and other beliefs related to the pandemic

Belief	% of the sample stated they have this belief
1. The corona and COVID pandemic is God's punishment for people's sins	35.3
2. Strong believers in religion and who pray are immune from COVID-19	32.3
3. COVID-19 is fulfilling the Christian Holy Scriptures marking the end of days	51.3
4. The coronavirus and COVID-19 are coming from the Beast and have come to take those that have no faith in God	26.7
5. The COVID-19 vaccine will induce a mark of triple six on those vaccinated	33.1
6. COVID vaccine can cause women to become infertile	13.7
7. I cannot rule out that some of the statements above are correct but am uncertain	8.0
8. I do not believe in any of the above statements	24.9

Table 3 presents the correlation coefficients between the six different beliefs listed in Table 2. We see a positive correlation between all the beliefs, including the non-religious belief related to infertility due to vaccination.

Table 3. Correlations between the different beliefs

	Belief 1	Belief 2	Belief 3	Belief 4	Belief 5	Belief 6
Belief 1	1					
Belief 2	0.351	1				
Belief 3	0.430	0.357	1			
Belief 4	0.386	0.376	0.410	1		
Belief 5	0.301	0.260	0.324	0.439	1	
Belief 6	0.151	0.240	0.137	0.233	0.299	1

Note: The belief numbers correspond to the numbers in Table 2.

We generate a variable for the number of religious beliefs that subjects have and use this as an additional indicator of the strength of religious beliefs related to the pandemic. Table 4 shows the distribution of the number of beliefs across our sample. We see that about 30% associate themselves with none of the beliefs while 9% associate themselves with all five beliefs.

Table 4. Number of religious beliefs, distribution

Number of Religious beliefs	Freq.	Percent	Cum.
0	253	30.3	30.3
1	176	21.1	51.4
2	138	16.5	67.9
3	108	12.9	80.8
4	84	10.1	90.9
5	76	9.1	100.0
Total	835	100	

Table 5 shows the variation in the average number of religious beliefs by a religious group in our sample. It is clear from the means and standard errors that there are significant differences across groups. It appears as an anomaly that the small group of only 13 subjects that claim no association with any religion has the highest average number of beliefs. We have no explanation for this. We will disregard this group in our analysis. We see that Seventh Day Adventists, Pentecostals, African Abraham Church, and Community of Christ Church members on average possess at least two of the stated religious beliefs. The Roman Catholics had the lowest average number of beliefs but also these on average believed in more than one of the five religious beliefs.

Table 5. Number of religious beliefs related to corona, by religion

Religion	Mean	St. Error	N
Roman Catholics	1.26	0.11	155
Seventh Day Adventists	2.00	0.20	70
Central African Presbyterians	1.68	0.12	174
Pentecostal	2.07	0.20	72
Jehova's Witnesses	1.18	0.27	17
African Abraham Church	2.38	0.34	29
Community of Christ Church	2.60	0.26	43
Sunni Muslim	1.85	0.14	153
Other religions	1.79	0.17	109
No Religion	2.69	0.51	13
Total	1.79	0.06	835

The small number of subjects belonging to Jehova's Witnesses caused us to include them under "Other religions".

Table 6 shows the distribution of corona/COVID-19 risk perceptions in the sample based on a 5-level scale. We see that as much as 78% of the sample considered the risk to be very serious, which is the highest level on our 5-level scale. About the same share of the sample stated that they were very worried about future corona waves.

Table 6. Distribution of COVID-19 risk perceptions

COVID risk perception	Freq.	Percent	Cum.
1. Not serious at all	39	4.7	4.7
2. Not so serious	35	4.2	8.9
3. Somewhat serious	55	6.6	15.4
4. Quite serious	53	6.3	21.8
5. Very serious	654	78.2	100
Total	836	100	

Table 7. Trust in vaccines, distribution

	Freq.	Percent	Cum.
1. Very low	134	16.1	16.1
2. Low	78	9.3	25.4
3. Good	119	14.3	39.6
4. High	190	22.8	62.4
5. Very high	314	37.6	100.0
Total	835	100	

Table 8 presents the vaccine-demand-related (dummy) variables. We see that 36.5% of the sample has received at least one dose of the COVID-19 vaccine. 54% are vaccinated or have actively tried to get vaccinated, indicating at least 18% have tried but failed. 63% are vaccinated or willing to get vaccinated, implying that 37% are vaccine-hesitant. 6% are recommending others not to get vaccinated.

Table 8. COVID-vaccination related variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Vaccinated against COVID-19	835	0.365	0.482	0	1
Vaccine demand, active attempt	836	0.543	0.498	0	1
Willing to get vaccinated	836	0.632	0.483	0	1
Vaccine hesitant	836	0.368	0.483	0	1
Warning others against vaccine	835	0.062	0.242	0	1

Finally, we give an overview of the general distribution of trust in political leaders, health personnel, and religious leaders related to the provision of reliable information related to the pandemic in our sample population. We asked “How much trust do you have in the politicians in Malawi being able to handle the corona pandemic well to protect the people?”, “How much trust do you have in health staff to give proper advice to you related to the pandemic?», and “How much trust do you have in your local

religious leaders giving you proper advise related to how to behave during the pandemic?" The answers are summarized in Table 9.

Table 9. Trust in political leaders, health staff, and religious leaders related to advising to protect people, % of the sample

Response	Politicians	Health personnel	Religious leaders
Very high trust	37.1	88.9	70.1
A quite high trust	8.3	3.5	8.5
Medium trust	10.2	3.8	8.6
Low trust	15.3	1.7	7.2
No trust	22.1	1.0	4.2
Don't know	6.6	1.2	1.4

Close to 90% of the sample population has very high trust in health personnel giving good advice related to the pandemic. It is noteworthy that the trust in religious leaders is also much higher than the trust in political leaders when it comes to giving advice related to the pandemic. The share of the sample (37%) is about the same for those having no or low trust in politicians as those having very high trust in politicians.

As an additional measure of generalized trust, we used the incentivized trust game where respondents played the game with another anonymous and unknown random respondent from the same region. In this game the respondent is introduced to the game and receives the following question: *You are given 1000 MK and can decide how much of the 1000 MK you are willing to invest in the tripled amount of your investment is to be sent to a random village member in another village in your region who participates in the survey and experiment and who is free to decide how much of the received amount to return to you. How much will you send to a village member in another village in your region in 200 MK units?* Table 10 shows the distribution of the choices made by the trustors in the game.

Table 10. Experimental generalized trust game outcome distribution

Amount sent by the trustor to a trustee	Freq.	Percent	Cum.
0 MK	183	21.9	21.9
200 MK	264	31.6	53.5
400 MK	208	24.9	78.4
600 MK	97	11.6	90.0
800 MK	50	6.0	95.9
1000 MK	34	4.1	100.0
Total	836	100.0	

6. Estimation strategy

Our key variables or interest of endogenous nature are the corona-related belief, risk and trust perception, and vaccine demand/hesitancy variables. These variables are likely influenced by the pre-determined variables that may be of long-term stable nature. We also inspect the correlations between the variables that are of long-term stable nature or subject invariant. These include religious affiliation, gender, and birth rank. The age of subjects is also exogenous and cannot be influenced by the subjects. In the notation in equations (1) to (4) below we handle the vector of subject characteristics in the term S_{hi} which includes a dummy for the subject being female, age, birth rank, and general trust as the share of MK 1000 sent by trustors in the game (Table 10). We assume that generalized trust (elicited with an incentivized experiment), and trust in authorities as informants about the pandemic represent perceptions that are more stable and exogenous than the COVID risk perceptions, the trust in the COVID vaccine, and the vaccine demand/hesitancy variables.

We consider beliefs associated with the pandemic to be less stable and potentially endogenous and possibly influenced by religion and other variables. We can rule out reverse causality between these variables and consider the pandemic as a natural experiment that triggers changes in beliefs, perceptions, and attitudes. Figure 1 gives an overview of how we theorize about the links between the key variables of interest.

Based on our conceptual framework and the cross-section survey data we have collected, we estimate the following panel data models shown in equations (1) to (4) for households *h* and subjects *i*. We use a combination of simple linear and non-linear panel data models for the analysis.

$BeliefN_{hi}$ represents belief *N*, where *N* represents five religious and one non-religious belief related to the pandemic, $No\ of\ Beliefs_{hi}$ represents the number of religious beliefs related to the pandemic.

To explore the answers to the first two research questions we estimate the following models for each belief *N* as well as for the number of religious beliefs (7 models):

$$BeliefN_{hi} = \alpha_{N0} + \alpha_{N1r}R^{D}_{hi} + \alpha_{N2}S_{hi} + C_h + e_{Nhi} \quad (1)$$

We used dummy variables for each religion (R^{D}_{ci}) with the Roman Catholic group as the base category in our analyses as this is one of the largest religious congregations in the country, S_{hi} represents the individual variables female dummy, age, birth rank, and generalized trust, C_h represents household random effects, and e_{Nhi} is the error term. We have used simple linear panel data models for these seven models. We follow the advice of Angrist and Pischke (2008) and use simple linear models even in cases when the dependent variables are categorical as such models, e.g. mostly linear probability (LP) models, give good estimates of average marginal effects even though they may be less efficient than certain

non-linear models. Our approach is to inspect for significant marginal effects for the key variables of interest to assess the answers to the more exploratory research questions RQ1 and RQ2 for which we had no specific hypotheses.

Related to research question RQ3 and hypotheses H1 and H2 we estimated models based on equation (2):

$$CovRisk_{hi} = \beta_0 + \beta_{1r}R^D_{hi} + \beta_2 BeliefN_{hi} + \beta_3 S_{hi} + \beta_4 TrustL_{hi} + C_h + \varepsilon_{hi} \quad (2)$$

where $CovRisk_{hi}$ represents the covid risk perception variable and $TrustL_{hi}$ represents the trust in politicians, trust in health personnel, and trust in religious leader variables. We assess whether covid risk perceptions are influenced by religion, trust in officials (political leaders, health personnel, religious leaders), and other exogenous variables such as sex, age, and birth rank. As VOVID risk perceptions are measures with a 5-level Likert scale, we have used panel ordered logit models in the estimation. We use four alternative specifications of these models to answer research question RQ3 and to test hypotheses H1a and H1b. The first two parsimonious models include either the vector of beliefs or the number of beliefs but without including the other controls. The third and fourth models contain all the other RHS variables specified in equation (2) as well. By comparing the first two and the last two models we can get a better idea about the role of the beliefs relative to the other variables in influencing risk perceptions.

Next, we estimate models to assess factors explaining or being correlated with the level of trust in the COVID-19 vaccine ($TrustVac_{hi}$):

$$TrustVac_{hi} = \delta_0 + \delta_1 CovRisk_{hi} + \delta_2 BeliefN_{hi} + \delta_3 R^D_{hi} + \delta_4 TrustL_{hi} + \delta_5 S_{hi} + C_h + \epsilon_{hi} \quad (3)$$

This model is used to answer our research questions RQ4 and RQ5 and to test hypotheses H2, H3a, H3b, and H3c. These models focus in particular on how vaccine-related beliefs may influence trust in vaccines. We use two alternative specifications to assess whether the infertility in women belief has a stronger effect on women than on men, by including an additional specification that interacts the female dummy with the infertility belief variable.

Lastly, we estimate demand for vaccine/vaccine hesitancy (Vac_{hi}) models to answer our research question RQ6, and to test hypotheses H4a, H4b, and H4c:

$$Vac_{hi} = \gamma_0 + \gamma_{1r} CovRisk_{hi} + \gamma_2 R^D_{hi} + \gamma_3 BeliefN_{hi} + \gamma_4 S_{hi} + \gamma_5 TrustVac_{hi} + C_h + \vartheta_{hi} \quad (4)$$

We use three dummy variables to measure demand for covid vaccination. These are a) having been vaccinated (at least one dose), b) actively tried to get vaccinated or are vaccinated, and c) not willing to get vaccinated (vaccine hesitant). These three variables are, for simplicity, captured with Vac_{hi} in equation (4) and Figure 1.

We regard the trust in the vaccine variable as an important potentially endogenous variable that may be affected by religious beliefs, especially beliefs associated with vaccination such as infertility of women on the vaccination demand/hesitancy. We apply 2 Stage Least Squares Instrumental Variable models to test this for each of the three vaccination demand models. The IV approach implies that we combine equations (3) and (4) in the three IV models. We use trust in politicians and trust in health personnel as instruments to predict trust in vaccines. These variables should have no direct effect on the demand for vaccines other than through trust in the vaccine (theoretical validity). We use the Sargan overidentification test to statistically test for this validity assumption. The test results confirm that there is no significant correlation between the second-stage error terms and the overidentified instruments for each of the three demand/hesitancy models. These instruments are also very strong. However, they detect only a weak sign of endogeneity (significant at 10% level in one of the models only, that for the active demand) while the Wu-Hausman and Durbin endogeneity tests are insignificant in the other two models. We, therefore, include the linear probability model (OLS) results as well.

7. Results

To explore the answers to the first two research questions RQ1); *To what extent are there religious and other non-scientific beliefs associated with the corona/COVID-19 pandemic in Malawi?*; and RQ2); *To what extent do these beliefs vary across religious affiliations?*; we estimate the following models for each belief *N* as well as for the number of religious beliefs (7 models) in Tables 11 and 12.

We observed already in the descriptive statistics in Table 2 that the six different beliefs related to the pandemic were very common in our sample of rural respondents and signifying that their religions have a strong influence on how they reason around the pandemic. Only 8% of the sample ruled out all the beliefs. It is, however, surprising that those who do not declare any specific religious affiliation still state that they believe in many of these religious beliefs. It may be a result of fear and doubts.

Table 11. Religious beliefs related to the pandemic and religious affiliations

	Belief 1	Belief 2	Belief 3	Belief 4	Belief 5
Religion: Base=Roman Catholic	0	0	0	0	0
Seventh Day Adventists	0.177**	0.0686	0.223***	0.121*	0.189***
	(0.069)	(0.066)	(0.069)	(0.065)	(0.073)
Central African Presbyterians	0.0958*	0.0438	0.147***	0.039	0.0833
	(0.049)	(0.049)	(0.051)	(0.044)	(0.052)
Pentecostal	0.155**	0.236****	0.244****	0.104*	0.0747
	(0.070)	(0.063)	(0.069)	(0.057)	(0.066)
Sunni Muslim	0.135**	0.135**	0.0966*	0.136***	0.088*
	(0.057)	(0.054)	(0.053)	(0.049)	(0.051)
African Abraham Church	0.278***	0.209*	0.164	0.231**	0.204*
	(0.106)	(0.109)	(0.107)	(0.108)	(0.104)
Community of Christ Church	0.218**	0.293****	0.337****	0.216***	0.234***
	(0.088)	(0.079)	(0.070)	(0.074)	(0.085)
Other religions	0.130**	0.0278	0.120**	0.093*	0.100*
	(0.056)	(0.057)	(0.056)	(0.049)	(0.058)
No Religion	0.393***	0.21	0.16	0.517****	0.163
	(0.149)	(0.139)	(0.153)	(0.139)	(0.149)
Female	0.072**	0.016	0.038	0.042	0.040
	(0.034)	(0.032)	(0.034)	(0.031)	(0.032)
Age	0.001	0.002**	0.001	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Birth rank	-0.008	-0.001	-0.007	-0.006	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Constant	0.181***	0.146***	0.352****	0.105**	0.286****
	(0.059)	(0.055)	(0.056)	(0.050)	(0.057)
Observations	835	835	835	835	835
R-squared, overall	0.033	0.044	0.033	0.043	0.026
Wald chi2	28.7	37.4	36.7	40.6	23.7
Prob>chi2	0.003	0.000	0.000	0.000	0.014

Note: Belief 1=The corona and COVID pandemic is God's punishment for people's sins, Belief 2=Strong believers in religion and who pray are immune from COVID-19, Belief 3=COVID-19 is fulfilling the Christian Holy Scriptures marking the end of days, Belief 4=The coronavirus and COVID-19 is coming from the Beast and has come to take those that have no faith in God, Belief 5=The COVID-19 vaccine will induce a mark of triple six on those vaccinated. Linear probability models with household random effects. Robust standard errors in parentheses, significance levels: * p<0.05, ** p<0.01, *** p<0.001.

Table 11 shows that these religious beliefs are very common and more common in some religious congregations than others. Doomsday associations are more common (significant at 1% levels) among the Community of Christ Church, Seventh Day Adventists, Central African Presbyterians, and the Pentecostals compared to the Roman Catholics (base category). However, we also see that the models in Table 11 only explain a very small share of the variation in the beliefs. The models are therefore not very good for the prediction of individual beliefs. This also limits the risk of endogeneity bias when using the belief variables as exogenous variables in the following models for trust and vaccine demand. We can also theoretically argue that these beliefs are likely to affect the trust in vaccines and vaccine

demand variables but it is highly unlikely that vaccine demand and trust in vaccines directly cause these religious beliefs related to the vaccine. This means we rule out reverse causality while we cannot rule out some endogeneity bias.

Table 12 demonstrates a substantial variation across religious groups in the average number of these five religious beliefs. However, the belief that COVID-19 vaccines lead to infertility among women is not significantly more common among any of the religious affiliations. These results provide interesting insights regarding our two first research questions.

Table 12. Number of religious beliefs and infertility belief vs. religious affiliation

	No of religious beliefs	Infertility belief
Religion: Base: Roman Catholic	0	0
Seventh Day Adventists	0.800***	-0.028
	(0.247)	(0.036)
Central African Presbyterians	0.427***	0.046
	(0.163)	(0.034)
Pentecostal	0.835****	0.051
	(0.212)	(0.045)
Sunni Muslim	0.596***	0.0685**
	(0.185)	(0.033)
African Abraham Church	1.103***	0.086
	(0.397)	(0.073)
Community of Christ Church	1.248****	0.118*
	(0.266)	(0.068)
Other religions	0.489***	0.0610*
	(0.184)	(0.036)
No Religion	1.433***	0.233*
	(0.534)	(0.139)
Female	0.199*	-0.001
	(0.117)	(0.024)
Age	0.004	-0.00187***
	(0.003)	(0.001)
Birth rank	-0.022	0.001
	(0.023)	(0.005)
Constant	1.062****	0.161****
	(0.177)	(0.036)
Observations	835	835
R-squared, overall	0.052	0.025
Wald Chi2	49.5	23.2
Prob>Chi2	0.000	0.017

Note: Linear panel data models with household random effects and robust standard errors in parentheses, significance levels: * p<0.10, ** p<0.05, *** p<0.01, **** p<0.001.

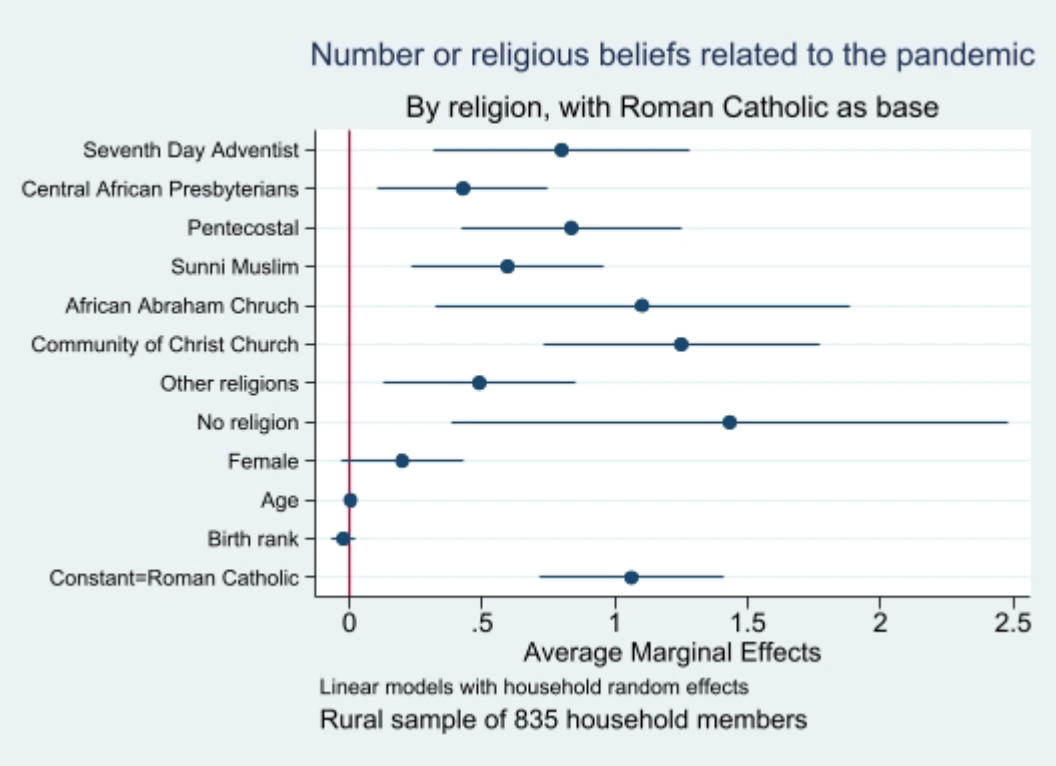

Figure 2. Variation in the number of religious beliefs, by religious affiliation

Our third research question is "*Are COVID risk perceptions influenced by religious affiliation and religious and infertility beliefs?*" We investigate this by regressing the COVID risk perceptions variable on the number of religious beliefs or the vector of belief dummy variables, without and with the following variables; the vector of religious group affiliations, trust in politicians, trust in health personnel, trust in religious leaders, and subject characteristics as controls. Trust in politicians and health personnel may imply trust in the information received (warnings about the COVID risks). We used ordered logit models with household random effects. The results are presented in Table 13. We find weak but consistent results across model specifications that the infertility belief associated with vaccination is positively correlated (at a 10% level of significance) with COVID risk perception while all the other belief variables are insignificant. Only the Pentecostals have a significantly lower risk perception than the base Roman Catholics. This implies that religion explains very little of the variation in COVID risk perceptions. Trust in politicians and trust in religious leaders were both positively and significantly associated with higher COVID risk perceptions, while, surprisingly, trust in health personnel was not so. This seems to indicate that religious leaders in our study areas have not had an active role in lowering the COVID risk perceptions but rather the opposite. They may be more influential on people in this religious society than health personnel that people may not contact unless they have a health problem.

Table 13. COVID risk perception models: Panel ordered logit models with household random effects

	COVID risk percep1	COVID risk percep2	COVID risk percep3	COVID risk percep4
Number of religious beliefs	-0.033		-0.042	
	(0.058)		(0.063)	
Infertility belief	0.489*	0.507*	0.525*	0.541*
	(0.286)	(0.287)	(0.310)	(0.309)
Belief 1:		-0.078		-0.054
		(0.188)		(0.206)
Belief 2:		0.200		0.240
		(0.206)		(0.222)
Belief 3		-0.0178		-0.0731
		(0.190)		(0.198)
Belief 4		-0.0445		-0.0235
		(0.232)		(0.250)
Belief 5		-0.229		-0.293
		(0.213)		(0.225)
Religion, base=Roman Catholic			0	0
Seventh Day Adventists			0.052	0.090
			(0.422)	(0.427)
Central African Presbyterians			-0.237	-0.222
			(0.301)	(0.303)
Pentecostal			-0.743**	-0.792**
			(0.355)	(0.360)
Sunni Muslim			-0.0651	-0.0778
			(0.299)	(0.300)
African Abraham Church			-0.254	-0.276
			(0.555)	(0.558)
Community of Christ Church			0.990*	0.974*
			(0.592)	(0.589)
Other religions			-0.101	-0.0827
			(0.328)	(0.329)
No Religion			-0.715	-0.753
			(0.740)	(0.736)
Trust in politicians			0.183****	0.177***
			(0.055)	(0.055)
Trust in health staff			0.046	0.040
			(0.099)	(0.100)
Trust in religious leaders			0.189***	0.193***
			(0.073)	(0.074)
Female, dummy			(0.085)	(0.076)
			(0.191)	(0.193)
Age			-0.0108**	-0.0118**
			(0.005)	(0.005)
Birth rank			-0.014	-0.014
			(0.040)	(0.039)
cut1	-3.055****	-3.062****	-2.317****	-2.395****

Constant	(0.207)	(0.212)	(0.546)	(0.557)
cut2	-2.364****	-2.370****	-1.594***	-1.669***
Constant	(0.184)	(0.189)	(0.551)	(0.561)
cut3	-1.725****	-1.730****	-0.922*	-0.995*
Constant	(0.163)	(0.170)	(0.541)	(0.553)
cut4	-1.296****	-1.300****	-0.464	-0.536
Constant	(0.154)	(0.161)	(0.541)	(0.553)
sigma2_u	0.0854	0.095	0.215	0.223
Constant	(0.279)	(0.274)	(0.285)	(0.281)
Observations	835	835	835	835
Households	331	331	331	331
Wald Chi2	2.94	4.7	48.7	49.2
Prob > chi2	0.2297	0.5826	0.0000	0.0003

Note: RE ologit models with household random effects and robust/oim standard errors in parentheses, significance levels: * p<0.10, ** p<0.05, *** p<0.01, **** p<0.001.

When it comes to the testing of the hypotheses related to RQ3, hypothesis H1a stated: *Religious beliefs reduce corona/COVID-19 risk perceptions among strong believers as the pandemic is seen as a punishment for not having the right belief/not being religiously active.* We find limited evidence to support this hypothesis. None of the religious beliefs were significant in the models above and the same was the case for the number of religious beliefs variable. Only in the case of Pentecostals did we find a significantly lower covid risk perception level that possibly could have such a religious belief explanation.

Our hypothesis H1b stated: H1b. *High trust in authorities (politicians, health personnel) related to information about the pandemic is associated with higher corona/COVID-19 risk perceptions.* We find strong support for this hypothesis as the trust in politicians and trust in religious leaders were highly significant and with positive signs. This indicates that religious leaders overall have contributed to raising awareness of the risks associated with the pandemic, rather than the opposite, and so have politicians. People that have not been sick or in contact with health personnel for other reasons have to a small extent been influenced by such personnel in their covid risk perceptions. The results, therefore, lend support to hypothesis H1b.

Research question RQ4a states: "*How do the religious and infertility beliefs associated with the pandemic influence the trust in vaccines?*" We investigate this by regressing the 5-level trust in vaccines variable alternatively on the number of religious beliefs and the infertility belief dummy variable. The same set of additional variables is used in both specifications, including the COVID risk perception, religion (vector of dummies), trust in leaders (three dummy variables), the generalized trust (experimental) variable, and the basic subject characteristics (female dummy, age, and birth rank). We run models without and with the interaction between the female dummy and the infertility belief variables. The results are presented in Table 14.

First, we assess hypothesis H2: *Trust in vaccines is reduced by religious beliefs, especially beliefs that vaccination is associated with the devil and with infertility among women.* The results provide strong evidence in support of this hypothesis as both the belief variables were significant and with a negative sign. The second model with the interaction effect provides strong evidence that females who also have the infertility belief have even lower trust in the vaccine. However, we find no evidence that the number of other religious beliefs that are not directly related to vaccines has a separate impact on the trust in vaccines. However, such an effect could be confounded with the religion variables as those belonging to the Seventh Day Adventists and Pentecostals had significantly lower trust in vaccines, while we saw earlier that they were more likely to possess several of the religious beliefs and had on average a larger number of these beliefs than the reference category, the Roman Catholics.

The trust in vaccine models serve also to answer RQ5: *How is trust in vaccines influenced by or correlated with the trust in political leaders, health personnel, religious leaders, and with generalized trust?* Our related H3a hypothesis states: *Trust in vaccines is higher among those that have higher trust in politicians and health personnel and among those exhibiting higher general trust.* Our results provide strong support for this hypothesis for all three trust variables which were significant at the 1, 0.1, and 5% levels for the three variables respectively, and with positive signs.

Hypothesis H3b states that: *Trust in religious leaders is ambiguously associated with trust in vaccines and varies systematically across religious groups*. The results in Table 14 show that the trust in religious leader variable is insignificantly associated with the trust in vaccine variable but has a non-negative coefficient in both models. The heterogeneity in this variable may be absorbed by the religion dummy variables. While we tried to interact the trust variable for the different religions, the sample sizes were too small for each group for us to get a good statistical assessment of the nature of the heterogeneity. It is likely, however, that the leaders in the religious congregations where there is lower trust in the vaccines are influential in creating this low trust in the vaccine.

Table 14. Trust in vaccines models: Panel ordered logit models with household random effects

	Trust in vaccine1	Trust in vaccine2
COVID risk perception	0.299****	0.299****
	(0.062)	(0.062)
No of religious beliefs	-0.071	-0.064
	(0.058)	(0.058)
The belief that vaccine induces triple-six mark	-0.480**	-0.505**
	(0.197)	(0.197)
Infertility belief	-0.694***	-0.162
	(0.237)	(0.327)
Religion, base=Roman Catholic	0	0
Seventh Day Adventists	-0.986***	-0.974***
	(0.303)	(0.303)

Central African Presbyterians	-0.178	-0.189
	(0.244)	(0.245)
Pentecostal	-0.765**	-0.767**
	(0.312)	(0.309)
Sunni Muslim	0.212	0.186
	(0.252)	(0.251)
African Abraham Church	-0.152	-0.183
	(0.446)	(0.452)
Community of Christ Church	-0.500	-0.537
	(0.410)	(0.408)
Other religions	0.170	0.176
	(0.251)	(0.252)
No Religion	0.058	0.018
	(0.538)	(0.516)
Trust in politicians	0.111***	0.110***
	(0.041)	(0.041)
Trust in health personnel	0.463****	0.468****
	(0.097)	(0.098)
Trust in religious leaders	0.0629	0.0501
	(0.059)	(0.059)
General trust (experimental)	0.581**	0.591**
	(0.264)	(0.263)
Female	-0.471****	-0.341**
	(0.142)	(0.159)
Age	0.00680*	0.00612
	(0.004)	(0.004)
Birth rank	-0.012	-0.0125
	(0.027)	(0.027)
Female*Infertility belief		-0.940**
		(0.430)
cut1	1.727***	1.731***
Constant	(0.594)	(0.592)
cut2	2.451****	2.461****
Constant	(0.608)	(0.607)
cut3	3.281****	3.297****
Constant	(0.620)	(0.618)
cut4	4.425****	4.443****
Constant	(0.642)	(0.640)
sigma2_u	0.351*	0.341*
Constant	(0.179)	(0.175)
Observations	835	835
Households	331	331
Wald Chi2	148.5	158.0
Prob > chi2	0.0000	0.0000

Note: Belief 1=The corona and COVID pandemic is God's punishment for people's sins, Belief 2=Strong believers in religion and who pray are immune from COVID-19, Belief 3=COVID-19 is fulfilling the Christian Holy Scriptures marking the end of days, Belief 4=The corona virus and COVID-19 is coming from the Beast and has come to take those that have no faith in God, Belief 5=The COVID-19 vaccine will induce a mark of triple six on

those vaccinated. RE ologit models with household random effects and oim standard errors in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01, **** p<0.001.

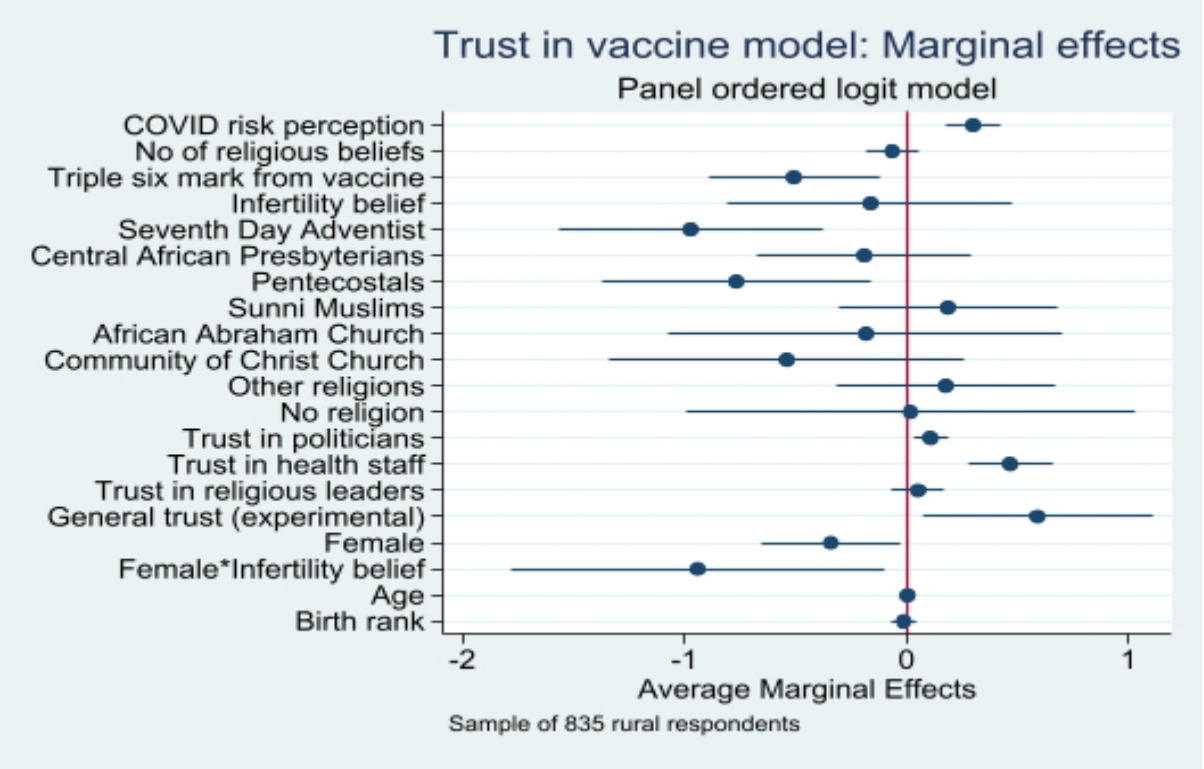

Figure 4. Marginal effects: Trust in vaccines panel ordered logit model

We ran the vaccine demand models for the three demand indicators (being vaccinated, actively tried to get vaccinated/has been vaccinated, and being vaccine hesitant). The results are presented in Tables 15 (LPM), Table 16 (IV), and Table 17 (IV-first stage). These models were used to answer our final research question RQ6: *How do the religious and vaccine-related beliefs and trust influence the demand for vaccination against corona infection/COVID-19?* we assess the following three hypotheses.

Hypothesis H4a states: *Trust in the vaccine strongly influences the demand for vaccination/vaccine hesitancy*. The LPM models in Table 16 show that the trust in the vaccine variable is highly significant and with a positive sign in the two vaccine demand models and a negative sign in the vaccine hesitancy model. The IV models provide results in the same direction although the significance levels are lower in the vaccine demand models and so are the absolute values of the coefficients on the predicted trust in vaccine variable. As we found only weak evidence of endogeneity bias we think the results from the LPM models are reliable. Overall, we conclude that we have found strong evidence that limited or low trust can undermine the demand for vaccines and enhance vaccine hesitancy.

Hypothesis H4b states: *Religious and infertility beliefs influence the attitudes towards corona/COVID-19 vaccination and reduce the likelihood that subjects get vaccinated*. The results show that the triple-six mark from the vaccine belief as well as the infertility belief in the case of women has an indirect as

well as a direct negative effect on the demand for the vaccine. However, the other religious beliefs did not show any sign of directly affecting vaccination demand but this effect could be confounded with the religion variable in the case of Seventh-Day Adventists who were significantly less likely to demand vaccination and significantly more likely to be vaccine-hesitant. Overall, the results were very consistent across the LPM and IV models as well as across the actual vaccination, active stated demand, and vaccine hesitancy models.

Our final hypotheses H4c states: *Females who believe that vaccination can cause infertility among women are particularly reluctant to vaccinate themselves against COVID-19* has strong indirect support through the negative effect of the infertility belief for females on the trust in the vaccine. The evidence of an additional direct effect is not quite as strong and more mixed across models although the tendency goes in the same direction. We cannot, therefore, reject this hypothesis. This belief, although it has no scientific basis, was found among close to 14% of our sample. The infertility belief especially hurts women with such a belief and who therefore have lower trust in the vaccine.

We tested for the endogeneity of the trust in vaccine variable and used trust in politicians and trust in health personnel as instruments to predict trust in vaccines, see Tables 16 and 17. We argue that these instruments do not directly affect the demand for vaccines, the effect is only through the trust in vaccine variable. The statistical tests showed that these instruments are strong and give an F-value of 26.5 which is high above the requirement to be above 10 for the instruments to be considered as strong. The statistical Sargan validity tests were also satisfied in all three demand models with p-values ranging from 0.29 to 0.98. However, the Wu-Hausman tests for endogeneity were insignificant in two of the models and weakly significant (at a 10% level) in one of the models (active demand for the vaccine). This may indicate that the endogeneity bias in these models is weak and we may not make a big mistake by including the trust in vaccine variable as an exogenous variable. But we also inspect the coefficients for the variable in the IV and the LP models. We see from Tables 15 and 16 that the absolute values of coefficients on the trust in vaccine variable are higher (and more significant) in the LPM than in the IV models. However, they are all significant and with the same sign.

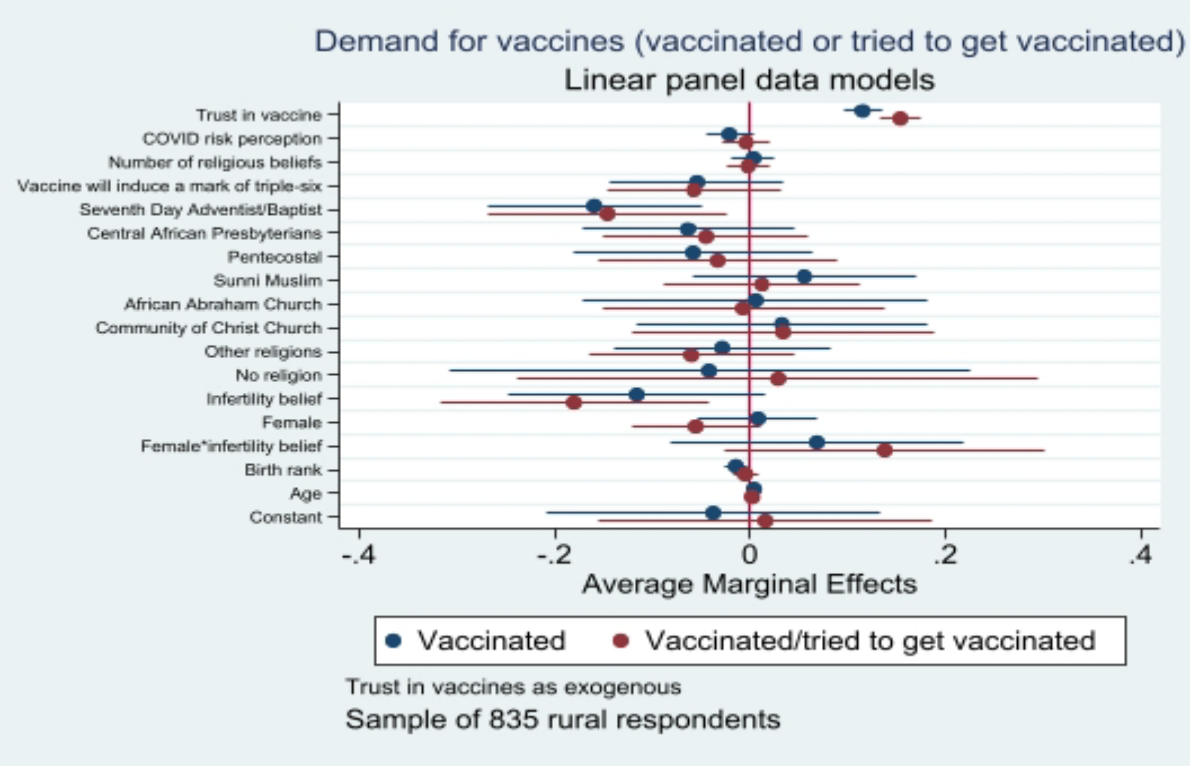

Figure 5. Demand for vaccines, Linear Probability models with household random effects

Table 15. Vaccine demand and beliefs (with trust in vaccine variable).

	COV19 vaccinated	Active vaccine demand	Vaccine hesitant
Trust in vaccine	0.116****	0.154****	-0.183****
	(0.010)	(0.010)	(0.009)
COVID risk perception	-0.020	-0.004	0.004
	(0.013)	(0.013)	(0.012)
No of religious beliefs	0.003	-0.002	-0.004
	(0.012)	(0.012)	(0.011)
The belief that vaccine induces triple-six mark	-0.0544	-0.0571	0.0212
	(0.045)	(0.045)	(0.043)
Religion, base=Roman Catholic			
Seventh Day Adventists	-0.159***	-0.145**	0.115**
	(0.056)	(0.063)	(0.058)
Central African Presbyterians	-0.064	-0.045	0.044
	(0.055)	(0.053)	(0.044)
Pentecostal	-0.058	-0.033	0.025
	(0.062)	(0.063)	(0.052)
Sunni Muslim	0.056	0.012	0.037
	(0.058)	(0.051)	(0.046)
African Abraham Church	0.005	-0.006	-0.008
	(0.090)	(0.073)	(0.052)
Community of Christ Church	0.033	0.034	-0.010
	(0.076)	(0.079)	(0.071)
Other religions	-0.028	-0.060	0.043
	(0.057)	(0.054)	(0.050)
No Religion	-0.041	0.029	-0.173**
	(0.136)	(0.136)	(0.077)
Infertility belief	-0.116*	-0.180**	0.128*
	(0.067)	(0.070)	(0.068)
Female, dummy	0.008	-0.0549*	0.031
	(0.031)	(0.033)	(0.030)
Female*Infertility belief	0.069	0.138*	-0.104
	(0.077)	(0.084)	(0.080)
Birth rank	-0.014**	-0.004	0.014**
	(0.006)	(0.006)	(0.006)
Age	0.005****	0.003***	-0.002***
	(0.001)	(0.001)	(0.001)
Constant	-0.038	0.016	0.977****
	(0.087)	(0.087)	(0.080)
Observations	835	835	835
R-squared	0.221	0.278	0.356
Wald chi2	322.4	481.4	765.9
Prob > Chi2	0.000	0.000	0.000

Note: Linear panel data models with household random effects and robust standard errors in Parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01, **** p<0.001.

Table 16. Robustness check: IV-models of vaccination demand/hesitation

	COV19 vaccinated	Active vaccine demand	Vaccine hesitant
Trust in the vaccine, predicted	0.0777*	0.0759*	-0.150****
	(0.045)	(0.046)	(0.041)
COVID risk perception	-0.008	0.015	-0.004
	(0.018)	(0.018)	(0.016)
No of religious beliefs	0.003	-0.004	-0.003
	(0.013)	(0.013)	(0.011)
The belief that vaccine induces triple-six mark	-0.075	-0.0910*	0.036
	(0.048)	(0.049)	(0.043)
Religion, base=Roman Catholic			
Seventh Day Adventists	-0.190***	-0.207***	0.139**
	(0.071)	(0.073)	(0.065)
Central African Presbyterians	-0.073	-0.061	0.049
	(0.049)	(0.049)	(0.044)
Pentecostal	-0.070	-0.073	0.043
	(0.067)	(0.068)	(0.061)
Sunni Muslim	0.062	0.022	0.034
	(0.050)	(0.051)	(0.045)
African Abraham Church	0.003	-0.028	0.004
	(0.089)	(0.090)	(0.081)
Community of Christ Church	0.009	-0.008	0.009
	(0.079)	(0.080)	(0.072)
Other religions	-0.035	-0.062	0.050
	(0.052)	(0.052)	(0.047)
No Religion	-0.043	0.018	-0.158
	(0.126)	(0.128)	(0.115)
Infertility belief	-0.114	-0.182**	0.126**
	(0.070)	(0.071)	(0.064)
Female	0.001	-0.0743**	0.040
	(0.035)	(0.035)	(0.032)
Female*Infertility belief	0.017	0.068	-0.071
	(0.096)	(0.098)	(0.087)
Birth rank	-0.016**	-0.007	0.015***
	(0.006)	(0.007)	(0.006)
Age	0.005****	0.003****	-0.002***
	(0.001)	(0.001)	(0.001)
Constant	0.061	0.252	0.879****
	(0.157)	(0.160)	(0.143)
Observations	835	835	835
Adjusted R-squared	0.190	0.217	0.333
First stage F-test – strength of instruments	26.5	26.5	26.5
Endogeneity test: Wu-Hausman F-test, p-value	0.313	0.065	0.392
Sargan overid test (validity), p-value	0.289	0.664	0.984

Table 17. IV First stage regression – instrumenting for trust in vaccination

vactrust	Coef.	Std. Err.
COVID risk perception	0.207****	0.043
No of religious beliefs	-0.028	0.038
The belief that vaccine induces triple-six mark	-0.386***	0.133
Religion, base=Roman Catholic		
Seventh Day Adventist	-0.737****	0.192
Central African Presbyterians	-0.169	0.147
Pentecostal	-0.523***	0.190
Sunni Muslim	0.148	0.151
African Abraham Church	-0.271	0.269
Community of Christ Church	-0.467**	0.231
Other religions	0.030	0.158
No religion	-0.092	0.387
Infertility belief, dummy	-0.072	0.214
Female, dummy	-0.232**	0.101
Female*Infertility belief	-0.730***	0.272
Birth rank	-0.020	0.020
Age	0.004	0.003
Instruments:		
Trust politicians	0.095****	0.027
Trust health staff	0.293****	0.056
Constant	1.410****	0.363

Note: 2SLS results from ivregress command in Stata 16, where trust politicians and trust health staff are used as instruments to predict trust in vaccines in all three models in Table above. Significance levels: * p<0.10, ** p<0.05, *** p<0.01, **** p<0.001.

8. Discussion

The findings in this study also provide some other interesting results and implications and we may also relate the findings to the wider literature on the pandemic and the importance of religion and religious beliefs for the perceptions, attitudes, and behavior related to the pandemic.

Table 1 shows that many associates the pandemic with punishment by God or the Devil for the sinful. However, people who believe their religion works as efficient insurance against COVID-19 can get disappointed. This belief is not only common in Malawi. “Jesus is my vaccine” is also used in anti-lockdown protests in the U.S. (Perry et al. 2020).

Given that most of our sample respondents are religiously active, why do not more of them think that their faith provides them insurance against COVID-19? Above 32% of the respondents believed that strong believers who pray are immune to COVID-19. Still, more than 78% perceived the COVID risk to be very high (highest on a 5-level Likert scale). Very few respondents also stated that they believed that prayer was among the three most important ways to protect oneself against COVID-19. This contrasts with another study of university students in Malawi where 10% of the students believed that

prayer was the most important way to protect oneself against COVID-19. This may indicate that the stated beliefs in our rural sample also are associated with doubts that materialize in the COVID risk perception variable that to a very limited extent was affected by the belief variables, except the infertility belief that was less widespread in the sample population.

The belief that the pandemic is a punishment for human sinfulness is also found in the U.S. and most commonly so among African American Protestants who are among the most religious compared to other groups (Shelton and Emerson 2012). Our literature review also found evidence of similar ideas among some religious leaders in Uganda, Tanzania, and Zimbabwe. Our study shows that vaccine-related beliefs are more important in terms of their influence on trust in vaccines and vaccine demand/hesitancy.

9. Conclusions

We have carried out a study of the relationship between religious and other beliefs associated with trust in authorities and generalized trust and how these influence the trust in corona/COVID vaccines and demand for vaccine/vaccine-hesitancy. The study was carried out towards the end of the fourth wave of the pandemic in a sample of hard-to-reach 835 rural respondents in six districts in Central and Southern Malawi. Personal interviews were combined with incentivized trust games to elicit generalized trust.

The mapping of religious beliefs related to the pandemic that five such beliefs were widespread, in addition to a non-religious belief that the corona/COVID vaccine could cause infertility in women. These beliefs were also more common among subsamples belonging to some of the religious congregations that were found in our study areas. Especially, the Seventh Day Adventists, the Pentecostals, the African Abraham Church, and the Community of Christ Church, on average believe in at least two of the five stated religious beliefs.

When inspecting how beliefs influence COVID risk perceptions we found that only the infertility belief was significantly positively associated while only the Pentecostals had a significantly lower COVID risk perception than others in the sample, while trust in politicians and trust in religious leaders were significantly positively associated with COVID risk perceptions. These may be regarded as key informants that are listened to concerning forming risk perceptions.

We found strong evidence that the trust in the vaccine is influenced negatively by the belief that the vaccine causes infertility in women (14% of the sample) and this belief had a stronger effect on the trust in the vaccine among women who also, in general, trusted the vaccine less than men. Those that believed that the vaccine would cause a triple-six mark from the Devil (33% of the sample) also had significantly lower trust in the vaccine. Furthermore, respondents belonging to the Seventh Day Adventists, the Pentecostals, and the Community of Christ Church had significantly lower trust in the vaccine than

those belonging to the Roman Catholic Church (base category). On the other hand, trust in politicians, trust in health personnel, and generalized trust were found to be positively associated with trust in vaccines.

Finally, trust in vaccines was found to strongly influence the demand for vaccines and reduce vaccine hesitancy. Much of the belief effects influenced the demand for vaccines/vaccine-hesitancy through the effect on the trust in vaccines variable. We think it is important to strengthen the motivation for corona/COVID vaccination in Malawi and that our study has pointed out important factors that may undermine such motivation. It may be important to target specific beliefs as well as specific religious groups with better information about the importance of vaccination as well as other protective measures until wide coverage of vaccination is reached. Convincing religious leaders seems may be an important way forward to achieve this. In our study areas, it seems that they had an important role in conveying the COVID risks while they have to a less extent promoted trust in vaccines and vaccination against the coronavirus/COVID-19.

Religion plays a strong role in many African as well as other countries. We, therefore, think our findings are not only relevant for Malawi but also for other African as well as other countries outside Africa. Most of the religious congregations in Malawi and elsewhere belong to international networks that potentially can help to protect against the pandemic even though there may exist persistent beliefs that are hard to change.

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