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Religion, Covid-19 and mental health ☆

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ABSTRACT

Covid-19 and the resulting lockdowns affected various aspects of people's lives, including their mental health. Using data from an online survey, we investigate the role of religiosity in mediating the effect of Covid-19 on mental health. From February-March 2021, we conducted online surveys in the USA among 5178 individuals. These surveys elicited responses on (i) the incidence of Covid-19 infections among the respondents or their immediate social networks, (ii) religious beliefs and practices, and (iii) mental health. Employing the CES-D scale, which tests for depression in clinical settings, we find that while the incidence of a Covid-19 infection is associated with significantly worse mental health, this negative association is significantly smaller for religious people. We show that the mental health benefits of being religious emanate from the ability to participate in religious activities.

1. Introduction

The Covid-19 pandemic and the measures taken to control its spread affected people's lives in multiple ways. An important negative consequence of the pandemic was the significant worsening of mental health across the world.[1] One of the significant determinants of mental health is religion. A recent study by Fruehwirth et al. (2019) establishes a causal relationship between religion and mental health, finding that an increase in religiosity decreases the probability of being depressed in adolescents. Nearly 65% of Americans believe religion plays a significant role in their daily lives (Crabtree, 2010; Frank Newport, 2015), and 36% of Americans attend a religious service weekly (Sahgal and Connaughton, 2021). Hence, it is conceivable that religiosity would play a role in how Covid-19 affected people's mental health in the United States.

This paper analyzes the relationship between Covid-19 incidence in an individual's social network on their mental health and the role of religiosity in this relationship. We do so by conducting a survey of 5178 individuals in the United States between February and March 2021. The survey sample was designed to broadly reflect the distribution of demographic characteristics like age, gender, income, education, and religion. Respondents answered questions about the incidence of Covid-19 in their immediate social network. They also answered a standard questionnaire designed to elicit their mental health on the Centre for Epidemiological Studies Depression scale, or the CES-D scale. Additionally, they also answered questions about their past and current religious activities, which were used to create an index of pre-Covid religiosity including elements of religious belief as well as those of religious practice.

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[1] See Adams-Prassl et al. (2022) and Banks and Xu (2020); for evidence of negative mental health consequences of lockdowns in the US and UK respectively.

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We first find that almost half of our respondents who reported an incidence of Covid-19 among themselves, family, or friends had worse mental health than those who did not, controlling for various demographic and environmental variables. This finding is in line with previous studies and the size of the effect is comparable to the difference in mental health between employed and unemployed individuals. We also find that religious people, on average, have better mental health than non-religious people. And finally, we find that the negative association between Covid-19 and mental health is much smaller for religious people. We find that the worsening of mental health associated with Covid-19 was around 60% higher for non-religious individuals compared to individuals with similar characteristics having average levels of religiosity.

We find that the benefits of religiosity are mainly attributable to religious attendance and not to belief and prayer. We also show that a loss of access to in-person religious activities due to Covid-19 induced social restrictions could have inhibited the potential gains. We compare counties where government policies towards Covid-19 were less strictly enforced compared to more strict counties and find that the positive associations between religiosity and mental health are only observed in the low-strictness counties. Hence, while there are benefits of shutting down religious establishments during a pandemic to prevent the spread of a contagious disease, there are also costs to the mental health of attendees that should be taken into account in any cost-benefit calculations for such policies.

We also document a high uptake of virtual religious services during the lockdown, suggesting that individuals substituted in-person religious gatherings with online religious interactions. Indeed, we find access to online religious activities reduces the negative association between Covid-19 and mental health.

We qualify our key results by emphasizing that these findings are correlational; we do not make any causal claims. We contribute to two strands of literature.

First, we add to the growing literature on the effect of the pandemic on mental health. Studies have found evidence of worsening mental health in the US, UK, Canada, Germany, and China, among others (Adams-Prassl et al., 2022; Banks and Xu, 2020; Armbruster and Klotzbücher, 2020; Beland et al., 2022; Wang et al., 2020). Most of these studies focus on the negative associations between mobility restriction and mental health. However, some studies also show the mental health impact on individuals who actually contract Covid-19 themselves (Renaud-Charest et al., 2021), or on healthcare workers who are surrounded by Covid-19 patients (Saracoglu et al., 2020). Since we have data on the incidence of Covid-19 not only on the respondents but also on their social network, we are able to demonstrate an association between the incidence of Covid-19 in one's social network and worse mental health.

Second, we contribute to the understanding of the role that religion plays in determining mental health.[2] Giles et al. (2023) show that a decline in religiosity had a significant effect on deaths due to suicides, poisonings, and alcoholic liver disease. Cesur et al. (2020) study the causal impact of war deployments on religion and conclude that religiosity may increase mental health through the provision of social support networks, counseling sessions, and regular prayer groups. The paper closest to ours is Fruehwirth et al. (2019), which demonstrates a causal relationship between religiosity and depression in adolescence. Given the unique context of the pandemic, we are able to show not only that religious people have better mental health overall, as other studies have done, but that religiosity is able to mitigate some of the negative effects of Covid-19 incidence.

The following section describes the online survey that the study draws on. Section 3 describes the data used, both from the survey as well as from other secondary sources. Section 4 presents the empirical specification and the results. Section 5 concludes.

2. The survey

We conducted an online survey targeting about 5000 respondents in the US during February and March 2021. We implemented the survey through Qualtrics, which is a leading online survey platform. Fig. 1 shows the spatial distribution of the survey respondents across US states and counties.

2.1. Sample

To make the survey representative of the US population, we defined three core quotas based on the age, gender, and region (location) of respondents. As Table A.1 shows, the distribution of our survey respondents very closely matches the population distribution (taken from the US census website) on these three dimensions. Beyond the core quotas, we further aimed to achieve representativeness of the sample based on income, education, and religion. The latter three quotas were a natural fallout based on age, gender, and region quotas. Nonetheless, the distribution of the sample collected on income, education, and religion again closely matches the respective population distributions (see Table A.1 in the Appendix).

[2] See Iyer and Rosso (2022) for a detailed overview of the literature on religion and mental health. See Hungerman (2020) for a review of economic research on links between religiosity and a range of social behaviors.

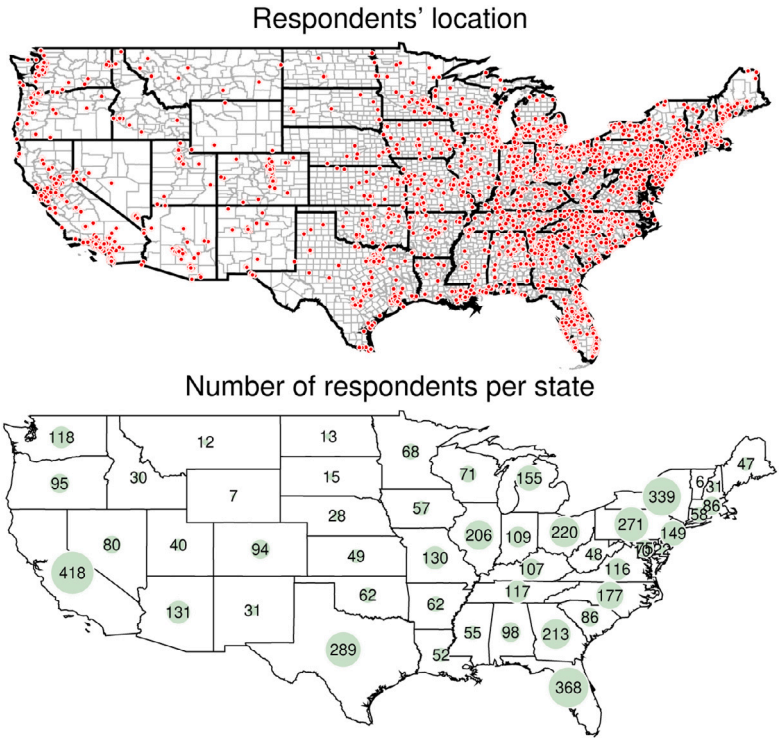

Fig. 1. Distribution of respondents over US states and counties.

2.2. Questionnaire

As Table G1 shows, our (online) survey had five sections. The introduction contained basic information about the nature of the survey and obtained consent from the survey respondents to record their responses. The second section, on demographics, asked questions on respondents' sex, age, race, location (state and county), employment status, annual income, level of education, marital status, and the number of household members. In addition, the demographics section also contained the following question on Covid-19:

Have you or anyone you know been infected with Covid-19? Please tick all that apply.

- ☐ Yes, myself
- ☐ Yes, my immediate family member(s)
- ☐ Yes, my close friend(s)
- ☐ Yes, member(s) of my religious congregation
- ☐ No

Section 3 asked about the respondent's religion and the name and location of the respondent's regular place of worship.

The last two sections of the survey are on religiosity and mental health. The section on religiosity asks questions on four aspects: the importance of religion, frequency of prayer, frequency of attending religious service, and frequency of attending other religious activities (see Figure G1). We take this formulation of eliciting religiosity from Fruehwirth et al. (2019). We elicit information about respondents' religiosity at the time of the survey, and also before Covid-19. The past religiosity responses may be colored by recall bias but are important to get around potential reverse causality.

The mental health section contains a Center for Epidemiological Studies Depression (CES-D) scale questionnaire that asks how the respondent felt during the last one month from the date of the survey. Figure G2 lists all questions in the mental health section. CES-D is a widely used measure of mental health first introduced by Radloff (1977). We use the same version of the questionnaire as used in Fruehwirth et al. (2019).

To avoid any order effect in responses, the orders of the religiosity and mental health sections were randomized. That is, roughly half of the respondents answered the religiosity section before answering the mental health questionnaire and the other half answered the mental health section first. We also implemented a number of quality checks to ensure that the responses were genuine (see Appendix G for details).

Table 1
Summary statistics.

Variable	Mean	SD	Median	Min	Max	Obs
CES-D	20.54	12.18	20.00	0.00	57.00	4980
Religiosity	6.40	4.18	7.00	0.00	13.00	4980
Covid	0.49	0.50	0.00	0.00	1.00	4980
Age	44.91	16.50	44.00	18.00	93.00	4980
Male	0.48	0.50	0.00	0.00	1.00	4980
Employed	0.51	0.50	1.00	0.00	1.00	4980

Notes: CES-D (Center for Epidemiologic Studies - Depression) is a 19-item measure assessing symptoms of depression. Covid is equal to one if anyone in the respondent's social network, including themselves, had contracted Covid-19.

3. Data

We use data from the survey described in Section 2 to generate our primary variables of interest: Covid-19 incidence, mental health, and religiosity, along with other socio-economic attributes. After discarding incomplete responses, we have a sample of 4980 individuals which we will be using for the analysis for the rest of the paper. We supplement this with county-level secondary data on important variables like past mental health, Covid-19 cases & deaths, and lockdown strictness.

3.1. Key variables

Mental health: We construct a measure for mental health using the Center for Epidemiologic Studies Depression Scale (CES-D). The responses to the 19 questions in this section are simply aggregated, to generate a score ranging from 0 to 57. A higher *CES-D score* indicates worse mental health.

Religiosity: Our survey provides information on four aspects of religiosity: the importance of religion, frequency of praying, frequency of attending religious service, and frequency of attending other religious activities. Each sub-measure of religiosity is measured on a scale of 0–3 or 0–4. Following Fruehwirth et al. (2019), we aggregate the responses on these four dimensions to generate the variable *Religiosity* which ranges from 0 to 13. Since it is possible that religiosity changed during the pandemic, we collect both *past* (before Covid-19) and present religiosity. For the rest of the analysis, we will use measures of past religiosity only, in order to avoid potential reverse causality.

Covid-19 incidence: We know from the survey if Covid-19 was contracted by any of the following: the respondent themselves, their family, their friends, and their religious congregation. We construct the dummy variable *Covid* which takes the value 1 if the respondent reported anyone in these four categories of people as having contracted Covid-19.

3.2. Summary statistics

Table 1 has the summary statistics of CES-D score, Covid, and Religiosity variables, along with some key demographic variables, for the whole sample. On the 57-point scale of CES-D score, the mean score of the respondents was around 20. Around half of the respondents themselves or someone in their social network had contracted Covid-19. See Fig. A.1 for the distribution of education, income, household size, and religious affiliation in the sample.

Table A.2 provides summary statistics of the key variables based on sex, race, and religiosity. Keeping in mind that lower CES-D scores imply better mental health, we find that men have better mental health than women. Similarly, "whites" have better mental health than "nonwhites" in our sample. A key motivation for the paper stems from the following observation: although high-religiosity respondents (or someone in their social network) were 10 percentage points more likely to contract Covid-19 compared to low-religiosity respondents, high-religiosity respondents have better mental health than low-religiosity respondents.

3.3. County-level controls

We use our primary survey data, supplemented with multiple county-level measures:

Lockdown Strictness Measures: We use Google COVID-19 Community Mobility Reports as the data for calculating lockdown strictness measure.[3] We construct county-level strictness dummies based on Global Positioning System (GPS) data of time spent away from home. The baseline for the Google reports is median values, for the corresponding day of the week, during the 5-week period January 3–February 6, 2020. We aggregate the number of days (compared to the baseline) the time spent away from home beyond a threshold i.e. if the median difference was more than 20%. This can be considered as the number of *high-strictness-days*. We aggregate the high-strictness-days till January 2021, and strictness dummies are constructed from above and below median values of the aggregated high-strictness days. Fig. A.2 in the Appendix shows the county-level distribution of lockdown strictness as measured by Google mobility data.

[3] https://www.google.com/covid19/mobility/.

As an alternative measure of strictness, we use data on the stay-at-home orders issued in each county. This is not our preferred measure as data is not available for all counties. However, our results remain robust to this measure as well, presented in Appendix F.

Mentally Unhealthy Days (MUD): We control for past mental health at the county level in our regressions. To do so, we use mental health data from the 2019 County Health Rankings, University of Wisconsin Population Health Institute. The reliability of this data is high since it is based on the Centers for Disease Control and Prevention (CDC)[4] Behavioral Risk Factor Surveillance System (BRFSS) survey.[5] The exact question asked was *"Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"*. The survey has over 400,000 responses that are provided as county-level estimates. Fig. A.3 in the Appendix plots MUD at the county level.

Covid-19 Cases & Deaths: We also control for county-level per capita covid cases & deaths since the fear of the pandemic may have adversely impacted mental health. We use county-level data on cases and deaths till February 2021 obtained from The New York Times, based on reports from state and local health agencies.[6]

4. Empirical specification & results

In this section, we start by describing the econometric model that we estimate. We then present the baseline results followed by some results indicating the channel through which religion influences the relationship between Covid-19 and mental health.

4.1. Specification

We estimate the following specification

$$CESD\ score_{ics} = \beta_1 Religiosity_{ics} + \beta_2 Covid_{ics} + \beta_3 (Religiosity_{ics} - \overline{Religiosity}) * Covid_{ics} + \mathbf{X'_{ics}}\boldsymbol{\beta_4} + \mathbf{Y'_{cs}}\boldsymbol{\beta_5} + \beta_s + \epsilon_{ics}$$

The subscripts indicate respondent i in county c in state s. X_{ics} includes respondent characteristics like age, gender, race, religion, income, education, employment, marital status, household size, industry, and occupation of work, and whether or not they were able to work from home. We also control for congregational attributes (where applicable): whether or not the individual was part of a congregation and the size of the congregation. Y'_{cs} indicates county-level controls including past mental health, Covid cases and deaths per capita, and lockdown strictness. β_s indicates state-fixed effects. We cluster standard errors by state.

We would expect β_1 to be negative and β_2 to be positive indicating the expected relationship of CES-D score with religiosity[7] and Covid incidence respectively. The religiosity variable in the interaction term is de-meaned so that β_2 denotes the effect of $Covid$ on a person with average religiosity. The coefficient of interest is β_3. If religiosity mitigates the impact of Covid-19 on mental health, it should be negative.

4.2. Baseline results

In our sample, religious people have better mental health (lower CES-D scores), as expected.[8] Table 2, column 1 reports the relationship between religiosity and CES-D scores without any controls, and the coefficient of Religiosity is negative and statistically significant. Columns 2 and 3 introduce $Covid$ and a mix of controls. Column 3 adds the interaction term between Religiosity and Covid, and column 4 shows the results of our full baseline specification, including both individual and county-level controls. All the columns show the OLS estimates with the dependent variable being CES-D scores, with a higher score representing worse mental health. Hence, the negative coefficients represent factors that contribute to a lower CES-D score, and hence better mental health.

Focusing on column 4, which is our preferred specification, we see that the association between religiosity and mental health is in the expected direction. A person with mean religiosity will have a CES-D score lower by $0.177 * 6.4 = 1.12$ than a non-religious person with similar characteristics. Similarly, the association between contracting Covid-19 and mental health is as expected. The CES-D score of a person with someone in their social network contracting Covid-19 was higher by around 2 points than a person with similar characteristics with no Covid-19 in their social network. Since the probability of contracting Covid could be endogenous, these coefficients should be interpreted as correlations. The size of the coefficients of both Religiosity and Covid are comparable to those of other variables like gender and employment.

Finally, the coefficients of the interaction term in columns 3 and 4, indicate that religiosity may significantly ameliorate the negative mental health impact of Covid-19. Moving from mean religiosity of 6.4 to zero religiosity increases the baseline effect of Covid-19 by almost 60%.[9] In Appendix E, we show that apart from religiosity, amongst some of the covariates we analyze, only religiosity has a significant ameliorating effect of covid on mental health.

We present results in Appendix C which indicate that the ameliorating benefits of religiosity in dealing with the mental health fallout are more significant for people with more severe mental health scores.

[4] Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion. Measuring healthy days monograph. Atlanta, GA: Author; 2000.

[5] https://www.cdc.gov/brfss/annual_data/annual_2019.html.

[6] The New York Times. (2021). Coronavirus (Covid-19) Data in the United States. Retrieved [26/07/2021], from here.

[7] We use respondent's past religiosity here. However, our sample does show that religiosity changes during the pandemic. Average religiosity is a little lower than pre-pandemic levels.

[8] Fig. B.1 is a binned scatterplot that shows an unambiguous relationship between better mental health and religiosity.

[9] The coefficient of the interaction term (column 4) −0.184 multiplied by −6.4 (a decrease in religiosity to zero) equals 1.2. This is 60% of the marginal effect of Covid at average religiosity as given by the coefficient of 2.004.

Table 2
Determinants of mental health.

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score
Religiosity	−0.175**	−0.088	−0.177**	−0.177**
	[0.075]	[0.093]	[0.082]	[0.083]
Covid		2.568***	1.965***	2.004***
		[0.409]	[0.346]	[0.347]
Covid × Religiosity		−0.307***	−0.186**	−0.184**
		[0.092]	[0.077]	[0.079]
Male dummy			−2.383***	−2.395***
			[0.310]	[0.308]
Dummy for white			1.207**	1.252***
			[0.464]	[0.465]
Dummy for being employed			−1.319***	−1.323***
			[0.424]	[0.423]
Individual-level controls	No	No	Yes	Yes
County-level controls	No	Yes	No	Yes
State FE	Yes	Yes	Yes	Yes
Observations	4980	4980	4980	4980
Adjusted R^2	0.003	0.027	0.179	0.179

Notes: All the regressions are OLS estimates. Column 1 is CES-D regressed on Religiosity, as indicated, other Columns have controls. Column 2, Column 3, and Column 4 show the interaction effect of Covid and Religiosity. County-level controls include mobility-based lockdown strictness measure, past mental health, and covid cases and death per capita. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4.3. How does religiosity reduce the negative mental health associated with Covid-19?

A natural question we address at this stage is what aspects of religiosity (discussed in Section 3) are driving the results that we have shown above. We answer this in Table 3, where we disaggregate the religiosity measure. It is clear that the results are strongly driven by attendance at religious services.

Hence, it is the *access* to religious services that provide the mitigating and ameliorating effects of religiosity. However, this aspect of religiosity was significantly (negatively) affected due to social restrictions imposed as part of Covid-19 containment measures. In Table 4, we consider the difficulty in physically accessing religious services using the lockdown strictness measure that was discussed in Section 3.

Columns 1 and 2 of Table 4 compare the effects of religiosity between the sub-samples based on low and high strictness, respectively. The results are quite stark — the beneficial effects of past religiosity on mental health are significant only when strictness was relatively low. In other words, strict lockdown measures eroded any benefits that emanated from being religious. For comparison, we present the full-sample results in column 3 (same as column 4, Table 2) where the benefits of religiosity are present. Next, using the full sample, we separately estimate the interaction term of $Covid \times Religiosity$ for low and high-strictness counties in column 4. The beneficial effect of religiosity in ameliorating the mental health impact of covid is again absent for respondents in high-strictness counties, while is highly significant and beneficial in low-strictness counties.

It is possible that the mobility-based measure we use could confound behavioral changes in people and government orders (or lack thereof) vis-à-vis lockdowns. Hence, in addition to the mobility-based measure, we construct a policy-based county-level lockdown strictness using stay-at-home orders issued in each county. Our results are robust to using the policy-based strictness measure in Table F.1.

This leads us to consider the alternate modes of access to religious services that respondents have reported. More than half of all respondents reported availing some form of virtual engagement with religious services (mean engagement for all modes is shown in Fig. B.2). Availing online services is defined as using at least one of the following services —virtual religious services, online discussion groups, online religious classes, or virtual choir singing.

We now want to see if people accessing online religious services were able to cope better with the negative mental health associated with Covid-19. As only religious people would access these services, we restrict the sample to only people with non-negative levels of religiosity. We would also assume that the level of religiosity of a person may matter for how beneficial online access is for them.

In Table 5 we investigate these relationships. We find that Covid-19 is consistently associated with higher CES-D scores but this association is weaker for those who access online religious services, as seen in the first column of the table. Columns 2 and 3 show that this effect is primarily driven by those who have a higher level of religiosity.

Table 3
Determinants of mental health, religiosity disaggregated.

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score
Religiosity	−0.269***	−0.177**		
	[0.067]	[0.083]		
Covid	1.993***	2.004***	1.998***	2.012***
	[0.355]	[0.347]	[0.355]	[0.348]
Covid × Religiosity		−0.184**		
		[0.079]		
Religiosity (Importance)			−0.235	−0.003
			[0.205]	[0.254]
Religiosity (Prayer)			−0.354**	−0.415*
			[0.144]	[0.210]
Religiosity (Attendance)			−1.061***	−0.590**
			[0.237]	[0.289]
Religiosity (Frequency of activities)			0.651***	0.415*
			[0.210]	[0.243]
Covid × Religiosity (Importance)				−0.460
				[0.313]
Covid × Religiosity (Prayer)				0.082
				[0.301]
Covid × Religiosity (Attendance)				−0.895***
				[0.328]
Covid × Religiosity (Frequency of activities)				0.478
				[0.289]
Observations	4980	4980	4980	4980
Adjusted R^2	0.178	0.179	0.181	0.182

Notes: All the regressions are OLS estimates with a full set of individual and county-level controls included. All the religiosity measures in the interactions are de-meaned. County-level controls include mobility-based lockdown strictness measure, past mental health, and covid cases and death per capita. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4
Determinants of mental health, physical access to religion.

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score
Religiosity	−0.264**	−0.112	−0.177**	−0.221**
	[0.120]	[0.131]	[0.083]	[0.090]
Covid	1.329***	2.787***	2.004***	1.349***
	[0.410]	[0.583]	[0.347]	[0.400]
Covid × Religiosity	−0.255**	−0.081	−0.184**	
	[0.103]	[0.171]	[0.079]	
Covid × Religiosity (Low strictness)				−0.254**
				[0.097]
Covid × Religiosity (High strictness)				−0.075
				[0.167]
Observations	2493	2487	4980	4980
Strictness	Only low	Only high	All	All
Adjusted R^2	0.182	0.179	0.179	0.180

Notes: All the regressions are OLS estimates with a full set of individual and county-level controls included. Strictness used here is a binary variable based on the GPS mobility at the county level. The coefficients Covid × Religiosity (High strictness) is a post-estimation test for the linear combination of the sum of coefficients (Religiosity × Covid) + (Religiosity × Covid × Strictness). Column 4 has relevant double interactions included in addition to the triple interaction. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5
Determinants of mental health, online access to religion.

	(1) CES-D score	(2) CES-D score	(3) CES-D score
Covid	2.265***	2.474***	2.415***
{Not accessed online service}	[0.521]	[0.529]	[0.888]
Covid	1.344***	2.122***	1.253*
{Accessed online service}	[0.486]	[0.699]	[0.715]
Online	0.379	1.525***	−0.147
	[0.395]	[0.540]	[0.634]
Observations	4238	2094	2144
Religiosity (R)	R> 0	0<R<Median (R)	R>=Median(R)
Adjusted R^2	0.167	0.223	0.132

All the regressions are OLS estimates with a full set of individual and county-level controls included. County-level controls include mobility-based lockdown strictness measure, past mental health, and covid cases and death per capita. Covid {Accessed online service} is defined as a post-estimation test for the linear combination of the sum of coefficients Covid + (Covid × Online). Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5. Conclusion

In this paper, we show how religiosity contributes to mental health more generally, but especially in the particular case of its effect during the Covid-19 pandemic. We find that being religious significantly reduces the negative mental health outcomes associated with Covid-19 incidence in one's social network. This beneficial effect of religiosity on mental health, in this context, is comparable to the effect of being employed. In addition, our OLS estimates show that other socioeconomic covariates do not mitigate the effects of Covid-19 on mental health as compared with religiosity.

We find that the frequency of past attendance at religious establishments drives the ameliorating effects of religiosity. In other words, if a respondent displayed high religious attendance in the past, this helped them to mitigate the effects of Covid-19 on their mental health. The role of attendance leads to our focus on access to religious establishments. The results are quite stark — being more religious has significant beneficial effects on mental health only when strictness is relatively low. On the contrary, higher lockdown strictness eroded any benefits that emanated from being religious. We use both mobility-based strictness measures and test the robustness of our results with a policy-based measure to construct lockdown strictness. Finally, we also find significant uptake of online religious services that were introduced in lieu of in-person services. People who accessed these services demonstrated a lower association between Covid-19 and mental health.

Our findings are correlational, but they contribute to the literature which attempts to understand the mental health effects of the Covid pandemic and the role of religion in ameliorating these effects. We consider our findings to be important when designing effective public policies which concern individuals' mental health and well-being.

Appendix A. Descriptive tables and figures

See Tables A.1 and A.2 and Figs. A.1–A.3.

Table A.1
Representativeness of the survey respondents.

Variable	Groups	Population distribution	Target respondents	Actual respondents
Age	18–24	13.0%	650	676
	25–34	19.0%	950	987
	35–44	18.0%	900	936
	45–54	19.0%	950	970
	55–64	17.0%	850	882
	65+	14.0%	700	728
Gender	Female	51%	2550	2652
	Male	49%	2450	2508
	Other	.	.	19
Region	Midwest	21%	1067	1121
	Northeast	18%	901	1009
	South	37%	1864	1958
	West	23%	1091	1169
Income	$0–$25k	43%	1760	2150
	$25k–$50k	27%	1500	1514
	$50k–$75k	14%	700	845
	$75k–$100k	7%	350	448
	$100k+	9%	450	612
Education	Less than HS	10%	251	500
	High school	29%	1450	1581
	Some college	26%	1300	1639
	Bachelors	21%	1050	1143
	Advanced degree	13%	565	650
Religion	Protestant	47%	2310	2350
	Catholic	21%	1050	1069
	Jewish	2%	100	114
	Mormon	2%	43	100
	Muslim	1%	50	57
	Other religion	4%	200	238
	No religion	23%	1300	1348

Notes: All population figures were taken from the US Census website (https://www.census.gov/). **Midwest**: IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI. **Northeast**: ME, MA, NH, NJ, NY, PA, RI, VT, CT. **South**: AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV. **West**: AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, WY. Income is annual individual income. Income, education, and religion quotas were natural fallout based on age, gender, and region quotas.

Table A.2
Summary statistics (By group).

	Gender				Race				Religiosity			
	Male		Female		White		Nonwhite		High		Low	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
CES-D	19.17	11.89	21.80^{+}	12.31	20.18	12.35	21.85^{+}	11.48	19.98	12.16	21.14^{+}	12.19
Religiosity	6.23	4.31	6.55	4.06	6.26	4.20	6.90^{+}	4.08	9.87	2.05	2.73^{+}	2.30
Covid	0.47	0.50	0.51^{+}	0.50	0.50	0.50	0.47	0.50	0.54	0.50	0.44^{+}	0.50
Age	44.51	16.58	45.28	16.42	47.12	16.20	36.96^{+}	15.05	46.00	16.05	43.76^{+}	16.89
Employed	0.58	0.49	0.44^{+}	0.50	0.49	0.50	0.56^{+}	0.50	0.54	0.50	0.48^{+}	0.50
Obs	*N = 2387*		*N = 2593*		*N = 3894*		*N = 1086*		*N = 2560*		*N = 2420*	

Notes: Male, Female, White, Nonwhite, High, and Low are all binary variables. Religiosity High and Low are dummies based on above and below mean religiosity values respectively. + Indicates a significant t-test at 1% on the means of the analogous group.

Fig. A.1. Distributions of key demographic variables of the survey.
Notes: The above graph plots the breakdown of the values of some categorical variables used in our survey. In the Religious Affiliation graph, Other Religions include —Baha'i, Buddhist, Hindu, Islam, and Jewish.

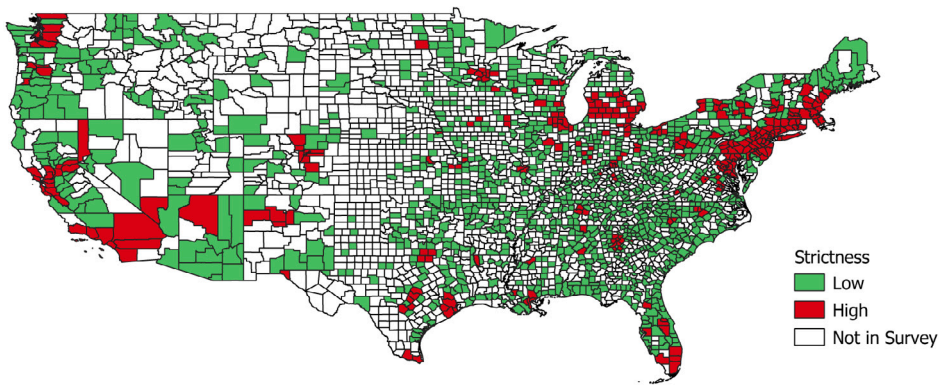

Fig. A.2. Lockdown Strictness of US counties.

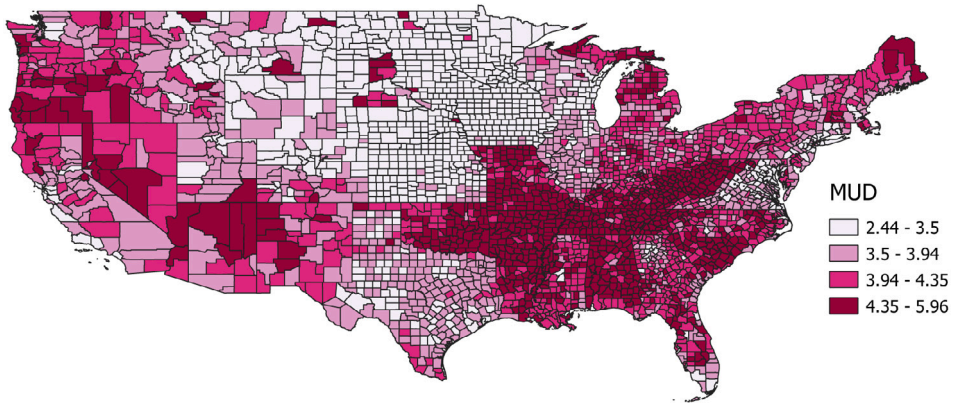

Fig. A.3. Distribution of Mentally Unhealthy Days over US counties.**Notes:** This map shows the MUD of counties using quantile (equal count) classification.

Appendix B. Additional figures supporting the results

See Figs. B.1 and B.2.

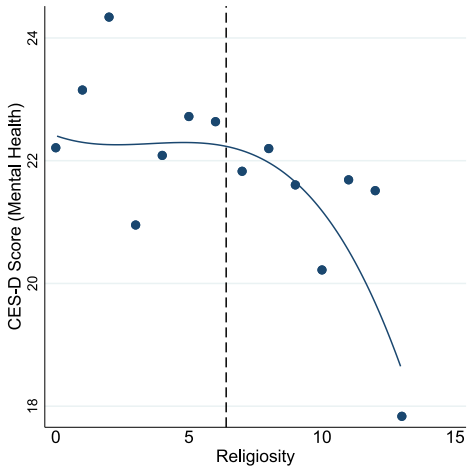

Fig. B.1. Binned Scatterplot of CES-D Scores and Religiosity.
Notes: The figure plots the least squares binscatter with a cubic polynomial fit of CES-D scores regressed on Religiosity with individual level controls. The dotted line shows the mean religiosity of 6.4, and the sub-sample means of CES-D scores are 21.13 and 19.97 with a statistically significant difference in means.

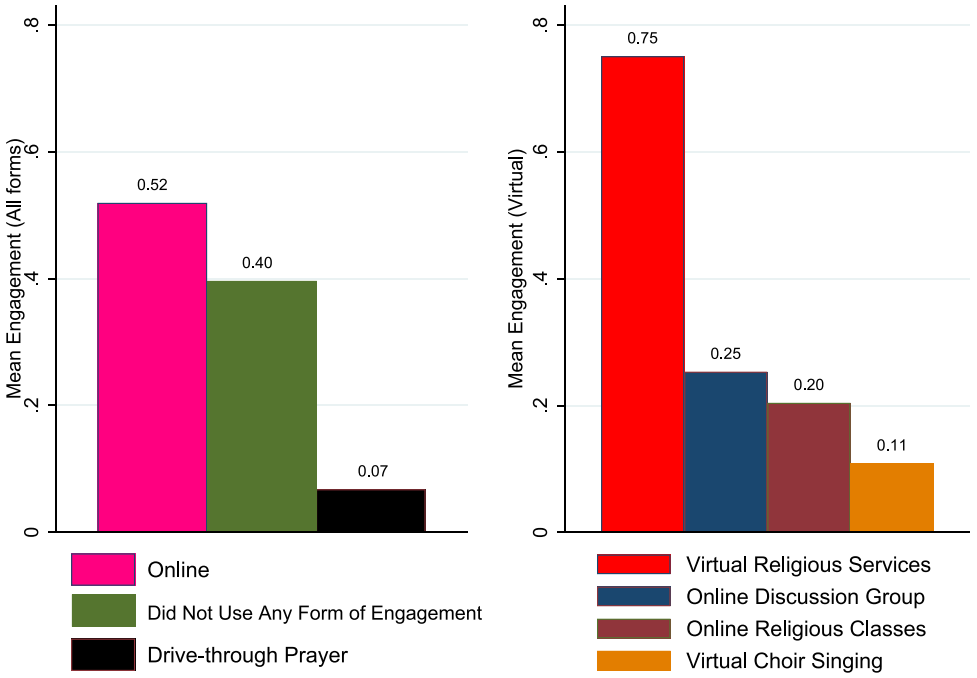

Fig. B.2. Virtual access to religious services.
Notes: The first figure shows the distribution of alternate access to religious services. The second figure shows the breakdown of online (virtual) access to religious services. A respondent can use multiple combinations of these virtual services offered by their church.

Appendix C. Heterogeneity in beneficial effects of religiosity

We create four binary variables which take the value of one if the respondent's mental health score is greater than the 20th, 40th, 60th and 80th percentiles respectively. These variables proxy for different levels of severity of mental health issues. We then estimate linear probability models with each of these binary variables as the dependent variable. The results are presented in Table C.1. The first column indicates that the incidence of Covid increases the probability of being in the top 80 percentile of CES-D scores by 9 percentage points for someone with average religiosity. An increase in religiosity does not significantly mitigate this effect as shown by the small and statistically insignificant coefficient of the interaction term. The last column shows that the incidence of Covid in a person's social network increases the probability of them being in the top 20 percentiles of CES-D scores by 3.7% for a person with average religiosity. But in this case, being religious strongly mitigates this effect. An increase in religiosity by one standard deviation reduces the probability of being in the top 20 percentiles of CES-D scores by 2.5 percentage points. Hence, a person with religiosity levels one standard deviation above the mean will have a two-thirds reduction in the likelihood of being severely depressed due to Covid.

Table C.1
Determinants of mental health, using CES-D quintiles.

	(1) > 20%	(2) > 40%	(3) > 60%	(4) > 80%
Religiosity	−0.009***	−0.008**	−0.005*	0.001
	[0.002]	[0.003]	[0.002]	[0.002]
Covid	0.081***	0.069***	0.046***	0.037***
	[0.012]	[0.014]	[0.014]	[0.012]
Covid × Religiosity	−0.003	−0.006*	−0.006**	−0.006**
	[0.003]	[0.003]	[0.003]	[0.003]
Observations	4980	4980	4980	4980
Adjusted R^2	0.116	0.149	0.138	0.072

Dependent variables are binary which indicates if a respondent has a mental health score higher than indicated percentile. All the regressions are OLS estimates with a full set of individual and county-level controls included. County-level controls include mobility-based lockdown strictness measure, past mental health, and covid cases and death per capita. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix D. Determinants of mental health, by Covid measures

The focus of Table D.1 is to investigate which aspects of the interaction between religiosity and covid contraction are driving the results in our results section. Column 1 shows the baseline effects of religiosity and Covid on CES-D scores. Column 2 shows the interaction effects of religiosity and Covid, which is the desired specification in our results section. Column 4 shows the disaggregated measures of Covid interaction with Religiosity. Clearly, the tangible and higher effects are seen in helping deal with covid contraction in families.

Table D.1
Determinants of mental health, by covid measures.

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score
Religiosity	−0.269***	−0.177**	−0.236***	−0.168**
	[0.067]	[0.083]	[0.069]	[0.076]
Covid	1.993***	2.004***		
	[0.355]	[0.347]		
Covid × Religiosity		−0.184**		
		[0.079]		
Covid (Self)			2.957***	2.807***
			[0.472]	[0.439]
Covid (Family)			0.699	0.789
			[0.505]	[0.514]
Covid (Friends)			1.069***	1.095***
			[0.264]	[0.262]
Covid (Congregation)			−2.076***	−0.805
			[0.745]	[0.959]
Covid (Self) × Religiosity				0.233*
				[0.132]
Covid (Family) × Religiosity				−0.267**
				[0.109]
Covid (Friends) × Religiosity				−0.088
				[0.076]
Covid (Congregation) × Religiosity				−0.296
				[0.195]
Observations	4980	4980	4980	4980
Adjusted R^2	0.178	0.179	0.180	0.181

Notes: All the columns include individual and county-level controls. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix E. Determinants of mental health, other socioeconomic covariates

The focus of Table E.1 is to show that other covariates that could plausibly help deal with the mental health effects of contraction of covid in the social network are absent. Only religiosity is a significant effect of note. Column 1 shows baseline OLS regression of covariates without any interaction effects with religiosity Column 2 onward we include other covariates that interacted with Covid. Clearly, Religiosity is the only covariate that has a significant beneficial effect on mental health.

Further, in Table E.2 we investigate triple interactions of covid, religiosity, and other covariates. We present the results for the coefficients of the linear combination of the respective triple interaction with Covid × Religiosity. For instance, from Column 2 we infer that religiosity offers additional benefits for the aged (defined as over 50 years old). Similar inference can be made from other columns.

Table E.1
Determinants of mental health, other socioeconomic covariates.

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score	(5) CES-D score
Religiosity	−0.269***	−0.177**	−0.267***	−0.269***	−0.269***
	[0.067]	[0.083]	[0.067]	[0.067]	[0.066]
Covid	1.993***	2.004***	1.413***	2.053***	1.951**
	[0.355]	[0.347]	[0.444]	[0.454]	[0.761]
Covid × Religiosity		−0.184**			
		[0.079]			
Covid × Single			1.104*		
			[0.569]		
Covid × Work from home				−0.196	
				[0.781]	
Covid × White					0.053
					[0.803]
Observations	4980	4980	4980	4980	4980
Adjusted R^2	0.178	0.179	0.178	0.178	0.178

Notes: All the columns include individual and county-level controls. Standard errors (in brackets) are clustered at the state level.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table E.2
Determinants of mental health, other covariates with religiosity.

	(1) CES-D	(2) CES-D	(3) CES-D	(4) CES-D
Covid × Religiosity	−0.184**			
	[0.079]			
Covid × Religiosity (Aged)		−0.280**		
		[0.132]		
Covid × Religiosity (Young)		−0.127		
		[0.092]		
Covid × Religiosity (White)			−0.178**	
			[0.088]	
Covid × Religiosity (Non-White)			−0.228	
			[0.173]	
Covid × Religiosity (Employed)				−0.140
				[0.101]
Covid × Religiosity (Unemployed)				−0.249*
				[0.125]
Observations	4980	4980	4980	4980
Adjusted R^2	0.179	0.179	0.179	0.180

Notes: All the regressions are OLS estimates with a full set of individual and county-level controls included. County-level controls include mobility-based lockdown strictness measure, past mental health, and covid cases and death per capita. Aged is a binary indicator for age over 50. Covid × Religiosity (Aged) is defined as a post-estimation test for the linear combination of the sum of coefficients (Covid × Religiosity × Aged) + (Covid × Religiosity). Standard errors (in brackets) are clustered at the state level.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Appendix F. Robustness of strictness measure

Apart from the Google mobility data, we also construct a measure based on the government's policy strictness. We construct a county-level lockdown strictness measure using the stay-at-home orders issued in each county. This allows us to compare two strictness measures — Google Mobility-based measure and the policy-based strictness measure. Amongst all the respondents that lived in counties of high strictness as categorized by our policy measure, roughly 65% of them were also categorized to be in a high strictness county based on the Google Mobility data.

Since the two measures are not perfectly collinear, we can check for the robustness of the measure by using policy-based strictness. Table F.1 reproduces Table 4, but by replacing strictness based on Google Mobility data with this new measure of policy-based strictness. The results are robust to our new measure of strictness (compare column 4 between the two tables). In fact, the beneficial effect of Religiosity is more pronounced in low strictness counties in Table F.1, relative to Table 4. Overall, our findings are robust to an alternative measure of strictness that is constructed using public policies.

Construction of Policy based strictness measure: We have manually complied the start and end dates for stay-at-home orders at the county level.[10] We use the duration of stay-at-home (SHO) orders (in days) in each county (and major city), to construct a dummy for policy-based strictness measure based on the mean value of SHO.

Table F.1
Determinants of mental health, physical access to religion (using policy strictness).

	(1) CES-D score	(2) CES-D score	(3) CES-D score	(4) CES-D score
Religiosity	−0.265**	−0.131	−0.178**	−0.212*
	[0.107]	[0.120]	[0.083]	[0.105]
Covid	1.220***	2.733***	1.989***	1.213***
	[0.430]	[0.515]	[0.346]	[0.423]
Covid × Religiosity	−0.284***	−0.042	−0.187**	
	[0.088]	[0.124]	[0.078]	
Covid × Religiosity (Low strictness)				−0.309***
				[0.088]
Covid × Religiosity (High strictness)				−0.048
				[0.124]
Observations	2318	2662	4980	4980
Strictness	Only low	Only high	All	All
Adjusted R^2	0.188	0.175	0.178	0.181

Notes: All the regressions are OLS estimates with a full set of individual and county-level controls included. Strictness used here is a binary variable based on Policy orders at the county level. The coefficients Covid × Religiosity (High strictness) is a post-estimation test for the linear combination of the sum of coefficients (Religiosity × Covid) + (Religiosity × Covid × Strictness). Column 4 has relevant double interactions included in addition to the triple interaction. Standard errors (in brackets) are clustered at the state level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix G. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2023.104621.

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