Religion, Prayer and Health Behavior

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Abstract

Most people throughout the world pray to prevent and treat many common illnesses. A belief in the effectiveness of prayer may influence science-based health behavior and health outcomes. This study examines the reliance on prayer to protect against COVID-19 in the United States. In data from the pandemic, a majority of US adults believe that prayer is effective against COVID and indicate praying for this purpose. We develop a simple model of health production that includes prayer as a perceived health input. Then we use a difference-in-difference framework to test the predictions of this model. Consistent with the model, vaccine access reduces the frequency of prayer. Results are heterogeneous by religiosity, with the strongest results among weakly-religious people, for whom prayer appears to function as a coping strategy. We do not find that religion "crowds out" vaccination or other science-based prevention behaviors.

JEL: I12, Z12, I18

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1 Introduction

Prayer is a fundamental aspect of religious life and a widespread behavior throughout the world (Baker 2008). In data from 2021, Froese and Uecker (2022) report that 77 percent of US adults pray at least occasionally. While people rely on prayer in different ways, it is common to ask God or another higher power for solutions to life challenges (Upenieks 2023). Religion plays an important role in the health domain. Faith is correlated with positive health behaviors, including cancer screening and avoidance of tobacco and alcohol (Benjamins 2006). Some Western providers recommend prayer to patients as a treatment approach (Masters and Spielmans 2007).

In prayer, people commonly ask God for solutions to health challenges for themselves and others (Wilkinson et al. 2008). We surveyed US adults who had recently been diagnosed with one of ten common illnesses.[1] For nearly every listed illness, a majority of people said that prayer is an effective treatment and that they have personally prayed for this purpose. These patterns suggest that many people see prayer as a health input. However, it is unclear how literally we should take these self-reports or how people may perceive that prayer enters the health production function. Approaches might vary substantially by religious affiliation and level of religiosity.

Reliance on prayer may have important consequences for science-based health behaviors. People might substitute away from other health inputs, including primary care visits, adherence to medications or wellness activities. Alternatively, praying may increase the demand for science-based health inputs among those who perceive that prayer and other inputs are complements. A rich literature explores the so-called Peltzman (1975) effect, in which technologies that reduce health risk along one margin lead to greater risk along other margins (e.g. Prasad and Jena 2014, Wilson et al. 2014). Prayer might moderate this risk calculation and the extent of the behavioral response. Alternatively, people might perceive that prayer complements or enhances the effectiveness of standard medical treatment (Dow et al. 1999, Becker 2007). Because existing research is primarily correlational, we lack evidence

[1] The figure is based on a survey from December 2024 to February 2025 of 1563 participants in the Understanding America Study. Participants were drawn from a representative sample and had received the listed diagnoses within the past twelve months.

about the way that people view prayer and its relationship to science-based health inputs.

This study considers the role of prayer as a health input during the COVID-19 pandemic in the United States. In survey data from early in the pandemic, large majorities of US adults viewed prayer as an effective way to prevent COVID-19 and said that they regularly prayed for this purpose. These responses suggest that, as with other illnesses, many people saw prayer as a health input against COVID-19. A key aspect of the health production framework is that health input utilization should be endogenous to disease risk. People who view prayer as a way to prevent COVID-19 should adjust the frequency of prayer according to COVID-19 risk. Nine months into the pandemic, the government began to roll out vaccines that greatly reduced COVID-19 risk. This change in the disease environment may have led people to reoptimize prayer along with other health behaviors.

We develop a simple model to illustrate the potential tradeoff between health inputs, including vaccination and either prayer or "avoidance" (i.e., social distancing and wearing masks). The vaccine rollout reduces the price of vaccination from effectively infinite to a small positive value. The effect of this change on use of the other input is ambiguous in general, but may lead to behavioral compensation in some circumstances. We also explore interactions according to the weight of the alternative good within the health production function. These interactions lead to predictions along two parallel dimensions of heterogeneity, religiosity and perceived vaccine effectiveness, which lead to additional empirical tests.

We utilize data from the Understanding America Study (UAS), a rich longitudinal survey of a representative sample of US adults (Alattar et al. 2018). During the pandemic, UAS surveyors administered a high-frequency panel survey related to COVID-19. This survey measured health behavior, perceived COVID-19 risk, the incidence of infection, and many other outcomes (Kapteyn et al. 2020). Importantly for this analysis, we track whether respondents have prayed in the past week to stay safe from COVID-19 and whether they believe prayer is effective against the illness.

We exploit the vaccine rollout as a source of identifying variation in COVID-19 risk. Public health authorities gradually rolled out the vaccine between December 2020 and April 2021, and the timing of eligibility varied by age and health status, as well as state, and occupation. We utilize data on all of these characteristics to construct individual-specific vaccine eligibility dates. Following Borusyak et al. (2024), we estimate the impact of vaccine eligibility on vaccination, perceived COVID-19 mortality risk, prayer, and an avoidance index using a difference-in-difference approach with two-way fixed effects. Vaccine eligibility strongly influences the probability of vaccination, as well as perceived COVID-19 mortality risk. We find that it reduces the probability of weekly prayer by 1 percentage point (2 percent) and reduces avoidance behavior by 0.03 standard deviations (s.d.).

Next we explore the theoretically-motivated dimensions of heterogeneity described above. We compute each respondent's religiosity using an established Pew Foundation index and divide the sample into "weak", "moderate", and "strong" subgroups. The impact on prayer is concentrated among the weakly religious subgroup, for which prayer falls by 1.8 p.p. (30 percent). The impact on prayer is precisely estimated and near zero among strongly religious respondents, leading to statistically significant heterogeneity in this response ($p = 0.03$). Estimates for vaccination, perceived mortality risk, and avoidance are somewhat larger for less religious people, but these differences are not statistically significant. For instance, the effect on vaccination is 14 p.p. for strongly religious people, compared to 17 p.p. for weakly religious people ($p = 0.11$ for this difference). We also measure the perceived effectiveness of COVID-19 vaccines immediately prior to the vaccine rollout. Reinforcing the theory, estimates are larger for people who perceive that the vaccines are effective, although differences for prayer and avoidance are not statistically significant.

We consider two possible explanations for this pattern. Prayer may function as a "coping behavior" that alleviates anxiety related to COVID risk. We estimate impacts on indices of positive and negative coping behaviors. Results for prayer align most closely with estimate for positive coping (including meditation, exercise, and relaxation), suggesting that it may have a similar function for many people. For instance, the effect on positive coping is also largest for weakly religious people and people who believe that vaccines are effective. We also consider the possibility the reduction in prayer simply reflects a return to in-person worship. Estimates are not consistent with this pattern, particularly for the low-religiosity group that has the largest prayer effect.

This study makes three primary contributions. It provides some of the first causal evidence of prayer as a health input. Existing evidence connecting prayer and religion to health is correlational and not grounded in economic theory. The response to vaccine eligibility indicates that some people optimize prayer according to disease risk. Tests of several other theoretical predictions also support the health production framework.

Next, by studying variation by religiosity, we show that the importance of prayer and religious in health production is heterogeneous. Weakly-religious people reduce prayer the most in response to vaccine eligibility, suggesting that prayer is more of a marginal health behavior for them. Because of the similarity of estimates across prayer and other positive coping outcomes, it appears that prayer functions as a coping strategy for less religious people. Estimates for vaccination are somewhat larger and estimates for avoidance behavior are somewhat smaller for religious people. Because these differences are not statistically significant, we do not conclude that religion crowds out vaccination or science-based prevention behavior.

Finally, this study provides the most credible analysis to date of risk compensation within the context of COVID-19 vaccination. Researchers have investigated the Peltzman (1975) effect in a variety of health contexts, including HIV and diarrhea (Bennett 2012, Juyal et al. 2021). Researchers have hypothesized about a Peltzman effect of COVID-19 vaccination (Juyal et al. 2021, Ioannidis 2021), but existing studies are correlational and not dispositive (Buckell et al. 2023, Henk et al. 2023). Our estimates below use the latest difference-in-difference methods, pass standard validity checks for this method, and are nationally representative of adults in the United States. Our finding that risk compensation varies by the degree of religiosity is consistent with the finding of Grabiszewski and Horenstein (2024) that effects are heterogeneous by agent type. This margin of heterogeneity is relevant for disease control policies as well as other health initiatives that target religious people.

This paper proceeds as follows. Section 2 describes the data and presents respondent perceptions about the role of prayer as COVID-19 prevention behavior. Section 3 develops a simple model of health production that incorporates prayer as an input. We derive testable predictions related COVID-19 vaccine eligibility. Section 4 presents difference-in-difference estimates related to COVID-19 vaccine eligibility that test these predictions. Section 5 concludes by discussing the implications of these findings.

2 Context and Data

2.1 Pandemic Timing and Policies

The COVID-19 pandemic began in the US in late January 2020, and the WHO declared COVID-19 a global pandemic on March 11. By June, two million cases had been reported, and by August, COVID-19 was the third leading cause of death in the US. During this time, the US implemented Operation Warp Speed to accelerate the development of COVID-19 vaccines (Burgos et al. 2021). This effort led to the development of several vaccine candidates by the autumn of 2020. The Food and Drug Administration granted an emergency use authorization (EUA) for the Pfizer vaccine on December 11, 2020. While the leading vaccines were somewhat effective at preventing infection, their largest impacts were in reducing the complications associated with severe COVID-19 infections (Mohammed et al. 2022). Contemporaneous news accounts show that the public quickly became aware of this feature of the vaccines (Medical News Today 2021).

Given the limited initial supply of vaccines, health authorities implemented a phased vaccination campaign. This effort loosely followed guidelines developed by the Food and Drug Administration Advisory Committee on Immunization Practices (ACIP) to prioritize vulnerable people and essential workers (Dooling 2021). In general, the guidelines prioritized first responders (defined in various ways), the elderly, and people with existing health vulnerabilities. However the FDA delegated distribution to state health departments, which adapted the guidelines to local priorities and circumstances. Eligibility dates also varied according to vaccine availability within each jurisdiction. Vaccinations began in earnest in January of 2021 and proceeded throughout the winter and spring of that year. By mid-April 2021, everyone aged 16 or older was eligible for vaccination. Although eligibility rules varied by state, age and health status explain most of the variation in the timing of vaccine eligibility.

Figure 2 illustrates the timing of the vaccine rollout and the importance of vaccine eligibility. We divide the sample by the median eligibility date and plot the percent of people who have been vaccinated by date for those with early and late eligibility. Red vertical bars in the figure indicate the beginning and end of the vaccination campaign.

Those who were eligible early received the vaccine sooner. By February 1, 2021, those with early eligibility were 11 p.p. more likely to be vaccinated than those with late eligibility. By March 1, this difference rises to 23 p.p. and remains at 18 p.p. by April 1. The persistent difference in vaccination into the summer of 2021 may reflect heterogeneity in other individual characteristics, such as age, that were associated with eligibility. We discuss the implications of these patterns for our estimates in the empirical analysis below.

2.2 Data and Variables

This analysis relies on data from the Understanding America Study (UAS). The UAS is an online panel survey administered by the University of Southern California (Alattar et al. 2018). Panel members are selected through address-based sampling and are compensated for participation. Respondents receive a tablet and internet access, if needed, to complete the survey. The survey began in 2014 and is based around the University of Michigan's Health and Retirement Study (HRS). The survey uses post-stratification weights to make the sample nationally representative in terms of sex, race, age, marital status, and education. Weights also adjust for differences in the sampling probabilities of geographic units according to Census region, urbanicity, and population size. Most UAS data are available for researchers to use with limited restrictions. The number of respondents has expanded over time, to a total of 9114 by 2023.

During the pandemic, the UAS implemented a high-frequency panel survey related to COVID-19. Surveyors followed up with respondents 34 times from March 2020 through July 2023, with most surveys occurring every two weeks during 2020 and the first six months of 2021 (Kapteyn et al. 2020).[2] The COVID panel survey included an extensive array of questions related to the health and economic impact of the pandemic. Most of these variables are measured longitudinally in a consistent way throughout the survey.

To construct vaccine eligibility, our primary independent variable, we combine publicly available vaccine eligibility rules with individual respondent characteristics. Multistate, a

[2]Surveyors carried out an initial survey from March 10-31, 2020 and then resurveyed respondents every two weeks through February 2021. Respondents were resurveyed every four weeks from February-June 2021. Five additional follow-ups were conducted from September 2021 through July 2023. There are 8107 unique respondents during the survey waves prior to the vaccine rollout and 16,423 unique respondents afterward. A median of 6238 respondents answer the survey in each round.

government relations firm, created and maintained a state-by-state list of vaccine eligibility dates and criteria. We construct individual-specific eligibility dates based on state of residence, age, and occupation.[3] Because of variation in the details of the rollout by state, we identify 64 distinct eligibility dates between December 2020 and April 2021.

The primary outcomes for this analysis are vaccination, subjective COVID-19 mortality risk, prayer, and avoidance behavior. Vaccination is measured through a self-report of the date when the respondent received at least one dose of a COVID-19 vaccine. Although the data capture follow-up doses, we focus on whether the respondent has received at least one inoculation. Subjective mortality risk is the respondent's subjective probability that he or she will die of COVID within three months conditional on infection.[4] We measure prayer through an indicator of whether the respondent has prayed "to stay safe from COVID-19" in the past week.[5] We create an "avoidance index" to collapse the array of measures of social distancing and the use of masks that are available in the data by computing the first principal component. Combining mask and social distancing variables into a single index is sensible because social distancing reduces the need for someone to use a mask. We normalize this index to have a mean of zero and standard deviation of one across the data.

We carry out a heterogeneity analysis according to the respondent's level of religiosity. Religiosity is measured using an index established by the Pew Research Center (Smith et al. 2015). The index includes the importance of religion in the respondent's life, attendance at religious services, regular prayer, and a belief in God. Following the Pew approach, we divide the sample into "weakly religious", "moderately religious" and "strongly religious" subgroups. Some elements of the index are based on responses that occurred in 2022, after

[3] The UAS elicited the occupations of respondents using six digit O*NET occupation codes in Month, Year. The first two digits of the code are general and are publicly available. To construct vaccine eligibility dates, We accessed confidential six-digit codes by application using a secure data enclave.

[4] The survey also measures subjective infection risk and subjective hospitalization risk. Respondents could either enter a response digitally or drag a slider from 0 to 100 percent to answer. We focus on mortality risk conditional on infection because the vaccines had the most salient impact on this margin. Estimates using other probabilities, or unconditional COVID-19 mortality risk (the product of subjective infection risk and subjective mortality risk conditional on infection) yield similar results.

[5] This measure does not include additional details about the prayer such as the duration or the frequency within the week. One concern is that highly religious people may be inframarginal for prayer over a week but could adjust prayer frequency over smaller intervals. In fact, additional data suggest that more highly religious people are marginal for weekly prayer, which minimizes this concern. We discuss this issue further in Section 5.2.

the vaccine rollout. Appendix A.4 shows that estimates are robust if we limit the analysis to responses that occurred prior to the rollout. Appendix A.3 describes these variables in more detail.

When examining results for the weakly religious sample, we distinguish between two primary subgroups. Atheists and agnostics make up 31 percent of this group, while people with "no particular religion" make up 44 percent. Respondents with no particular religion actively chose this designation over a particular denomination. Ethnographic evidence suggests that many people in this group hold spiritual beliefs without subscribing to a particular church (Lee 2014). These groups also differ in terms of prayer. In the pre-vaccine period, 7 percent of weakly religious people with "no particular religion" prayed about COVID, while only 4 percent of atheists and agnostics did so.

Our analysis also examines heterogeneity according to the perceived effectiveness of vaccines. This variable is measured on a four-point Likert scales in November and December of 2020, immediately prior to the beginning of the vaccine rollout. To simplify the exposition, and because few people say that vaccines are highly ineffective, we collapse these categories and distinguish between people who perceive that vaccines are effective and ineffective. The perceived effectiveness of prayer is elicited in a similar way.

2.3 Sample Characteristics

This subsection summarizes the relevant characteristics of the UAS sample. Panel A of Table 1 provides summary statistics for the sample over the period from March-December 2020, prior to authorization and distribution of COVID-19 vaccines. Column 1 shows results for the full sample. With weighting, the sample matches the distribution of age, gender, marital status, and geographic location of the US. 55 percent of respondents have at least one of nine listed chronic health conditions.[6] During this period, respondents perceived a 7 percent risk of death conditional on COVID-19 infection within three months.[7]

[6]The health conditions include diabetes, cancer, heart disease, hypertension, asthma, chronic lung disease, kidney disease, autoimmune disease and obesity.

[7]Table A.4 summarizes the religious denominations within the sample. 17 percent of respondents are Protestant, 14 percent are Catholic, and 19 percent belong to other religious denominations. 9 percent of respondents self-identify as evangelical. Although evangelicals are normally considered a subset of Protestants, a substantial number of non-Protestants also self-identify in this way. Evangelicals may have a particularly

Columns 2-6 of Table 1 show how demographic and religious characteristics vary according to levels of religiosity. Given the large sample size, nearly all comparisons are statistically significant. However the table shows that there are only small differences by religiosity in several characteristics, including age, education, employment, presence of chronic health conditions, perceived COVID-19 risk and work in the education and health care occupations that received vaccination priority. Religiosity is correlated with female gender, marital status, and residence in the South. The most religious subgroup in Column 6 is disproportionately Protestant and evangelical according to Table A.4.

Figure 3 illustrates perceptions about the perceived effectiveness of avoidance (masks and social distancing), vaccination and prayer, distinguishing between Pew religiosity categories. People have high confidence in masks, social distancing, and vaccination as ways to prevent COVID-19, and these perceptions are very similar regardless of religiosity. By contrast, the perceived effectiveness of prayer varies substantially by religiosity. Among the least religious respondents, 71 percent believe that prayer is 'somewhat ineffective' or 'very ineffective' as a way to prevent COVID-19. By contrast, 81 percent of the most religious respondents believe that prayer is somewhat or very effective, with the vast majority of these responses indicating very effective. For this group, prayer is slightly less effective than social distancing by as effective as wearing a mask. On average, people perceive that prayer is somewhat effective against COVID-19. This pattern is consistent with beliefs for other diseases, as we report in Figure 1.

Panel B of Figure 3 gauges perceptions of a complementarity between between prayer and science-based health inputs. We elicit whether people perceive that prayer enhances the effectiveness of either vaccines or masks, as it would if these inputs were seen as complements. Most people do not perceive complementarities, regardless of their level of religiosity. Among the least-religious cohort, 5 percent perceive that prayer makes these behaviors more effective. Even among the most-religious respondents, only 20 percent of respondents perceive that prayer enhances the effectiveness of masks or vaccines. The lack of perceived complementarity informs our model below by suggesting a large elasticity of substitution

strong belief in the impact of prayer to effect change. 48 percent of respondents say that they are Atheist, agnostic, or have no religion.

across prayer and other health inputs.[8]

3 Model

This section develops a simple model to explore the implications of the belief that prayer is a health input. People maximize utility over health, h, and other consumption, c. To study whether people treat prayer as a health input, it is helpful to think of h as representing *perceived* health. People produce health by purchasing two health inputs, v and x, which represent vaccination and another input, which could be either prayer or avoidance. p_v and p_x are the prices of the inputs, and the price of consumption is normalized to 1. To proceed, we solve the cost minimization problem over x and v to derive the implicit price of health, p_h, and then maximize utility over consumption and health. We obtain theoretical predictions about the effect of vaccine eligibility by considering a discrete drop in p_v.

3.1 Health Production

People produce health using a CES production function with two inputs, v and x. α indicates the weight that the person places on x, which is related to religiosity and perceived vaccine effectiveness below. The elasticity of substitution, σ ranges from 0, which represents perfect complements, to infinity, which represents perfect substitutes. For a given level of health, $\overline{h}$, people optimize over x and v by solving the following cost minimization problem.

$$\min_{x,v} \; p_v v + p_x x$$

$$\text{subject to}$$

$$[\alpha x^{\frac{\sigma-1}{\sigma}} + (1-\alpha) v^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \;\geq\; \overline{h}$$

This cost minimization problem yields the following conditional factor demands:

[8] Appendix A.2 describes an supplementary analysis of this issue. In January and February of 2025, we elicited the probability that hypothetical people would contract COVID-19. These people differ in terms of whether they pray regularly, get vaccinated, and engaged in avoidance behavior. Prayer and avoidance only modestly reduced perceived infection risk conditional on vaccination, further suggesting that these inputs are not seen as complements.

$$v \;=\; \frac{h}{\left[A(\alpha)\right]^{\frac{\sigma}{\sigma-1}}} \tag{1}$$

$$x \;=\; \frac{h\, s^{-\sigma}}{\left[A(\alpha)\right]^{\frac{\sigma}{\sigma-1}}} \tag{2}$$

where $A(\alpha) \equiv \alpha s^{1-\sigma} + (1-\alpha)$. In $A(\alpha)$, $s \equiv \frac{(1-\alpha)p_x}{\alpha p_v}$, is the relative cost-effectiveness of x in terms of producing health. Computing the expenditure associated with these factor demands leads to an expression for the "price of health", p_h.

$$p_h \;=\; [\alpha^{\sigma} p_x^{1-\sigma} + (1-\alpha)^{\sigma} p_v^{1-\sigma}]^{\frac{1}{1-\sigma}} \tag{3}$$

The derivative of this expression equals the vaccine cost share, s_v. Since this share is positive, the price of health increases in the price of vaccination.

$$s_v \;\equiv\; \frac{\partial \ln p_h}{\partial \ln p_v} \;=\; \frac{(1-\alpha)^{\sigma} p_v^{1-\sigma}}{\alpha^{\sigma} p_x^{1-\sigma} \;+\; (1-\alpha)^{\sigma} p_v^{1-\sigma}} \in (0,1) \tag{4}$$

Next we maximize utility over c and h using the expression for p_h from Equation (3).

$$\max_{h,c}\; [\beta h^{\frac{\gamma-1}{\gamma}} + (1-\beta) c^{\frac{\gamma-1}{\gamma}}]^{\frac{\gamma}{\gamma-1}}$$

subject to

$$p_h h + c \leq y$$

Solving this utility maximization problem leads to the optimal level of health, which can be substituted into Equations (1) and (2) to obtain closed-form solutions for the health inputs.

$$h^{*} \;=\; \frac{y\beta^{\gamma}}{(1-\beta)^{\gamma} p_h^{\gamma} \;+\; \beta^{\gamma} p_h} \tag{5}$$

3.2 The Impact of Vaccine Eligibility

To model the arrival of the COVID-19 vaccine, we compare h^*, x^*, and v^* in the pre-vaccine period (Period 0), when $p_{v0} = \infty$ and $s_0 < 1$, and the post-vaccine period (Period 1), when $p_{v1} > 0$ has a small finite value and $s_1 > 1$. To simplify the discussion, we assume that $\sigma > 1$, so that x and v are sufficiently substitutable, consistent with evidence presented earlier. It is also helpful to assume that $p_{v1} \leq p_x$, so that the vaccine is not more expensive than the other good.

We consider the impact of the introduction of vaccines on v^*, h^* and x^*. For health and the alternative good, it is convenient to analyze the ratios between Period 1 and Period 0, $\frac{h_1}{h_0}$ and $\frac{x_1}{x_0}$. However since $v_0^* = 0$, the ratio $\frac{v_1}{v_0}$ is not defined. Instead, for vaccines, we can consider $\Delta v = v_1 > 0$.

$$\Delta v \;=\; \frac{h_1^*}{\big[A_1(\alpha)\big]^{\frac{\sigma}{\sigma-1}}} \;>\; 0. \tag{6}$$

with $A_1(\alpha) \equiv \alpha s_1^{1-\sigma} + (1-\alpha)$, where $s_1 \equiv \frac{(1-\alpha)p_x}{\alpha p_{v1}}$.

Equation (3) shows that the introduction of vaccines, which reduces p_v, also necessarily reduces p_h. Substituting p_{h0} and p_{h1} into Equation (5) and taking the ratio, we obtain the expression:

$$\frac{h_1^*}{h_0^*} \;=\; \frac{p_{h0} + (\frac{1-\beta}{\beta})^{\gamma} p_{h0}^{\gamma}}{p_{h1} + (\frac{1-\beta}{\beta})^{\gamma} p_{h1}^{\gamma}} \;>\; 1 \tag{7}$$

This expression shows that the introduction of vaccines improves perceived health.

The effect on x is most clearly seen by taking the ratio $\frac{x_1^*}{x_0^*}$. Equation (8) shows that the effect of vaccine availability on the other input x is ambiguous because it reflects three opposing forces: perceived health improves (pushing x up), vaccination becomes cheaper (pulling x down through substitution), and the CES aggregator mechanically adjusts the input mix (again pushing x up). Behavioral compensation, a reduction in x, occurs when the substitution effect dominates the two upward forces.

$$\frac{x_1^*}{x_0^*} = \underbrace{\frac{h_1}{h_0}}_{>1} \times \underbrace{\left(\frac{s_0}{s_1}\right)^{\sigma}}_{<1} \times \underbrace{\left(\frac{A_0(\alpha)}{A_1(\alpha)}\right)^{\frac{\sigma}{\sigma-1}}}_{>1} \gtrless 1. \tag{8}$$

with $A_j(\alpha) \equiv \alpha s_j^{1-\sigma} + (1-\alpha)$ and $s_j \equiv \frac{(1-\alpha)p_x}{\alpha p_{v_j}}$ $(j \in \{0,1\})$.

3.3 Predictions by Perceived Vaccine Effectiveness and Religiosity

Next we consider how the effects of vaccine eligibility vary with α, the weight on x in the health production function. Considering prayer as x, both high religiosity or low confidence in vaccines increase α. This symmetry means that predictions for religiosity and perceived vaccine effectiveness are isomorphic but oppositely signed.

Figure 3 provides guidance about realistic magnitudes of α. Strongly religious people perceive prayer to be somewhat more effective than vaccination. Moderately religious people view prayer and vaccination as equally effective. Weakly religious view vaccination as much more effective than prayer. All religiosity groups view avoidance as slightly more effective than vaccination. These responses are consistent with moderate or low values of α, which helps to sign our predictions. We examine comparative statics of Equations (6)-(8) by α.

To estimate the differential effect on vaccination, we log differentiate Equation (6) with respect to α.

$$\frac{d \ln \Delta v}{d\alpha} = \underbrace{\frac{1}{h_1^*} \cdot \frac{dh_1^*}{d\alpha}}_{<\ 0} + \underbrace{\frac{\sigma}{1-\sigma} \cdot \frac{A_1'(\alpha)}{A_1(\alpha)}}_{\gtrless\ 0} \tag{9}$$

The sign of this expression is ambiguous because of the last component. The second term is negative as long as vaccines are relatively cheap and effective and α is moderate, so that x is not overwhelmingly important in beliefs. The critical threshold depends upon the prices, as well as α and σ. For instance, if $\sigma = 2$ and $\alpha = 0.3$, then the second term is negative as long as $p_{v1} \leq p_x$. A negative derivative implies that people with higher values of α vaccinate less.

Next we consider the comparative static with respect to health and log-differentiate with respect to α.

$$\frac{d}{d\alpha}\ln\left(\frac{h_1^*}{h_0^*}\right) = \underbrace{\frac{1 + c\gamma p_{h0}^{\gamma-1}}{p_{h0} + c\,p_{h0}^{\gamma}} \cdot \frac{dp_{h0}}{d\alpha}}_{<\ 0} - \underbrace{\frac{1 + c\gamma p_{h1}^{\gamma-1}}{p_{h1} + c\,p_{h1}^{\gamma}}}_{>0} \cdot \underbrace{\frac{dp_{h1}}{d\alpha}}_{\geq 0} \tag{10}$$

This expression is strictly negative under the assumption that $p_{v1} \leq p_x$. The first term in this expression captures the differential effect of α on perceived health prior to the vaccine rollout. An increase in α lowers the price of health in the pre-vaccine period, p_{h0}. The second term reflects the effect of α on the price of health in the post-vaccine period, p_{h1}. Since $p_{v1} \leq p_x$, an increase in α weakly increases p_{h1}, making the second term non-positive. Therefore, we expect smaller improvements in perceived health for more religious people, as well as for people who do not believe in vaccines.

Next we consider the comparative static for the alternative health input, x. Because the direct effect of vaccine availability is ambiguously signed in Equation (8), the interaction with respect to α is ambiguously signed as well. This interaction consists of the health effect in Equation (10) and a CES reweighting term that is ambiguously signed. As discussed, the health effect is theoretically ambiguous but is negative for plausible values of α. In addition, the second term represents reweighting of health inputs within the CES production function once vaccines are introduced. This term may be positive if the x input is inframarginal and therefore does not decline substantially once vaccines are introduced.

$$\frac{d}{d\alpha}\ln\left(\frac{x_1^*}{x_0^*}\right) = \underbrace{\frac{d}{d\alpha}\ln\left(\frac{h_1^*}{h_0^*}\right)}_{<0} + \underbrace{\frac{\sigma}{\sigma-1}\frac{d}{d\alpha}\ln\left(\frac{A_0(\alpha)}{A_1(\alpha)}\right)}_{\gtrless 0}, \tag{11}$$

Because of both terms, we may expect a smaller change in x for people with higher values of α. Since people with higher values of α adjust their health demand less, they also adjust their demand for x less. In addition, x may be more inframarginal for people with high values of α, turning the CES reweighting term positive and further mitigating x declines. In the case of prayer, α equates to greater religiosity, meaning that religious people may have smaller declines prayer either because they perceive smaller health improvements from vaccination or because prayer is more inframarginal. Since the perceived effectiveness of avoidance does not vary with religiosity in Figure 3, we do not expect differences by religiosity in the impact of vaccination on avoidance. An alternative interpretation of α is that vaccines are ineffective. Therefore we expect smaller prayer and avoidance responses for people who lack confidence in vaccines.

Table 2 summarizes these theoretical predictions. The direct effect of the vaccine rollout should be to increase vaccination, reduce subjective mortality risk, and reduce reliance on prayer and avoidance. We expect a weaker effect on vaccination, subjective mortality risk and prayer for more religious people. However we do not predict a difference in the impact on avoidance by religiosity since all groups have similar beliefs about the effectiveness of avoidance and vaccines in Figure 3. For a similar theoretical logic, the vaccine rollout has a larger effect for people who believe in vaccines, and these people experience larger declines in subjective mortality risk, prayer, and avoidance. Since both heterogeneity analyses derive from the common mechanism of α, both sources of heterogeneity provide complementary tests of the model.

4 Analysis of the COVID-19 Vaccine Rollout

Next we evaluate the impact of the COVID-19 vaccine rollout on perceived mortality risk, prayer, and science-based avoidance behavior. By preventing severe infections, the arrival of vaccines discretely reduced COVID mortality risk (Huang and Kuan 2022). According to the model, people may utilize fewer health inputs that are substitutes for vaccines. Therefore, an analysis of the response to the rollout allows us to test the model and the role of prayer as a health input. Section 2.1 describes the timing of the rollout in more detail.

We estimate the impact of vaccine eligibility using a difference-in-difference approach. From December 2020 through April of 2021, governments gradually relaxed vaccine eligibility requirements and offered the vaccine to more and more people. This approach compares the change in outcomes for people who became eligible early to the change in outcomes for those who became eligible late. With 64 distinct eligibility dates, this context is susceptible to the issues of bias raised by Goodman-Bacon (2021) and others with standard two-way fixed effects estimates. We follow the Borusyak et al. (2024) approach to estimate the following equation:

$$y_{it} = \alpha_i + \gamma_{te} + \beta E_{it} + \varepsilon_{it} \tag{12}$$

In this expression, i indexes the individual and t indexes the survey date. e indicates categories of perceived vaccine effectiveness, which was measured immediately prior to the vaccine rollout. Interacting time fixed effects with these categories improves the precision of the estimates and allows for a direct comparison with estimates that examine heterogeneity along this dimension, however results are similar under a single common time trend. E_{it} is an indicator that the respondent is eligible for the vaccine on date t. We incorporate post-stratification weights to align the sample with the demographic characteristics of US adults. Standard errors are clustered by individual. We estimate the impact of the vaccine rollout on the vaccination, subjective mortality risk, prayer and avoidance.

4.1 Identification

The standard difference-in-difference identification assumption is that the eligibility date is not correlated with differential trends in the outcome variables. In this context, the eligibility criteria directly induce differences in the levels of characteristics that were the basis for eligibility. As we describe above, authorities first offered the vaccine to older people and those from prioritized professions. We assess these differences by dividing the sample according to the median eligibility date (March 8, 2021). Table 1 illustrates that, as expected, people with early eligibility are older and more likely to be employed in jobs related to health and education. Nonetheless, eligibility has only a weak association with gender and education. The table also shows that people with early eligibility are modestly more religious.

To assess the possibility of pre-eligibility trends in the primary outcomes, Figure 4 plots the patterns in the primary outcomes of vaccination, mortality risk, prayer, and avoidance for 24 weeks before and 12 weeks after eligibility. We divide the sample into two-week periods and estimate coefficients on these periods within the Borusyak et al. (2024) framework. Consistent with our subsequent analysis by perceived vaccine effectiveness, the figure shows heterogeneity in post-eligibility estimates along this dimension. For all outcomes, pre-eligibility trends appear flat, and in all cases we fail to reject that the coefficients are jointly zero. Panel (c) shows a small dip in prayer prior to eligibility ($p = 0.028$). We investigate further in Appendix A.4 by comparing pre-trends by perceived vaccine effectiveness. Figure A.2 shows that people who view the vaccine as ineffective are responsible for this pattern, which is reassuring since this subgroup is not responsible for our main impacts on prayer or other outcomes.

5 Results

5.1 Overall Estimates and Heterogeneity by Perceived Vaccine Effectiveness

Estimates of the direct effect of vaccine eligibility on appear in Panel A of Table 3. Consistent the difference in uptake by eligibility in Figure 2, vaccine eligibility leads to a 14 percentage point (p.p.) increase in vaccination in Column 1 ($p < 0.001$), as well as a 1.7 p.p. (9 percent) decline in perceived mortality risk conditional on COVID-19 infection in Column 2. In Columns 3 and 4, vaccine eligibility reduced the frequency of weekly prayer by 1 p.p. (2 percent) and reduced avoidance behavior by 0.025 s.d. Scaling by the impact on vaccination in Column 1, the average treatment effect on the treated (ATT) on prayer is roughly -7.1 p.p. and the ATT on avoidance is -0.18 s.d. These estimates are consistent with the theoretical predictions in Table 2, suggesting that the vaccines led to behavior compensation and that people optimized prayer as a health input.

Panel B of Table 3 examines heterogeneity according to perceived vaccine effectiveness. In principle, the impact of vaccine eligibility on perceived COVID risk and other variables depends heavily on whether someone perceives the vaccine as effective. In the context of the model, vaccine effectiveness is inversely proportional to α, and therefore we expect larger absolute impacts on all outcomes for people who perceive that vaccines are effective, at Table 2 illustrates. Results align with this interpretation. Columns 1 and 2 show strong gradients in perceived vaccine effectiveness. For respondents who perceive that the vaccine is very effective, eligibility increases vaccination by 21 p.p. and reduces subjective mortality risk by 2.2 p.p. (12 percent). By contrast, the rollout only increases vaccination by 3.2 p.p. and does not affect perceived risk for those who view the vaccine as ineffective. Effects on prayer an avoidance follow a similar pattern, with the largest estimates for people who perceive that the vaccine is effective, although differences are not statistically significant.

We assess the robustness of these results to including additional covariate controls. By including individual fixed effects, our main specification already controls for time-constant individual attributes. However differential trends that are correlated with vaccine eligibility could still confound these estimates. Figure 5 reproduces the estimates in Table 3 and then controls sequentially for the interaction of time indicators with political party variables, age groups, census regions, and education categories.[9] In general, allowing for more flexible time trends does not substantially change the estimates. An exception to this pattern is that age controls reduce the impact on subjective mortality risk in Panel (b).

Appendix A.4 carries out additional robustness tests. Table A.2 shows that results are robust if we shift the eligibility date 14 days forward or back. Results are not sensitive to short-term changes in the outcomes around eligibility. This pattern is consistent with a causal effect of eligibility on vaccination: it takes time to get vaccinated once someone becomes eligible, and then risk perceptions and behavior gradually adjust. The appendix also shows that vaccine effectiveness results are robust under alternative ways of constructing this variable.

5.2 Heterogeneity by Religiosity

Heterogeneity estimates by religiosity appear in Table 4. Panel C of Table 2 summarizes our theoretical predictions for these interactions. Despite concerns about vaccine hesitancy

[9]Education is divided into four categories. The first category includes education levels equal to or less than a high school graduate or GED; the second category includes some college with no degree and associate college degree—occupational/vocational programs; the third category consists of associate college degree—academic programs and Bachelor's degree. Master's degree, professional school degree, and doctorate degree make up the fourth category. Observations are grouped into three age categories: 18–39, 40–59, and 60–112. There are four census regions: Northeast, Midwest, South, and West. Political party affiliation is divided into four categories: (1) Democrats or some other party, (2) Republicans or Libertarians, (3) Independents (no political party), some other party, or not aligned with any political party, and (4) missing values. Say when the variables were measured and make it clear that they were all measured before the vaccine rollout.

among religious people, the table shows that the impact on vaccination only varies modestly by religiosity. The effect for low-religiosity people is 0.17 while the effect for high-religiosity people is 0.14 ($p = 0.11$ for this difference). Likewise, highly religious people have a somewhat smaller effect on perceived mortality risk than other groups ($p = 0.12$ for this difference).

Next we turn to prayer and avoidance. Column 3 shows that the impact on prayer is concentrated among less religious people. Prayer falls by 1.8 p.p. (30 percent) for weakly religious peopled ($p < 0.01$). It falls by 1.4 p.p. (2 percent) for moderately religious people ($p = 0.06$) and there is no effect for highly religious people. The two mechanisms in Equation (11) can explain this pattern: religious people perceive smaller health gains from vaccination and prayer is more inframarginal as a health input for this group. In Column 4, less religious people also have larger effects on avoidance, however the difference is not statistically significant.[10]

The measurement of prayer introduces a possible explanation for the differential response among less religious people. Prayer is measured in a binary way by week. The apparent lack of an effect may simply reflect that religious people pray very often and are therefore likely to pray at least once a week regardless of COVID risk. We investigate this possibility with supplementary data on the frequency of prayer within a week from January 2025. Figure 6 shows that among both highly and moderately religious people, the modal prayer frequency is seven times per week. However the figure also shows more mass in the "prays 1 time per week" bin in the high- and moderate-religiosity groups than in the low-religiosity group. In other words, there are more marginal people in the moderately-religious and strongly-religious groups because most weakly-religious people do not pray at all. This pattern suggests that, in fact, the lack of an effect for highly religious people is not an artifact of the binary prayer measure.

An analysis by religious denomination can help us understand the strong effects for weakly religious people. As we describe above, atheists/agnostics and people with "no par-

[10]Since we measure the perceived effectiveness of prayer, it is also possible to estimate heterogeneity along this margin. In practice religiosity and beliefs in the effectiveness of prayer are highly correlated. 13 percent of weakly religious people think prayer is effective and 92 percent of strongly religious people hold this belief. Analyzing heterogeneity on this margin instead of religiosity leads to similar results. People who believe that prayer is ineffective show larger absolute impacts on vaccination ($p = 0.03$) and mortality risk ($p < 0.001$). The differences between the two groups are statistically significant for vaccination and mortality risk ($p < 0.001$), but not for prayer ($p = 0.13$) or avoidance ($p = 0.44$).

ticular religion" are the two main types subcategories within this group. Figure 7 examines heterogeneity across these categories and "other religious denominations." Atheists and agnostics have particularly strong impacts on vaccination and subjective mortality risk. We observe an interesting contrast between the behavioral responses of these groups. Prayer declines by 0.019 p.p. among people with no particular religion (nearly twice the overall impact on this outcome), while it does not change significantly for atheists and agnostics ($p = 0.31$ for this difference). By contrast, avoidance declines sharply for atheists and agnostics, while it does not change for people with no particular religion($p = 0.0001$ for this difference). This pattern helps to explain why we observe the strongest prayer response among the weakly religious group, which ostensibly relies the least on prayer.

5.3 Interpretation

According to the evidence presented above, many people view prayer as a health input and behave accordingly. Our key prediction is that prayer to avoid COVID-19 risk should respond to the level of risk in the environment. The significant negative effect of vaccine eligibility on prayer supports this conclusion among weakly and moderately religious people. The impact on prayer is qualitatively similar to the impact on avoidance. Results also align with other predictions of our model. Weakly religious people have the largest point estimates for vaccination and subjective mortality risk, although these differences are not statistically significant. Estimates by vaccine effectiveness test a complementary interpretation of α, the weight on the alternative good within the model. Larger estimates among people who perceive that vaccines are effective further support our framework.

This interpretation also aligns with self-reports. Figure 3 shows that a majority of people perceive that prayer is an effective way to stay safe from COVID-19. Paradoxically, prayer is most responsible to COVID-19 risk among weakly religious people, who also perceive it to be least effective against COVID. We consider two alternative explanations for this pattern.

First, prayer may be a way to alleviate psychological distress. Evidence suggests that the pandemic generally exacerbated psychological distress and that the arrival of vaccines ameliorated this effect (Riehm et al. 2021, Holingue et al. 2020, Perez-Arce et al. 2021). In this aspect, prayer may function like other coping behaviors. Research on coping distinguishes between positive and negative behaviors, concluding that the positive and negative behaviors arise from distinct psychological factors (Park et al. 2008). We assess the comparison with coping by reproducing our earlier estimates for indices of positive and negative coping behavior. Positive coping includes relaxation, meditation and exercise, while negative coping includes the use of alcohol, tobacco, cannabis, vaping, and other drugs. For each variable, the survey records the number of days in the past week that the respondent has done the activity. We compute the first principal component of the included outcomes within each grouping.

Estimates for the positive and negative coping indices appear in Columns 1 and 2 of Table 5. Results for positive coping closely align with prior results for prayer. Vaccine eligibility reduces the positive coping index by 0.02 s.d. ($p = 0.03$). This effect is concentrated among people who perceive that the vaccine is effective, for whom the effect is 0.03 s.d. ($p = 0.002$). The effect on positive coping is largest for low-religiosity respondents, while the effect is actually positive and significant for the high-religiosity group. Column 2 shows a different pattern for negative coping. Here effects are insignificant, except for a strong increase in negative coping among people who perceive that vaccination is ineffective. Taken together, these results suggest that prayer may function as a positive coping strategy for low-religiosity people.

Another potential interpretation of the impact of vaccine eligibility on prayer is that vaccination may have facilitated in-person religious activities. Without access to in-person meetings, people may have relied more heavily on solitary prayer early in the pandemic. The vaccination campaign could have reduced prayer by allowing people to return to in-person worship.

Column 3 of Table 5 considers this explanation by reproducing our main specifications for an indicator for weekly participation in religious services. In Panel A, vaccine eligibility increased participation by 0.5 p.p., however this estimate is statistically insignificant and small in relation to the impact on prayer in Table 3. In Panel C, it is clear that a switch to in-person church attendance cannot explain the impact on prayer among low-religiosity people since the effect on church attendance for this group is small and negative. In sum, these results do not suggest that the decline in prayer simply reflects a shift toward in-person worship.

6 Discussion

During the pandemic, a majority of US adults saw prayer as an effective way to "stay safe from COVID-19" and prayed for this purpose. People responding in this way seemingly view prayer as a health input that may function like social distancing, masks, and vaccination. In this respect, COVID seems to resemble many other common health challenges, for which people view prayer as an important way to improve health. Despite the prevalence of these beliefs, it is unclear whether people behave accordingly. Embedding prayer into a model of health behavior clarifies the patterns we may expect if prayer is a health behavior. A key prediction of the health production framework is that COVID-related prayer should rise with COVID-19 risk. The model also generates the counterintuitive prediction that, under some conditions, prayer should be most responsive to the disease environment for the least religious people. By the same theoretical argument, people who believe in vaccines should respond more strongly: intuitively, up-weighting prayer in health production necessarily implies down-weighting vaccines and other inputs.

The vaccine rollout from December 2020 to April 2021 allows us to test these predictions. The introduction of vaccines discretely reduced the risk of COVID-19, allowing us to gauge the responsiveness of prayer to the disease environment. Public health authorities began by offering the vaccine to elderly and vulnerable people and first responders, and then gradually expanded eligibility as we describe above. We study the impact vaccine eligibility among a representative sample of US adults in the Understanding America Study. We implement a two-way fixed-effects differences-in-differences model to estimate the impact of vaccine eligibility on vaccination, perceived mortality risk, prayer, and avoidance (an index of social distancing and mask usage across in different settings). Vaccine eligibility leads to a small but statistically significant reduction in prayer, an effect that is qualitatively similar to the impact on avoidance. In this way, prayer behavior aligns with beliefs about the effectiveness of prayer against COVID.

We go on to investigate patterns by religiosity. The impact on prayer is largest among weakly religious people, for whom vaccine eligibility reduces prayer by 30 percent. The impact could be smaller for more religious people either because prayer is more inframarginal or because the perceived health benefit is smaller for this group. To understand these results further, we distinguish between the two main types of weakly religious people: atheists/agnostics and people with "no particular religion." As expected, prayer is not responsive for atheists and agnostics, who pray infrequently both before and after vaccines. By contrast, people with no particular religion respond strongly. For these people, prayer may function as a marginal input that they perceive as necessarily only in extreme circumstances. Calling upon prayer in this way may help people cope with fear and uncertainty. Impacts on positive coping resemble estimates for prayer and support this interpretation.

We do not find evidence that religion "crowds out" vaccination or other science-based health behavior. We do not necessarily expect strong differences since weakly and strongly religious groups have similar beliefs about the effectiveness of vaccines and avoidance in Figure 3. Compared to weakly religious people, the impact of vaccine eligibility on vaccination is 18 percent smaller and the impact on avoidance is 45 percent smaller in the strongly religious group, but neither difference is statistically significant. This result contradicts the popular notion of resistance to vaccines and masks among religious people, but may reflect similar hesitancy among some less-religious people.

Results help understand the possible complementarity between religion and health behavior. First, self-reports do not suggest a complementarity since few people believe that prayer enhances the impact of science-based behaviors using two distinct methods of elicitation. Vaccine eligibility estimates also do not suggest complementarity. Vaccine eligibility does not increase prayer, and we do not observe larger impacts on vaccination among religious people, as we would if prayer and vaccines were seen as complements. This pattern could have important policy consequences: interventions that increase the perceived complementarity between prayer and science-based health behavior could be especially motivating for religious people.

Finally, the integration of prayer as another input into the health production function may not fairly represent the role of prayer in the lives of religious people, for whom prayer is tightly integrated into their lifestyle and identity. People may not literally feel that prayer translates into reduced COVID risk. Rather it may contribute to a spiritual dialogue with God that enables the person to make wise health decisions and thereby stay safe. The lack of vaccine eligibility on prayer among religious people may reflect the importance of prayer in their daily life. For strongly religious people, praying regularly is a lifestyle choice rather than an action to cope with a crisis.

Table 1: Pre-Rollout Sample Characteristics by Religiosity and Vaccine Eligibility

		Religiosity			Vaccine Eligibility		P-values	
	All	Weak	Moderate	Strong	Early	Late	Relig.	Elig.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Demographics								
Age	49.8	45.6	50.1	52.3	58.1	41.6	0.00	0.00
Female	0.51	0.44	0.51	0.57	0.51	0.51	0.00	0.77
Married	0.56	0.51	0.54	0.62	0.59	0.53	0.00	0.00
Education	10.9	11.3	10.8	10.7	11.0	10.7	0.00	0.00
Employed	0.53	0.55	0.55	0.50	0.43	0.65	0.03	0.00
Healthcare/education field	0.11	0.10	0.10	0.12	0.18	0.03	0.09	0.00
Republican	0.27	0.15	0.26	0.38	0.31	0.23	0.00	0.00
Northeast census region	0.18	0.20	0.19	0.14	0.23	0.13	0.00	0.00
Midwest census region	0.21	0.24	0.21	0.18	0.22	0.19	0.01	0.01
South census region	0.38	0.27	0.36	0.48	0.36	0.40	0.00	0.01
West census region	0.23	0.29	0.24	0.20	0.19	0.28	0.00	0.00
B: Health and Religion								
Chronic health condition	0.55	0.52	0.54	0.58	0.75	0.35	0.00	0.00
Subjective COVID mortality risk	0.07	0.06	0.07	0.08	0.08	0.06	0.00	0.00
COVID infection (last 2 weeks)	0.01	0.02	0.01	0.01	0.01	0.02	0.72	0.00
Perceived vaccine effectiveness	18.86	20.16	20.40	15.80	12.29	25.46	0.00	0.00
Perceived avoidance effectiveness	3.51	3.55	3.51	3.47	3.55	3.47	0.05	0.00
Perceived prayer effectiveness	4.80	4.84	5.37	3.96	4.66	4.95	0.00	0.47
Pew Religiosity Index	0.40	-2.89	0.16	2.95	0.59	0.22	0.00	0.00
Prays weekly about COVID	0.60	0.06	0.61	0.94	0.63	0.56	0.00	0.00
Avoidance index	-0.05	-0.02	-0.06	-0.05	0.02	-0.12	0.40	0.00
Number of Observations	141,153	33,649	61,798	45,706	66,734	74,369	–	–

Note: the table reports sample means for the period from March 11-December 10, 2020. All statistics use post-stratification weights to ensure that the sample is representative of US adults in terms of gender, race, age marital status, and education, as explained in the text. Vaccine eligibility categories are split at the median of March 8, 2021.

Table 2: Theoretical Sign Predictions for Vaccine Eligibility Effects

	Outcome				Conditions for Signed Effect
	Vaccination	Subjective Mort. Risk	Prayer	Avoidance	
	(1)	(2)	(3)	(4)	(5)
A: Direct effect	+	−	−	−	Eligibility lowers the price of vaccination and improves perceived health; Assume the behavioral compensation effect dominates.
B: Vaccine effectiveness interaction	+	−	−	−	Higher perceived vaccine effectiveness (lower α) implies larger perceived health gains and stronger behavioral responses. Assume α is small or moderate.
C: Religiosity interaction	−	+	+	0	Perceived health gains decrease in α; Assume prayer not is dominant (small or moderate α); no religiosity gradient for effectiveness of avoidance.

Table 3: Difference-in-Difference Estimates of the Impact of Vaccine Eligibility

	Vaccination	Mortality Risk	Prays Weekly	Avoidance Index
	(1)	(2)	(3)	(4)
A: Overall Impact				
Overall	0.14***	-0.017***	-0.010***	-0.040***
	(0.0071)	(0.0022)	(0.0040)	(0.011)
Pre-rollout mean	0.00	0.19	0.60	-0.04
Observations	185,723	185,723	185,723	164,951
B: Impact by Perceived Vaccine Effectiveness				
Vaccine not effective	0.026***	0.0009	0.0035	-0.024
	(0.0096)	(0.0038)	(0.0093)	(0.032)
Vaccine effective	0.16***	-0.020***	-0.010**	-0.045***
	(0.0086)	(0.0026)	(0.0044)	(0.011)
Pre-rollout mean				
Vaccine not effective	0.00	0.17	0.70	-0.46
Vaccine effective	0.00	0.20	0.58	0.06
Equality of coefficients (p-value)	0.00	0.00	0.17	0.74
Observations	185,723	185,723	185,723	164,951

Note: Regressions are based on the specification: $y_{it} = \alpha_i + \beta_{te} + \gamma E_{it} + \varepsilon_{it}$ in which i indexes the individual, t indexes the two-week time period, e is perceived vaccine effectiveness, and E_{it} is the individual's vaccine eligibility. Estimates follow the difference-in-difference imputation approach of Borusyak et al. (2024). Estimates are weighted to be nationally representative in terms of in terms of sex, race, age, marital status, and education, as explained in the text. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: The Impact of Vaccine Eligibility by Religiosity

	Vaccination	Mortality Risk	Prays Weekly	Avoidance Index
	(1)	(2)	(3)	(4)
Weakly religious	0.17***	-0.024***	-0.018***	-0.055***
	(0.013)	(0.0038)	(0.0046)	(0.015)
Moderately religious	0.13***	-0.015***	-0.014*	-0.031*
	(0.010)	(0.0033)	(0.0073)	(0.016)
Strongly religious	0.14***	-0.015***	-0.0019	-0.030*
	(0.011)	(0.0033)	(0.0040)	(0.017)
Pre-rollout mean				
Weakly religious	0.00	0.17	0.06	-0.02
Moderately religious	0.00	0.20	0.61	-0.06
Strongly religious	0.00	0.20	0.94	-0.04
Equality of coefficients (p-value)	0.11	0.12	0.03	0.46
Observations	185,723	185,723	185,723	164,951

Note: Regressions are based on the specification: $y_{it} = \alpha_i + \beta_{te} + \gamma E_{it} + \varepsilon_{it}$ in which i indexes the individual, t indexes the two-week period, e is perceived vaccine effectiveness, and E_{it} is the individual's vaccine eligibility. Estimates also include the interaction between time indicators and religiosity or religious affiliation categories, as applicable. Estimates follow the difference-in-difference imputation approach of Borusyak et al. (2024). Estimates are weighted to be nationally representative in terms of sex, race, age, marital status, and education, as explained in the text. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Pathways for the Impact of Vaccine Eligibility on Prayer

	Positive Coping Index	Negative Coping Index	Attends Rel. Services
	(1)	(2)	(3)
A: Overall Impact			
Overall	-0.021**	0.012	0.0048
	(0.010)	(0.010)	(0.0036)
B: Impact by Perceived Vaccine Effectiveness			
Vaccine not effective	0.034	0.078***	0.00022
	(0.025)	(0.030)	(0.011)
Vaccine effective	-0.034***	-0.0036	0.0057
	(0.012)	(0.010)	(0.0038)
Equality of coefficients (p-value)	0.01	0.01	0.63
C: Impact by Religiosity			
Weakly religious	-0.055***	0.027	-0.00052
	(0.018)	(0.018)	(0.0024)
Moderately religious	-0.048***	0.019	0.0048
	(0.015)	(0.017)	(0.0045)
Strongly religious	0.039**	-0.0012	0.0014
	(0.018)	(0.014)	(0.0078)
Equality of coefficients (p-value)	0.00	0.45	0.58

Note: Regressions are based on the specification: $y_{it} = \alpha_i + \beta_{te} + \gamma E_{it} + \varepsilon_{it}$ in which i indexes the individual, t indexes the two-week time period, e is perceived vaccine effectiveness, and E_{it} is the individual's vaccine eligibility. Positive coping includes meditation, exercise and relaxation. Negative coping includes the use of cannabis, tobacco, vaping, drinking alcohol, and using drugs. For both indices, I compute the first principal component of the included variables and then standardize this index. Estimates follow the difference-in-difference imputation approach of Borusyak et al. (2024). Estimates are weighted to be nationally representative in terms of in terms of sex, race, age, marital status, and education, as explained in the text. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

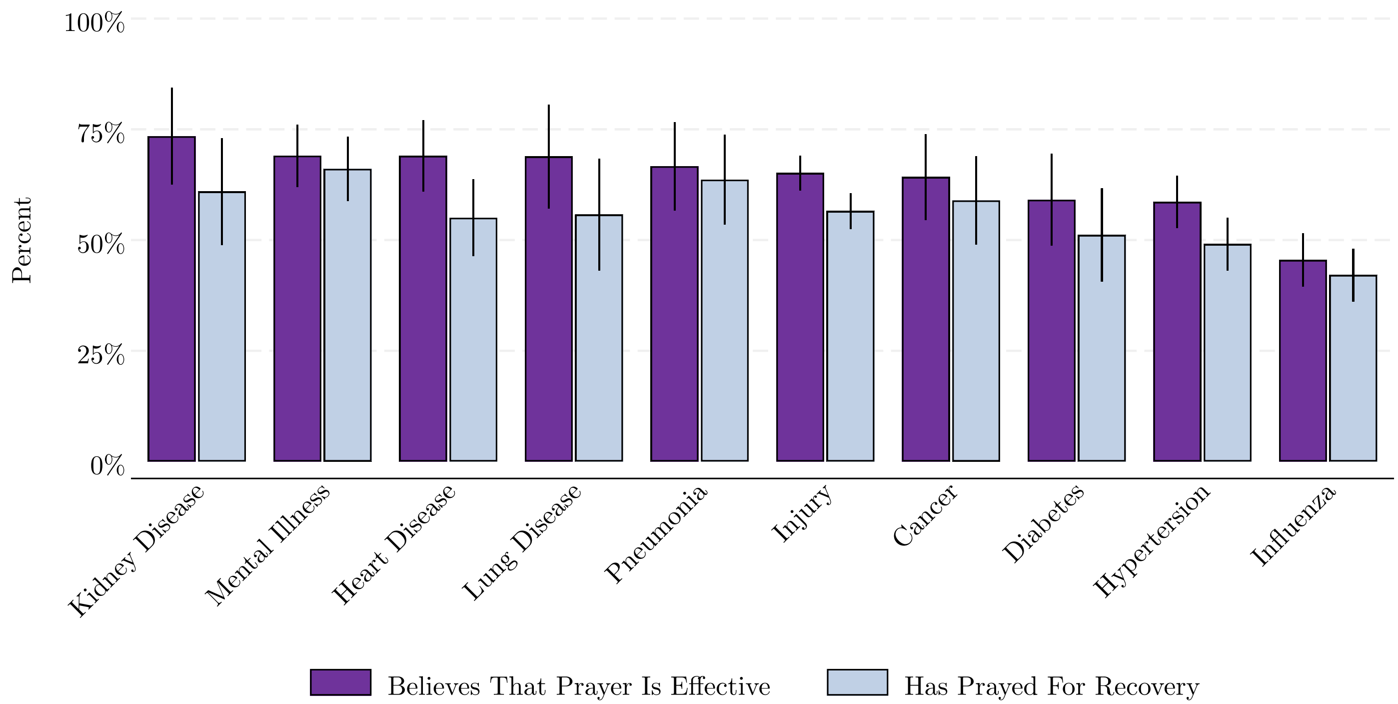


Figure 1: Perceived Effectiveness and Utilization of Prayer across 10 Health Problems

Note: the figure shows perceived effectiveness and utilization of prayer across 10 health problems. Error bars show 95 percent confidence intervals. Blue bars report the percentage of respondents who perceive prayer as an effective way to recover for health problems, while the purple bars reports the percentage of respondents who have prayed as a way to recover from health problems. The sample is based on a survey of 1563 participants in the Understanding America Study that was conducted from December 18, 2024 to February 09, 2025.

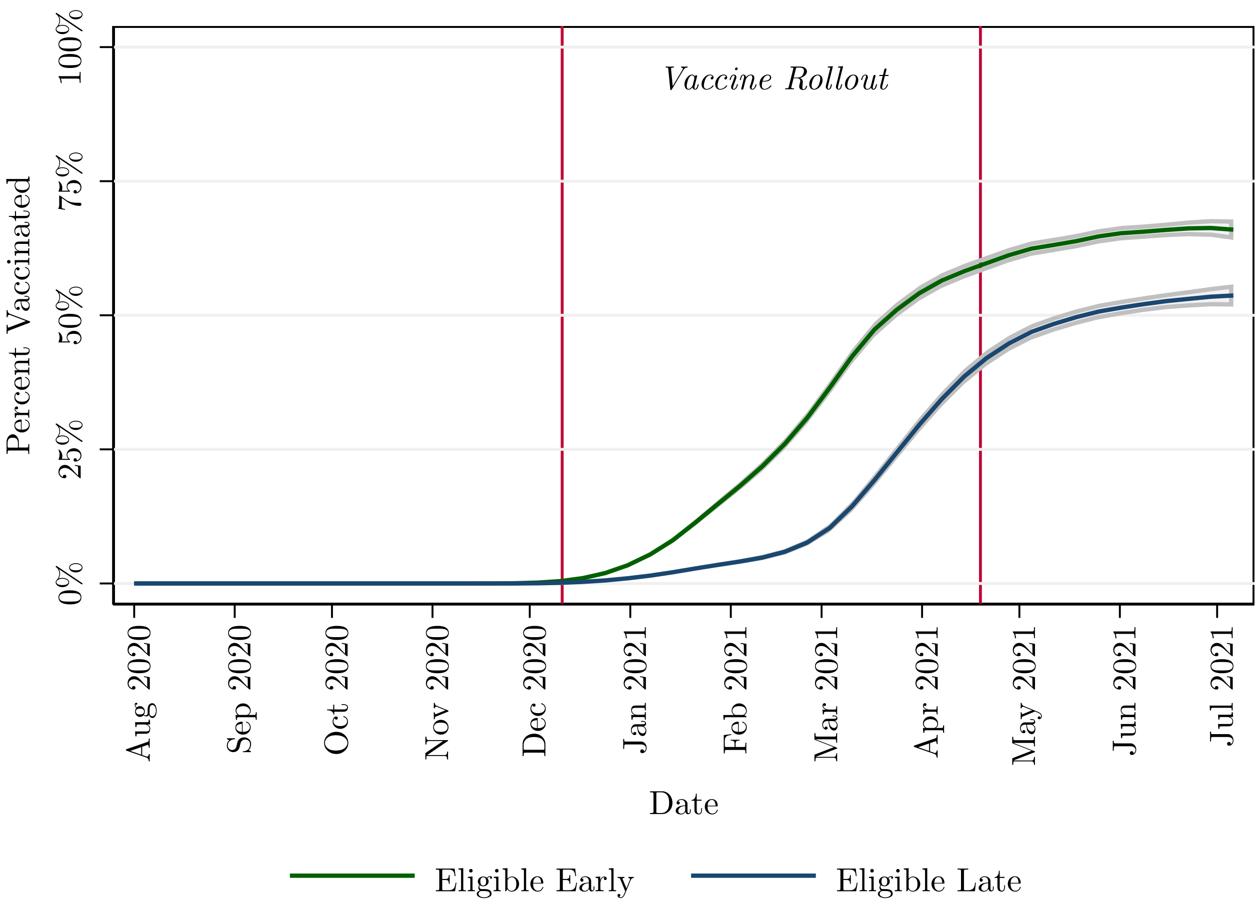
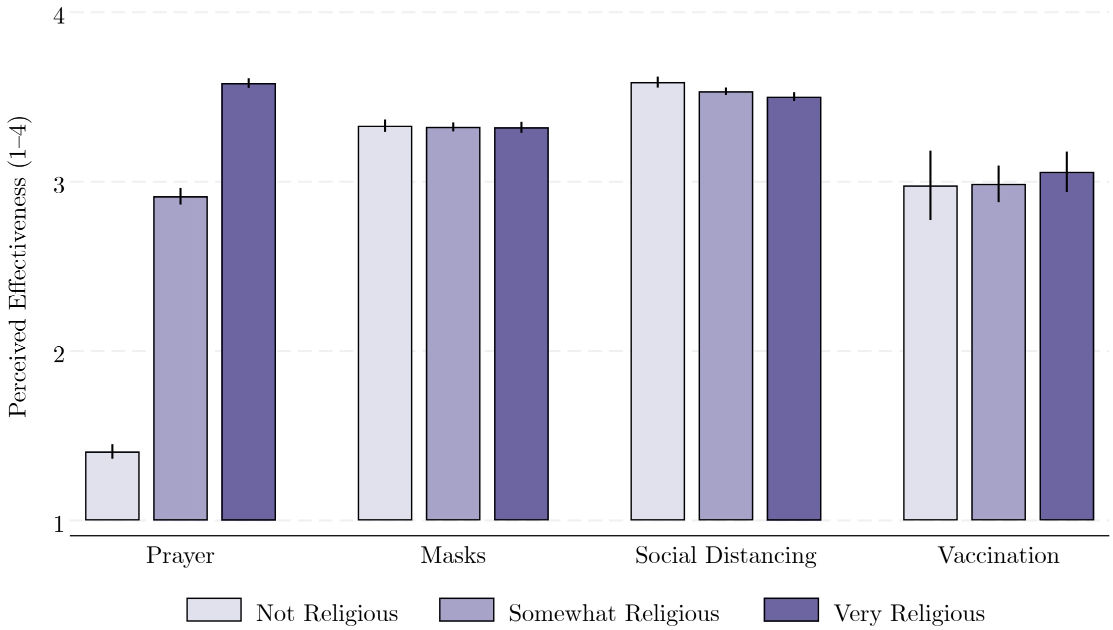


Figure 2: Vaccine Eligibility and the Timing of the Vaccine Rollout

Note: the figure divides the sample according to the median date of vaccine eligibility. Error bars show 95 percent confidence intervals based on individual-clustered standard errors. Estimates are weighted to be nationally representative of US adults as explained in the text.



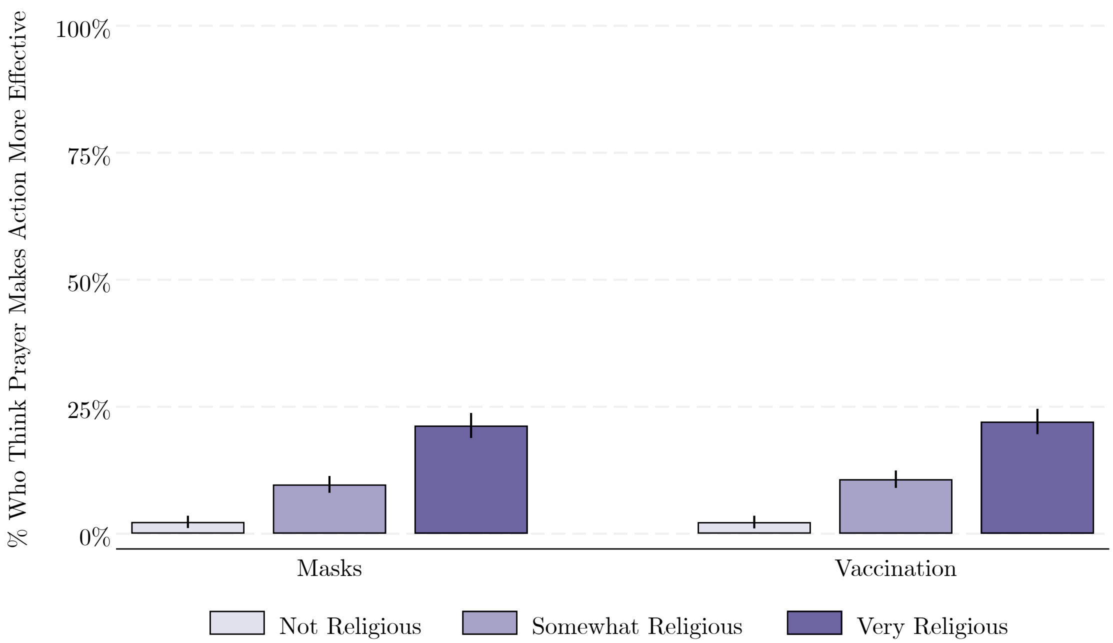


Figure 3: Perceptions About the Effectiveness and Complementarity Between COVID-19 Prevention Behaviors

Note: the figures divide the sample into religiosity categories. Error bars show 95 percent confidence intervals. Estimates are weighted to be representative of US adults, as described in the text. Panel (a) reports the average perceived effectiveness of prayer, masks, social distancing, and vaccination against COVID-19 on a four-point Likert scale. Panel (b) shows the percent of respondents who perceive a complementarity between prayer and other health inputs.

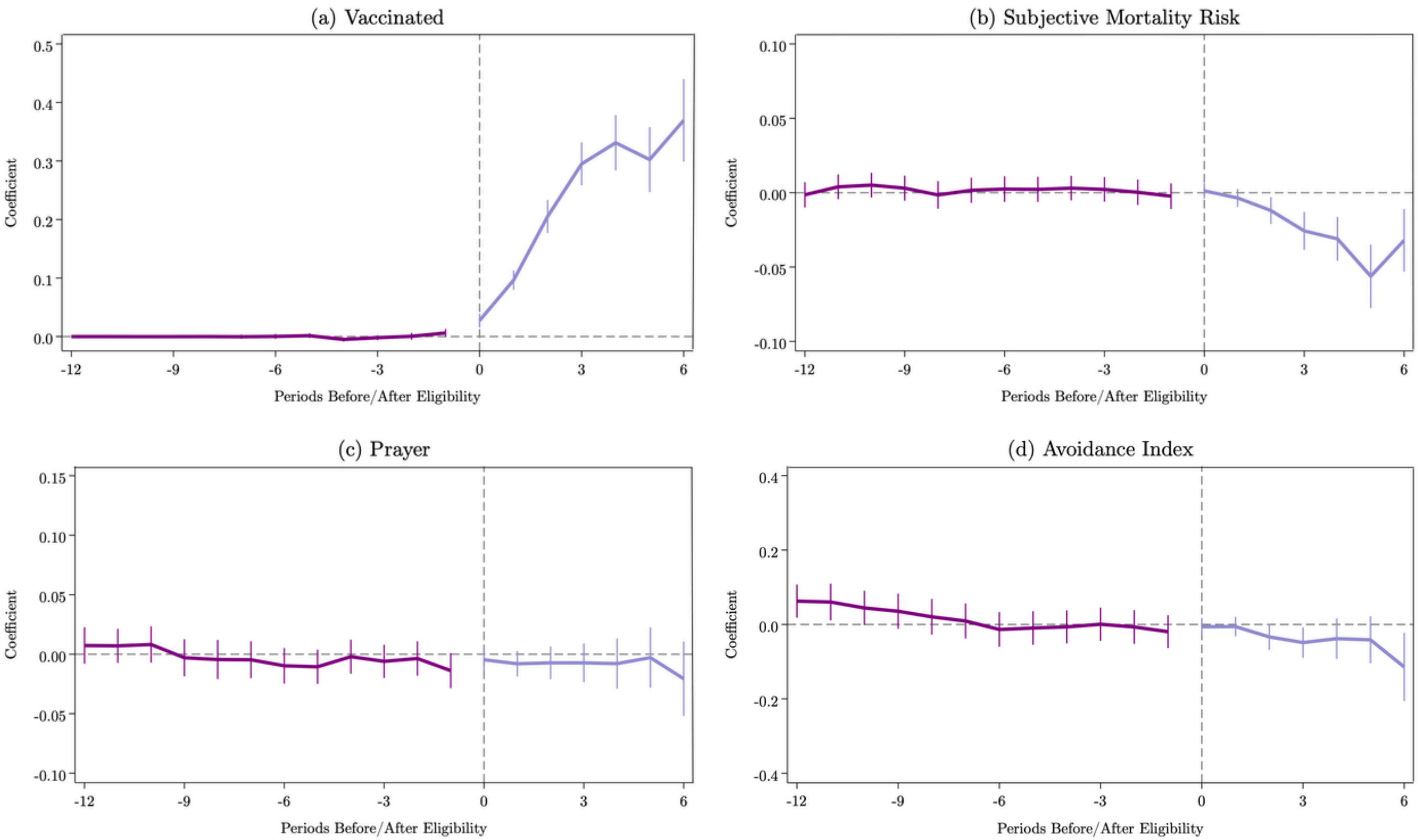


Figure 4: Pre-Trends in Key Outcomes

Note: The figure estimates biweekly pre- and post-eligibility trends for key outcome variables. Estimates are based on on the DID imputation method of (Borusyak et al. 2024). Variables are defined as in the text. Periods are two weeks long. Error bars indicate 95 percent confidence intervals based on individually-clustered standard errors. Estimates are weighted to be nationally representative.

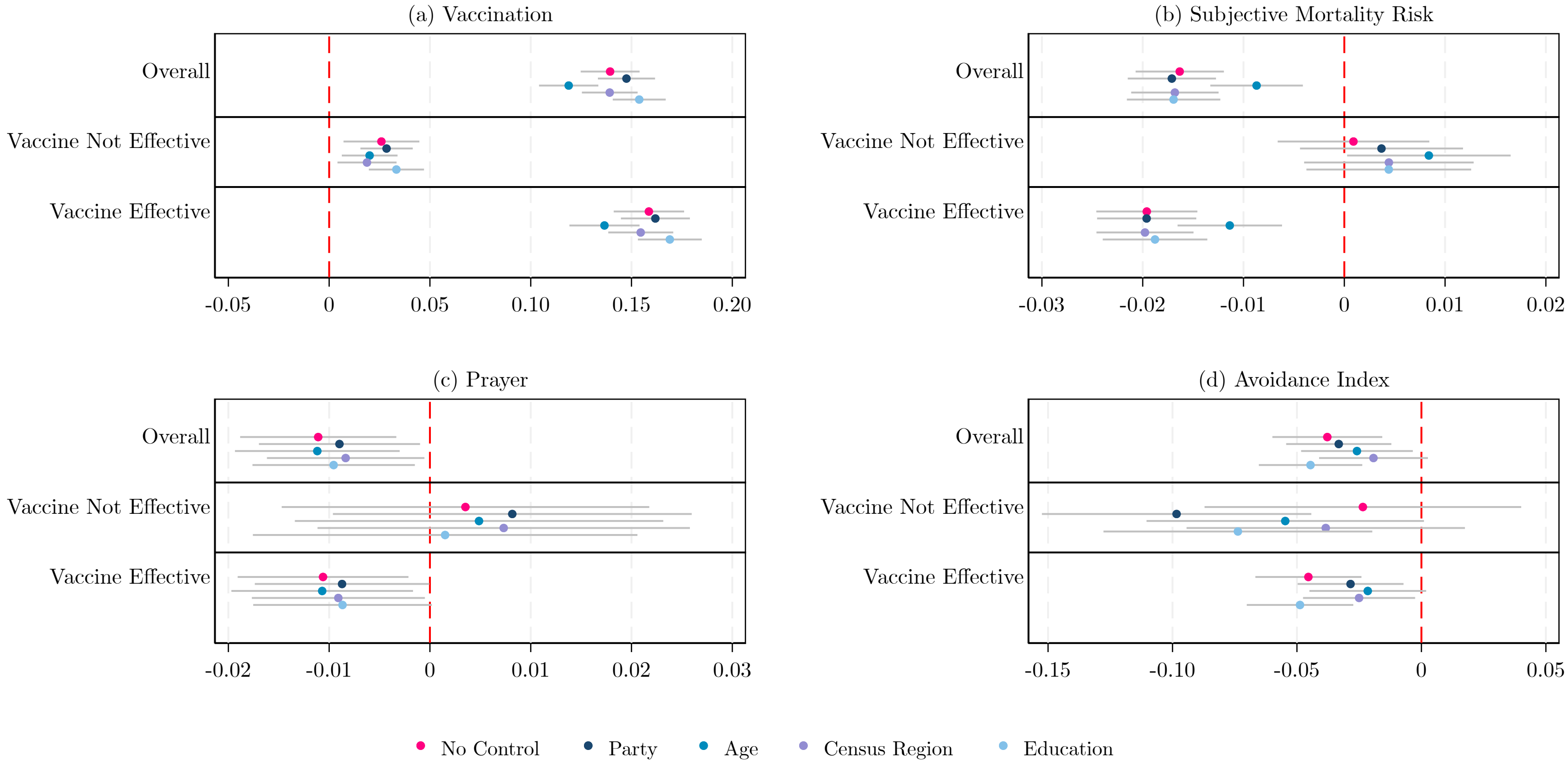


Figure 5: Point Estimates with Different Controls by Perceived Vaccine Effectiveness

Note: The figure presents point estimates for key outcome variables by perceived vaccine effectiveness. Within each outcome-effectiveness combination, it includes coefficients from five regressions: one with no controls and four with an interaction between the time indicator and one of the following variables: political party, age, census region, or education. In each graph, the grid line indicating a coefficient of zero is marked with a red dashed line. Error bars represent 95 percent confidence intervals based on individually clustered standard errors.

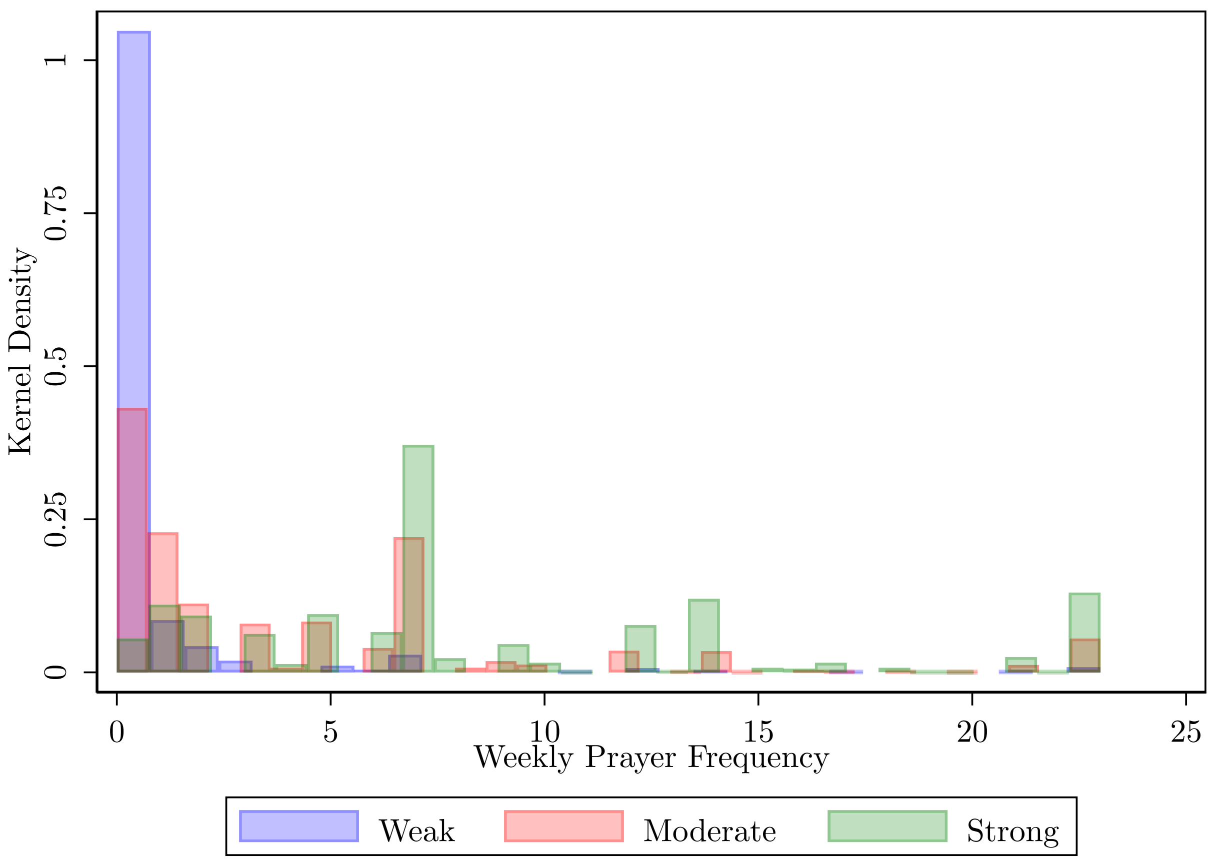


Figure 6: Distribution of Prayer Frequency By Religiosity

Note: the figure shows the frequency distribution of prayer within a week by religiosity based on survey data from January 2025.

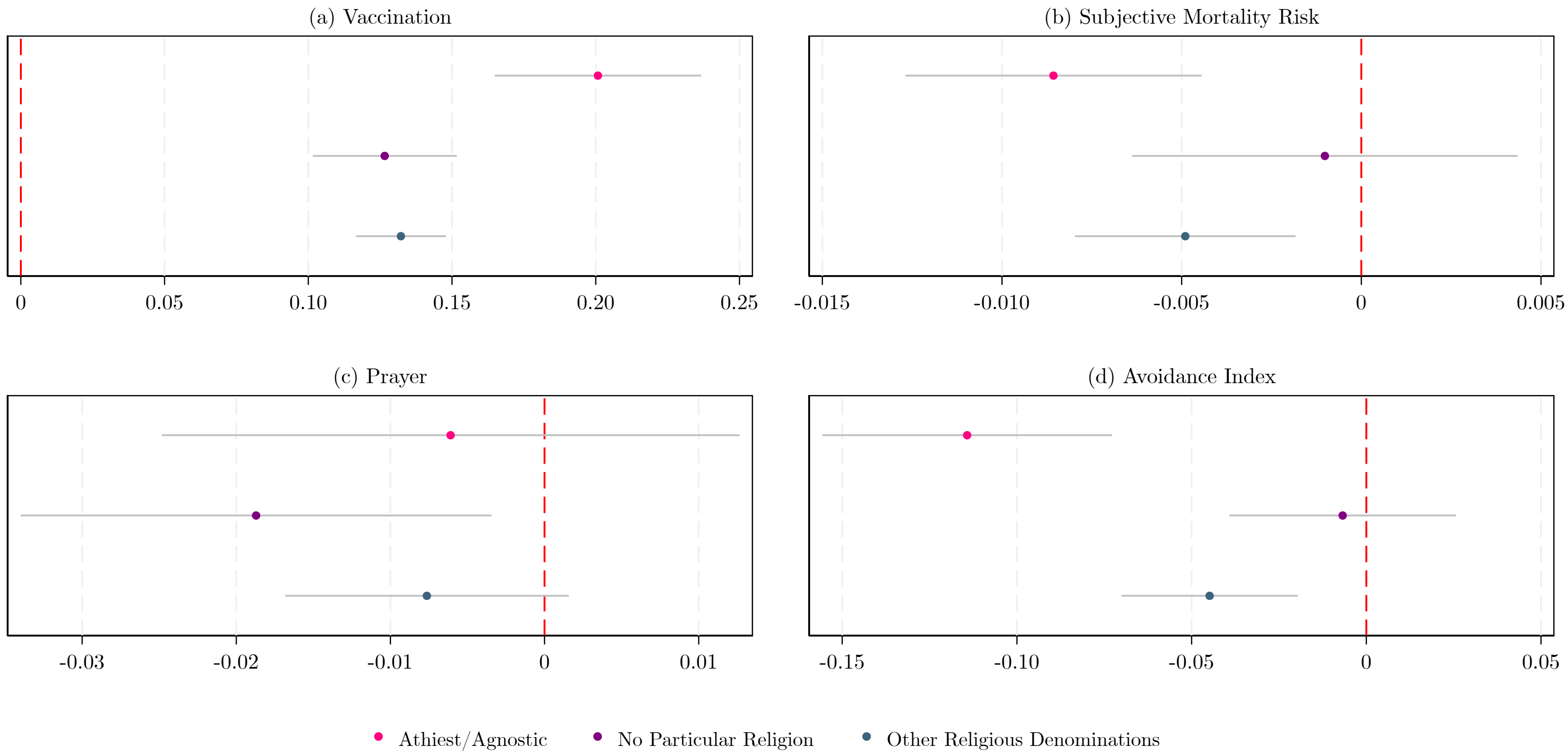


Figure 7: Estimates for Atheists/Agnostics and People with No Particular Religion

A Appendix

A.1 Additional Data Sources

To further investigate attitudes toward prayer, the survey incorporated additional variables related to religion and prayer in February and March of 2022. These questions measure whether the respondent perceives that prayer makes other COVID prevention strategies, including wearing a mask and receiving a vaccination, to be more or less effective. An additional cross-sectional survey in January and February of 2025 measures the importance of prayer for a broader array of health domains and collects more detail on the frequency and nature of prayer in general. An important caveat for these data is that they were collected a year after the vaccine rollout. Therefore it is possible that experiences with the rollout could have influenced the way that people responded to these questions.

A.2 Additional Evidence Regarding Input Substitutabilty

Figure A.1 presents data from the Understanding America Study in a survey collected between December 17, 2024 and February 6, 2025 (Survey UAS 673). Respondents were asked to estimate COVID-19 infection risk under hypothetical scenarios. We elicited how many out of 100 people similar to themselves would contract COVID-19 within a year when engaging in different combinations of protective behaviors, including prayer, vaccination, and non-pharmaceutical interventions such as mask use and avoiding public places. Responses were recorded on a 0–100 scale, and the order of scenarios was randomized. If two behaviors are complements, then practicing them in combination should have an effect that is larger than the sum of the effects of practicing them separately. Taken alone, vaccination reduces risk by 17 p.p. , prayer reduces risk by 5 p.p. , and avoidance reduces risk by 22 p.p. . The combination of vaccination and prayer has a similar effect to vaccination alone. Combining vaccination and avoidance reduces risk by an additional 5 points compared to vaccination alone, which is much less than the sum of the effects of the two activities. These patterns further reinforce that people do not perceive these health inputs to be complementary.

A.3 Variable Definitions

- The variable "avoidance index" incorporates social distancing and mask wearing behaviors over the past week in various contexts. The variables that are available are different in the three distinct time periods below. Within each period, we compute the first principal component of the available variables. We normalize the index within each period.
  - **March–June 2020:** The index includes basic avoidance behaviors: (1) avoiding high-risk individuals, (2) avoiding public spaces, (3) avoiding restaurants, (4) working or studying from home, (5) wearing a face mask, and (6) washing hands. These questions were asked in binary form: "Yes" or "No".

- **July 2020–June 2021:** PCA expands to include detailed avoidance behaviors, such as avoiding the following activities in the past seven days: (1) gatherings of 10+ people, (2) crowded places such as bars and clubs, (3) grocery stores or pharmacies, (4) close contact with non-household members, (5) visiting others' homes, (6) outdoor activities (e.g., walking, hiking, or exercise), (7) air travel, (8) public transportation, and (9) having visitors at home. These expanded questions had three response options: "Yes," "No," or "Unsure." The index also includes face mask usage during these activities, measured on a 6-point Likert scale: "Always," "Most of the time," "Sometimes," "Rarely," "Never," or "Unsure."
- **September 2021–May 2023:** PCA employs only the expanded set of detailed avoidance variables and face mask usage introduced in the previous period (July 2020–June 2021), excluding the basic behavioral measures used in the initial period.

- Following the 2014 Pew Research Center Religious Landscape Study (Pew Research Center 2018), we constructed a measure of "Religiosity" as the sum of four components. Each component is categorized into three levels: high, medium, and low.
  - **Importance of Religion in Life**: This component is derived from UAS 15 (June 2015–January 2016) and UAS 37 (February 2016–October 2022). The question asked was: "How important is religion in your life?" The original question had six response options: "The most important thing," "Very important," "Somewhat important," "Not too important," "Not at all important," and "Don't know".
  - **Church Attendance**: Similar to the first component, this component is derived from UAS 15 (June 2015–January 2016) and UAS 37 (February 2016–October 2022). The question asked was: "How often do you attend religious services besides weddings and funerals?" The original question had seven response options: "Daily," "Multiple times a week," "Once a week," "One to two times a month," "Less than once a month," "Never," and "Don't know".
  - **Belief in God**: This component is derived from UAS 351 (February 2022–March 2022). The question asked was: "Which of the following comes closest to your beliefs?" The original question had four response options: "I believe in God," "I believe in some other higher power or spiritual force," "I do not believe in any higher power or spiritual force," and "I'm not sure".
  - **Prayer Frequency**: This component is constructed using responses from waves 1–21 of the UAS Coronavirus Tracking Survey. The relevant question asked: "Which of the following have you done in the last seven days to keep yourself safe from coronavirus?" "Prayer" is one of the 16 response options, and the measure is defined as the average frequency of reporting prayer across waves.

- 24.58 percent of people responded to some questions that contribute to the religiosity index after the vaccine rollout. Estimates are similar if we exclude these people from the analysis, as we explain below.

A.4 Additional Estimates

Figure A.2 distinguishes between categories of perceived vaccine effectiveness. The Borusyak et al. (2024) approach does not allow us to estimate separate pre-trends by heterogeneity categories. Prayer shows a small dip from Period -2 to Period -1, however the figure shows that this pattern is driven by people who perceive that the vaccine is not effective. Avoidance shows a downward trend from Periods -12 to -6, however the series is flat in the weeks immediately prior to eligibility.

Table A.2 presents estimates using three alternative treatment-timing shifts, showing that the main results in Table 3 remain robust when allowing vaccination to occur up to 14 days before or after eligibility. Vaccine eligibility statistically significantly increases vaccination by 11 p.p. when the eligibility date is advanced by two weeks, and by 16 p.p. when the eligibility date is delayed by two weeks, compared to 14 p.p. when there is no shift in treatment timing. Although the estimates differ slightly when the treatment timing is changed, these differences are intuitive and small in magnitude. We therefore conclude that even if some individuals were vaccinated several days before or after their eligibility date, our estimation results remain robust. Similar patterns are observed for the other three outcomes.

Table A.3 further confirms robustness by restricting the sample to respondents whose religiosity index was measured prior to the vaccine rollout. More than 75 percent of the sample remains in the estimation. The overall impact of vaccine eligibility on the four main outcomes shows little change. When the sample is grouped by religiosity, most estimates also remain similar, except for the effect of vaccine eligibility on mortality risk among moderately religious individuals. In the main results, this effect is 1.5 p.p. and is statistically significant at the 1 percent level, whereas it is 0.78 p.p. and statistically significant at the 10 percent level in this restricted sample. This pattern suggests that the effect in the main results may be driven by respondents whose religiosity index was measured after the vaccine rollout.

Figure A.3 decomposes the Avoidance Index into 22 individual components, showing that the primary effect of vaccine eligibility is driven by mask-wearing during close contact with non-household members and during outdoor activities such as walking, hiking, or exercise. Figure A.4 similarly examines the components of positive and negative coping strategies in Table 5, suggesting that prayer may serve as a form of exercise or relaxation for some individuals.

In the paper, we collapse perceived vaccine effectiveness into two categories. In fact, this variable takes five possible values, as we illustrate in Figure A.5. To assess the robustness of this approach, Figure A.6 shows estimates of the effects of vaccine eligibility for all possible vaccine effectiveness categories. The resulting patterns are broadly consistent with those obtained using the two-category classification in Table 3 and Table 5. Similarly, we collapse religiosity into three categories, however Figure A.7 shows the full distribution of the index. To assess the sensitivity to this categorization, Figure A.8 presents estimates by nine categories of religiosity, yielding patterns comparable to those based on the three-category classification in Table 4 and Table 5.

A.5 Impacts on COVID infection

Table A.1 reproduces our main estimates for COVID-19 infection. Respondents may be coded as positive for COVID-19 through three possible channels: a positive COVID-19 test, a doctor's diagnosis, or a subjective belief that they contracted COVID-19. This flexibility is important because the availability of COVID-19 tests varies over the course of the pandemic. Patterns in the table are not consistent with estimates for perceived mortality risk in the paper. In Panel A, we find no overall effect of vaccine eligibility on COVID-19 infections. This pattern could reflect the fact that vaccines did more to reduce the severity of COVID-19 infections rather than to prevent them. In Panel B, vaccine eligibility reduces COVID-19 infections significantly for those who perceive that the vaccine is not effective and for those who perceive it to be very effective. However it appears to increase infections among those who perceive the vaccine to be somewhat effective. These differences are statistically significant ($p < 0.01$). The non-monotonicity by vaccine effectiveness is difficult to interpret. Finally, in Column C, we find no significant effects for any religiosity subgroups. Results are not consistent with our findings in Table 4, which shows that all groups reduce perceived COVID-19 mortality risk.

A.6 Determination of Vaccine Eligibility

We calculate vaccine eligibility by combining individual characteristics with state-specific eligibility criteria. As described in the text, the Federal government purchased vaccine doses from drug manufacturers and then relied on state health departments to distribute vaccines. Following CDC guidelines, these agencies prioritized providing vaccines to first responders and vulnerable individuals, including the elderly and those with compromised health situations. States set rollout dates based on their interpretation of these guidelines, access to vaccine doses, and local infrastructure for vaccine delivery. Multistate, a government relations firm, maintained a list of state-specific eligibility dates and criteria. We combine these data with information on individual UAS respondents to determine each person's eligibility. These characteristics include age, chronic health conditions, residence in a nursing home, occupation, and state of residence. Where possible, we rely on responses that occurred prior to the vaccine rollout. However occupation data were collected during February-April 2021, during the vaccine rollout. Occupation data are based on six-digit o*net codes, which is the highest level of granularity. We applied for access to these confidential data and utilized a secure data enclave to construct the eligibility variable.

One concern with reliance on occupation data that were collected during the vaccine rollout is that some people might sort into occupations that give them earlier eligibility. This concern seems unlikely given the training and experience needed to enter many of the relevant occupations (e.g. first responders, health care workers and educators). As an additional test of possible occupational sorting, we examine whether vaccine eligibility is associated with any unusual employment patterns early in the vaccine rollout. We do not find evidence of sorting. From December 11, 2020 to March 7, 2021 (the median eligibility date), 98 percent of employed early-eligible people remained in the same job while 97 percent of employed late-eligible people did so. This suggests that it is unlikely people chose occupations to hasten vaccine eligibility.

Table A1: The Impact of Vaccine Eligibility on COVID Infection

	COVID-19
	(1)
A: Overall Impact	
Overall	-0.0026
	(0.0021)
B: Impact by Perceived Vaccine Effectiveness	
Vaccine not effective	-0.019***
	(0.0053)
Vaccine somewhat effective	0.0054**
	(0.0024)
Vaccine very effective	-0.0061*
	(0.0035)
Equality of coefficients (p-value)	0.00
D: Impact by Religiosity	
Weakly religious	0.0032
	(0.0035)
Moderately religious	-0.0023
	(0.0037)
Strongly religious	-0.0012
	(0.0033)
Equality of coefficients (p-value)	0.50

Note: Regressions are based on the specification: $y_{it} = \alpha_i + \beta_{te} + \gamma E_{it} + \varepsilon_{it}$ in which i indexes the individual, t indexes the two-week time period, e is perceived vaccine effectiveness, and E_{it} is the individual's vaccine eligibility. Estimates follow the difference-in-difference imputation approach of Borusyak et al. (2024). Estimates are weighted to be nationally representative in terms of sex, race, age, marital status, and education, as explained in the text. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: The Impact of Vaccine Eligibility with a Shifted Treatment Timing

	Vaccination	Mortality Risk	Prays Weekly	Avoidance Index
	(1)	(2)	(3)	(4)
A: Vaccine Eligibility Date Advanced by 14 Days				
Overall	0.11***	-0.011***	-0.011**	-0.043***
	(0.0059)	(0.0022)	(0.0037)	(0.010)
Observations	175,559	175,559	175,559	156,125
B: Vaccine Eligibility Date Delayed by 14 Days				
Overall	0.16***	-0.015***	-0.010**	-0.047***
	(0.0078)	(0.0025)	(0.0044)	(0.011)
Observations	175,823	175,823	175,823	156,362
C: Dropped Observations from 14 to 1 Day Before Eligibility				
Overall	0.14***	-0.014***	-0.012**	-0.048***
	(0.0070)	(0.0024)	(0.0042)	(0.011)
Observations	171,412	171,412	171,412	152,514

Note: Regressions are based on the specification: $y_{it} = \alpha_i + \beta_{te} + \gamma E_{it} + \varepsilon_{it}$ in which i indexes the individual, t indexes the two-week time period, e is perceived vaccine effectiveness, and E_{it} is the individual's vaccine eligibility. In the regressions, the treatment date E_{it} is hypothetically shifted 14 days earlier or later for each treated unit. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: The Impact of Vaccine Eligibility Using the Pre-Rollout Religiosity Index

	Vaccination	Mortality Risk	Prays Weekly	Avoidance Index
	(1)	(2)	(3)	(4)
A: Overall Impact (Sample with Non-Missing Pre-Rollout Religiosity Index)				
Overall	0.13^{***}	-0.013^{***}	-0.011^{**}	-0.046^{***}
	(0.0081)	(0.0026)	(0.0042)	(0.011)
Pre-rollout mean	0.00	0.19	0.60	-0.04
Observations	140,080	140,080	140,080	124,870
B: Impact by Pre-Rollout Religiosity Index				
Weakly religious	0.16^{***}	-0.021^{***}	-0.015^{**}	-0.058^{***}
	(0.012)	(0.0041)	(0.0059)	(0.016)
Moderately religious	0.12^{***}	-0.0078^{*}	-0.016^{*}	-0.032^{*}
	(0.012)	(0.0041)	(0.0081)	(0.017)
Strongly religious	0.13^{***}	-0.012^{***}	0.00007	-0.045^{**}
	(0.011)	(0.0037)	(0.0047)	(0.021)
Pre-rollout mean				
Weakly religious	0.00	0.17	0.10	-0.06
Moderately religious	0.00	0.22	0.75	-0.01
Strongly religious	0.00	0.18	0.96	-0.11
Equality of coefficients (p-value)	0.03	0.06	0.06	0.56
Observations	140,080	140,080	140,080	124,870

Table A4: Pre-Rollout Religious Denominations by Religiosity and Vaccine Eligibility

		Religiosity			Vaccine Eligibility		P-values	
	All	Weak	Moderate	Strong	Early	Late	Relig.	Elig.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Evangelical Protestant	0.09	0.00	0.07	0.19	0.12	0.07	0.00	0.00
Non-Evangelical Protestant	0.08	0.04	0.09	0.08	0.11	0.05	0.00	0.00
Catholic	0.14	0.05	0.15	0.18	0.16	0.11	0.00	0.00
Other religion	0.19	0.08	0.17	0.28	0.19	0.18	0.00	0.25
Atheist or agnostic	0.27	0.54	0.27	0.10	0.25	0.30	0.00	0.00
No particular religion	0.21	0.32	0.23	0.10	0.18	0.23	0.00	0.00
Number of Observations	141,153	33,649	61,798	45,706	66,734	74,369	–	–

Note: the table reports sample means for the period from March 11-December 10, 2020. All statistics use post-stratification weights to ensure that the sample is representative of US adults in terms of gender, race, age marital status, and education, as explained in the text. Vaccine eligibility categories are split at the median of March 8, 2021.

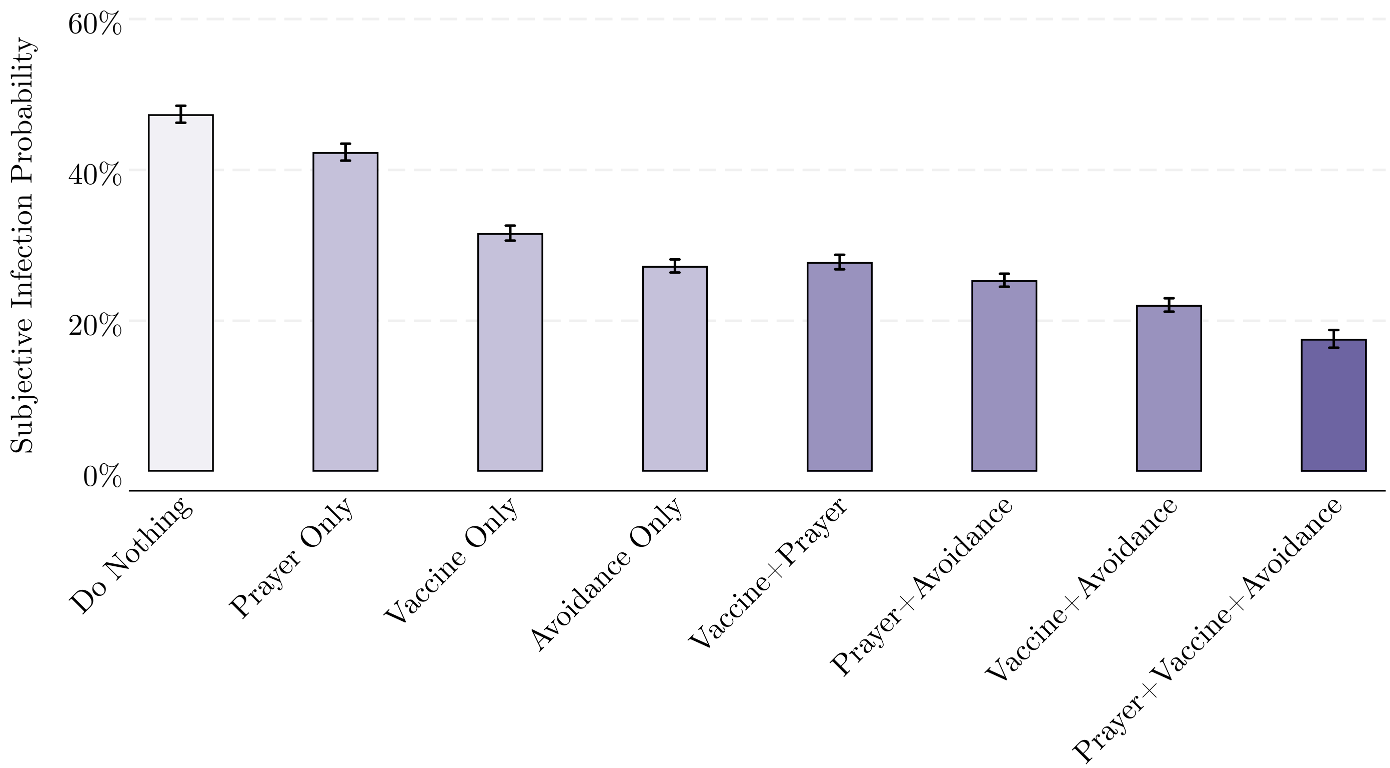


Figure A.1: Perceptions About the Complementarity Between COVID-19 Prevention Behaviors

Note: The figure presents point estimates for subjective infection probability when using different preventive behaviors. The estimation results are essentially the same when the sample is divided into different subgroups of religiosity.

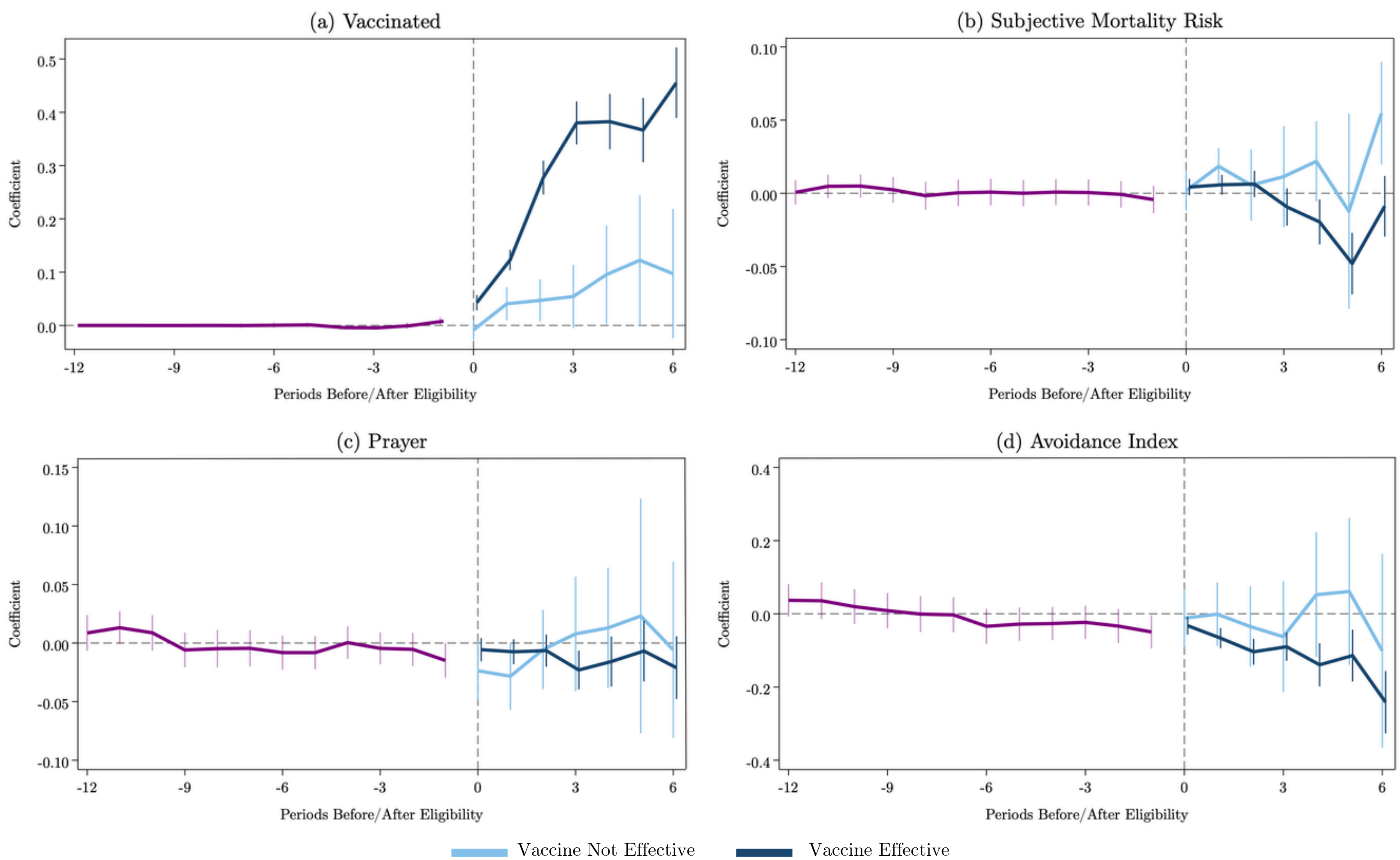


Figure A.2: Trends by Perceived Vaccine Effectiveness

Note: The figure estimates biweekly pre- and post-eligibility trends for key outcome variables. Post-eligibility trends are estimated separately by perceived vaccine effectiveness. Estimates are based on on the DID imputation method of (Borusyak et al. 2024). Variables are defined as in the text. Error bars indicate 95 percent confidence intervals based on individually-clustered standard errors. Estimates are weighted to be nationally representative.

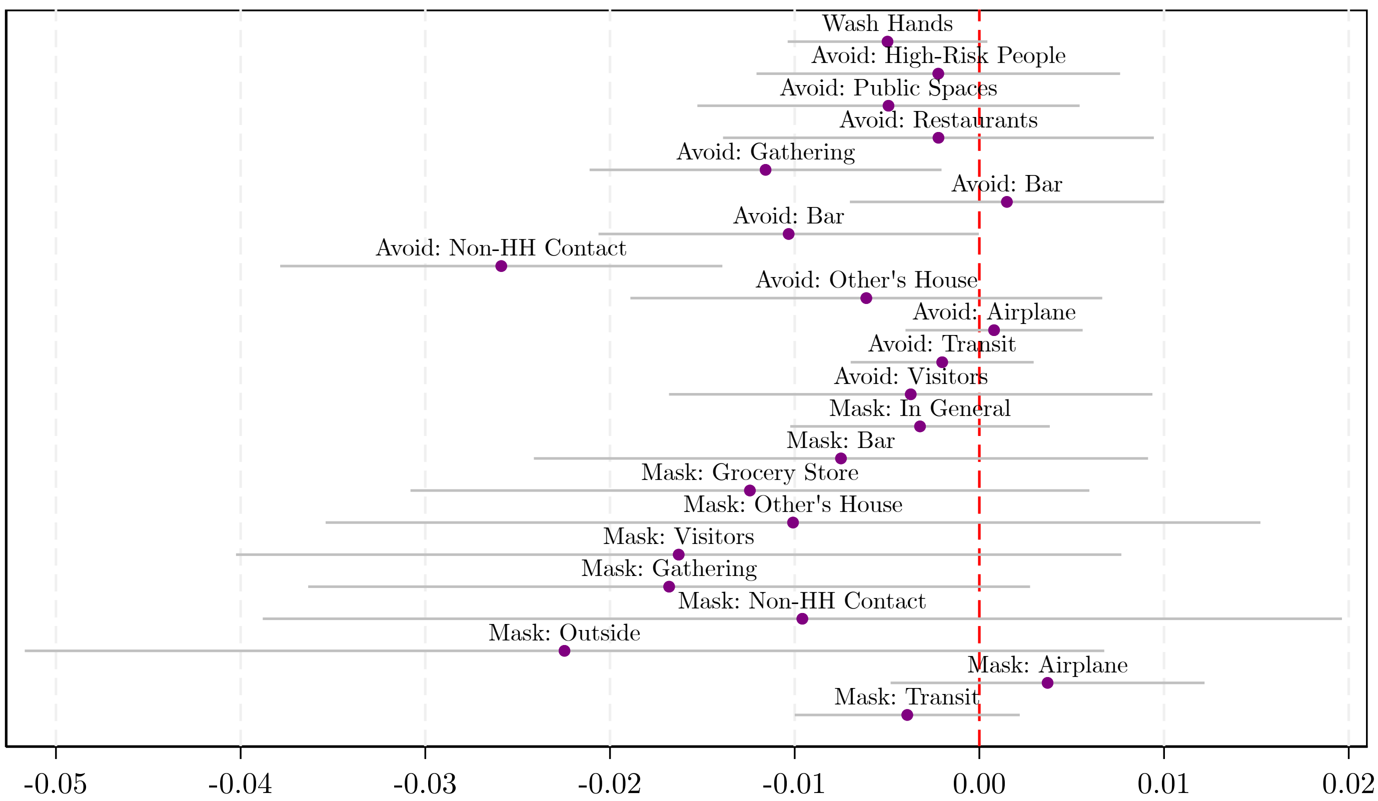


Figure A.3: Effects of Vaccine Eligibility on Components of Avoidance Index

Note: This figure shows the estimated impact of vaccine eligibility on the individual components of Avoidance Index. The index captures a range of behaviors, including avoiding high-risk individuals, public spaces, restaurants, and social gatherings, as well as engaging in personal protective practices such as mask wearing and handwashing.

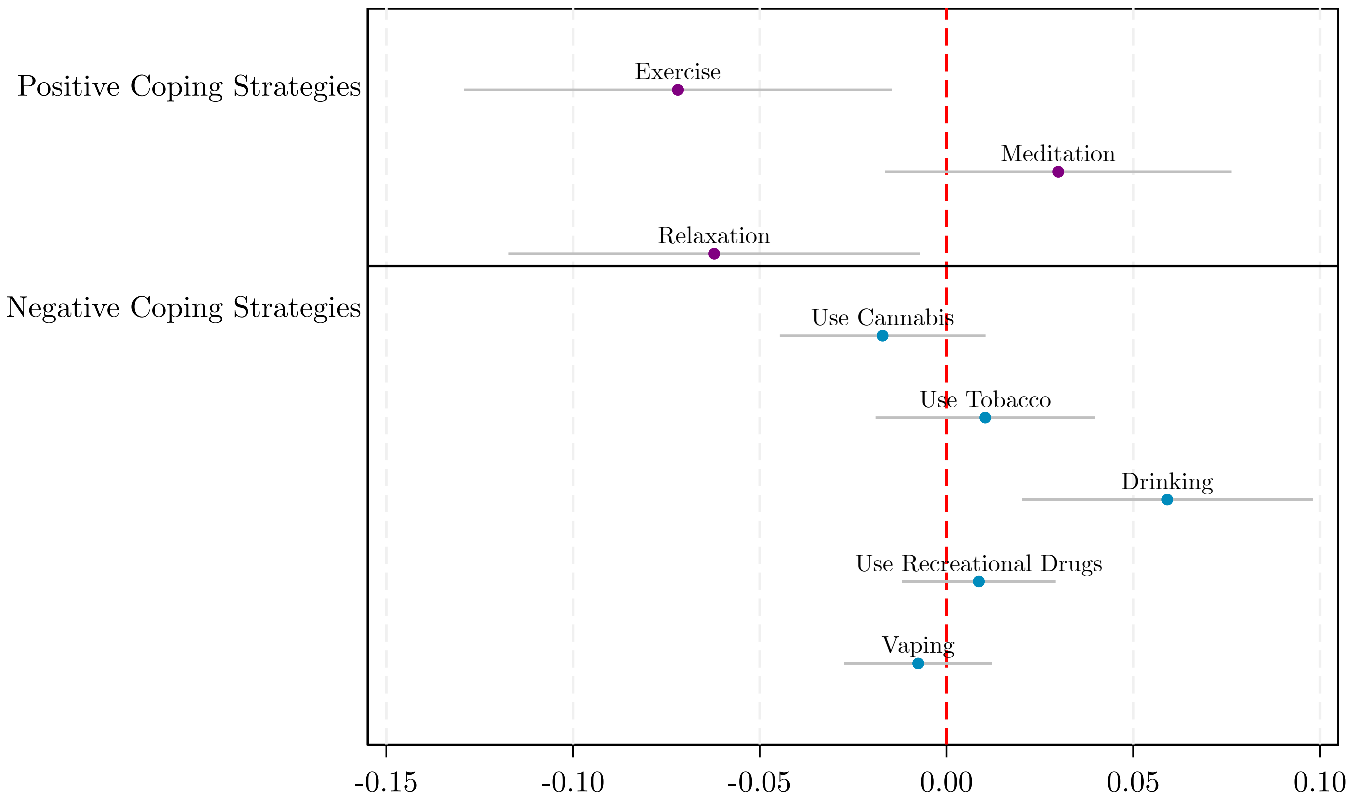


Figure A.4: Effects of Vaccine Eligibility on Components of the Coping Index

Note: This figure shows the estimated impact of vaccine eligibility on the individual components of the Positive and Negative Coping Index.

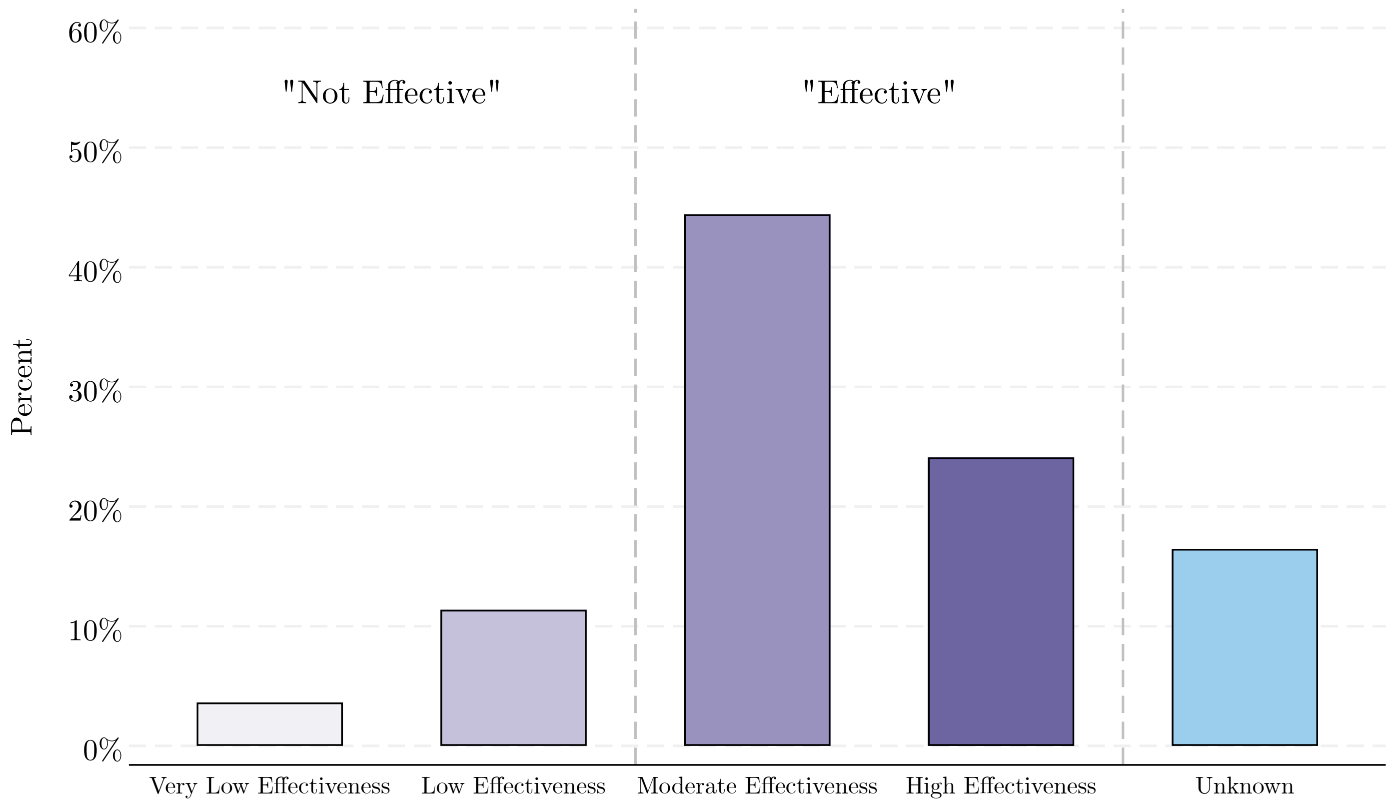


Figure A.5: Distribution of Effectiveness of Vaccine

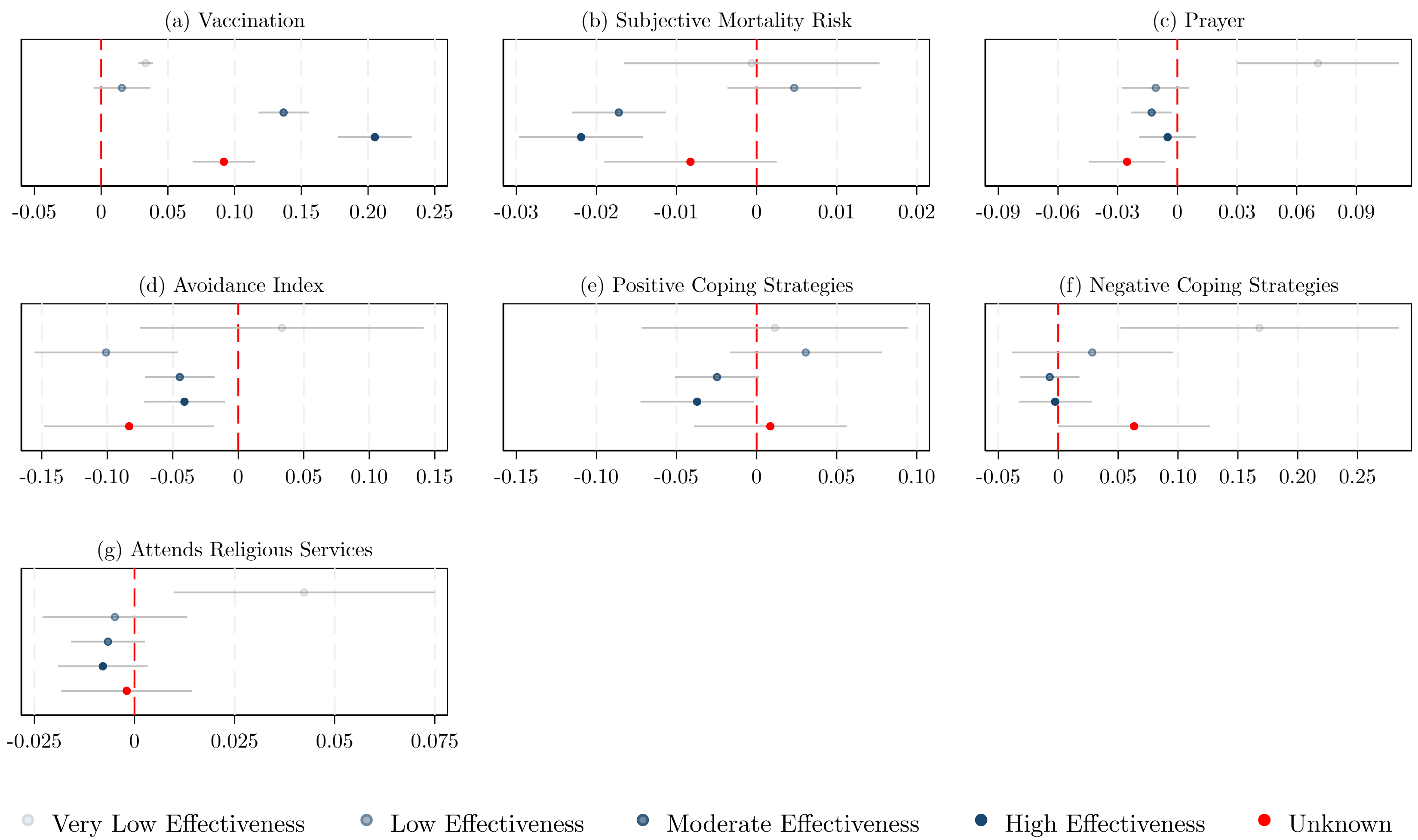


Figure A.6: Effects of Vaccine Eligibility on Outcomes by Full Categories of Effectiveness of Vaccine

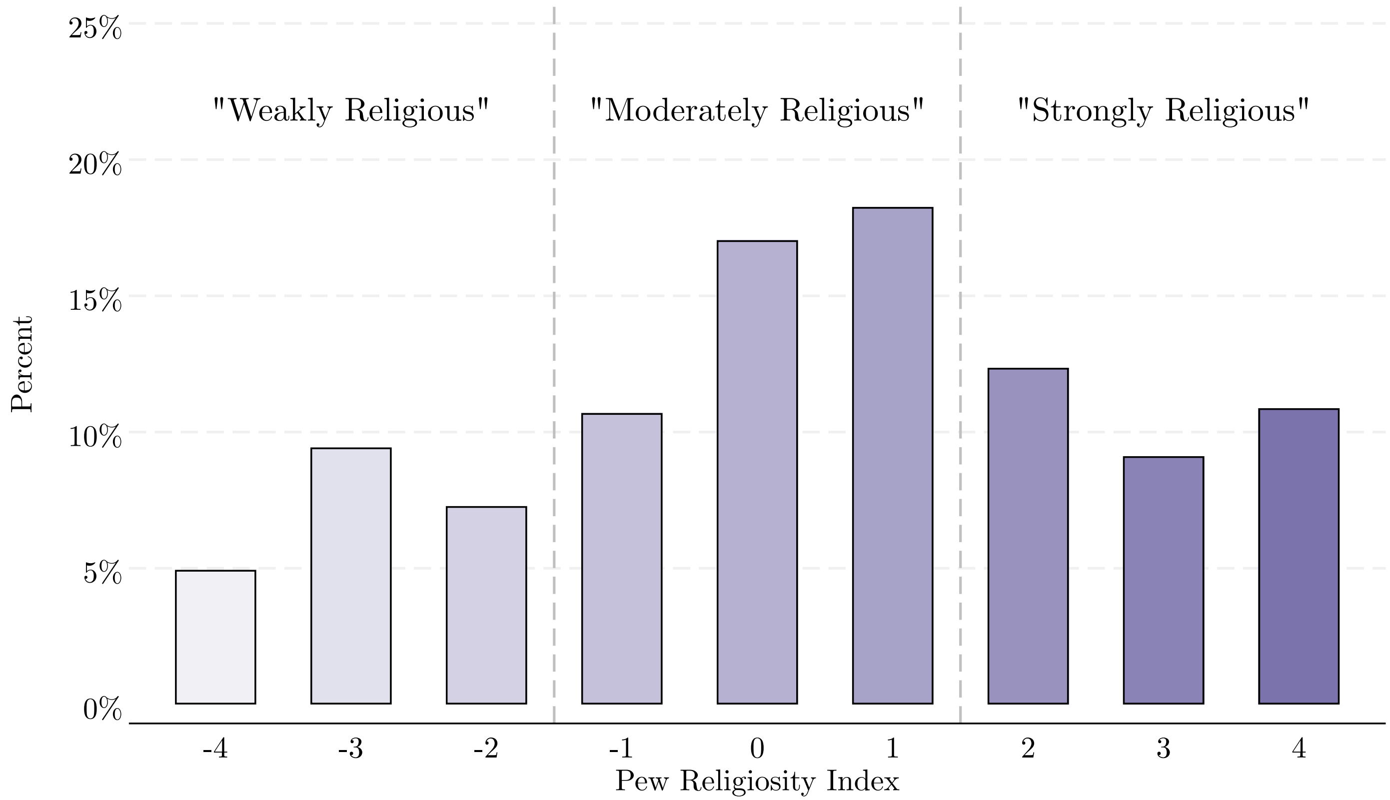


Figure A.7: Distribution of Religiosity

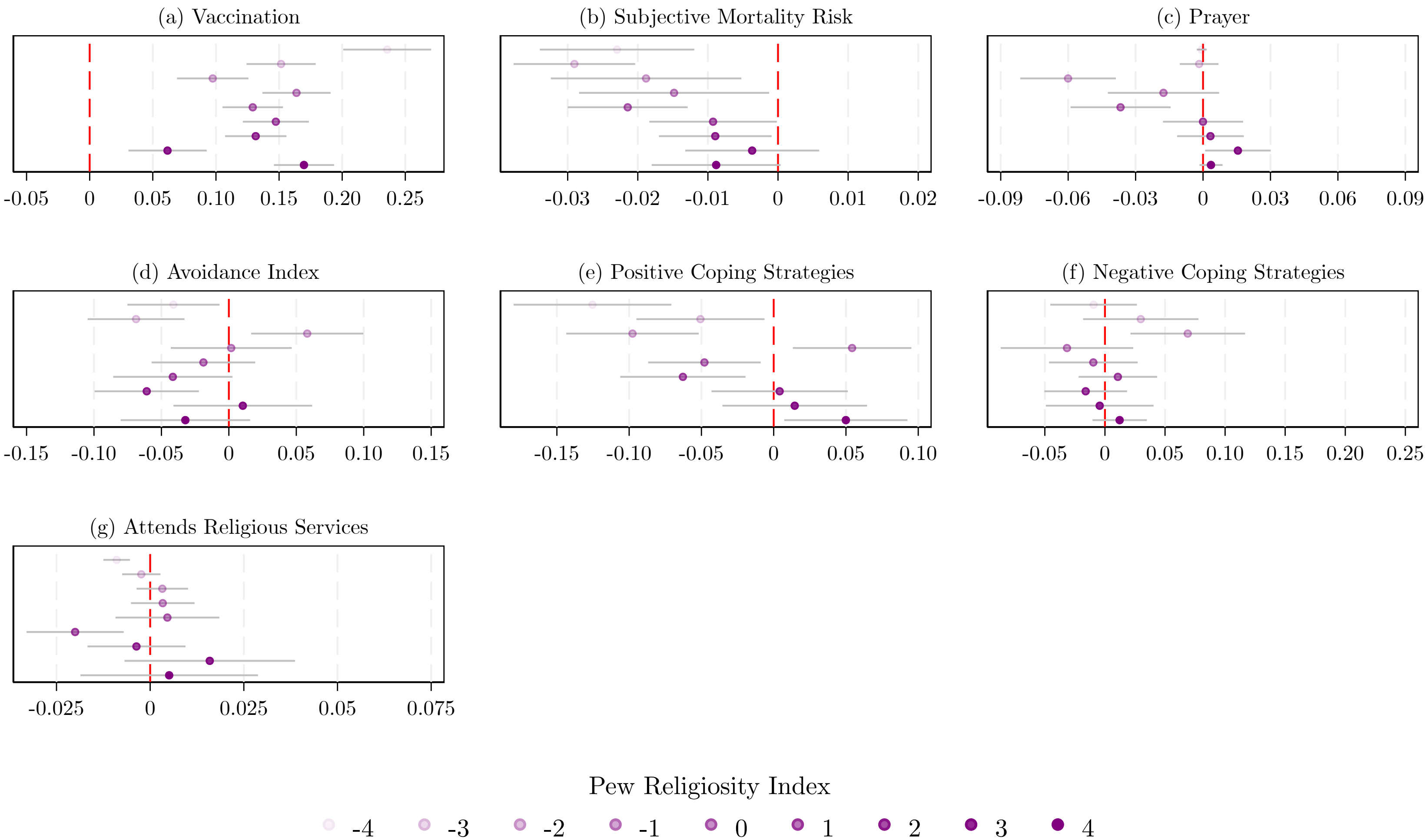


Figure A.8: Effects of Vaccine Eligibility on Outcomes by Full Categories of Religiosity

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