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RESEARCH ARTICLE

Religious Traditions Exhibit Heterogeneous Effects on Vaccination Uptake: A U.S. County-Level Regression Analysis Supporting Tailored Health Outreach

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Introduction: This study examines whether specific religious traditions—rather than just religion itself—demonstrate significant associations with COVID-19 vaccination rates.

Methods: County-level COVID-19 vaccination data (2021−2022) were matched with religious composition data from the 2020 U.S. Religion Census for 6 major religious traditions. The analysis uses negative binomial regression to examine how religious adherence is associated with vaccination rates, controlling for other variables.

Results: Catholic and Mainline Protestant populations showed significant positive associations with vaccination rates (+12.4% and +25.1% respectively), whereas Evangelical Protestant populations demonstrated significant negative associations (−12.9%). Associations persisted when controlling for other variables, including political ideology, with Republican voting preference emerging as the strongest predictor across all religious traditions (coefficients ranging from −55.6% to −93.7%). Mormon, Black Protestant, and Muslim populations showed no significant associations, including in national and region-specific analyses.

Conclusions: Religious traditions influence preventive health measures through limited but significant group-specific processes. Church-sect positioning partially explains these patterns, with historically culturally integrated traditions showing greater receptivity to vaccination than those maintaining some cultural tension. Given the contrasts in associations across religious traditions, public health outreach approaches should consider the context of specific religious traditions rather than merely approaching religion as a monolithic variable.

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INTRODUCTION

Religion's effect on vaccination uptake was occasionally studied before the coronavirus disease 2019 (COVID-19),[1,2] but research increased sharply after 2020 as vaccine hesitancy became central to global conversations. A recent review of research on religion's impact on vaccination more broadly noted multidimensional and often contradictory findings.[2] Some studies showed an independent religious effect,[3−5] with a particular focus on White Evangelical Protestants and religiously patriotic Americans.[6−9] Other studies presented surprising findings, such as one study that documented higher rates of vaccine hesitancy among the religiously unaffiliated[10] and another that identified an inverted shaped relationship between Evangelical Protestant affiliation and vaccination rates.[11] However, others claim that the "religious effect" oversimplifies complex institutional and social dynamics,[12] with final effects either being mixed or disappearing entirely once controlling for other variables.[13−15]

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Analyzing and understanding religion's effects is important not only for fully explaining responses to public health measures during COVID-19 but also for anticipating responses to future public health events. Furthermore, among the many explanations for vaccination rates, religion is particularly important given its protected constitutional status—religious exemptions incentivize workplaces and other institutions to preemptively grant vaccination exemptions rather than face legal challenges.[16] Therefore, understanding religious influences becomes important for developing effective public health strategies beyond legal mandates.

This study uses 2020 U.S. Religion Census data to predict county-level COVID-19 vaccination rates for 2021–2022. Unlike previous work focused on a single religious tradition or religion-probing questions in widely administered surveys, this analysis examined how the strength of a religious tradition's institutional presence in a county influences community-wide vaccination patterns during a major public health emergency.

How does religion influence health decisions? Religious traditions guide the decisions of members in 2 mutually reinforcing ways: as a social organization that influences behavior[17] and as systems of values that guide decisions.[18] When the response to a public health crisis comes from mainstream secular scientific institutions and value systems, the religious tradition's historic relationship with and attitudes toward those institutions becomes salient. Some traditions have historic close ties to secular mainstream culture and institutions (a church typology), whereas others maintain some distance (a sect typology).[19,20] Accordingly, members of traditions that historically cooperate with mainstream culture's institutions may be more receptive to state-sponsored public health measures, whereas members of traditions that maintain some distance may view such initiatives with greater skepticism.

The Public Religion Research Institute (PRRI)[5] anticipated these differences early in the COVID-19 pandemic. Using a nationally representative survey, PRRI documented substantial differences in early attitudes toward vaccination: Jewish Americans, White Catholics, and Mainline Protestants showed high vaccine acceptance, whereas White Evangelical Protestants demonstrated greater hesitancy.[21] Since the PRRI study, 2 useful data sources have become available: comprehensive county-level COVID-19 vaccination rates from the Centers for Disease Control and Prevention (CDC) and county-level denominational censuses from the 2020 U.S. Religion Census. Currently, with the widespread availability of COVID-19 vaccines, scholars are better positioned to analyze how religious traditions predict vaccination rates. Accordingly, 2 hypotheses are proposed based on the church-sect typologies:

H1: Counties with higher concentrations of Catholic and Mainline Protestant populations—traditions historically accommodated to secular mainstream culture and institutions—will have higher COVID-19 vaccination rates.

H2: Counties with higher concentrations of Evangelical Protestant and Mormon populations—traditions historically maintaining tension with secular mainstream culture—will have lower COVID-19 vaccination rates.

Seemingly outside the scope of traditional church-sect typologies are Mormons, Black Protestants, and Muslims. Mormons were first considered a new religious movement—neither church nor sect—and today have a dual tension/integration relationship with secular culture. Black Protestant churches emerged from the U.S. history of racial segregation. Muslim populations in the U.S. represent a distinct religious minority largely resulting from recent immigration. All 3 traditions share with sects a degree of tension with mainstream secular culture and its institutions, albeit with varied premises. Therefore, a third hypothesis is as follows:

H3: Counties with higher concentrations of Mormon, Black Protestant, and Muslim populations—traditions experiencing tension with mainstream secular culture and institutions—will have lower COVID-19 vaccination rates.

METHODS

Analyses are at the county level because vaccine data are at that level, counties are sufficiently small to capture meaningful sociodemographic characteristics, and counties are the primary delivery points for federal- and state-funded programs. Data sources are described in Table 1. Daily vaccination rates were first collected from the CDC tracker website for the dates February 1, 2021, through October 31, 2022. This specific period was when people began receiving vaccinations nationwide through the date when CDC stopped collecting daily vaccination data.[22] The next step was to calculate the population-weighted monthly vaccination rates at the county level by averaging the daily vaccination rates and taking population sizes into consideration. Considering that the daily vaccination rate reflects the number of newly vaccinated individuals each day rather than a cumulative total, the resulting monthly rate is not

Table 1. Description of Data Sources

Data source	Variables	Year	Description
CDC tracker	Monthly vaccination rate at the county level	2021–2023	The CDC tracker is an online platform that compiles and presents data related to COVID-19 in the U.S., including cases, testing, hospitalization, and vaccination data, among others. It is updated regularly and provides an essential resource for public health officials, researchers, and the general public to monitor the status and progression of COVID-19.
U.S. Religious Census	Religious composition at the county level	2020	The U.S. Religious Census is a nationwide survey aimed at gathering detailed data on religious congregations and membership across various faiths. It provides insights into religious composition and trends in the U.S., helping researchers, policymakers, and religious organizations understand the shifting landscape of religious affiliation and practice in American society.
American Community Survey	Sociodemographic covariates at the county level	2020	The American Community Survey is an ongoing survey conducted by the U.S. Census Bureau. It gathers detailed demographic, social, economic, and housing data annually from a representative sample of U.S. households, providing crucial insights for policymakers, researchers, and businesses to understand community needs, allocate resources effectively, and make informed decisions for planning and development.
MIT Election Lab	Voting data in the 2020 presidential election at the county level	2020	The MIT Election Lab focuses on analyzing and interpreting voting data, offering valuable insights into electoral trends. The 2020 presidential election data from the lab provide extensive information on voter turnout, demographic influences, and regional voting patterns.

CDC, Centers for Disease Control and Prevention.

cumulative. Therefore, the monthly rate represents the proportion of newly vaccinated individuals within a given month rather than the cumulative percentage of the population that has been vaccinated over time.

The monthly vaccination rate was then matched with county-level religious data from the 2020 U.S. Religion Census. The U.S. Religion Census represents a partnership among numerous religious denominations that report numbers of congregations, members, and total adherents (i.e., all participants) for counties. As such, the U.S. Religion Census represents direct counts of more than 300 denominations. Some smaller, loosely organized denominations, especially those without centralized headquarters, are not represented in these tallies. Nevertheless, the data represent the largest, most reliable tally of U.S. denominations, and the decennial tallies align well with the pandemic's timing. The Association of Religion Data Archives, located at Indiana University Indianapolis, aggregates the U.S. Religion Census denominations into major religious traditions, following the RELTRAD ("religious traditions") scheme.[23] The 3 main aggregated traditions consist of Black Protestant, Evangelical Protestant, and Mainline Protestant. In addition, this analysis included 3 other sizable religious groups: Catholic, Mormon, and Muslim. Figure 1 shows the geographic distribution of these 6 religious traditions.

Existing research demonstrates that sociodemographic factors, including income,[24] insurance coverage,[25] educational attainment,[26] race/ethnicity,[27] migration status,[28] geographic location,[29] and political attitudes,[27] influence vaccination attitude/uptake. This study's models include American Community Survey–sourced county-level covariates controlling for these variables, namely average household income (in $1,000s), percentage of uninsured population, percentage of adults aged ≥25 years with a college degree, percentage identifying as a certain ethnicity/race, and percentage foreign-born. County rural/urban (i.e., nonmetro/metro) status comes from the U.S. Office of Management and Budget designations, where metropolitan counties are defined as those that contain a core urbanized population of 50,000+ or are integrated with such core counties as measured by commuting zones. Finally, the MIT Election Lab provides percentage voting for the Republican candidate in the 2020 presidential election.

Negative binomial regression is well suited for nonnegative, right-skewed data. For Black Protestant and Muslim traditions, which are relatively small and geographically concentrated traditions (in the South/urban areas and urban areas, respectively), further tests were deemed necessary, focusing only on the U.S. South (Black Protestants) and U.S. metropolitan regions (Black Protestants and Muslims). Furthermore, the vaccination rate may vary depending on a county's proportion of immigrants, particularly in areas with Muslims. Accordingly, an interaction term was included between the percentage Muslim population and the percentage foreign-born population for the urban-only Islam model. To account for hard-to-measure covariates such as

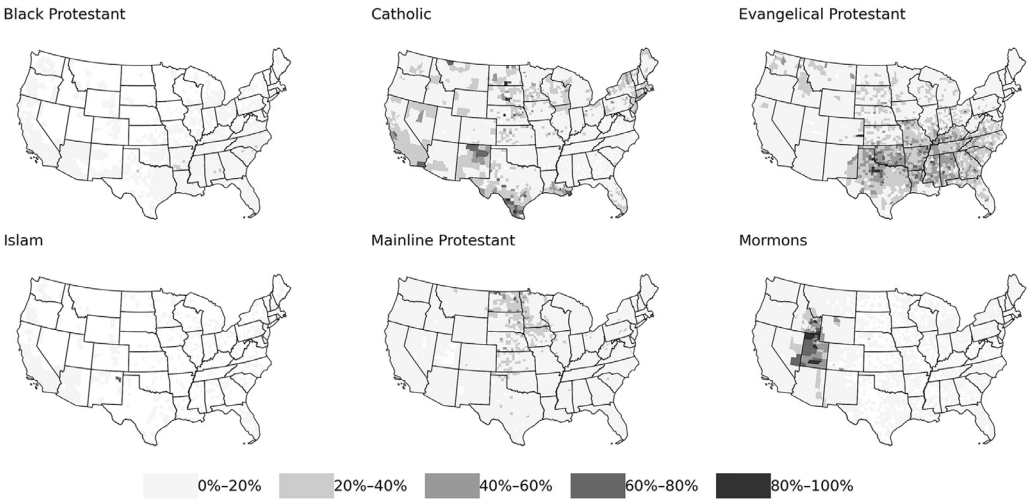

Figure 1. Spatial distribution of religious populations across the U.S.

statewide health policies and unobserved factors such as local healthcare infrastructure and nonreligious attitudes toward vaccination, the models included state, county, and month fixed effects. Only the final model is presented, although occasional reference exists to earlier models that excluded fixed effects, interactions between Muslims and foreign-born, and race/ethnicity. Analyses were conducted in Stata, version 16.1. Given that all data are publicly available, this study was not subject to institutional review for human participant research.

RESULTS

Table 2[30] presents descriptive statistics. The mean monthly vaccination rate for all counties across the entire study period was 0.1%. For independent variables,

Table 2. County-Level Descriptive Statistics

County-level variable	N[a]	Mean/%	SD	Min	Max
Monthly vaccination rate	65,068	0.10	0.17	0	3.93
% Black Protestant adherents	36,397	3.51	4.55	0.01	34.63
% Catholic adherents	61,407	12.49	12.36	0.05	95.79
% Evangelical Protestant adherents	64,767	23.75	18.13	0	452.45[b]
% Islam adherents	13,906	1.23	3.07	0.01	70.47
% Mainline Protestant adherents	64,599	8.96	8.26	0	69.45
% Mormon adherents	39,232	3.63	10.17	0.10	113.39[b]
% Voting Republican, 2020 election	65,124	65.09	16.02	8.73	96.18
Mean income ($1,000)	65,145	54.83	14.56	22.29	147.11
% Uninsured	65,187	9.55	5.05	0	45.12
% Foreign-born	65,187	4.70	5.65	0	54.05
% College graduates	65,187	23.21	9.99	0	78.87
Metropolitan county (=1)	65,267	0.37	0.48	0	1
% Northeastern counties	4,557	6.98	—	—	—
% Midwestern counties	22,155	33.95	—	—	—
% Western counties	8,694	13.32	—	—	—
% Southern counties	29,861	45.75	—	—	—

[a]The sample sizes (N) for the monthly vaccination rate and covariates represent entity—time pairs (i.e., county-month). The study included 3,108 counties over 21 months (i.e., from February 2021 to October 2022), with some counties missing data for certain months because of various reasons, such as reporting mechanisms and changes in reporting policies. The means or percentages were calculated across all county-month pairs. For example, the percentage of votes for the Republicans at the county level ranges from 8.7% to 96.2%, with an average of 65% and an SD of 16. This approach is consistent with Albrecht.[30]
[b]The U.S. Religion Census reports several counties with adherent populations greater than 100% of the county population, a product of congregation-focused tabulation methods or unresolved discrepancies.
Max, maximum; Min, minimum.

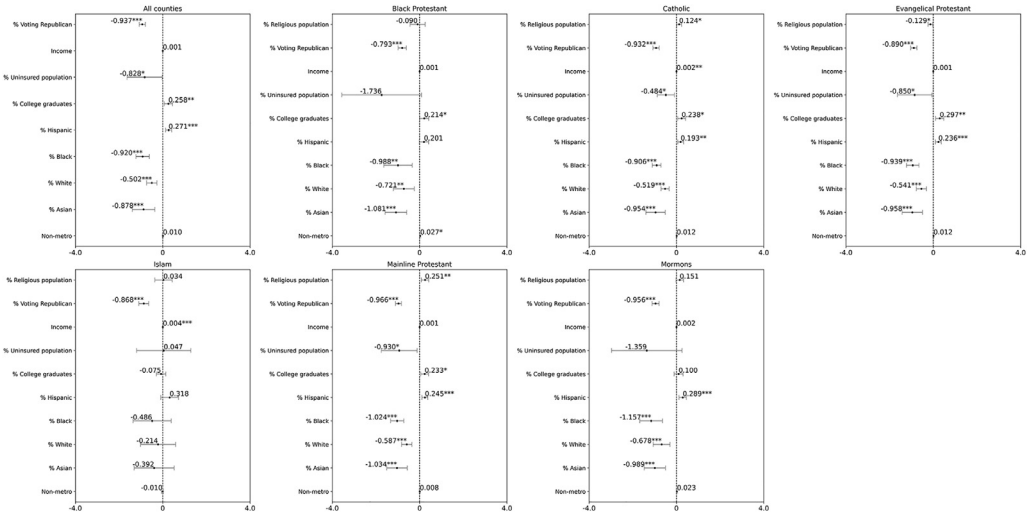

Figure 2. Coefficient plot of independent variables from negative binomial regression results.

Evangelical Protestants constitute nearly one fourth of all religious adherents, followed in descending order by Catholics and Mainline Protestants and then Black Protestants, Mormons, and Muslims. For controls, the average county-level household income was $54,870, the average college degree attainment was 23%, the Republican presidential candidate was the preferred choice in 65% of U.S. counties in 2020, a total of 37% of the counties were metropolitan, and White was the largest ethnic/racial identity followed by Hispanic, Black, and Asian.

The analysis proceeded in 2 stages. First, a general model was established that examined how key demographic and socioeconomic factors predict county-level vaccination rates across all U.S. counties ("All counties"). This general model was extended by developing models that incorporated each religious tradition separately, isolating each tradition's distinctive effect while controlling for other factors. The results shown in Figure 2 and in appendix table (available online) demonstrate how each religious tradition predicts county-level COVID-19 vaccination rates while controlling for key demographic and socioeconomic factors.

Variations exist in how classic church-sect framework religious traditions—Evangelical Protestant, Mainline Protestant, and Catholic—predict vaccination rates. Conversely, traditions outside the classic church-sect framework—Mormon, Black Protestant, and Islam—demonstrate no statistically significant associations. Counties with higher Catholic populations showed a significant positive association with vaccination rates (coefficient, 0.124; $p<0.05$), as well as those with higher Mainline Protestant populations (coefficient, 0.251; $p<0.01$). In contrast, counties with higher Evangelical Protestant populations demonstrated a significant negative association (coefficient, −0.129; $p<0.05$).

The initial analysis showed no significant effects for Black Protestant and Muslim populations at the national level. However, these religious traditions are geographically concentrated—Black Protestants primarily in urban areas and the South, whereas Muslims are primarily in urban areas—and many Muslims are foreign-born. As such, more focused analyses were conducted[1] focusing on urban and Southern counties, and[2] with Islam −foreign-born interactions (Appendix table, available online). The results had contrasting directions—positive for Black Protestant-urban and Islam with foreign-born interaction effects but negative for Black Protestant-South and Islam-urban. However, none of these results were statistically significant, indicating that no conclusions can be drawn about the effect of these religious traditions on COVID-19 vaccination uptake.

Although the influence of some religious traditions was significant, it operated alongside other important predictors (Figure 2 and Appendix table [available online]). Political ideology emerged as the strongest predictor across all models, with higher percentages of Republican voters consistently associated with lower vaccination rates (coefficients ranging from −0.556 to −0.937, $p<0.001$). The % uninsured population had a negative effect across all counties (coefficient, −0.828; $p<0.05$) and Protestantism and Catholicism in particular. Race/ethnicity was significant across most religious traditions, with the Hispanic population having positive coefficients and the Black, White, and Asian populations having negative coefficients. Although in earlier models without race/ethnicity Black Protestant population had a significant negative association with vaccination, adding

the race/ethnicity variables eliminated it, with % Black now notably having the significant association (coefficient, −0.988; $p<0.01$). Given most Black Protestant adherents also identify as Black, results suggest that no association exists between Black Protestantism and vaccination independent of race. College graduates had a positive association across all counties and several religious traditions. Income had a significant positive effect within Catholicism and Islam only, though the coefficients are small (0.002 to 0.004).

DISCUSSION

The findings of this study broadly suggest that religion itself is not a predictor of vaccination acceptance or rejection. Rather, the particular ways religious traditions position themselves institutionally and the specific values that they emphasize shape their relationship with public health initiatives. Although some individual-level analyses suggest that religious associations diminish when controlling for sociodemographic factors, this study's county-level findings demonstrated that religious traditions squarely within the church-sect framework maintain significant predictive associations, even when controlling for numerous variables, whereas traditions outside this framework have no significant associations.

The positive association with Catholic and Mainline Protestant traditions aligns with church-sect theory: historically, church traditions that accommodate popular cultural values appear to maintain receptivity to public health initiatives, including those promoted through government channels. Alternatively, the Evangelical Protestant case reveals how cultural-institutional positioning shapes skepticism in health behaviors. Their theology embeds spirituality in individual transformation rather than hierarchical institutionalism, producing an ambivalent relationship with institutions that extends to mainstream cultural initiatives, including those of the government, perhaps explaining why Evangelical Protestants show lower vaccination rates even when controlling for political ideology.

Although results for Mormons, Black Protestants, and Muslims were not significant, attributes of these religions suggest associations are possible but beyond this study's scope. Mormonism has a complex religious positionality with mainstream American culture, having strict sectarian attributes while also representing a highly institutionalized, centralized religion[31] that integrates relatively successfully with mainstream American cultural institutions, such as in higher education.[32] In terms of health, Mormons highly esteem certain body care practices, including dietary restrictions[33] and religious dress requirements, suggesting possible uptake in COVID-19 vaccination as a body care practice. Within Islam, certain teachings promote medical treatment and disease prevention,[34] although other studies suggest Muslims may have a religious fatalism toward contagious diseases[13] or express concern about vaccine halal status.[35] Black American individuals—religion aside—have reasons for vaccine hesitancy because of historic racialized harms in health care, but it is unclear whether Black Protestantism could independently predict vaccination levels. Possibly, these traditions have internally competing emphases that offset each other, are extremely small to measure clear associations in this study, or truly have little to no effect on COVID-19 vaccination uptake.

These varied findings across religious traditions point to broader implications for public health. First, religion itself does not positively or negatively predict health behaviors. The contrasts found across classic church-sect traditions—from the positive association of Catholics and Mainline Protestants to the negative association of Evangelical Protests—suggest a range of value differences and cultural/institutional relationships. (e.g., long-standing Catholic integration with Western society and its values versus Evangelical Protestants' tendency to position themselves as critics of American mainstream/secular culture). Public health strategies must account for existing relationships of religious traditions with mainstream institutions.

Second, religious resistance to public health measures may reflect deeper tensions with perceived mainstream/popular opinion leaders rather than objections to the health measure itself, even as objections to the health measure are at the fore in discourse. Historically sectarian traditions such as Evangelical Protestantism may be expressing, by their thinking, a totally reasonable suspicion of leaders highly esteemed in secular culture. In such cases, public health appeals through secular authority, scientific expertise, and legal mandates may be counterproductive, potentially reinforcing existing tensions. Public health initiatives may be more effective when working through existing religious institutional structures and approaching skeptics with humility and respect. Sectarians—anticipating disrespect or mandates from "the establishment"—may take an entrenched position if preventative health measures become compelled or compulsory.

Limitations

Despite the robust analysis, this study has at least 2 limitations. First, this study employs aggregated data that are subject to the ecological fallacy, where conclusions and interpretations from a higher-level unit of analysis, such as the county level, do not necessarily apply to the

individual level. This study has only empirically demonstrated that places with certain religious populations have higher or lower COVID-19 vaccination rates. This study has not demonstrated that religious people themselves are vaccine hesitant or accepting. Although the connection is plausible,[22] county-level religious concentrations could indicate other possible variables that are not measured in this study. Second, the U.S. Religion Census data have some limitations, including missing denominations and irregular data submissions, which the U.S. Religion Census Board has detailed in their results. However, given the sizable samples in religious families, more complete census data would likely only strengthen the statistically significant findings.

CONCLUSIONS

This study's county-level findings demonstrate that religious traditions maintain significant predictive effects for vaccination levels, even when controlling for numerous social variables. Church-sect positioning largely explains the responses of religious traditions. These findings suggest public health officials should consider a differentiated approach to religion, such as partnering with church-type traditions through their established hierarchies while engaging sect-type traditions through trusted local leaders who can translate health initiatives into frameworks that align with group values. In the case of vaccinations, religion itself is exceedingly reductionist a variable to predict health behavior.

DATA AVAILABILITY STATEMENT

The complete data and code for replicating this study are available at www.github.com/shuai-zhou/covid_religion.

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CREDIT AUTHOR STATEMENT

Cory A. Anderson: Conceptualization, Project administration, Writing — original draft, Writing — review & editing. Shuai Zhou: Data curation, Formal analysis, Visualization, Writing — original draft, Writing — review & editing. Guangqing Chi: Methodology, Supervision, Writing — review & editing.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2025.108139.

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