Original title: Religious participation and health: A global comparative study

Current title: Multiple measures of religiosity and health: A global comparative study

Zachary Zimmer PhD, Mount Saint Vincent University
Florencia Rojo MA, University of California San Francisco
Mary Beth Ofstedal PhD, University of Michigan
Chi-Tsun Chiu PhD, Academia Sinica
Yasuhiko Saito PhD, Nihon University
Carol Jagger PhD, Newcastle University

Corresponding author: Zachary Zimmer, Department of Family Studies and Gerontology, Global Aging and Community Initiative, Mount Saint Vincent University, 166 Bedford Highway, McCain Centre Room 201C, Halifax, Nova Scotia, Canada, B3M2J6. Email: zachary.zimmer@msvu.ca. Ph: 902-220-9484.

Abstract

The objective of this paper is to understand the connection between measures of religiosity and health globally. Data are from the World Values Survey (93 countries, N=121,770). Religiosity is measured using three indicators: religious participation, belief and spirituality. Health is self-rated. Country-specific ordered logistic regressions determine the association between health and religiosity in each country. Country-level variables and cross-level interactions used in multilevel models assess how macro-level variables affect religiosity and religiosity slopes. Significant positive associations between all religiosity measures and health exists in only three countries (Georgia, South Africa and USA); negative associations in only two (Slovenia and Tunisia). Participation relates to better health in countries with greater religious diversity (OR=1.13; 95% CI=1.04-1.22). Beliefs (OR=0.69; 95% CI=0.51-0.94) and spirituality (OR=0.68; 95% CI=0.53-0.87) are associated with better health in countries with lower socioeconomic status, operationalized as HDI. Spirituality relates to better health where there are greater restrictions on religion (OR=1.12; 95% CI=1.01-1.25). All religiosity measures associate with worse health in communist/former communist countries. In conclusion, the association between religiosity and health varies across countries and measures. Variation is partly explained by country-level factors, such as religious diversity, which partly shape the degree and direction to which religiosity associates with health within each country.

A large body of research, conducted over decades and employing a broad range of objective and subjective health outcomes, has concluded that religion is, on balance, salutary. This work is well summarized in a series of review articles. [1-7] Demographic research has provided particularly persuasive evidence of longevity advantages accrued to those that frequently participate in religious activity.[8-12] The relationship has been considered a function of several inter-related mechanisms. Religion increases size of social networks and improves quality of interaction by linking individuals to others with common values, interests and concerns, who provide friendship, emotional support, and practical assistance.[13-15] Religion functions in promotion of healthy behaviors, for instance, conveying negative views about as tobacco and alcohol use and positive views about meditation, prayer and mindfulness. [16,17] Another set of mechanisms may be referred to more generally as psychosocial effects, including the impact of religion in reducing stress and providing coping mechanisms.[18,19] Religion not only plays a role in easing one's own existential anxieties over the propinquity of mortality but also plays a function when dealing with adversity such as sickness and death of loved ones.[20-22]

The great majority of research on religiosity and health has been conducted in the U.S. As such, the extent to which associations between religiosity and health vary globally across national borders remains unresolved. However, there are reasons to believe effects are contextual, relating to social, political and economic circumstances. One proposition suggests religion is more efficacious in countries with fewer restrictions and greater choice on religious behavior since choice translates into being able to select activities from which satisfaction is derived, gaining something inherent but perceptible, either consciously or not.[23] Conversely, religion is less helpful where practice of any or the pursuit of specific religions is not normative, there are hostilities toward religious groups, restrictions on practice, adverse social consequences

for engaging in religion, and little choice in what and how to practice. In these societies and within these environments, pressures to conform can be stressful, and restriction in free-time activities disallows for intrinsically satisfactory participation. Consequently, the argument proposes, religiosity is not likely to relate to better health outcomes in the type of communist and former communist regimes typical in Eastern Europe or Asia, where religious practice is either not tolerated or non-normative, and adherents are new and seeking help when their circumstances are unfavorable and the future potentially ominous.[23]

Another unresolved issue is measurement. The largest volume of and most robust evidence for a beneficial influence is based on frequency of practice and attendance.[24-26] However, religion is complex and encompasses different dimensions. For instance, there is the distinction between participation and belief. Participation involves attending services, engaging in prayer, respecting and acting upon rituals and volunteering for religious organizations, whilst belief entails strength or importance of god and faith, ideology, and philosophies that are intrinsically experienced. This becomes more complicated when trying to measure spirituality, which, while linked to religion, is often referred to in hard to characterize terms, such as the search for and contemplation of meaning of life.[27]

This paper assesses the degree to which the relationship between religiosity and health is country- or measurement-specific. Through analysis of World Values Survey (WVS) data, which contains information for 93 countries on self-rated health and three measures of religiosity: frequency of attendance (participation), importance of god (belief), and extent to which an individual ponders the meaning and purpose of life (spirituality); we test the hypothesis that *religiosity on an individual level is associated with better health across all countries regardless of measure*. We then test the extent to which the relationship is modified by country-level

measures of religious diversity, restrictions on religious practice, socioeconomic development as operationalized by the Human Development Index, and communist forms of governance.

METHODS

Dataset

Analyses use waves 3 to 6 of the WVS, a set of nationally representative cross-sectional surveys covering a broad range of topics on norms, beliefs, social and political characteristics of people in countries covering a large proportion of the world.[28] At the time of this analysis, there were six waves incorporating samples aged 18 and older from 97 countries. This study employs data from the longitudinal multiple-wave database, using 93 countries that include variables on religiosity needed for analysis. When data is available for one country across multiple waves, we use the most recent. About 2/3 of observations come from wave 6.

Individual-level measures

Health is measured with a single question: "All in all, how would you describe your state of health these days? Would you say it is very good, good, fair, or poor?" Three indicators of religiosity, which are asked in all waves being used in the current study, are labeled as *participation* (P), *belief* (B) and *spirituality* (S). Participation is based on frequency of attendance on a seven-point scale from never to more than once a week. Belief is a measure that considers one's rating about the importance of god in one's life from 1 (not at all important), to 10 (very important). Spirituality is defined by the answer to a question about the frequency with which one thinks about the meaning and purpose of life, with responses on a four-point scale.

Country-level measures

Diversity (D) is an aggregate of religious denomination constructed using the Simpson index of ecological diversity, with a minimum of zero (where all respondents are of the same denomination) and maximum one (where each respondent is a member of a different denomination).[29] *Restriction* (R) is an index, measured on the degree of government restrictions placed on religious practice, obtained from the Pew Research Center's Global Religious Futures Project.[30] It is a composite of 20 items gauging the ways in which national and local governments constrain religious expressions. Country-level socioeconomic status is operationalized by using the *Human Development Index* (H) published each year by UNDP, which is a composite of life expectancy, education and per capita income.[31] *Communism* (C) is a dichotomous measure coded as one for the communist and former communist countries of Asia and Eastern Europe, which include China, Vietnam, Russia and other former Soviet bloc countries.

Analytical strategy

To enable comparison on the same metric, three religiosity measures are standardized with zero mean and unit standard deviation across the total sample merged across waves. First, ordered logistic regression models are fitted to determine the relationship between religiosity measures and health separately for each country. Models control for *sex* (F) with female coded as one, *Age* (A), continuously measured, and a quadratic of age (A^2) is included because results indicated the association between age and self-rated health is often nonlinear. Second, multilevel models with random intercepts and slopes assess the overarching association between religiosity and health (P, B and S) plus the extent to which this overarching association varies across

countries. One set of multilevel models include fixed effects for individual-level religiosity measures (P, B and S); A, A^2 and F, country-level measures (D, R, H and C), and random effects that quantify the variation in self-rated health across countries and the variation in the religiosity-health association across countries. A second set of multilevel models add cross-level interactions (e.g. P*D) to assess the degree to which the variation in the religiosity-health association is explained by country-level characteristics. The correlation between D and R is very strong (Pearson's r = -0.556), so these measures are entered and reported in separate models, thus we report six models in total, two for each of the three measures of religiosity.

The multilevel model integrates two equations. The first predicts self-rated health based on an individual's characteristics, which is their age (A), age-squared (A^2), sex (F) and level of religiosity (e.g., P). The second assesses the value of self-rated health that is idiosyncratic to each country but influenced by macro-level characteristics, which are diversity (D), restriction (R), the human development index (H) and communism (C). Without cross-level interaction, the equation is indicated as:

$$\text{Level 1: } Y_{ij} = B_{0j} + B_{1j}A_{ij} + B_{1j}A^2_{ij} + B_{1j}F_{ij} + B_{1j}P_{ij} + r_{ij}$$

$$\text{Level 2: } B_{0j} = \gamma_{00} + \gamma_{01}D_j + \gamma_{01}H_j + \gamma_{01}C_j + u_{0j}$$

Y_{ij} is self-assessed health for person i living in country j, which is a function of a country-specific intercept B_{0j}, individual level-variables A, A^2, F, and P, and an error term r_{ij}. The country-specific intercept B_{0j}, which is the self-assessed health common to all persons living in country j, is in turn determined by the Level 2 equation, which is a function of a grand intercept common to all countries γ_{00}, country-level variables D, H and C (or R, H and C in another equation), and the random component u_{0j} that is the variation between the predicted value and the actual values of self-rated health in each country. When a cross-level interaction is added,

the effect of religiosity on self-rated health is a function, in addition to the above, of an effect based on a country-level variable that is specific to each country. For instance, interacting religiosity P with diversity D, the Level 2 equation expands to:

$$\text{Level 2 } B_{0j} = \gamma_{00} + \gamma_{01}D_j + (\gamma_{10} + \gamma_{11}D_j + u_{1j}) + \gamma_{01}H_j + \gamma_{01}C_j + u_{0j}$$

Where γ_{11} is the effect of the variable D that is specific to country j, and u_{1j} is the random effect of the slope of D for country j.

From the model coefficients, the predicted probabilities of very good health are calculated for the ten most populated countries plus Taiwan (for comparison with China), using the model explaining the greatest variance. The chosen countries provide a broad spectrum across country-level characteristics. Probabilities are calculated as follows: lowest and highest values of P, B and S are used; individual-level variables are set at sample means; country-level variables are set at country-specific values. Results are interpreted as the predicted probability of very good health for a person that is of average age and sex, lives in a specific country and is influenced by country level factors measured in the model.

RESULTS

Table 1 provides summary statistics for study variables. The dataset comprises 121,770 individuals in 93 countries; mean age is 41.0 years, 51% is female, 69% rate their health as very good or good. Mean diversity, restriction and HDI scores are 0.441, 0.390 and 0.725 respectively, and 27% of respondents live in countries that are classified as currently or formerly communist.

The association between religious participation and self-rated health, controlling for age, age-squared, and sex, in each country, along with 95% confidence intervals are shown

graphically in Figure 1 in the form of the log odds of better self-rated health given a one unit increase in participation; negative numbers indicate negative (inverse) associations between participation and health, positive numbers positive associations. Countries are indicated by three letter abbreviations, the key to which is found in the Appendix. Whilst the preponderance of associations between participation and self-rated health are positive, there is much variability across countries. A significant positive association is evident in 24 countries. The strongest association is found in Cyprus, Ethiopia, and the Philippines. A significant negative association is found in four countries, the strongest association being in China, Pakistan, and Iraq (Figure 1).

Figures 2 and 3 show similar results for religiosity measured as beliefs and spirituality. Similar to participation, there is considerable variation between countries in the association between beliefs or spirituality and health. Across all three measures, significant positive associations with self-rated health are found in three countries only: Georgia, South Africa, and U.S., whilst only two countries, Slovenia and Tunisia, have negative associations between religiosity and health that are significant across all religiosity measures. In 30 countries associations are consistently positive, and in 12 consistently negative, but not always significant, while 45 countries display a mix of positive and negative associations across the three religiosity measures.

When multilevel models are fitted, as in Table 2, adjusting for country-level factors of diversity, restriction, socio-economic development as measured by HDI, or communist governance, there are significant associations between better health and both religious participation (e.g., Model 1: OR=1.06; 95% CI=1.04-1.08) and spirituality (e.g., Model 5: OR=1.03; 95% CI=1.00-1.07) and health such that those who more often participate in religious activity or more often contemplate the meaning and purpose of life tend to rate their health more

favorably than others (Table 1). In contrast, there is no evidence of a relationship between self-rated health and religious belief (e.g., Model 4: OR=1.01; 95% CI=0.96-1.05), measured as how important god is in one's life.

Table 3 shows that adding interactions between the religiosity and country-level factors significantly improves model fit (change (Δ) in -2LL statistic). It also changes the interpretation of the association between religiosity measures and health. The positive association between self-rated health and religious participation becomes more favorable the greater the within-country religious diversity (Model 1: OR=1.13; 95% CI=1.04-1.22), but less favorable in communist or former communist countries (e.g., Model 1: OR=0.94; 95% CI=0.90-0.99). While there was no association between religious belief and health in the previous table, the main effect in the interaction model suggests beliefs relate to better health in non-communist countries with very low HDIs (Model 4: OR=1.36; 95% CI= 1.06-1.76). Conversely, beliefs associate with less favorable health in countries with communist governance (e.g., Model 4: OR=0.89; 95% CI=0.84-0.95) and in countries with higher HDIs (Model 4: OR=0.69; 95% CI=0.51-0.94). Similar to belief, spirituality associates with better self-ratings of health in countries with lower HDIs (e.g., Model 5: OR=0.66; 95% CI=0.51-0.85) and non-communist current or former governments (e.g., Model 5: OR=0.93; 95% CI=0.89-0.99). Spirituality is associated with better health where there are greater restrictions on religion (Model 6: OR=1.12; 95% CI=1.01-1.25).

By graphing the predicted probabilities from the multilevel models, Figure 4 shows how the chance of very good health changes in a group of selected countries when comparing the lowest and highest level of religiosity across the measures. Greater participation is generally associated with better self-rated health although the magnitude of the association differs vastly. In the U.S., for instance, a country with a high degree of religious diversity, those that have low

participation have a 0.302 probability of reporting very good health and this increases to 0.370 if participation is high, a 22.9% increase . In countries with minimal diversity, participation does not have much impact. For instance, in Pakistan the chances of reporting very good health increase from 0.185 for low participation to 0.200 for high participation, an 8.2% increase. The influence of communist or former communist governance is seen in China where greater participation is associated with a modest reduction in the chances of reporting very good health. Using beliefs as a measure, associations are flat or negative in countries with high HDIs, such as Taiwan where a low belief in god relates with a 0.309 probability of very good health compared to 0.298 for a high belief. But, in Bangladesh, where HDI is low, beliefs have the opposite association, with low to high belief increasing the probability of reporting very good health from 0.114 to 0.160. High spirituality is associated with greater predicted probability of reporting very good health in non-communist countries with low HDIs, for example Therefore, in Nigeria, a non-communist country with a below average HDI, those least spiritual are least likely to have very good health and those most spiritual are most likely, with probabilities of 0.176 and 0.251 respectively. In communist countries with higher HDIs, spirituality is associated with a lower predicted probability of reporting very good self-rated health. In Russia, the former Soviet country with a higher than average HDI, the probabilities are also 0.176 for low spirituality but fall to 0.160 for high.

DISCUSSION

This study arrives at several conclusions. First, the association between religiosity and self-rated health varies widely across countries. The hypothesis that greater religiosity is associated with better health is true consistently across religiosity measures in only a handful of

countries. Interestingly, one such country is the U.S., where most of the research on the topic has taken place and from where the notion that religion exerts a strong favorable effect on health has derived. Second, whether the association is significant, positive, or negative, depends on the measure of religiosity. In some countries greater religious participation is associated with better health. In other countries better health shows little association with participation but is strongly related to a belief in the importance of god. Third, country-level characteristics partly explain why associations differ. More specifically, greater religious participation is associated with better health in countries with a lot of religious diversity. Individuals with a strong belief in god report better health in socioeconomically depressed countries with deficient wealth, education and health (that is, low HDI). Spirituality, considered as contemplating the meaning and purpose of life, is positively related to self-rated health in countries with low HDI and where there is substantial government restriction on practicing. In contrast individuals with greater religiosity, regardless of measure, are less likely to report very good health in the former Soviet bloc countries and communist countries in Asia.

We are left to speculate upon reasons for this substantial variation across countries and measures. While it has not been tested frequently, our results are supported by a small number of studies that have looked comparatively at religiosity and well-being.[32-35] These and our analyses indicate religiosity leads to positive outcomes in countries with religious diversity, perhaps because in such places individuals freely practice without fear, shame or pressure to conform,[23] or because participation itself may be affirming, since where practice is a choice, people that engage gain something tangible from it and thus are drawn to religion for practical reasons – it is good for them and good for their health. In countries without diversity

participating may not be an option, not condoned, or specific forms of expressions are restricted, which leads to pressure to conform.

Alternatively, in countries where socioeconomic resources are deficient, a strong belief in god or inherent spirituality appears beneficial, as individuals may not have institutions outside the church on which to rely on for health inducing activity. A strong belief system may provide satisfaction given an otherwise difficult life. Where religion is constrained it is more internal rather than outward expressions that are helpful. By engaging in spiritual thinking the chances of religious retribution is minimal, but reductions in stress and anxiety may be pertinent health benefits.

Religiosity is not good for health in communist and post-communist countries in Eastern Europe and Asia. As suggested, religion in these particular societies may still be frowned upon and adherents are likely new.[23] New adherents may be most downcast and unhealthy and looking for meaning to life. A good example of this is the comparison of our findings in China and Taiwan, countries with a common history, shared ethnic backgrounds and common values and norms based on Confucian ideals, yet different forms of government, levels of religious diversity and restriction. In Taiwan, religious participation is strongly related to better health, while belief and spirituality appears unrelated to health, whilst in China there appears to be little relationship between religiosity and health or the relationship is inverse.

The China versus Taiwan comparison highlights that our study stands in contrast to the majority of research implicating religion as having a beneficial impact on health,[1,5,6,9,36] not least because most of this has taken place in the U.S. Indeed, our country-specific findings agree with this since the U.S. stands as only one of three countries where associations between religiosity

and health are consistently positive. Clearly the conclusion regarding how religiosity and health associate depends on the country in which the analysis is being conducted.

There are limitations to this study. Self-rated health is subjective and individuals with similar disorders are likely to rate their health differently across populations. It is however the only measure of health available in this data, and there is no other data source containing information on religiosity across this many countries. Moreover, while it may differ across populations, within population self-rated health is a solid measure of overall health that encompasses both physical and psychological status. For all its disadvantages, self-rated health has been shown to be easily translatable, reliable, to have content and predictive validity, and to represent an inclusive and holistic conception of health.[37,38] Similarly, measures of religiosity imperfectly represent constructs. The question used to indicate spirituality does not mention religion or spirituality directly, however, the notion of contemplating the meaning of life clearly is related to something non-physical and transcendent, characteristics that are thought to indicate spirituality, and the question is included in WVS together with other questions on religiosity. Finally, there is much variation across countries left unexplained. For instance, while multilevel models with cross-level interactions predict belief and spirituality should not improve health in the U.S., the country-specific results indicate that all religiosity measures related to better health in the U.S. Religion is clearly very complicated and there are many ways to conceptualize religion. Notwithstanding what we have been able to determine here, associations between religiosity and health in individual countries are idiosyncratic.

The main strength of this paper is the ability to assess this association, using consistent measures, across 93 countries that cover much of the world's population. We have ascertained that there is the potential for religion to play an important public health role where religion can

be freely practiced without obstruction. But, a better understanding of the construct, what it

represents within different populations, and the mechanisms that connect religiosity and health,

is essential.

REFERENCES

1.   Lavretsky H. Spirituality and aging. Aging Health 2010;6:749-69.
2.   Moreira‐Almeida A. Religion and health: the more we know the more we need to know. World Psychiatry 2013;12:37-8.
3.   Zimmer Z, Jagger C, Chiu C-T, Ofstedal MB, Rojo F, Saito Y. Spirituality, religiosity, aging and health in global perspective: A review. SSM-Population Health 2016;2:373-81.
4.   Larson DB, Swyers JP, McCullough ME. Scientific research on spirituality and health: A report based on the Scientific Progress in Spirituality Conferences. Washington, DC: National Institute for Healthcare Research; 1998.
5.   Krause N. Religion and health: Making sense of a disheveled literature. Journal of Religion and Health 2011;50:20-35.
6.   Koenig HG. Religion, spirituality, and health: The research and clinical implications. International Scholarly Research Network 2012;2012:1-33.
7.   Seybold KS, Hill PC. The role of religion and spirituality in mental and physical health. Current Directions in Psychological Science 2001;10:21-4.
8.   Hummer RA, Benjamins MR, Ellison CG, Rogers RG. Religious involvement and mortality risk among pre-retirement aged US adults. In: Ellison CG, Hummer RA, eds. Religion, Families, and Health: Population-Based Research in the United States. New Brunswick, NJ: Rutgers University Press; 2010:273-91.
9.   Hummer RA, Ellison CG, Rogers RG, Moulton BE, Romero RR. Religious involvement and adult mortalaity in the United States: Review and perspective. Southern Medical Journal 2004;97:1223-30.
10.   Gillum RF, King DE, Obisesan TO, Koenig HG. Frequency of attendance at religious services and mortality in a US national cohort. Annals of Epidemiology 2008;18:124-9.
11.   Hill TD, Angel JL, Ellison CG, Angel RJ. Religious attendance and mortality: An 8-year follow-up of older Mexican Americans. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences 2005;60:102-9.
12.   Musick MA, House JS, Williams DR. Attendance at religious services and mortality in a national sample. Journal of Health and Social Behavior 2004;45:198-213.
13.   Pirutinsky S, Rosmarin DH, Holt CL, et al. Does social support mediate the moderating effect of intrinsic religiosity on the relationship between physical health and depressive symptoms among Jews? Journal of behavioral medicine 2011;34:489-96.
14.   Krause N. Exploring the stress-buffering effects of church-based and secular social support on self-rated health in late life. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences 2006;61:332-47.
15.   Koenig HG, Hays JC, George LK, Blazer DG, Larson DB, Landerman LR. Modeling the cross-sectional relationships between religion, physical health, social support, and depressive symptoms. The American Journal of Geriatric Psychiatry 1997;5:131-44.
16.   Hill TD, Ellison CG, Burdette AM, Musick MA. Religious involvement and healthy lifestyles: Evidence from the survey of Texas adults. Annals of Behavioral Medicine 2007;34:217-22.
17.   Strawbridge WJ, Shema SJ, Cohen RD, Kaplan GA. Religious attendance increases survival by improving and maintaining good health behaviors, mental health, and social relationships. Annals of Behavioral Medicine 2001;23:68-74.

18.   Pargament KI, Koenig HG, Perez LM. The many methods of religious coping: Development and initial validation of the RCOPE. Journal of clinical psychology 2000;56:519-43.

19.   Krause N, Ellison CG, Shaw BA, Marcum JP, Boardman JD. Church‐based social support and religious coping. Journal for the scientific study of religion 2001;40:637-56.

20.   Rogers T. Manifestations of religiosity and the aging process. Religious Education 1976;71:405-15.

21.   McFadden SH. Religion and Well‐Being in Aging Persons in an Aging Society. Journal of Social Issues 1995;51:161-75.

22.   Pargament KI. The Psychology of Religious Coping: Theory, Research, and Practice. New York: Guilford; 1997.

23.   Inglehart RF. Faith and freedom: Traditional and modern ways to happiness. In: Diener E, Helliwell JF, Kahneman D, eds. International Differences in Well-Being. New York: Oxford University Press; 2010:351-97.

24.   Hummer RA, Ellison CG, Rogers RG, Moulton BE, Romero RR. Religious involvement and adult mortality in the United States: Review and perspective. Southern medical journal 2004;97:1223-30.

25.   Li S, Stampfer MJ, Williams DR, VanderWeele TJ. Association of religious service attendance with mortality among women. Journal of the American Medical Association 2016;Online First.

26.   Strawbridge WJ, Cohen RD, Shema SJ, Kaplan GA. Frequent attendance at religious services and mortality over 28 years. American journal of public health 1997;87:957-61.

27.   Zinnbauer BJ, Pargament KI, Cole B, et al. Religion and spirituality: Unfuzzying the fuzzy. Journal for the scientific study of religion 1997;36:549-64.

28.   World Values Survey. World Values Survey 1981-2014 Longitudinal Aggregate v.2015041. JDSystems, Madrid, Spain: World Values Survey Association (www.worldvaluessurvey.org). Aggregate File Producer; 2017.

29.   Simpson EH. Measurement of diversity. Nature 1949;163:688.

30.   Pew Research Center. Latest Trends in Religious Restrictions and Hostilities. Washington, DC: Pew Research Center; 2015.

31.   UNDP. Human Development Report 2000. New York: United Nations; 2000.

32.   Okulicz-Kozaryn A. Religiosity and life satisfaction across nations. Mental Health, Religion & Culture 2010;13:155-69.

33.   Lun VM-C, Bond MH. Examining the relation of religion and spirituality to subjective well-being across national cultures. Psychology of Religion and Spirituality 2013;5:304-15.

34.   Elliott M, Hayward RD. Religion and life satisfaction worldwide: The role of government regulation. Sociology of Religion 2009;70:285-310.

35.   Stavrova O. Religion, self-rated health, and mortality: Whether religiosity delays death depends on the cultural context. Social Psychological and Personality Science 2015;6:911-22.

36.   Oman D, Reed D. Religion and mortality among the community-dwelling elderly. American Journal of Public Health 1998;88:1469.

37.   Idler EL, Benyami Y. Self-rated health and mortality: A review of twenty-seven community studies. Journal of Health and Social Behavior 1997;38:21-37.

38.   Molarius A, Janson S. Self-rated health, chronic diseases, and symptoms among middle-aged and elderly men and women. Journal of clinical epidemiology 2002;55:364-70.

Table 1: Descriptive statistics for study variables

	Percent (N)	Mean (Standard deviation)	Source
Individual-level data			
Age		41.27 (16.42)	
Sex			
Male	48.7 (59,309)		
Female	51.3 (62,461)		
Self-assessed health			
Very good	25.1 (30,596)		WVS
Good	44.1 (53,726)		
Fair	24.7 (30,063)		
Poor	6.1 (7,384)		
Religiosity measures			
Participation		.008 (.999)	WVS
Belief		.003 (.995)	WVS
Spirituality		-.001 (1.002)	WVS
Country-level data			
Diversity		.441 (.250)	WVS
Restriction		.390 (.241)	Pew
HDI		.725 (.139)	UNDP
Communist country			CIA
Yes	27.2 (33,106)		
No	72.8 (88,664)		

Note: Percentage and N in parentheses for categorical variables. Mean and standard deviations in parentheses for continuous variables. Source refers to the source of the information as follows: WVS – World Values Survey; Pew – Based on the Pew Research Center report on *Latest Trends in Religious Restrictions and Hostilities*. UNDP – Based on various years of the *Human Development Report*; CIA - Based on information obtained from the CIA World Factbook.

Table 2: Odds ratios and 95% confidence intervals for self-rated health in 93 countries, 1995-2014, non-interaction models (N=121,770)[a]

	Measure of religiosity											
	Participation				Belief				Spirituality			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual-level												
Religiosity	1.06***	1.04, 1.08	1.06***	1.04, 1.08	0.99	0.95, 1.04	1.01	0.96, 1.05	1.03**	1.00, 1.07	1.03**	1.00, 1.07
Female	-0.79***	0.76, 0.83	-0.79***	0.76, 0.83	0.80***	0.76, 0.84	0.80***	0.76, 0.84	0.80***	0.77, 0.85	0.80***	0.77, 0.84
Age	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98
Age-squared[b]	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00
Country-level												
Diversity (D)	1.34	0.90, 2.00			1.56***	1.00, 2.43			1.35	0.90, 2.02		
Restrictions (R)			0.091	0.58, 1.43			0.94	0.62, 1.43			0.93	0.58, 1.50
HDI (H)	4.27***	2.21, 8.24	4.58***	2.42, 8.67	3.32**	1.75, 6.29	2.30***	1.28, 4.15	3.39***	1.81, 6.35	3.67***	1.98, 6.79
Communism (C)	0.46***	0.37, 0.57	0.45***	0.37, 0.56	0.48***	0.39, 0.59	0.42***	0.34, 0.52	0.45***	0.36, 0.57	0.45***	0.36, 0.56
Random components												
Intercept	0.201	.152, .250	0.206	.154, .257	0.188	.137, .240	0.189	.139, .240	0.202	.152, .253	.207	.155, .259
Slope	0.008	.004, .012	0.008	.004, .012	0.027	.012, .043	0.029	.012, .048	0.019	.009, .030	.019	.009, .030
	-136,980.8		-136,991.8		-136,932.9		-136,927.9		-136,855.7		-136,856.8	

*** P < .01   ** .01 < P < .05   * .10 > P > .05

[a]Multilevel ordered logit models predicted self-rated health using individual-level religiosity measures, sex, age, age-squared, country-level effects, and random effects.

[b] To four decimal places all are 0.9999 (0.9998, 1.0000)

Table 3: Odds ratios and 95% confidence intervals for self-rated health in 93 countries, 1995-2014, interaction models (N=121,770)[a]

	Measure of religiosity											
	Participation				Belief				Spirituality			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual-level												
Religiosity	1.02	0.98, 1.04	1.11***	1.07, 1.16	1.31*	0.97, 1.76	1.36**	1.06, 1.76	1.44***	1.17, 1.77	1.34***	1.09, 1.66
Female	0.79***	0.75, 0.83	0.79***	0.76, 0.83	0.80***	0.76, 0.84	0.80***	0.76, 0.84	0.81***	0.77, 0.85	0.81***	0.77, 0.85
Age	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98	0.97***	0.96, 0.98
Age-squared[b]	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00	1.00**	1.00, 1.00
Country-level												
Diversity (D)	1.33	0.89, 1.99			1.49*	0.95, 2.34			1.26	0.66, 1.66		
Restrictions (R)			0.91	0.58, 1.42			0.90	0.60, 1.37			0.94	0.59, 1.50
HDI (H)	4.40***	2.28, 8.50	4.68***	2.47, 8.85	3.54***	2.28, 8.50	3.07***	1.85, 6.79	3.56***	1.90, 6.65	3.73***	2.01, 6.92
Communism (C)	0.46***	0.37, 0.57	0.45***	0.37, 0.56	0.49***	0.40, 0.61	0.44***	0.36, 0.54	0.47***	0.39, 0.58	0.45***	0.36, 0.56
Cross-level interactions												
Religiosity X D	1.13***	1.04, 1.22										
Religiosity X R			0.92*	0.83, 1.01							1.12**	1.01, 1.25
Religiosity X H					0.72*	0.50, 1.03	0.69**	0.51, 0.94	0.66***	0.51, 0.85	0.68***	0.53, 0.87
Religiosity X C	0.94**	0.90, 0.99	0.94**	0.90, 0.99	0.91**	0.84, 0.98	0.89** *	0.84, 0.95	0.93***	0.89, 0.99	0.92***	0.87, 0.97
Random components												
Intercept	0.201	.152, .251	.206	.154, .257	0.187	.134, .240	0.192	.142, .243	0.194	.015, .243	0.207	.155, .259
Slope	0.006	.002, .009	.007	.004, .010	0.020	.008, .032	0.022	.010, .034	0.014	.006, .022	0.013	.006, .021
	-136,973.4		-136,976.8		-136,926.9		-136,919.3		-136,841.2		-136,843.8	
Δ -2 X LL[c]	14.8***		30.0***		12.0***		17.2***		29.0***		26.0***	

*** P < .01   ** .01 < P < .05   * .10 > P > .05

[a]Multilevel ordered loigt models predicted self-rated health using individual-level religiosity measures, sex, age, age-squared, country-level, cross-level interactions, and random effects.

[b]To four decimal places all are 0.9999 (0.9998, 1.0000).

[c]Showing improvement in fit in comparison to the non-interaction model presented in Table 1.

Figure 1: Country specific log odds for the relationship between religious participation and self-rated health, showing point estimates and 95% confidence intervals[1]
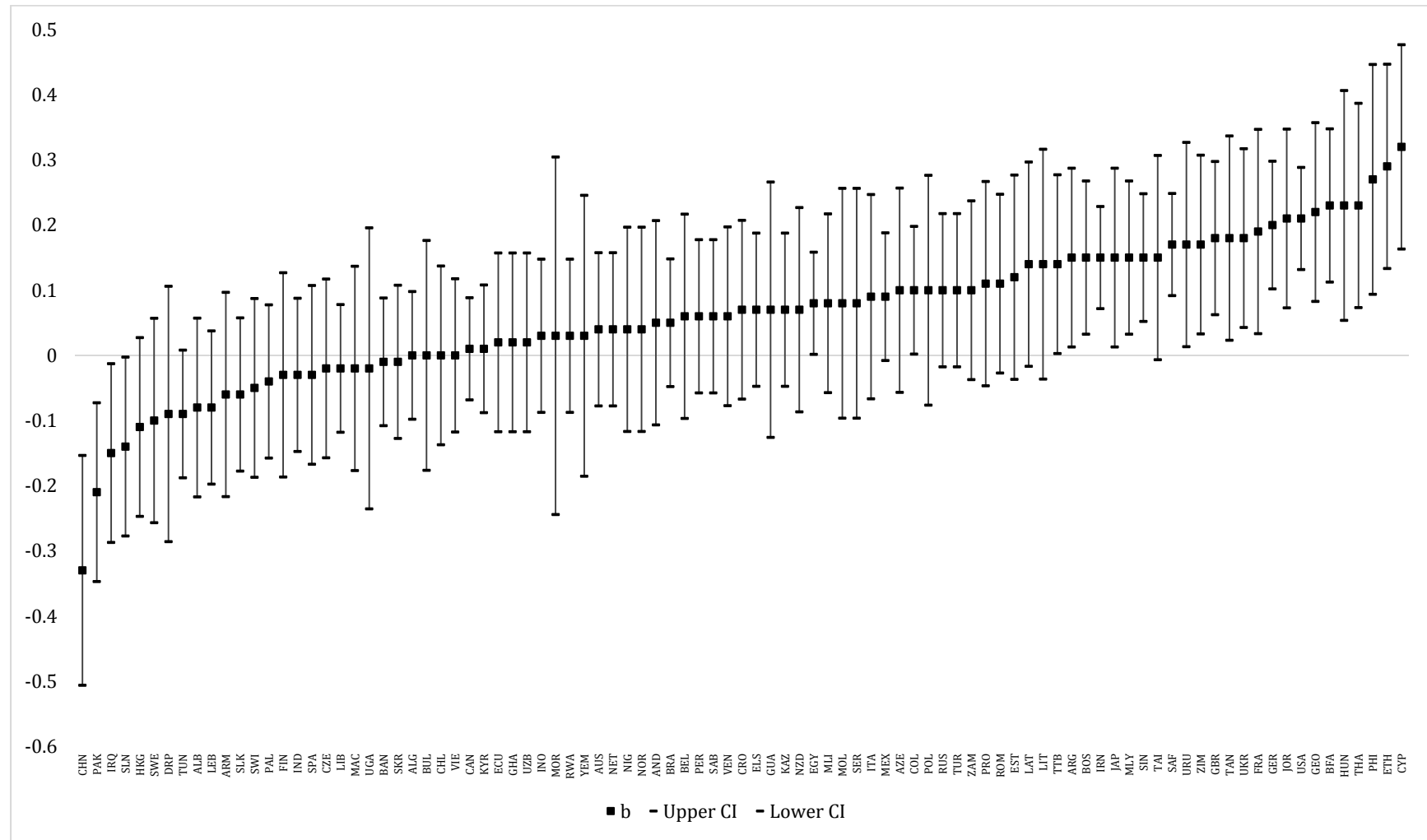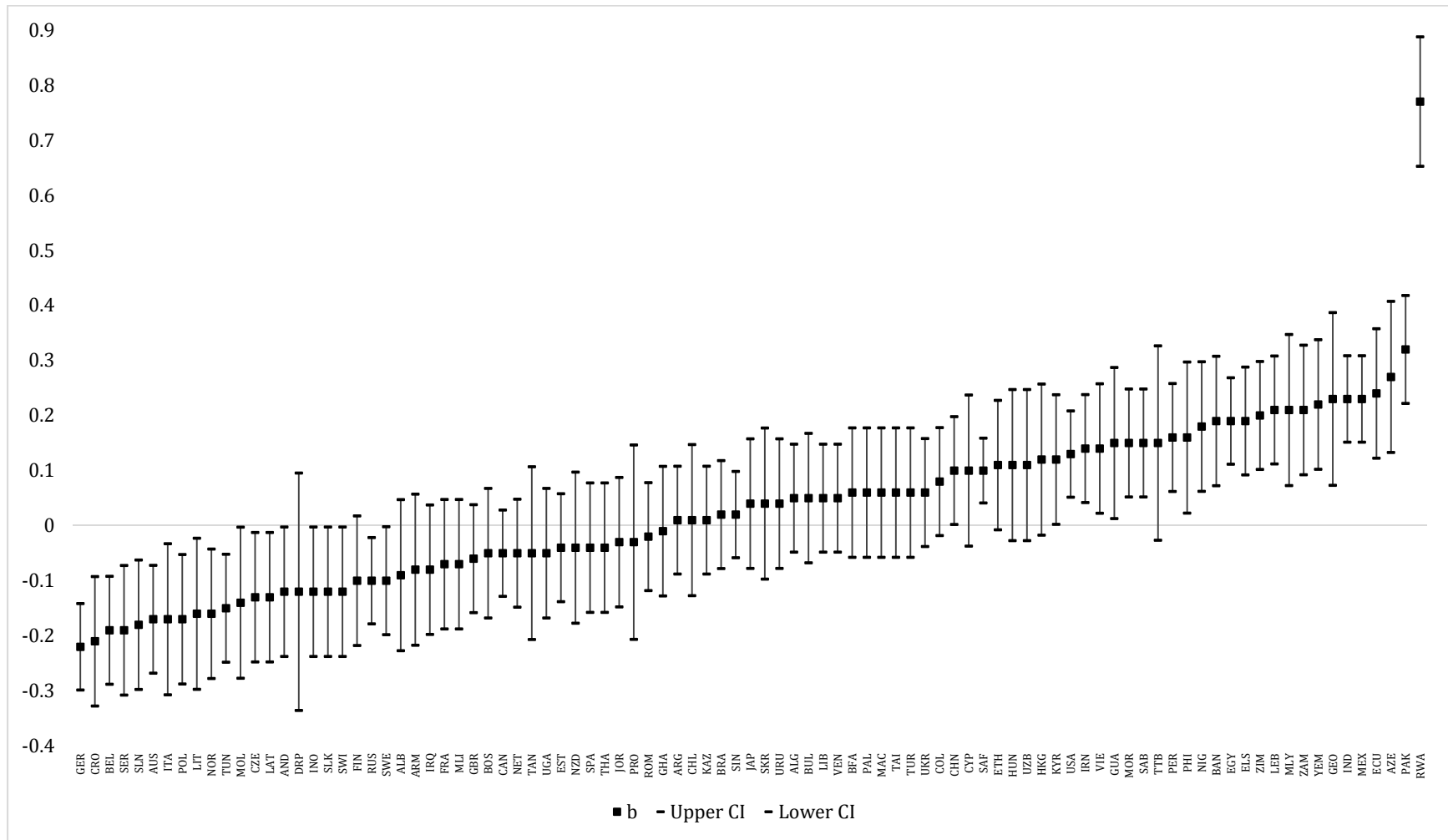

[1] Each result controls for age and sex. Country names are abbreviated. The key to the abbreviations is found in supplemental materials.

Figure 2: Country specific ordered logit log odds for the relationship between religious beliefs and self-rated health, showing point estimates and 95% confidence intervals[1]
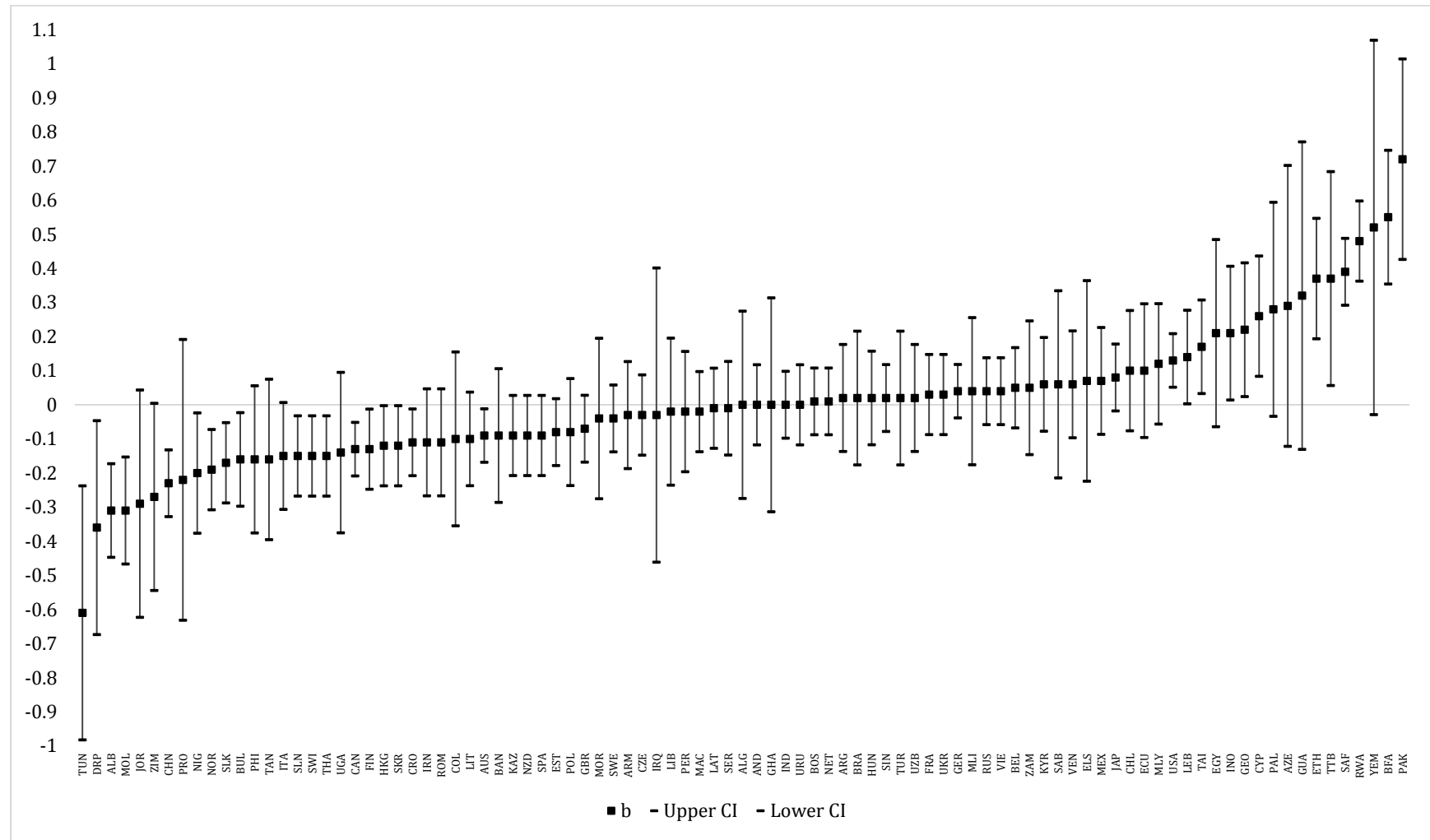

[1] Each result controls for age and sex. Country names are abbreviated and key is below.

Figure 3: Country specific ordered logit log odds for the relationship between spirituality and self-rated health, showing point estimates and 95% confidence intervals[1]

[1] Each result controls for age and sex. Country names are abbreviated and key is in supplemental materials.

Figure 4: Predicted probability of reporting very good self-rated health given highest and lowest scores for three religiosity measures for selected countries[1]
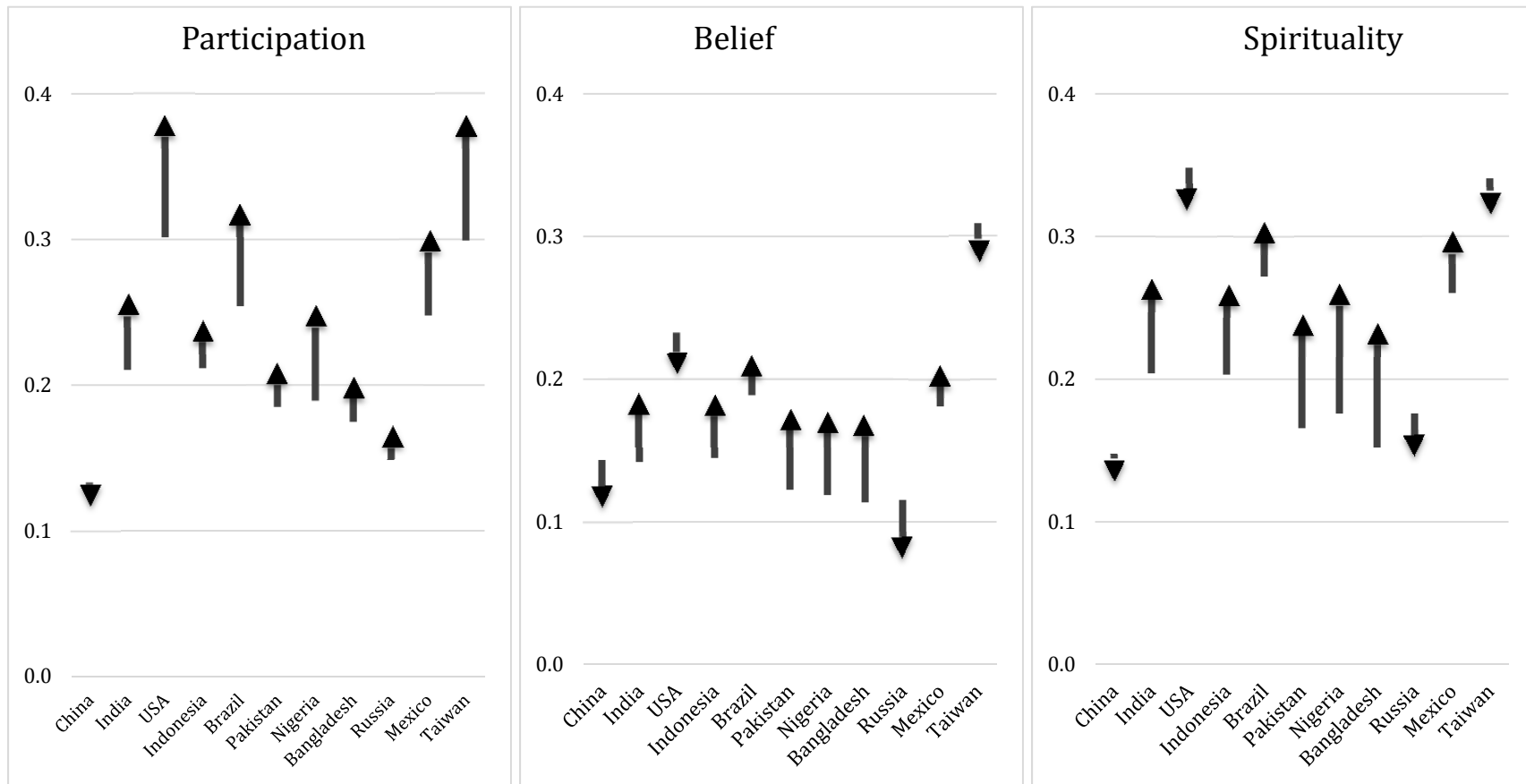
[1]Results are based on the best fitting model from Table 3. The ends of the vertical lines indicate lowest and highest probabilities. The arrows indicate the direction of the relationship such that arrows pointing upward means religiosity increases the probability of very good health and arrows pointing downward means religiosity decreases the probability of very good health. The height of the vertical lines indicate the magnitude of the change in probability when between lowest and highest religiosity score.

Appendix: Country key

Country	Abbr.	Country	Abbr.	Country	Abbr.
Albania	ALB	Great Britain	GBR	Puerto Rico	PRO
Algeria	ALG	Guatemala	GUA	Rep. of Macedonia	MAC
Andorra	AND	Hong Kong	HKG	Romania	ROM
Argentina	ARG	Hungary	HUN	Russia	RUS
Armenia	ARM	India	IND	Rwanda	RWA
Australia	AUS	Indonesia	INO	Saudi Arabia	SAB
Azerbaijian	AZE	Iran	IRN	Serbia	SER
Bangladesh	BAN	Iraq	IRQ	Singapore	SIN
Belarus	BEL	Italy	ITA	Slovakia	SLK
Bosnia	BOS	Japan	JAP	Slovenia	SLN
Brazil	BRA	Jordan	JOR	South Africa	SAF
Bulgaria	BUL	Kazakhstan	KAZ	South Korea	SKR
Burkina Faso	BFA	Kyrgyzstan	KYR	Spain	SPA
Canada	CAN	Latvia	LAT	Sweden	SWE
Chile	CHL	Lebanon	LEB	Switzerland	SWI
China	CHN	Libya	LIB	Taiwan	TAI
Colombia	COL	Lithuania	LIT	Tanzania	TAN
Croatia	CRO	Malaysia	MLY	Thailand	THA
Cyprus	CYP	Mali	MLI	Trinidad & Tobago	TTB
Czech Rep.	CZE	Mexico	MEX	Tunisia	TUN
Domincan Rep.	DRP	Moldova	MOL	Turkey	TUR
Ecuador	ECU	Morocco	MOR	Uganda	UGA
Egypt	EGY	Netherlands	NET	Ukraine	UKR
El Salvador	ELS	New Zealand	NZD	United States	USA
Estonia	EST	Nigeria	NIG	Uruguay	URU
Ethiopia	ETH	Norway	NOR	Uzbekistan	UZB
Finland	FIN	Pakistan	PAK	Venezuela	VEN
France	FRA	Palestine	PAL	Vietnam	VIE
Georgia	GEO	Peru	PER	Yemen	YEM
Germany	GER	Philippines	PHI	Zambia	ZAM
Ghana	GHA	Poland	POL	Zimbabwe	ZIM