

Original Contribution

Mediators of the Association Between Religious Service Attendance and Mortality

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Mounting evidence consistently shows associations between religious service attendance and reduced mortality risk, yet research identifying mediators remains limited. Using prospective data from the Health and Retirement Study (2006–2014; $n = 5,200$ US adults), we evaluated a range of potential mediators. After robust control for confounders (demographic, health, health-behavior, and social factors), among positive psychological factors, we observed mediation through increased life satisfaction (5.27%; $P \leq 0.001$) and possibly positive affect (1.52%; $P = 0.06$) but not optimism, mastery, or purpose. Among dimensions of psychological distress, we observed mediation through reductions in hopelessness (1.92%; $P = 0.01$), trait anger (1.98%; $P = 0.03$), state anger (2.23%; $P = 0.03$), and possibly loneliness (1.21%; $P = 0.06$), but not cynical hostility or negative affect, and some evidence that increased anxiety (−3.61%; $P = 0.008$) and possibly depressive symptoms (−1.14%; $P = 0.05$) increased mortality odds. Among social factors, we observed mediation through contact with friends (10.73%; $P = 0.005$) but not living with a spouse or contact with children or other family. Among health behaviors, we observed mediation through exercise (5.38%; $P \leq 0.001$) and negative mediation through alcohol frequency (−2.55%; $P = 0.03$) and possibly body mass index (−2.34%; $P = 0.08$) but not smoking. These results highlight a range of mediators that might underlie the association between religious service attendance and reduced risk of mortality.

mechanisms; mediators; religion; religious service attendance

Abbreviations: BMI, body mass index; HRS, Health and Retirement Study; R/S, religion and spirituality.

Religion and spirituality (R/S) shape people's cognitions, emotions, behaviors, and interpersonal interactions. They are also woven into the daily fabric of a large portion of people's lives. According to a 2016 Gallup Poll of 1,025 US adults, 89% believe in God or a universal spirit, and 75% consider religion of considerable importance (1). A growing body of research suggests that R/S is associated with reduced risk of mortality (2–8). For example, recent prospective studies of 74,000 women from the Nurses' Health study, and 36,000 women from the Black Women's Health Study found that women who attended religious service weekly had a 33%–37% lower risk of mortality (after adjustment for a range of potential confounders) (3, 4).

The mechanisms behind this association are unclear, and a key remaining challenge is to identify them. A growing number of studies have examined potential mediators through which R/S might affect health. Most find that R/S influences a person's likelihood of engaging in restorative, and abstaining from harmful, health behaviors and psychosocial processes, including

increased exercise, increased use of preventive health-care services, lower rates of smoking or illegal drug use, decreased likelihood of excessive drinking, less depression, lower rates of suicide, increased social support, increased positive affect, increased meaning and purpose in life, and increased life satisfaction (9–18). The associations between R/S and potential mediators (e.g., exercise, diet) are not entirely uniform, however, and at times mixed (19, 20).

These important pioneering studies have contributed substantially to the literature. Nonetheless, when attempting to pinpoint mechanisms between R/S and health, they are limited in a number of ways. First, many studies do not account for important confounders. Second, some studies attempt to evaluate mediation by adjusting for mediators; however, this method often does not adequately test mediation (21). Third, some studies use data from specific subpopulations (e.g., college students), patient groups (e.g., people with cardiovascular disease), or specific religious denominations with strict health codes, and

we do not know whether results from these studies generalize. Fourth, some studies were not intended to formally evaluate mediation and therefore had health behaviors and psychosocial processes as end points in their study. Thus, in many of the studies it remains unclear which mechanisms prospectively underlie the association between R/S and all-cause mortality.

In this study, we used recent advances in the causal inference literature for mediation to assess the relative magnitude of different pathways by which our exposure might affect the outcome. By using multiple waves of data we were better able to take into account temporal relationships between the service attendance exposure, confounders, mediators, and the mortality outcome. Moreover, the recent methods for causal mediation analysis allow for the exposure and mediator to interact. We built upon important prior work in this area by using data from a prospective, nationally representative, and ethnically diverse sample of women and men aged ≥ 50 years and also evaluated a larger array of potential mechanisms than has been considered before (22).

METHODS

Study population

We used data from the Health and Retirement Study (HRS), an ongoing nationally representative panel study of US adults aged ≥ 50 years. The HRS surveys respondents every 2 years and, starting in 2006, a random 50% of HRS respondents was selected for an enhanced face-to-face interview (23). After the interview, respondents were given a self-report psychosocial questionnaire, which they completed and returned. Among people interviewed, the response rate for this questionnaire was 90%, resulting in 7,230 respondents. Respondents were excluded from the analyses if they: 1) died before the start of the primary mortality outcome in 2010 ($n = 813$)—mortality was assessed from 2010 through 2014—or had missing information on the 2) exposure ($n = 165$) or 3) covariates ($n = 1,052$). The final analytical sample was 5,200 for the religious service attendance and mortality analyses.

The primary exposure was religious service attendance in 2008, with attendance in 2006 controlled for as a covariate to examine the association between incident attendance and risk of mortality (assessed from 2010 to 2014). Mediators were assessed in 2010, with mediators (and all other covariates) controlled for in 2006. The HRS website (<http://hrsonline.isr.umich.edu/>) provides extensive documentation about the study. Because the present study used deidentified, publicly available data, the institutional review board at the Harvard T.H. Chan School of Public Health exempted it from review.

Measures

Religious service attendance. Frequency of religious service attendance was self-reported in 2006 (covariate) and 2008 (exposure). Respondents were asked, “About how often have you attended religious services during the past year?” Responses were categorized as: not at all, <1 /week, ≥ 1 /week.

Mortality measurement. Information about mortality was collected between 2010 and 2014 using data from the National Death Index and was confirmed through proxy reports during

exit interviews—interviews conducted by a surviving spouse, child, or other close family member/friend.

Potential mediators. A range of mediators was assessed in 2010 and considered in this study, including positive psychological factors (life satisfaction, optimism, mastery, positive affect, purpose in life), dimensions of psychological distress (depressive symptoms, cynical hostility, hopelessness, loneliness, negative affect, anxiety, trait anger, state anger), health behaviors (exercise, alcohol consumption frequency, smoking, body mass index (BMI)), social factors (living with spouse, contact with children ≥ 1 /week, contact with other family ≥ 1 /week, contact with friends ≥ 1 /week; contact includes meetups, phone calls, and letters/emails), other psychosocial factors (sense of control over health, sense of control over finances, financial strain), and physical functioning. HRS guides provide extensive documentation about each of these measures (23–26).

Covariates. We adjusted the analyses for known predictors of mortality in this cohort. All covariates were assessed by self-report in 2006 (the first available measurements before religious attendance exposure). Potential confounders included socio-demographic factors (age, sex, race/ethnicity (white, black, Hispanic, other), marital status (married/not married), educational attainment (no degree, high school diploma or equivalent, college degree or higher), health insurance (yes/no), and total wealth (based on quintiles of the score distribution in this sample)); baseline health (assessed by major health conditions (yes/no): cancer, heart disease, stroke, lung disease, diabetes, hypertension), social factors (assessed via (yes/no): living with spouse, contact with children ≥ 1 /week, contact with other family ≥ 1 /week, contact with friends ≥ 1 /week, social participation (8-item indicator of social participation), and social integration (frequency of attending nonreligious meetings/programs hosted by groups, clubs, or organizations)) (27); and health behaviors (smoking status (never, former, current), frequency of exercise (never, 1–4/per month, >1 /week), frequency of alcohol consumption (abstinent, <1 –2 days/month, 1–2 days/week, and ≥ 3 days/week), BMI (calculated as weight (kg)/height (m)²: <24.9 , 25.0–29.9, ≥ 30.0)), and physical functioning (15-item measure of physical function limitations (e.g., climbing 1 flight of stairs, kneeling) and activities of daily living (e.g., dressing, eating, bathing)).

Statistical analysis

We used mediation methods (21) to determine the proportion of the association between religious service attendance (in 2008) and mortality (between 2010 and 2014) that was mediated by the potential mediators (in 2010). For mediators, the first available measurement after religious attendance exposure was taken (2010 wave). The mediators were assessed through multivariable linear regression and logistic regression models of the outcome and the mediators; these results were then combined to estimate direct and indirect effects. These methods assume that baseline covariates can adequately control exposure-outcome, mediator-outcome, and exposure-mediator confounding (28). Proportion mediated on a risk difference scale was calculated, and formal tests were conducted to evaluate for evidence of mediation (21). We first evaluated people who attended religious service ≥ 1 /week versus not at all, then in a subsequent analysis those who attended <1 /week versus not at all. All analyses were performed

Table 1. Baseline Characteristics of Study Participants According to Frequency of Religious Service Attendance in the Health and Retirement Study ($n = 5,200$), United States, 2008

Characteristic	Frequency of Religious Service Attendance		
	Not at All ($n = 1,243$), %	<1 Time per Week ($n = 1,661$), %	≥1 Times per Week ($n = 2,296$), %
Sociodemographic factors			
Age, years ^a	67.3 (9.6)	66.7 (9.1)	69.0 (8.9)
Female sex	47.4	56.4	63.3
Married	63.6	65.8	71.3
Race/ethnicity			
White	88.7	79.1	75.9
Black	5.0	12.2	14.7
Hispanic	4.2	6.6	7.4
Other	2.2	2.2	2.1
Years of education ^a	12.9 (4.8)	13.2 (4.7)	12.8 (3.5)
Insurance	85.4	86.0	89.2
Total wealth ^a	486,145 (1,036,015)	582,004 (1,504,644)	546,646 (1,008,146)
Health behaviors			
Never-smoker	31.5	41.4	53.6
Exercise frequency >1/week	57.6	62.3	64.3
Alcohol frequency ≥3 days/week	26.6	20.4	13.8
Health factors			
Chronic condition ^b	67.5	70.6	71.2
Body mass index ^{a,c}	28.2 (5.8)	28.5 (5.8)	28.3 (5.6)
Social factors			
Living with spouse	69.6	69.4	72.7
Contact with children ≥1/week	64.5	77.6	79.5
Contact with other family ≥1/week	41.5	53.6	54.9
Contact with friends ≥1/week	59.3	63.0	70.3
Physical functioning problems	2.6 (3.0)	2.4 (2.9)	2.3 (2.7)

^a Values are expressed as mean (standard deviation).^b Chronic conditions included diabetes, cancer, hypertension, heart disease, stroke, and lung disease.^c Weight (kg)/height (m)².

using Stata, version 14.1 (StataCorp LLC, College Station, Texas), and mediation analyses were performed using the PARAMED package (29). All the models adjusted fully for all covariates (in 2006) as well as the mediator being evaluated in the previous wave (2006).

RESULTS

Table 1 (reduced version) and Web Table 1 (available at <https://academic.oup.com/aje>) (full version) summarize the characteristics of the study respondents. For the total effect of baseline religious service attendance (2008) on all-cause mortality (2010–2014; number of deaths = 675), results from a logistic regression adjusting for all 2006 covariates indicated that regular service attendance in 2008 was associated with a reduced risk of mortality (odds ratio = 0.61, 95% confidence interval: 0.42, 0.87; Web Table 2).

Table 2 displays the mediation results for all of the hypothesized mediators, comparing people who attended service ≥1 times per week with people who did not attend at all. In summary, among positive psychological factors, we found evidence for mediation between religious service attendance and mortality through increased life satisfaction (5.27%; $P \leq 0.001$) and possibly positive affect (1.52%; $P = 0.06$) but did not find evidence with optimism (0.63%; $P = 0.14$), mastery (0.43%; $P = 0.61$), or purpose in life (−0.04%; $P = 0.96$). Among dimensions of psychological distress, we observed evidence for mediation through reductions in hopelessness (1.92%; $P = 0.01$), trait anger (1.98%; $P = 0.03$), state anger (2.23%; $P = 0.03$), and possibly loneliness (1.21%; $P = 0.06$) but not cynical hostility (0.69%; $P = 0.14$) or negative affect (0.81%; $P = 0.22$). There was also evidence that increased anxiety (−3.61%; $P = 0.008$) and possibly depressive symptoms (−1.14%; $P = 0.05$) from service attendance increased the odds of mortality. Among social

Table 2. Mediation Analyses Between Religious Service Attendance (2008) and All-Cause Mortality (2010–2014) in the Health and Retirement Study ($n = 5,200$), United States^{a,b}

Mediator	Proportion Mediated, %	P Value for Estimated Indirect Effect
Positive psychological factors		
Life satisfaction	5.27	<0.001
Optimism	0.63	0.142
Mastery	0.43	0.606
Positive affect	1.52	0.063
Purpose in life	−0.04	0.960
Psychological distress		
Depressive symptoms	−1.14	0.050
Cynical hostility	0.69	0.141
Hopelessness	1.92	0.012
Loneliness	1.21	0.061
Negative affect	0.81	0.217
Anxiety	−3.61	0.008
Trait anger	1.98	0.029
State anger	2.23	0.027
Social factors		
Living with spouse	1.13	0.340
Contact with children ≥ 1 /week	1.10	0.458
Contact with other family ≥ 1 /week	4.07	0.097
Contact with friends ≥ 1 /week	10.73	0.005
Health behaviors		
Exercise	5.38	<0.001
Alcohol consumption frequency	−2.55	0.030
Smoking	−0.20	0.677
Body mass index ^c	−2.34	0.078
Other psychosocial factors		
Sense of control over health	0.39	0.604
Sense of control over finances	0.22	0.761
Financial strain	−0.32	0.526
Physical functioning problems	0.40	<0.001

^a Religious service attendance ≥ 1 /week versus not at all.^b Sample size ranged from 2,853 to 3,492.^c Weight (kg)/height (m)².

factors, we observed possible mediation through contact with friends (10.73%; $P = 0.005$) but did not find strong evidence for living with a spouse (1.13%; $P = 0.34$), contact with children (1.10%; $P = 0.46$), or contact with other family members (4.07%; $P = 0.10$). Among health behaviors, other psychosocial factors, and physical functioning, we found evidence for mediation through exercise (5.38%; $P \leq 0.001$) and negative mediation through alcohol frequency (−2.55%; $P = 0.03$) and possibly BMI (−2.34%; $P = 0.08$) but no evidence for smoking (−0.20%; $P = 0.68$), control over health (0.39%; $P = 0.60$), control over finances (0.22%; $P = 0.76$), or financial strain (−0.32%; $P = 0.53$). Finally, we found evidence of mediation through physical functioning (0.40%; $P \leq 0.001$).

Web Table 3 details the estimates of the indirect effect, direct effect, and total effect for each mediator. Web Tables 4 and 5 display these same results for people who attended service <1 /week versus people who did not attend at all. The Web Appendix describes changes in service attendance from 2006 to 2008.

DISCUSSION

In this large, nationally representative, and prospective cohort of adults aged ≥ 50 years, we observed that several factors mediated the association between religious service attendance and reduced mortality, including life satisfaction, hopelessness, trait anger, state anger, contact with friends, exercise, and physical

functioning. Our results are consistent with some past studies suggesting associations between religious service attendance and various potential mechanisms. In contrast to these other studies, we controlled for a range of important potential confounders, used prospective cohort data from a nationally representative and ethnically diverse sample (which had the right temporal ordering of data (confounders-exposure-mediator-outcome)), and used methods of causal mediation analysis that allowed for exposure-mediator interaction. Further, because we controlled for past attendance, we were able to evaluate incident rather than prevalent service attendance.

When comparing results from our study to results in past studies, there are some discrepancies. For example, smoking was not a mediator in the present study but was a mediator in another recent study (3). A potential reason for this discrepancy could be the time frame; this study only considered mediators that were 2 years after the exposure. Therefore, our results are likely conservative given that we only evaluated effects mediated through changes in the mediator over a short duration; most studies have, for example, had a longer follow-up. Factors such as smoking might be important mediators over longer time periods but less so in shorter intervals. We were also somewhat surprised that each mediator explained only a small percentage of the effect. However, the proportion of estimated effects mediated in this study might be underestimated because mediators were considered at only a single time point, and even that mediator measurement might be subject to measurement error, generally rendering estimates of mediation conservative (30). Additionally, compared with many prior studies we controlled extensively for potential confounders, including prior service attendance, and also prior values of the mediator. Future studies should evaluate time-varying religious attendance and mediators over longer intervals of time (31).

Although most of the mediators between religious service attendance and mortality were health-enhancing, we observed that depressive symptoms, anxiety, alcohol consumption frequency, and possibly BMI were mediators associated with increased risk of mortality. In the case of alcohol and BMI, this was because service attendance was associated with decreased alcohol consumption and BMI, but both were associated with lower mortality; in the case of anxiety and depressive symptoms, this was because service attendance was associated with slightly increased risk of both.

This study has several limitations. Religious service attendance data was collected through self-report and might suffer from over-reporting or measurement error. This would tend to lead to conservative estimates of total effects, but the consequences for the proportion mediated could be in either direction (21). Additionally, confounding by unmeasured variables is always a limitation in observational research. However, we controlled for a broad range of variables that could confound our main variables of interest. This study also featured several strengths, including a large, prospective cohort study design in a nationally representative and ethnically diverse sample. Further, the study had clear temporality of the exposure, covariates, and outcome. The study also adjusted for baseline religious service attendance along with baseline confounders, mediators, and outcomes; we were thus able to evaluate “incident exposure” rather than “prevalent exposure,” providing stronger evidence for causality (32–34).

In conclusion, in this large prospective cohort study of US adults aged ≥ 50 years, we observed several factors that might mediate the association between higher religious service attendance and reduced mortality. Future research should continue examining potential mediators using modern causal inference methods and prospective data. Our results do not at all imply that health-care providers should prescribe attendance at religious services, but for those who already self-identify as religious but do not attend service, these results could lead them to reconsider this potentially underutilized community resource (35, 36).

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