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The relationship between religion and cardiovascular outcomes and all-cause mortality in the women's health initiative observational study

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Some studies suggest that religiosity may be related to health outcomes. The current investigation, involving 92,395 Women's Health Initiative Observational Study participants, examined the prospective association of religious affiliation, religious service attendance, and strength and comfort from religion with subsequent cardiovascular outcomes and death. Baseline characteristics and responses to religiosity questions were collected at enrollment. Women were followed for an average of 7.7 years and outcomes were judged by physician adjudicators. Cox proportional regression models were run to obtain hazard ratios (HR) of religiosity variables and coronary heart disease (CHD) and death. After controlling for demographic, socioeconomic, and prior health variables, self-report of religious affiliation, frequent religious service attendance, and religious strength and comfort were associated with reduced risk of all-cause mortality [HR for religious affiliation = 0.84; 95% confidence interval (CI): 0.75–0.93] [HR for service attendance = 0.80; CI: 0.73–0.87] [HR for strength and comfort = 0.89; CI: 0.82–0.98]. However, these religion-related variables were not associated with reduced risk of CHD morbidity and mortality. In fact, self-report of religiosity was associated with increased risk of this outcome in some models. In conclusion, although self-report measures of religiosity were not associated with reduced risk of CHD morbidity and mortality, these measures were associated with reduced risk of all-cause mortality.

Keywords: religion and health; religion and psychology; religious behaviour and health; religious behaviour and mortality; religious behaviour and coronary heart disease; religious behaviour and cardiovascular disease

Introduction

Both professional journals and the popular press have offered substantial coverage to the possible relationship between religion or spirituality and health (e.g. *American Psychologist*, special issue, January 2003; *Newsweek*, 10 November 2003). Yet the nature,

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and even existence, of this relationship is highly controversial. While Sloan, Bagiella, and Powell (1999) conclude, 'suggestions that religious activity will promote health are unwarranted,' Powell, Shahabi, and Thoresen (2003) 'clearly disagree with their conclusion.' Indeed, Benson (1996, p. 173) goes so far as to say, 'whenever [religious] faith is present remembered wellness is triggered and health can be improved.'

In a thorough review of the literature, Powell et al. (2003) examine several hypotheses related to the relationship between religion and physical health. Some hypotheses, they assert, such as that religion or spirituality slows the progression of cancer or improves recovery from acute illness, have consistently failed confirmation in repeated studies. On the other hand, they cite numerous methodologically sound studies suggesting that church/service attendance provides, 'on average, approximately a 30% reduction in [all-cause] mortality after adjustment for demographic, socioeconomic, and health related confounders and approximately a 25% reduction in mortality after adjustment for established risk factors.'

However, other aspects of the relationship between religion and health are less clear. For example, whether religion or spirituality is associated with any form of cardiovascular disease (CVD)-related mortality or morbidity has not been adequately assessed. While numerous studies purport to examine this question, Sloan and Bagiella (2002) conclude that almost all contain substantial methodological weaknesses. These weaknesses include: small numbers of participants, impossibility of random assignment, lack of a control group or of investigator blinding, high levels of dropouts, violation of the intention to treat principle, use of multi-component interventions, inadequate defining of operational terms, not using proper statistical control methods, and many others.

Indeed, Powell et al. (2003) identified only four properly designed prospective studies that related religion to CVD. Oman, Kurata, Strawbridge, and Cohen (2002) and Hummer, Rogers, Nam, and Ellison (1999) found a relationship between weekly church/service attendance and reduced CVD mortality. Goldbourt, Yaari, and Medalie (1993) determined that Orthodox Jews were less likely to die of coronary heart disease (CHD) than the non-Orthodox. Finally, Colantonio, Kasl, and Ostfeld (1992) assessed the influence of various measures of religiosity on the incidence of stroke, and did not find any to be statistically significant predictors after adjustment for confounders and known protective factors.

Taken together, these four studies imply that some facet of religion or spirituality may protect against CVD. Yet, as Powell et al. (2003) state, 'More longitudinal studies of cardiovascular diseases, and, in particular, cardiovascular morbidity are needed.' The current investigation aims to further investigate these issues.

Our hypothesis is that religious affiliation, participation, and support are predictive of reduced risk of all-cause mortality and CHD morbidity and mortality. Given the large population that may be affected, even a risk reduction as modest as 10%, less than observed in some of the above cited studies, would be of clinical importance, provided results were significant and not due to chance.

Methods

Participants

The Women's Health Initiative (WHI), a study sponsored by the National Institutes of Health, involved 40 clinical centres across the United States. Women aged 50–79 years were recruited by mass mailings using voter registration, insurance, driver's license, and

other lists. WHI participants were screened for enrollment into a placebo-controlled, double-blind randomised clinical trial (CT) of hormone replacement and/or dietary modification, or into an observational study (OS). Women ineligible or unwilling to take part in the CT were assigned to the OS, along with women recruited expressly for the OS. The latter was designed to evaluate the long-term impact of biological, genetic, and lifestyle factors on the risk of cancer, CVD, osteoporosis, and other health events. Further details of the WHI design are described elsewhere (The WHI Study Group, 1988). Only women who participated in the OS are included in the current investigation.

Upon enrollment in the study, participants completed several self-report questionnaires regarding demographics, health history, health behaviours, psychosocial factors, and religion. Of the 93,676 participants enrolled in the OS component, 1281 were excluded from analyses due to missing data on one or more of the religion-related questions, leaving 92,395 participants for the current study.

All research was conducted with approval of the relevant ethical review panel.

Data collection

The demographic information collected at baseline and used in the current study included self-report of age, ethnicity, and income and educational levels. Health history questions related to ability to complete activities of daily living, history of CVD (including myocardial infarction [MI], stroke, angina, transient ischemic attack, and revascularisation), cancer, and breast cancer. Body mass index (BMI) was obtained via measures of height and weight taken at the first clinical visit. Participants also rated their overall health, a measure correlated with actual health and that is a strong predictor of mortality across numerous studies (Idler & Benyamini, 1997). Health behaviour questions related to smoking status, alcohol use, and physical activity. Psychosocial questions included those about social support (based on the Medical Outcome Study questionnaire; Sherbourne & Stewart, 1991), life events [based on Ruberman, Weinblatt, Goldberg, and Chaudhargs' (1984) modification of the Alameda County Study (Berkman & Syme, 1979) questionnaire], life satisfaction (a rating of satisfaction with 'current quality of life,' from 0–10), and depression [based on the eight-item screening instrument used in the Medical Outcome Study (Burnam, Wells, Leake, & Landsverk, 1988)]. Finally, three religion items asked about religious affiliation, frequency of religious service attendance, and the level of strength and comfort provided by religion.

Outcome ascertainment

Follow-up data were collected to determine when and if each participant succumbed to all-cause mortality or CHD morbidity or mortality (defined as 'clinical MI', i.e., 'in-hospital fatal or nonfatal MI'; or death due to atherosclerotic cardiac disease or suspected CHD). Following each year after study enrollment, participants completed a medical history questionnaire. If hospitalisation or other significant events were indicated, further information and medical records were obtained for local physician adjudicators who classified the event as per study protocol. Follow-up data also included the date of last contact which was the last date on which the medical history update was completed by

the participant. The average follow-up period was 7.7 years (SD = 1.5; median = 7.9) after the start of the study.

Statistics

Several analyses were conducted to describe and compare those included and excluded from the study. (Statistical significance was set to $p < 0.05$ for all tests.) The differences between those included ($n = 92{,}395$) and excluded ($n = 1281$) from analyses were assessed for abovementioned demographic, health history, health behaviour, and religion variables. Chi-square tests were used for categorical variables and *t*-tests for continuous variables. (Table 1 lists baseline demographic information, as well as those characteristics that differed between included and excluded participants.) The distribution of study participants based on their responses to the religion questions is shown in Table 2. Table 3 shows crude rates of morbid and mortal events, based on responses to the religion questions.

Cox hazard ratios (HR) were used to assess any potential effect of religious affiliation, service attendance, or strength and comfort on the relative risks of all-cause mortality and CHD morbidity and mortality (Tables 4–5). For each outcome variable, six models were constructed for each of the three religion variables (i.e., affiliation, frequency of service attendance, and level of strength and comfort provided by religion): an unadjusted model; a model controlling for demographics, socioeconomic factors, and prior health history (Model 1); a model including all variables in Model 1 plus controls for psychosocial variables (Model 2); a model including all variables in Model 1 plus controls for health behaviours (Model 3); a model including all variables in Model 1 plus controls for psychosocial variables and health behaviours, and additionally controlling for depression and physical activity (Model 4); Model 4 but excluding all participants with prior history of MI or stroke (Model 4a). *P*-values and CIs were not adjusted for multiple comparisons.

Causes of death among women who died after the first year were compared, based on the participants' answers to the three religion-related questions. Chi-square tests were used to compare the results (Tables 6–8).

Results

Demographics

Differences between the study population ($N = 92{,}395$) and those excluded due to missing data ($N = 1281$) on any of the three religion-related questions (i.e., affiliation, attendance, strength and comfort) are shown in Table 1. Compared with the excluded participants, the included participants were younger, and more often white, of higher income, and better educated. This group also reported better health, had lower mean BMI, was less likely to have a history of MI, and had different alcohol-drinking habits.

Table 2 shows the distribution of study participants' answers to the religion-related questions, indicating that 92.7% of participants listed some affiliation. The largest group was Protestant, followed by Catholics, other Christians, Jews, and those who selected 'none' or 'other'. Those participants who had not attended services in the last month comprised the largest group, followed by those who had attended once

Table 1. Description of study participants.

	Included in analysis ($N = 92{,}395$)	Excluded (due to missing religion data) ($N = 1281$)
Demographics		
Age/mean (S.D.)*	63.6 (7.4)	64.3 (7.7)
Age group (%)*		
50–59	31.7	30.1
60–69	44.0	41.0
70–79	24.3	28.8
Ethnicity (%)*		
Non-Hispanic White	83.5	69.6
Hispanic/Latino	3.8	10.6
African American	8.1	13.3
Other	4.4	5.9
Missing	0.3	0.6
Socioeconomic status		
Income (%)*		
Less than $20,000	14.9	20.6
$20,000–49,999	40.3	32.6
$50,000–99,999	27.5	23.3
$100,000 or more	10.1	8.1
Don't know	3.0	4.4
Missing	4.3	10.9
Education (%)*		
No high school	5.1	9.8
High school/vocational degree	52.4	48.6
College degree	23.2	21.5
Graduate degree	18.5	17.4
Missing	0.8	2.7
Prior health		
Activities of daily living/mean (S.D.)	4.03 (0.29)	4.05 (0.35)
Missing = 3358		
Self-reported health (%)		
Fair/Poor	9.7	10.6
Good	31.8	25.8
Very Good	40.4	29.7
Excellent	17.7	14.2
Missing	0.4	19.7
History of CVD (%)		
Prior MI*	2.5	3.4
Missing	0.1	0.1
Prior stroke	1.5	2.1
Missing	0.1	0.0
Any CVD	9.8	11.4
History of cancer (%)		
Breast cancer	5.7	4.8
Missing	0.9	7.4
Any cancer	12.9	12.7
Missing	0.7	7.4
Body mass index/mean (S.D.)*	27.3 (5.86)	27.7 (6.30)
Missing = 1108		

(*Continued*)

Table 1. Continued.

	Included in analysis ($N = 92,395$)	Excluded (due to missing religion data) ($N = 1281$)
Mod. to stren. Activity >20 min.		
None	13.5	13.9
Some limited activity	38.1	33.4
2–<4 episodes/week	18.3	15.8
4 episodes/week	29.2	24.2
Missing	1.0	12.7
Health behaviours		
Cigarette smoking (%)		
Never	50.3	43.7
Past	42.3	37.0
Current	6.2	5.0
Missing	1.3	14.3
Alcohol use (%)*		
Non-drinker	11.2	11.6
Past drinker	18.8	16.5
Less than 1 drink/month	11.5	9.8
Less than 1 drink/week	20.0	20.7
1-less than 7 drinks/week	25.5	23.1
7+ drinks/week	12.5	9.3
Missing	0.6	9.1

Note: Total $N = 93,676$.
(*$p < 0.05$).

Table 2. Religious characteristics of study participants.

Religion	
Affiliation (%)	
Catholic	27.3
Protestant	40.9
Other Christian	11.0
Jewish	7.7
Other (Eastern, Muslim, others)	5.7
None	7.3
Attended service in last month (%)	
Never	34.1
Less than once/week	21.4
Once/week	30.2
More than once/week	14.3
Religion provides strength and comfort (%)	
None	12.5
A little	24.1
A great deal	63.3

Note: Total $N = 92,395$

per week, less than once per week, and more than once per week. Finally, most participants reported that religion provided them 'a great deal' of strength and comfort (63.3%), while the second largest group reported 'a little' (24.1%). Only 12.5% reported 'none.'

Table 3. Coronary heart disease events and all-cause mortality by religiosity variables; crude rates.

	N	CHD Events	%*N*	*P*	Death Events	%*N*	*P*
Religious affiliation				<0.0001			0.97
Yes	85,673	2300	2.7		5712	6.7	
No	6722	127	1.9		449	6.7	
Attendance at services				0.031			0.011
None in the last month	31,493	778	2.5		2198	7.0	
<Once a week	19,787	540	2.7		1240	6.3	
Once a week	27,927	722	2.6		1827	6.5	
More than once a week	13,188	387	2.9		896	6.8	
Strength and comfort from religion				<0.0001			0.026
None	11,591	227	2.0		723	6.2	
A little	22,277	563	2.5		6441	6.5	
A great deal	58,527	1637	2.8		3997	6.8	

Relationships between religiosity variables and all-cause mortality and CHD morbidity and mortality

There were 6161 deaths and 2427 CHD events among the participants included in the analysis. Table 3 shows the number of morbid and mortal events by the religion variables over the 7.7 year study period. Women with religious affiliation, who attended services most often, and who derived a great deal of strength and comfort from their religion, had higher crude rates of CHD. There was no difference in crude death rate between those who reported any religious affiliation versus the unaffiliated. However, those women who attended services most often or not at all had higher death rates than those who attended, but did so once per week or less. Those who report a great deal of strength and comfort from religion also had the highest death rates. The absolute differences were small, though, and likely significant only due to the large sample size.

Proportional hazards ratios for all-cause mortality are shown in Table 4 for groups of participants based on their answers to the religion-related questions. In all cases, the ratios are in reference to the first group in each category. The results are presented in unadjusted form, followed by five models, as described above.

The HR for those reporting religious affiliation, after adjustment for demographic, socioeconomic, and prior health variables, was 0.84 (CI = 0.75–0.93). Additional adjustment for psychosocial variables and for health behaviours did not change the results. However, when both psychosocial and health variables were added to the model at the same time (Model 4), results were no longer significant (HR = 0.91; CI = 0.82–1.02). Furthermore, participants who attended religious services, even if less than once per week, were at significantly reduced risk of death in all four adjusted models, compared with those who did not attend at all. Degree of religious strength and comfort was not significantly related to mortality in the adjusted models, except for Model 1 where those reporting 'a great deal' were at reduced risk (HR = 0.89; CI = 0.82–0.98).

When Model 4 was recalculated omitting all participants with prior history of MI or stroke (Model 4a), results remained similar: Religious affiliation and strength and comfort

were not significantly related to mortality. Religious service attendance was protective against mortality for those who attended once per week (HR = 0.90; CI = 0.83–0.97) and those who attended more than once per week (HR = 0.87; CI = 0.78–0.97).

Table 5 shows the proportional hazards ratios for CHD for groups of participants based on their answers to the religion-related questions. Models 3 and 4 show an increased risk of CHD for those reporting 'a little' or 'a great deal' of strength and comfort from religion, but this difference was no longer significant in the latter group when Model 4 was recalculated omitting participants with prior history of MI or stroke (Model 4a). There was no consistent pattern with regard to religious affiliation or service attendance, regardless of whether participants with MI or stroke history were included.

Tables 6 and 7 compare the causes of death among women who died after the first year, based on the participants' religious affiliation status and their frequency of religious service attendance. No significant differences were found for either of these comparisons. However, as demonstrated by Table 8, those reporting 'a great deal' of strength and comfort from religion were less likely to succumb to cancer death than those reporting less strength and comfort, but more likely to succumb to various forms of cardiovascular deaths and deaths categorised as of 'other or unknown' cause.

Table 4. Hazards ratios of all-cause mortality by religiosity[a,b].

	Unadjusted	M1	M2	M3	M4	M4a
Religious affiliation						
No (ref.)						
Yes	1.03	0.84	0.85	0.90	0.91	0.91
	0.94–1.13	0.75–0.93	0.76–0.95	0.81–0.97	0.82–1.02	0.81–1.03
Church/service attendance						
Not in last month (ref.)						
Less than once/week	0.91	0.85	0.86	0.91	0.91	0.93
	0.84–0.97	0.79–0.92	0.79–0.93	0.84–0.98	0.84–0.99	0.85–1.02
Once/week	0.95	0.80	0.81	0.88	0.89	0.90
	0.90–1.01	0.75–0.86	0.76–0.87	0.82–0.95	0.82–0.95	0.83–0.97
More than once/week	1.00	0.80	0.80	0.89	0.88	0.87
	0.92–1.08	0.73–0.87	0.73–0.87	0.81–0.97	0.80–0.97	0.78–0.97
Religion provides strength/comfort						
None (ref.)						
A little	1.05	0.95	0.98	0.97	1.01	1.01
	0.96–1.15	0.86–1.05	0.88–1.08	0.88–1.08	0.91–1.11	0.90–1.12
A great deal	1.14	0.89	0.93	0.96	0.99	0.97
	1.06–1.24	0.82–0.98	0.85–1.02	0.88–1.05	0.90–1.09	0.87–1.07

Notes: [a]95% confidence intervals printed below each figure.
[b]Model 1 – controls for demographic (age, ethnicity), socioeconomic (income, education), and prior health (activities of daily living, self-reported health, CVD, breast cancer, cancer, BMI) variables.
Model 2 – same as Model 1 plus controls for psychosocial variables (social support, life events, life satisfaction).
Model 3 – same as Model 1 plus controls for health behaviours (smoking, alcohol consumption).
Model 4 – same as Model 1 plus controls for psychosocial variables, health behaviours, depression, and physical activity.
Model 4a – same as Model 4 but excluding all participants with history of MI or stroke.

Table 5. Hazards ratios of CHD morbidity and mortality by religiosity[a,b].

	Unadjusted	M1	M2	M3	M4	M4a
Religious affiliation						
No (ref.)						
Yes	1.46	1.15	1.21	1.20	1.21	1.22
	1.22–1.75	0.95–1.0	0.98–1.48	0.98–1.46	0.99–1.49	0.96–1.56
Church/service attendance						
Not in last month (ref.)						
Less than once/week	1.11	1.08	1.08	1.14	1.12	1.08
	1.00–1.24	0.96–1.22	0.96–1.23	1.01–1.28	0.99–1.27	0.93–1.26
Once/week	1.06	0.92	0.92	0.98	0.97	0.98
	0.96–1.17	0.82–1.02	0.82–1.03	0.83–1.10	0.86–1.09	0.85–1.13
More than once/week	1.21	1.01	1.04	1.09	1.07	1.08
	1.08–1.37	0.88–1.16	0.90–1.19	0.95–1.26	0.97–1.29	0.91–1.29
Religion provides strength/comfort						
None (ref.)						
A little	1.31	1.14	1.18	1.18	1.23	1.29
	1.12–1.53	0.96–1.35	0.99–1.40	1.00–1.40	1.04–1.47	1.05–1.58
A great deal	1.49	1.11	1.16	1.18	1.22	1.18
	1.29–1.71	0.95–1.29	0.97–1.36	1.01–1.38	1.03–1.44	0.97–1.43

Notes: [a]95% confidence intervals printed below each figure.
[b]Model 1 – controls for demographic (age, ethnicity), socioeconomic (income, education), and prior health (activities of daily living, self-reported health, CVD, breast cancer, cancer, BMI) variables.
Model 2 – same as Model 1 plus controls for psychosocial variables (social support, life events, life satisfaction).
Model 3 – same as Model 1 plus controls for health behaviours (smoking, alcohol consumption).
Model 4 – same as Model 1 plus controls for psychosocial variables, health behaviours, depression, and physical activity.
Model 4a – same as Model 4 but excluding all participants with history of MI or stroke.

Table 6. Causes of death by religious affiliation.

Causes	No, not affiliated	Yes, affiliated
Number of deaths (excluding deaths in first year)	425	5488
Causes of death*	% of deaths	% of deaths
Cancer deaths	47.1	42.4
Coronary heart disease	9.9	13.2
Stroke	8.0	7.4
Other cardiovascular (pulmonary emboli, other cardiovascular, unknown cardiovascular)	6.1	8.2
Traumatic deaths	3.8	2.4
Other or unknown deaths	25.2	26.5

Note: *$p = 0.053$.

Table 7. Causes of death by religious attendance.

Causes	Not in last month	Less than once per week	Once per week	More than once per week
Number of deaths (excluding deaths in first year)	2099	1185	1752	877
Causes of death*	% of deaths	% of deaths	% of deaths	% of deaths
Cancer deaths	44.5	41.9	42.6	39.8
Coronary heart disease	12.5	14.0	11.6	15.3
Stroke	7.1	7.9	7.5	7.6
Other cardiovascular (pulmonary emboli, other cardiovascular, unknown cardiovascular)	8.2	7.9	7.6	8.4
Traumatic deaths	2.8	2.5	1.9	2.7
Other or unknown deaths	24.9	25.8	28.8	26.1

Note: *$p = 0.13$.

Table 8. Causes of death by strength and comfort from religion.

Causes	None	A little	A great deal
Number of deaths (excluding deaths in first year)	688	1381	3844
Causes of death*	% of deaths	% of deaths	% of deaths
Cancer deaths	51.2	47.7	39.4
Coronary heart disease	10.2	12.5	13.6
Stroke	7.6	7.5	7.4
Other cardiovascular (pulmonary emboli, other cardiovascular, unknown cardiovascular)	6.4	7.8	8.4
Traumatic deaths	2.6	2.2	2.6
Other or unknown deaths	22.1	22.2	28.7

Note: *$p < 0.0001$.

Discussion

The Women's Health Initiative's cohort of over 90,000 postmenopausal women across the United States provided an opportunity to examine relationships between religiosity and health. The extensive data collected from this multiethnic group of subjects also allowed controlling for possible confounding variables. Furthermore, follow-up data permitted the construction of various adjusted models to ascertain whether any religion–health link can be accounted for by protective factors already thought to be associated with religious identification or behaviour.

Data from 92,395 participants were available for analyses; an additional 1281 participants were excluded due to missing information on the religion-related questions. There were significant differences between these two groups in terms of demographic, socioeconomic, and health characteristics (Table 1). However, in large samples, small differences are statistically significant.

Within the study sample, potential confounding variables include age, ethnicity, income and education, and those related to disability and history of poor health. Indeed, the literature suggests (Powell et al., 2003) that older and minority persons are more likely to be religious and also more likely to die. Adjusting for age and ethnicity prevents potential underestimation of any health protective property of religiosity. Moreover, healthier people and those of higher socioeconomic status may be likely to live longer and are also better able to attend religious services than others. Without control for these factors, a relationship between ability to attend services and health might actually underlie an apparent relationship between attendance and health.

Additionally, healthy lifestyle choices, such as electing not to smoke or drink in excess, are characteristic of religious people and also related to good health (Powell et al., 2003). Comparing models that control for these known protective factors with those that do not allow insight into whether any relationship between religion and health can be explained through established risk factors.

As mentioned above, the current study revealed a significant relationship between increased religious service attendance and reduced all-cause mortality (Table 4). Risk reduction of 10–20% (depending on the model) was observed, which may be important, especially given the large size of the population that may be affected. Furthermore, those who attended at least once per week were at reduced risk even when all participants with prior history of MI or stroke were omitted from analysis, increasing the likelihood that service attendance is prospectively associated with reduced mortality, rather than that experiencing disease encourages religious behaviour. As such, our results are consistent with the growing number of longitudinal studies of healthy populations with similar results referred to above. Indeed, some of these studies have even demonstrated a dose-response relationship. One recent prior study demonstrating that religious service attendance is protective against mortality concluded that their results, combined with those 'of prior studies makes the possibility that the effect is spurious highly implausible' (Musick, House, & Williams, 2004). In fact, Powell et al. (2003) found that the average strength of the relationship across such studies was a 30% reduction in mortality after adjustment for confounders, and a 25% reduction after adjustment for known protective factors.

Notably, our results suggest a more modest reduction in risk than these previous studies. However, in many of the models the CIs allow for the possibility of a larger effect size. Moreover, it must be emphasised that the current study involved an average follow-up period of 7.7 years, while at least one study that found religious attendance protective against mortality involved a much longer follow-up period of 31 years (Oman et al., 2002). Furthermore, another study (Krause, 1998) that found a relationship used a more general measure of organisational religiosity. In addition to asking participants how often they attend religious services, researchers also inquired, for example, about frequency of attendance at Bible study groups, adult Sunday school classes, and prayer groups. It is possible that results of our study would have been different had participants been followed for a longer period or if we had used a broader measure of religious attendance. Relatedly, our finding that those reporting religious affiliation were also at reduced risk of mortality in most models suggests that focussing exclusively on frequency of religious service attendance may be overly narrow.

It should be noted that studies that found religious attendance protective against mortality have included both younger (House, Robbins, & Metzner, 1982; Hummer et al., 1999; Musick et al., 2004) and older adults (Koenig et al., 1999; Krause 1998; Oman & Reed, 1998). Additionally, some have found a stronger protective effect among women than among men (House et al., 1982; Koenig et al., 1999). Oman et al. (2002) examined the

interactions between age and gender and found the strongest relationship between religious attendance and reduced mortality among women 70 years and older, while results for all other age/gender groups were not significant.

By contrast, Musick et al. (2004) found that religious service attendance was less protective against mortality among older subjects in their study and in a similar one by Seeman, Kaplan, Knudsen, Cohen, and Guralink (1987). They hypothesise that religious involvement may be most protective against mortality among middle-aged adults, as opposed to older adults, because lifestyle changes associated with religion may be more effective against the preventable deaths more often suffered by individuals in this age group. Put in this context, results of the current study, unique in that its sample was both very large and mostly involved women over the age of 60 years (mean age = 63.61 years), may support the contention that religious attendance is somewhat less protective against mortality for older adults, at least among women. Had we conducted a similar study with younger women, we may have discovered risk reduction of a magnitude similar to that found in other studies.

The fact that results showed significant reduction in risk of mortality in all models, even those that controlled for psychosocial and health behaviours, also seems critical. The protection against mortality provided by religion cannot be entirely explained, therefore, by such factors as the social support or lifestyle choices regarding smoking and alcohol consumption that service attendance may engender.

While the above discussion pertains to all-cause mortality, our study also focussed on risk of CHD morbidity and mortality (Table 5). Participant report of religious affiliation and attendance at religious services did not consistently affect the risk of CHD events in the adjusted models. However, those reporting strength and comfort from their religion were actually at increased risk of disease in some models. Despite our attempts to control for prior health variables, it may be that those cardiac patients who were most ill were also most likely to turn to religion for support. This approach is buttressed by the fact that those reporting 'a great deal' of strength and comfort from religion were more likely to succumb to most forms of cardiovascular deaths. (Interestingly, though, cancer deaths were less frequent in this group; see Table 8.) In fact, among participants in this group without prior history of MI or stroke (Model 4a) any increased risk was not significant (CI = 0.97–1.43).

In any event, our results do not support the hypothesis that religious affiliation, service attendance, or strength and comfort reduce the risk of CHD events. Given our findings that religious affiliation and service attendance reduce the risk of all-cause mortality, it seems that such risk reduction may not result from prevented CHD events, but via other pathways.

In an effort to assess which pathways may be relevant to the decreased mortality found for those with religious affiliation and more frequent religious service attendance, causes of death were compared across groups. However, no significant differences were found (Tables 6–7). Although the relatively high number of deaths categorised as 'other or unknown' may somewhat obscure analysis, it was not possible to identify particular types of mortality found less often among those reporting affiliation or frequent service attendance.

Whether religion or spirituality is associated with CVD-related morbidity or mortality has not previously been adequately assessed (Sloan & Bagiella, 2002). Powell et al. (2003) identified only four properly designed prospective studies that related religion to CVD. As explained above, these examined CVD-related mortality, CHD, and stroke. However,

the broad focus of our CHD endpoint, combined with our very large sample size, make the current study unique.

Furthermore, whether religious strength and comfort are supportive of physical health has also not been adequately assessed. Previous studies have examined the variable in combination with other measures of depth of religiosity. For example, Zuckerman, Kasl, and Ostfeld (1984) investigated whether deeply religious people are protected against death, combining several measures of religiosity, making it difficult to assess the impact of religious strength or comfort alone. It is similarly difficult to disentangle the results in other studies involving this variable (e.g. Idler & Kasl, 1992; Kutner et al., 1994; Musick et al., 2004). Thus the current study may be the first to assess the impact of religious strength and comfort by itself in protecting against CHD events and all-cause mortality. Future research will hopefully further examine this perplexing variable.

While the current study found religious affiliation and service attendance protective against all-cause mortality in post-menopausal women, further large-scale research might continue to examine when this may be true for younger and male samples. The question of whether such involvement is protective against other forms of morbidity and mortality in post-menopausal women and other groups should also be investigated. Furthermore, the fact that our study and most that preceded ours have found as much as a 25% reduction in all-cause mortality even after adjusting for confounding variables and known risk factors suggests that there are other important mechanisms that may connect religious involvement to reduced mortality that are not yet understood.

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