

Religious attendance as a predictor of survival in the EPESE cohorts

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Background Interest has arisen in recent years in the relationship between religious involvement and health outcomes. Although most of the early literature consists of studies with methodological flaws, some recent well-conducted reports show that religious attendance is associated with reduced mortality in selected subgroups and populations.

Methods In this study, we investigated the relationship between religious attendance and mortality using the 14 456 participants in the National Institute of Aging-funded 'Established Populations for Epidemiologic Studies of the Elderly'.

Results Our analyses show that after controlling for important prognostic factors, frequent religious attendance was associated with increased survival in the entire cohort [risk ratio (RR) = 0.78, 95% Confidence interval (CI) 0.70–0.88]. However, stratified analyses show that this association exists for only two of the four sites.

Conclusions We conclude that the association between religious attendance and survival is not robust and may depend upon unknown confounders and covariates.

Keywords Religious attendance, mortality, EPESE

Interest in the association between religious activities and health has grown considerably in the past decade. Recent polls indicate that the US population is highly religious: most people believe in heaven and hell,¹ in the healing power of prayer,² and that faith can promote recovery from disease.³ The popular press frequently reports cases in which religious faith and practice are said to promote comfort and/or healing. One study reported that 77% of hospital patients wanted physicians to consider their spiritual needs.⁴

Interest within the medical profession has paralleled the increased interest among the general public. By the year 2000, over half of the medical schools in the US offered courses in religion, spirituality, and health.⁵ Of the 296 physicians surveyed at the October 1996 meeting of the American Academy of Family Physicians, 99% were convinced that

religious beliefs can heal and 75% believed that prayers of others could promote a patient's recovery.

This interest in introducing religious practices into clinical medicine runs counter to another trend in contemporary medicine: the reliance on rigorously controlled studies. American medicine increasingly finds itself required to engage in practices whose efficacy is supported by empirical evidence. Practices that fail to meet this criterion are discouraged.

In this context, studies of religious involvement and health may have implications for clinical practice. Of course, most studies in this area are observational, not randomized clinical trials, and ethical considerations prohibit randomizing individuals to attend religious services or to engage in spiritual activities. Nevertheless, given the interest among the general public and within the medical profession, unequivocal evidence of clinically meaningful epidemiological associations between indices of religious involvement and health should be taken seriously, in the absence of significant ethical concerns.

A recent review concluded that the evidence linking attendance at religious services to reduced mortality was 'persuasive'.⁶ However, these findings are not consistent across populations and often hold only in subgroups. The objective of the current study was to understand the putative relationship between religious attendance and mortality using data from all four sites of the Established Populations for Epidemiologic

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Studies of the Elderly (EPESE) study, one of the largest datasets on older Americans.

Methods

This study used a prospective cohort design. Data were collected from the non-institutionalized populations aged 65 and more, enrolled between 1980 and 1987 in the National Institute of Aging-sponsored EPESE.⁷ The study included four sites: East Boston, MA; Iowa and Washington Counties, IA; New Haven, CT; and Duke University, NC. Sampling methods are documented elsewhere.⁸ Each participant was interviewed at the time of enrolment (baseline), and at follow-ups performed every year over a period of 6 years. At baseline, the data represents 14 456 participants over the four sites. Baseline interviews for East Boston, Iowa, and New Haven were conducted between 1981 and 1982. Duke was the last of the four sites to join the study, conducting baseline interviews in 1986.

All data available publicly and common to all four sites were used for the analysis described in this paper. To protect confidentiality, dates of death were not included in the public dataset. Data on survival (in months) were provided free of any identifiers by NIA.

Assessment

The baseline questionnaire was administered during a household interview. Follow-up interviews were conducted annually either by phone or household visit for a total of 6 follow-up interviews per participant. If a subject was unable to provide information, due to illness or otherwise, a proxy interview was conducted with a close relative or staff member in a nursing home.

Covariates

We classified the covariates into 6 groups: (i) demographics; (ii) indexes of physical health; (iii) smoking; (iv) religious attendance; (v) social involvement; and (vi) indexes of mental health.

Demographic variables included gender, age (categorized in 5-year classes: <70; 70–74; 75–79; 80–84; 85+), marital status (married, separated, divorced, annulled, widowed) and education (categorized as ≤11, >11 years of school with the latter as the reference category).

General health was assessed using measures of physical functioning, self-rating of health, presence of chronic medical conditions, and admission to a nursing home. Physical functioning comprised three sets of variables. The first measured a person's ability to perform daily tasks, including: walking across a small room; bathing; grooming; dressing; eating; getting from bed to chair; and using the toilet. The second measured the person's ability to: do heavy work around the house; walk up/down stairs; and walk half a mile without difficulty. The third set measured difficulty in: pushing large objects; stooping, crouching, kneeling; extending arms; and writing. Thus, these measures of physical functioning describe different degrees of physical impairment. Each measure was coded to compare subjects with no impairment to subjects with one or more impairments in any of the categories.

Self-rating of health was measured by the question: 'Compared to other people your own age, would you say that your general health is excellent, good, fair, or poor?' Responses were dichotomized to excellent or good vs fair or poor.

Chronic medical conditions were measured as being told by a medical professional that the subject had any of the following: myocardial infarction, stroke, cancer, diabetes, high blood pressure, or broken hip. These health variables were coded to compare subjects with none of these conditions to the presence of one or more.

Subjects were asked if they had ever been in a nursing home. Cigarette smoking was assessed with the question, 'Do you smoke cigarettes (regularly) now?'.

Religious attendance was assessed by the question: 'About how often do you go to religious meetings or services?' Responses were grouped as: Never/almost never to once or twice a year; every few months to once or twice a month; and once a week to more than once a week.

Social involvement reflected contact with family members and friends, membership in a social club, household composition, and employment status. Responses were dichotomized to compare no visits with one or more relatives or friends visiting. Employment status was measured by asking the participants if they were working at a paying job.

Household composition was measured by asking participants if they lived alone, with a spouse, with a spouse and someone else, or in some other arrangement. Responses were dichotomized to compare living alone with living with someone else or other arrangements.

Formal social involvement was measured by the question: 'Are you a member of any clubs or organizations such as church related groups, labour unions, farm organizations, social or recreational groups?'

Mental health was assessed using a version of the Center for Epidemiological Studies-Depression (CES-D) scale⁹ and a short version of the Mini Mental State Examination. Ten items from the CES-D were common to all four study sites. They are reported in the appendix.

Response options differed from site to site. At the Iowa site, they were: (i) hardly ever; (ii) some of the time; (iii) most of the time; (iv) don't know; and (v) refused. At Duke, options were: (i) yes; (ii) no; and (iii) don't know. To standardize the scores among groups, responses were recoded to dichotomize between 'rarely, or never' (scored as 0) compared with 'ever' expressing depressive symptoms (scored as 1). Responses originally coded as 'don't know', or 'refused' were considered missing. A depression score was calculated by summing the dichotomized responses to each item. Thus, each subject's depression score ranged from 0 to 10.

Mental status was assessed by responses to 10 questions from the Mini-Mental State Examination (see Appendix). For each of the questions, a correct answer was coded as 0 and an incorrect answer as 1. Mental status was operationalized as the sum of these scores (range 0–10).

Other variables common to all four sites but not included in the results were: income group, mean arterial pressure, weight, and alcohol consumption. Income group and alcohol consumption were reported in fewer than half of the participants. Mean arterial pressure and weight had too many unreliable values.

Ethnic group was reported only for the New Haven and Duke sites.

Missing data

A missing value was filled in using data for the same variable from the most recent previous interview if available. If no

previous interview contained data for that patient, the field was left blank. Data missing at baseline were kept blank.

Censoring times

Survival times were calculated in months. Subjects who survived past the follow-up time or dropped out during the course of follow-up were censored. If censoring time was not known, a value corresponding to the time of the subject's last follow-up was used.

Statistical analysis

We used Kaplan-Meier analysis to summarize the survival experience for the four cohorts. The log-rank test was used to compare the survival curves for the four sites and to conduct univariate analysis on the predictors.

Associations between the covariates and survival were examined using Cox proportional-hazards regression models. All analyses were conducted using the statistical software SAS (SAS, Institute, Inc.). In the first step of the analysis, each variable was examined to ascertain stability of subjects' responses over time. Five variables with frequencies that changed substantially over time were entered in the regression model as time-dependent covariates. One measure of physical functioning (physical functioning 3), self-rating of health and presence of chronic conditions were entered as time-varying covariates using the assessments made at baseline and at each year of follow-up. For religious attendance baseline, 3- and 6-year measurements were considered in the model as time-varying covariates. Club/organization membership was entered as a time-dependent starting at the third year of follow-up, since it was not measured before. For all other covariates baseline measurements were used in the multivariate model. All findings with a significance level exceeding 0.05 were considered statistically significant.

To investigate mechanisms by which religious attendance might affect mortality in each cohort, we used step-wise entry of all the variables. In a first model, we considered demographics (age, sex, marital status, and education) and measurement of religious attendance. All other variables were added in groups to this first model to account for possible confounding. Thus, in a second model we added measures of physical functioning and physical health (model 2). Smoking status was added next (model 3). A fourth model was fitted by adding depression scores and mental status to model 3. Measures of social involvement were added independently to model 4 in a fifth model.

Results

The EPESE sample comprises 14 456 subjects at baseline from four different sites: East Boston, Iowa, New Haven, and North Carolina (Duke). Baseline demographic and other characteristics for the sample are presented in Table 1. Subjects were uniformly distributed in the five age categories, 62% were female, and almost half (45%) were married. Two-thirds (68%) had less than 12 years of education. Overall, the sample represents a physically healthy elderly population. The majority of the subjects (83%) could perform daily tasks like bathing, grooming, or dressing; about half of them (52%) could perform more difficult tasks like doing heavy work around the house or walk up/down stairs, but only a third (32%) could perform fairly difficult tasks like pushing large objects, stooping,

crouching, or kneeling. Almost (61%) rated themselves in good health and 58% had one or more chronic conditions at baseline. The majority of the subjects (83%) were not current cigarette smokers, and 96% had never been admitted to a nursing home.

Subjects were relatively socially involved. Although more than 40% lived alone, 63% and 72% had regular visits by close relatives and friends respectively. Only 11.7% of the people worked at a paying job at baseline.

The mean depression score at baseline was 2.1 (± 2.2) and the mini-mental status score was low (1.47 ± 1.6), indicating a relatively psychiatrically healthy population.

Data on religious affiliation were available only for the Iowa, New Haven, and Boston sites. In Iowa, 82% of the sample was Protestant. In New Haven, 51% was Catholic, 13% Protestant and 13% Jewish. In East Boston, 88% were Catholic. Although not recorded, it was reported that the Duke population was mostly Protestant and other studies from the Duke EPESE dataset confirm this.¹⁰ At baseline, 30% of the subjects did not attend religious services while 46% attended at least once a week.

Overall, the four cohorts were comparable in baseline characteristics (Table 1). The Iowa Cohort was slightly healthier than the others, with higher percentages of participants with good to excellent physical functioning, a lower percentage of smokers, and a lower mini-mental status score. Iowa and Duke had the highest percentage of subjects attending religious services once per week or more (63.6% and 51.8%, respectively). Almost half (43.5%) of the East Boston subjects attended religious services only once a year or never. In New Haven, there was an approximately equal distribution of subjects in the frequent, moderate, and infrequent attendance categories.

By the end of the 6-year follow-up, 4499 subjects had died. At the univariate level (Table 2), male gender, older age, being separated, divorced or widowed, lower level of education, poor physical functioning, poor health status, smoking, diminished social contacts, living alone, and poor mental and psychiatric status were predictors of death. Frequent religious attendance, working at a paying job, and membership in a club were associated with longer survival.

Results of the Cox proportional-hazards analyses are reported in Tables 3 and 4. Table 3 presents the risk ratios (RRs) for the full model with all predictors. RRs for all the standard risk factors were in the expected direction (see Table 3).

Religious attendance of once to more than once per week was protective against death (RR: 0.79, 95% CI = 0.71–0.89), compared with no attendance. Attendance every few months did not significantly contribute to longer survival relative to less frequent attendance.

We conducted a stratified analysis by site to determine if the associations observed in the overall sample were consistent across the four cohorts. These findings are presented in Table 4. As in the entire sample, RRs for most of the risk factors maintained their magnitude and significance in all four sites. Having been admitted to a nursing home was a significant predictor of death only for the Iowa and Duke sites. Good self-rating of health was significant only for Iowa. Working at a paying job was a significant predictor only for New Haven and Duke. Mental status was no longer a predictor for Iowa while household composition was a significant risk factor for this site. Religious attendance of once to more than once per week was significantly protective against mortality only for the East Boston and Duke sites.

Table 1 Baseline characteristics of the sample

Variables	E. Boston (<i>n</i> = 3809)	Iowa (<i>n</i> = 3673)	New Haven (<i>n</i> = 2812)	N. Carolina (<i>n</i> = 4162)	Total
Gender					
Male	1449 (38.04)	1420 (38.66)	1169 (41.57)	1458 (35.03)	5496 (38.02)
Age (yr)					
<70	1277 (33.53)	986 (26.84)	962 (34.21)	1419 (34.09)	4644 (32.13)
70–74	1081 (28.38)	988 (26.90)	768 (27.31)	1124 (27.01)	3961 (27.40)
75–79	697 (18.30)	815 (22.19)	491 (17.46)	793 (19.05)	2796 (19.34)
80–84	413 (10.84)	523 (14.24)	335 (11.91)	505 (12.13)	1776 (12.29)
85+	341 (8.95)	361 (9.83)	256 (9.10)	321 (7.71)	1279 (8.5)
Marital status					
Married	1790 (51.88)	2081 (60.02)	1046 (41.49)	1590 (40.23)	6507 (45.01)
Divorced	197 (5.71)	91 (2.62)	315 (12.50)	332 (8.40)	935 (6.47)
Widowed	1463 (42.41)	1295 (37.35)	1160 (46.01)	2030 (51.37)	5948 (41.15)
Education					
1–11 years of school	2796 (75.55)	1924 (52.92)	1857 (68.15)	3165 (77.29)	9742 (68.81)
Physical functioning 1					
Some difficulty	739 (19.56)	405 (11.06)	475 (17.03)	786 (18.99)	2405 (16.64)
Physical functioning 2					
Some difficulty	1823 (49.01)	1346 (38.89)	1183 (44.09)	1942 (48.76)	6294 (43.54)
Physical functioning 3					
Some difficulty	2330 (64.87)	2024 (63.71)	1564 (57.37)	2931 (74.11)	8849 (61.21)
Health-self-rating					
Fair–Poor	1554 (40.80)	1080 (29.40)	1143 (31.12)	1867 (44.86)	5644 (39.04)
Chronic conditions					
At least one	1574 (41.32)	1503 (40.92)	1207 (42.92)	1853 (44.52)	6137 (42.45)
Nursing home					
Yes	45 (1.18)	128 (3.51)	108 (3.87)	80 (1.95)	361 (2.50)
Cigarette smoking					
Yes	744 (19.59)	317 (8.68)	568 (20.31)	714 (17.20)	2343 (16.21)
Religious attendance					
Never/once-twice per year	1624 (43.45)	728 (23.73)	1045 (37.83)	945 (22.89)	4342 (30.04)
Every few months/ once-twice per month	535 (14.31)	389 (12.68)	604 (21.87)	1046 (25.33)	2574 (17.81)
Once per week/more than once per week	1579 (42.24)	1951 (63.59)	1113 (40.30)	2138 (51.78)	6781 (46.91)
Visits by close relatives					
None	500 (16.87)	600 (20.07)	564 (27.92)	679 (19.27)	2343 (16.21)
Visits by close friends					
None	220 (7.81)	153 (5.63)	299 (14.49)	164 (4.53)	836 (5.78)
Household composition					
Live alone	1450 (38.07)	1280 (37.39)	1511 (53.73)	1570 (37.72)	5811 (40.91)
Organizational membership					
No	2199 (73.92)	1277 (40.94)	1235 (57.85)	1300 (40.20)	6011 (41.58)
Working at paying job					
No	3434 (91.33)	3055 (83.74)	2501 (90.13)	3670 (28.99)	12660 (88.27)
Depression score					
Mean	2.352	2.102	2.301	1.779	2.109
SD	2.471	2.005	2.274	2.136	2.239
Mini mental status score					
Mean	1.539	0.881	1.562	1.815	1.472
SD	1.500	1.154	1.672	1.792	1.599

Numbers indicate frequencies, unless otherwise noted. Percentages of responses per variable are indicated in parentheses.

Physical functioning 1: measures a person's ability to perform daily tasks, including: walking across a small room; bathing; grooming; dressing; eating; getting from bed to chair; and using the toilet.

Physical functioning 2: measures the person's ability to do heavy work around the house; walk up/down stairs; and walk half a mile without difficulty.

Physical functioning 3: measures difficulty in pushing large objects; stooping, crouching, kneeling; extending arms; and writing.

Health self-rating: measures the subjects' perceptions of their health status.

Chronic conditions: measures the presence of any of the following conditions: myocardial infarction, stroke, cancer, diabetes, high blood pressure, and broken hip.

Nursing home: measures if subjects had ever been in a nursing home.

Table 2 Description of the sample by mortality

Variables	Survive (<i>n</i> = 9957)	Not survive (<i>n</i> = 4499)
Site		
East Boston	2564 (67.31)	1245 (32.69)
Iowa	2711 (73.81)	962 (26.19)
New Haven	1819 (64.69)	993 (35.31)
Duke	2863 (68.79)	1299 (31.21)
Gender		
Male	3391 (61.70)	2105 (38.30)
Female	6566 (73.28)	2394 (26.72)
Age (yr)		
<70	3749 (80.73)	895 (19.27)
70–74	2957 (74.65)	1004 (25.35)
75–79	1835 (65.63)	961 (34.37)
80–84	957 (53.89)	819 (46.11)
85+	459 (35.89)	820 (64.11)
Marital status		
Married	4711 (72.40)	1796 (27.60)
Divorced	643 (68.77)	292 (31.23)
Widowed	3892 (65.43)	2056 (34.57)
Education		
1–11 years	6528 (67.01)	3214 (32.99)
>11 years	3306 (74.88)	1109 (25.12)
Physical functioning 1		
No difficulty	8835 (73.85)	3129 (26.15)
At least one difficulty	1080 (44.91)	1325 (55.09)
Physical functioning 2		
No difficulty	6108 (80.87)	1445 (19.13)
At least one difficulty	3485 (55.37)	2809 (44.63)
Physical functioning 3		
No difficulty	3552 (77.20)	1049 (22.80)
At least one difficulty	5914 (66.83)	2935 (33.17)
Health—self-rating		
Excellent—Good	6561 (74.46)	2251 (25.54)
Fair—Poor	3396 (60.17)	2248 (39.83)
Chronic conditions		
None	6300 (75.73)	2019 (24.27)
At least one	3657 (59.59)	2480 (40.41)
Nursing home		
No	9748 (69.66)	4246 (30.34)
Yes	144 (39.89)	217 (60.11)
Cigarette smoking		
No	8437 (69.99)	3617 (30.01)
Yes	1489 (63.55)	854 (36.45)
Religious attendance		
Never/once—twice per year	2148 (54.00)	1830 (46.00)
Every few months	1768 (68.69)	806 (31.31)
Once per week/ more than	5234 (77.19)	1547 (22.81)

Table 2 continued

Variables	Survive (<i>n</i> = 9957)	Not survive (<i>n</i> = 4499)
Visits by close friends		
None	1568 (66.92)	775 (33.08)
One or more	6533 (71.37)	2621 (28.63)
Visits by close friends		
None	518 (61.96)	318 (38.04)
One or more	7405 (71.30)	2981 (28.70)
Household composition		
Live alone	3941 (67.82)	1870 (32.18)
Live with someone	5892 (70.18)	2503 (29.82)
Organizational membership		
No	4619 (76.84)	1392 (23.16)
Yes	4645 (85.20)	807 (14.80)
Working at a paying job		
No	8480 (66.98)	4180 (33.02)
Yes	1421 (84.43)	262 (15.57)
Mini mental status		
Mean	1.272	1.942
SD	1.402	1.906
Depression		
Mean	1.988	2.409
SD	2.185	2.341

Numbers indicate frequencies, unless otherwise noted. Percentages, in parentheses, are for each response conditioned on mortality (row percent).

Physical functioning 1: measures a person's ability to perform daily tasks, including: walking across a small room; bathing; grooming; dressing; eating; getting from bed to chair; and using the toilet.

Physical functioning 2: measures the person's ability to do heavy work around the house; walk up/down stairs; and walk half a mile without difficulty.

Physical functioning 3: measures difficulty in pushing large objects; stooping, crouching, kneeling; extending arms; and writing.

Health self-rating: measures the subjects' perceptions of their health status.

Chronic conditions: measures the presence of any of the following conditions: myocardial infarction, stroke, cancer, diabetes, high blood pressure, and broken hip.

Nursing home: measures if subjects had ever been in a nursing home.

Table 5 shows the RRs for religious attendance in the five step-wise regression models. Moderate religious attendance, every few months to once-twice per month, was a significant predictor in the model including only the demographic variables. In successive models including measures of physical and mental health, smoking and social involvement, moderate religious attendance was no longer a significant predictor. Frequent religious attendance, once to more than once, also was a significant predictor in the model including demographics only in all four sites. This variable maintained its significance after adding physical functioning, physical health and, smoking variables to the model in all four sites. After adding mental status to the model, frequent religious attendance was no longer a significant predictor for the Iowa cohort. In the fifth model, in which measures of social involvement were accounted for after controlling for demographics, physical functioning and smoking status, frequent religious involvement was no longer a significant predictor of mortality in the Iowa and New Haven cohorts.

Table 3 Cox Proportional Hazards Model results: all covariates included

Variable	RR	95% CI
Site		
E. Boston vs Duke	0.81	(0.71–0.92)
Iowa vs Duke	1.04	(0.90–1.20)
New Haven vs Duke	1.33	(1.16–1.52)
Gender		
Female vs male	0.46	(0.42–0.52)
Age (yr)		
	1.32	(1.27–1.37)
Marital Status		
Separated/divorced vs married	1.27	(1.02–1.59)
Widowed vs married	1.21	(1.04–1.41)
Education		
0–11 yrs vs >11 yrs	0.94	(0.83–1.05)
Physical functioning 1		
Some difficulty vs no difficulty	1.36	(1.20–1.53)
Physical functioning 2		
Some difficulty vs no difficulty	1.54	(1.38–1.73)
Physical functioning 3		
Some difficulty vs no difficulty	1.35	(1.18–1.53)
Self rating of health		
Fair–poor vs Excellent–good	1.15	(1.04–1.28)
Chronic conditions		
At least one vs none	3.52	(3.18–3.89)
Nursing home		
Yes vs no	1.58	(1.22–2.04)
Cigarette smoking		
Yes vs no	1.42	(1.26–1.60)
Religious attendance		
Every few months to once–twice per month vs never/1–2 times/year	0.92	(0.80–1.04)
Once to more than once per week vs never/1–2 times/year	0.78	(0.70–0.88)
Visits by close relatives		
No vs yes	0.97	(0.86–1.09)
Visits by close friends		
No vs yes	0.99	(0.83–1.21)
Household composition		
Alone vs with someone	0.96	(0.83–1.10)
Club/organization membership		
No vs yes	1.05	(0.92–1.20)
Working at a paying job		
Yes vs no	0.78	(0.65–0.93)
Depression		
	1.00	(0.98–1.03)
Mini mental status		
	1.10	(1.07–1.14)

RR, Risk Ratio.

Physical functioning 1: measures a person's ability to perform daily tasks, including: walking across a small room; bathing; grooming; dressing; eating; getting from bed to chair; and using the toilet.

Physical functioning 2: measures the person's ability to do heavy work around the house; walk up/down stairs; and walk half a mile without difficulty.

Physical functioning 3: measures difficulty in pushing large objects; stooping, crouching, kneeling; extending arms; and writing.

Health self-rating: measures the subjects' perceptions of their health status.

Chronic conditions: measures the presence of any of the following conditions: myocardial infarction, stroke, cancer, diabetes, high blood pressure, and broken hip.

Nursing home: measures if subjects had ever been in a nursing home.

Discussion

Among both the general public and within the medical community, considerable interest has recently arisen regarding the possibility that religious involvement may be associated with beneficial health outcomes. While much of the relevant literature is characterized by methodological problems,^{11,12} some recent well-conducted studies demonstrate associations between attendance at religious services and mortality and a recent review concluded that the evidence was 'persuasive'.⁶ However, even the well-conducted studies raise questions about the consistency of this effect. For example, Hummer *et al.* found that after adjusting for confounders and covariates including functional status and social connection, frequency of religious attendance was inversely associated with mortality in a study of over 21 000 subjects.¹³ However, the protective effect was entirely absent for patients with cancer and only marginally significant for patients with heart disease, the two diseases that account for the bulk of deaths in the US. Omen and Reed found that in a community sample of 1931 affluent, largely white adults over the age of 55 years in Marin County, CA,¹⁴ religious attendance was associated with reduced mortality in multivariate model (RR = 0.76, 95% CI = 0.62–0.94), an effect seen for both men and women. However, when they used a different measure of attendance and added individual items representing various types of social engagement, the RR rose to 0.81 (95% CI = 0.81–1.00) and the model retained museum or art gallery attendance (RR = 0.81, 95% CI = 0.63–1.04) as a marginally significant effect. Contrary to the main finding of Oman and Reed, in the Tecumseh Community Health studies¹⁵ and Alameda County studies,¹⁶ frequency of attendance at religious services was inversely associated with mortality but after control for all relevant covariates, this relationship held only for women. In contrast, for men but not women in the Tecumseh study, frequency of attendance at meetings of voluntary organizations was associated with reduced mortality while religious attendance was not.¹⁵ In a study by Schoenbach,¹⁷ the effect of religious attendance on mortality was seen primarily for white men only. In the Duke cohort ($n = 3968$) of the EPESE study, the effect of religious attendance was significant in the multivariate model, but in the full model, the effect for men achieved only marginal significance (RR = 0.83, 95% CI 0.69–1.00).¹⁰ In the New Haven EPESE cohort, no such association was found¹⁸ but more generally, social and productive activities were associated with reduced mortality.¹⁹

Some studies, while showing associations between religious attendance and reduced mortality, do so from the perspective that religious attendance is one of many indices of social engagement. For example, in a cohort of 15 938 subjects, aged 55 years or more, enrolled in the National Health Interview Survey, attendance at religious services in the past two weeks was inversely related to mortality but so were attending shows, movies, and concerts, socializing with friends and neighbours, visits with relatives, and volunteerism.²⁰ Not surprisingly, analysis of a subset of these data restricted to participants aged 70 years and more showed the same findings.²¹

A recent meta-analysis of the association of religious involvement, a construct that includes religious attendance and other indices, e.g. private religious behaviour such as reading the Bible, suggested that mortality was inversely associated with involvement, with an OR = 1.29 (95% CI = 1.21–1.39).²²

Table 4 Cox Proportional Hazard Model results by site

Variable	East Boston	Iowa	New Haven	Duke
Gender				
Female vs male	0.53 (0.42–0.67)	0.39 (0.31–0.51)	0.43 (0.34–0.55)	0.49 (0.40–0.59)
Age (yr)	1.26 (1.16–1.38)	1.39 (1.26–1.52)	1.33 (1.23–1.45)	1.31 (1.22–1.40)
Marital status				
Separated/divorced vs married	1.07 (0.67–1.75)	0.88 (0.39–0.99)	1.38 (0.86–2.23)	1.52 (1.10–2.11)
Widowed vs married	1.09 (0.79–1.52)	0.75 (0.48–1.18)	1.50 (1.04–2.17)	1.25 (0.99–1.58)
Education				
0–11 yrs vs >11 yrs	0.88 (0.69–1.15)	0.84 (0.66–1.05)	1.05 (0.83–1.32)	0.98 (0.78–1.20)
Physical functioning 1				
Some difficulty vs no difficulty	1.48 (1.16–1.88)	1.30 (0.93–1.80)	1.21 (0.91–1.61)	1.44 (1.19–1.77)
Physical functioning 2				
Some difficulty vs no difficulty	1.68 (1.33–2.13)	1.74 (1.35–2.25)	1.43 (1.12–1.84)	1.41 (1.17–1.71)
Physical functioning 3				
Some difficulty vs no difficulty	1.28 (0.98–1.66)	1.54 (1.13–2.08)	1.31 (1.02–1.70)	1.31 (1.03–1.66)
Self rating of health				
Fair–poor vs Excellent–good	0.93 (0.76–1.14)	2.05 (1.62–2.59)	1.03 (0.83–1.28)	1.06 (0.89–1.26)
Chronic conditions				
At least one vs none	4.41 (3.60–5.39)	2.79 (2.19–3.56)	3.34 (2.70–4.20)	3.42 (2.88–4.05)
Nursing home				
yes vs no	1.21 (0.49–2.99)	2.04 (1.29–3.21)	1.22 (0.74–2.00)	1.92 (1.19–3.09)
Cigarette smoking				
yes vs no	1.30 (1.03–1.64)	1.52 (1.09–2.11)	1.65 (1.23–2.11)	1.33 (1.08–1.65)
Religious attendance				
Every few months to once–twice per month vs never/1–2 times/year	0.88 (0.66–1.19)	0.86 (0.61–1.21)	0.93 (0.71–1.23)	0.92 (0.74–1.13)
Once to more than once per week vs never/1–2 times/year	0.74 (0.59–0.93)	0.87 (0.66–1.13)	0.95 (0.75–1.21)	0.67 (0.54–0.83)
Visits by close relatives				
no vs yes	0.77 (0.58–0.99)	0.91 (0.69–1.19)	1.07 (0.85–1.34)	1.09 (0.89–1.34)
Visits by close friends				
no vs yes	1.21 (0.84–1.74)	0.73 (0.41–1.31)	0.93 (0.69–1.27)	1.00 (0.66–1.53)
Household composition				
alone vs with someone	1.03 (0.76–1.41)	1.6 (1.04–2.48)	0.82 (0.58–1.16)	0.89 (0.73–1.08)
Club/organization membership				
no vs yes	1.18 (0.88–1.58)	0.94 (0.70–1.26)	1.26 (0.94–1.70)	1.03 (0.82–1.29)
Working at a paying job				
yes vs no	0.68 (0.45–1.01)	1.16 (0.82–1.64)	0.62 (0.40–0.95)	0.73 (0.54–0.99)
Depression	1.00 (0.96–1.05)	1.01 (0.95–1.07)	1.01 (0.96–1.06)	1.00 (0.97–1.04)
Mini mental status	1.09 (1.02–1.17)	1.09 (0.99–1.20)	1.11 (1.04–1.18)	1.09 (1.02–1.14)

RR, Risk Ratio.

Physical functioning 1: measures a person's ability to perform daily tasks, including: walking across a small room; bathing; grooming; dressing; eating; getting from bed to chair; and using the toilet.

Physical functioning 2: measures the person's ability to do heavy work around the house; walk up/down stairs; and walk half a mile without difficulty.

Physical functioning 3: measures difficulty in pushing large objects; stooping, crouching, kneeling; extending arms; and writing.

Health self-rating: measures the subjects' perceptions of their health status.

Chronic conditions: measures the presence of any of the following conditions: myocardial infarction, stroke, cancer, diabetes, high blood pressure, and broken hip.

Nursing home: measures if subjects had ever been in a nursing home.

Table 5 Step-wise regression results

Model	Religious attendance	E. Boston	Iowa	New Haven	Duke
Model 1	Moderate	0.74 (0.61–0.89)	0.74 (0.59–0.92)	0.77 (0.64–0.92)	0.71 (0.62–0.82)
	Frequent	0.53 (0.46–0.61)	0.59 (0.50–0.70)	0.62 (0.53–0.73)	0.44 (0.38–0.50)
Model 2	Moderate	0.82 (0.66–1.00)	0.80 (0.63–1.01)	0.85 (0.70–1.03)	0.93 (0.80–1.08)
	Frequent	0.67 (0.58–0.78)	0.81 (0.68–0.96)	0.75 (0.64–0.88)	0.64 (0.55–0.74)
Model 3	Moderate	0.84 (0.69–1.02)	0.80 (0.63–1.02)	0.86 (0.71–1.04)	0.94 (0.81–1.09)
	Frequent	0.69 (0.59–0.80)	0.84 (0.70–0.99)	0.78 (0.66–0.92)	0.66 (0.57–0.76)
Model 4	Moderate	0.87 (0.70–1.09)	0.81 (0.63–1.06)	0.90 (0.74–1.09)	0.94 (0.79–1.10)
	Frequent	0.71 (0.60–0.84)	0.92 (0.76–1.11)	0.80 (0.68–0.95)	0.66 (0.56–0.78)
Model 5	Moderate	0.82 (0.62–1.08)	0.85 (0.61–1.18)	0.89 (0.68–1.17)	0.92 (0.76–1.12)
	Frequent	0.68 (0.56–0.84)	0.80 (0.62–1.03)	0.91 (0.72–1.16)	0.67 (0.55–0.81)
Model 6	Moderate	0.89 (0.66–1.19)	0.86 (0.61–1.21)	0.93 (0.71–1.23)	0.92 (0.75–1.13)
	Frequent	0.74 (0.59–0.93)	0.87 (0.66–1.13)	0.95 (0.75–1.21)	0.67 (0.54–0.83)

RRs (95% CIs)

Moderate, Once to more than once/week; frequent, every few months to once-twice/month.

Model 1: Demographics + religious attendance.

Model 2: Demographics + religious attendance + physical functioning.

Model 3: Demographics + religious attendance + physical functioning + smoking.

Model 4: Demographics + religious attendance + physical functioning + smoking + mental status.

Model 5: Demographics + religious attendance + physical functioning + smoking + social involvement.

Model 6: Full Model.

However, this OR represented the univariate association. After inclusion of relevant confounders and covariates in hierarchical models, the OR dropped to 1.23, $P = 0.306$.

These inconsistencies led us to examine the entire EPESE dataset to investigate whether factors that could account for them could be identified. We found that while frequent religious attendance was inversely associated with mortality in the EPESE cohort as a whole after controlling for demographics, physical functioning and health status, less frequent attendance was not significantly predictive of survival. Moreover, at the Duke and East Boston sites, frequent religious attendance was significantly associated with reduced mortality. At the New Haven and Iowa sites, although the effect was in the same direction, it did not reach significance. Given the large sample size this is unlikely to be related to a power issue; rather, it reflects a weaker association. The four cohorts were homogeneous at baseline and none of the predictors accounted for these differences.

Thus, these results suggest that the association between religious attendance and mortality is not a strong and consistent one.

Factors that might explain the different behaviour of the four cohorts, including religious affiliation, socio-economic class, ethnicity, and social involvement, were not available in the entire dataset and therefore, we were unable to test their associations with mortality. Data on socio-economic status were mostly missing and unreliable and could not be analysed. Data on ethnicity were available for the New Haven and the Duke sites only and show that at both sites the majority of the individuals were white. Data on religious affiliation were available only for the Iowa, New Haven, and Boston sites.

Social factors have an important influence on health outcomes^{23–27} and several previous studies suggest the

relevance of such factors. House concluded that ‘social relationships, or the relative lack thereof, constitute a major risk factor for health—rivaling the effects of well-established health risk factors such as cigarette smoking, blood pressure, blood lipids, obesity, and physical activity’ p. 541.¹⁵ In the EPESE dataset, social involvement was measured by frequency of visits by relatives and friends and membership in a club, as well as household composition, and working at a paying job. However, data on club membership were available only from the third year onwards, making this covariate only partially informative. No data were available about other types of social involvement, like voluntary work, frequency of visits to a library or any other public activities, or productive activities, a variable shown to predict survival in the New Haven EPESE cohort.¹⁹ We speculate that remaining socially engaged in one’s community is the operative factor in studies demonstrating relationships between religious attendance and mortality; religious attendance may represent one of many different ways of remaining socially engaged and the degree to which it is expressed in relationship to mortality depends upon the opportunities for involvement in social activities available in different communities.

Therefore, although some well-conducted studies suggest a relationship between religious attendance and survival, the general picture is one of inconsistent findings even among well-conducted studies. The beneficial effect of religious attendance on mortality is not stable across studies, the RRs are variable in magnitude, and often the results are significant only for subgroups. When a relationship between religious attendance and mortality is seen, it is likely that many factors are involved in explaining or un-confounding it. Therefore, the different findings may be the result of whether or not these factors are

accounted for in the analysis. Religious attendance may be itself a marker for, rather than a cause of, a healthier status. That is, those who attend religious services also follow a healthier lifestyle, are more socially involved, and are more health conscious. Also, a self-selection bias undoubtedly plays a significant role in this relationship. Electing to attend religious services may reflect a constellation of variables that connect more closely to survival.

In conclusion, although we understand that some may be inclined to emphasize the association between religious attendance and mortality even if it is present only in selected subgroups and under specific conditions, we believe that until consistent and unconfounded evidence of such an association is found, it would be misleading to declare a beneficial effect of religious attendance on survival.

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Appendix

Items of the CES-D common to all four sites.

- (i) I felt depressed.
- (ii) I felt that everything I did was an effort.
- (iii) My sleep was restless.
- (iv) I was happy.
- (v) I felt lonely.
- (vi) People were unfriendly.
- (vii) I enjoyed life.
- (viii) I felt sad.
- (ix) I felt that people disliked me.
- (x) I could not get going.

Items of the MMSE:

- (i) How old are you?
- (ii) When were you born?
- (iii) What is the date today?
- (iv) What day of the week is it?
- (v) Who is the president of the U.S.?
- (vi) Who was president before him?
- (vii) What is your mother's maiden name?
- (viii) What is your telephone number?
- (ix) What is your street address?
- (x) Subtract 3 from 20, and keep subtracting.