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Frequency of Attendance at Religious Services and Mortality in a U.S. National Cohort

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Abstract

OBJECTIVE—Few nationally representative cohort studies have appeared on frequency of attendance at religious services and mortality. We test the hypothesis that > weekly attendance compared with nonattendance at religious services is associated with lower probability of future mortality in such a study.

METHODS—Data were analyzed from a longitudinal follow-up study of 8450 American men and women age 40 years and older who were examined from 1988 to 1994 and followed an average of 8.5 years. Measurements at baseline included self-reported frequency of attendance at religious services, sociodemographics, and health, physical and biochemical measurements.

RESULTS—Death during follow-up occurred in 2058. After adjusting for confounding by baseline sociodemographics and health status, the hazards ratios (95% confidence limits) were never 1.00 (reference); < weekly 0.89 (0.75–1.04), $p = 0.15$; weekly 0.82 (0.71–0.94) $p = 0.005$; and > weekly attenders 0.70 (0.59–0.83), $p < 0.001$. Mediators, including health behaviors and inflammation, explained part of the association.

CONCLUSIONS—In a nationwide cohort of Americans, predominantly Christians, analyses demonstrated a lower risk of death independent of confounders among those reporting religious attendance at least weekly compared to never. The association was substantially mediated by health behaviors and other risk factors.

Keywords

Aging; Cultural Factors; Epidemiologic Methods; Mortality; Religion; Spirituality

Consideration of religion and spirituality has recently found a place in curricula of many American medical schools (1). Justification for this development rests partly on studies showing that spirituality and religion continue to play important roles in the subjective well being of many patients in the United States (2–7). Yet, critics have decried this movement as an “unholy alliance” (8). In part, their criticism rests on the lack of scientific consensus as to whether and by what mechanism spirituality or religion affects the physical health of Americans, conflicting results having appeared in the recent literature. For example, studies

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found an apparent protective effect of frequent attendance at religious services at baseline on subsequent mortality in both a California county and a U.S. national cohort of adults (9,10). However, a multicenter study of elderly cohorts in four American cities found an effect of frequent attendance on mortality in only two of the sites and concluded that any apparent effect was spurious (11). Given this controversy, additional attempts to replicate the findings are appropriate.

Religious affiliation, attendance at religious services, and other religious behavior is more prevalent in the United States, a nation in which most persons identify their religion as Christian, than in most other industrialized nations (12). Lack of religious participation has been suggested as a “fundamental cause” of mortality similar to low socioeconomic status (13). Possible mechanisms for an inverse association between participation in the activities of a religious institution and mortality have been discussed at length elsewhere (14,15). The religion of the majority of American believers (Christianity) combines a positive worldview, social support, healthy lifestyle, and uplifting and calming ritual, all of which are hypothesized to have positive health effects. In U.S. studies, evidence is growing that greater public religiousness as indicated by a high frequency of attendance at religious services is associated with beneficial health behaviors (e.g., smoking avoidance, having a personal physician), increased social integration and support received or provided, improved coping with stressful life events, reduced depression, and positive emotions leading to health-promoting physiological effects of decreased chronic sympathoadrenal activation, improved immune function, and less chronic inflammation (13,16–22). Some researchers suggest more proximate affects of ritual on psychophysiological pathways (23). Several small studies were consistent with some of the effect of attendance on mortality being mediated by health behaviors, and inflammation, but little by religious or nonreligious social support, personality, mental health, private religious activity or fatalism (19,23,24). One recent study suggested that providing rather than receiving support from fellow congregants was associated with lower mortality in the elderly (16). Other highly prevalent, secular, voluntary activities such as sports following are unlikely to offer such a combination of health promoting effects, although this is an area still under study.

We further test the hypothesis of an independent, inverse association of frequency of attendance at religious services with mortality in the U.S. general population, a population identifying predominantly with the Christian religion. We analyzed newly available data on mortality in a unique national health examination and follow-up survey conducted with scientific sampling and state-of-the-art interviewing, examination and laboratory methods. No other previous national examination survey included any measure of religiousness.

MATERIALS AND METHODS

Subjects

The Third National Health and Nutrition Examination Survey (NHANES III) was conducted in 1988–1994 on a nationwide multistage probability sample of 39,695 persons from the civilian, noninstitutionalized population ages 2 months and older of the United States. Details of the plan, sampling, operation, response, and institutional review board approval have been published as have procedures used to obtain informed consent and to maintain confidentiality of information obtained (25). The personal interviews and physical and laboratory examinations of NHANES III subjects provided the baseline data for the study. This analysis was based on follow-up data collection through 2000. Of 33,994 persons with baseline interview data, 13,944 were younger than 17 years of age, and 26 lacked data for matching, leaving 20,024 eligible for mortality follow-up. The NHANES III linked mortality file contains information based upon the results from a probabilistic match between NHANES III and the National Center for Health Statistics National Death Index records. The NHANES III linked

mortality file provides mortality follow-up data from the date of NHANES III survey participation (1988–1994) through December 31, 2000.

Of the 20,024 interviewed persons eligible for mortality follow-up, 1875 were not examined, 2 deaths were excluded for missing data on cause of death leaving 18,147. To satisfy the proportional hazards assumption for Cox regression analyses (26), it was necessary to exclude from all analyses persons ages 17–39 ($n = 6572$). Because pregnancy influences many physiologic and psychological variables, 280 pregnant women were excluded. Because the frequency of attendance at religious services may not be a meaningful indicator of religiosity in adherents of Hinduism, Buddhism, or Native American religions, it was deemed appropriate to exclude Asians and American Indians ($n = 720$). Persons with missing data for frequency of attendance, education, poverty index, marital status, self-reported health status, history of cancer (other than skin), history of heart attack, cigarette smoking status, mean systolic blood pressure, serum total cholesterol were also excluded ($n = 2125$). After all exclusions, 8450 persons remained for mortality analyses. The length of follow-up of survivors ranged from 0.2 to 12.1 years, mean 8.5 years, median 8.9 years (interquartile range 7.4–10.3 years).

Analysis Variables

Exposure Variable—During a household interview, survey participants were asked, “How often do you attend church or religious services?” Interviewers recalculated responses as times/year. Values ranged from 0 to 1825 times per year. Values in excess of 365 ($n = 7$) were coded missing, as were four “don’t know” responses. Although frequency of religious attendance was coded as a continuous variable, there was strong preference by respondents for certain numbers corresponding to responses such as “weekly” and “monthly.” Therefore, frequency was categorized by assuming a frequency of 52 to represent attending weekly and 0 to represent never attending to account for these response patterns and for comparability with the only previous national cohort study (9). Religious attendance is relatively stable in older adults with $r = 0.69$, $p < 0.01$ between measures 6 years apart (19). Unfortunately, no data on religious affiliation or other dimensions of religiousness were available.

Confounding and Mediating Variables—A review of the literature identified potential confounding variables: age, gender, race/ethnicity, education, and poverty income ratio, and health status at baseline. This was assessed as self-reported general health, presence or absence of any history of major morbidity by physician diagnosis (heart attack, heart failure, stroke, medication for hypertension, diabetes, chronic bronchitis, emphysema, or non-skin cancer) and limitation of mobility (self-reported difficulty in climbing one flight of stairs or walking a quarter mile with survey physician impression of mobility used to impute missing data). Possible mediators of the effect of religious attendance were leisure-time physical activity, regular clinic or physician, smoking, alcohol use, social support other than from the congregation, marital status, body mass index, blood pressure and C-reactive protein. Measurement of blood pressure, height, weight, and serum analytes is described elsewhere (25).

Outcome Variables—The National Center for Health Statistics conducted a mortality linkage of NHANES III with the National Death Index. The current linkage of the NHANES III includes deaths for adult participants occurring from the date of NHANES III interview through December 31, 2000. Information regarding the date of death, age at death, was collected from matched death certificates. Variables used in the selection step of the matching process were social security number, components of name and date of birth. Efforts to trace all NHANES III participants who died may have been unsuccessful in some cases. However, previous validation studies of tracing in the NHANES I Epidemiologic Follow-up Study showed that only about one percent of deaths were not successfully identified using these

methods (27). For details about NHANES III Linked Mortality Files, see http://www.cdc.gov/nchs/r&d/nchs_data/linkage/nhanes_data_linkage_activities.htm).

Statistical Analysis

Detailed descriptive statistics and measures of association were computed using the SUDAAN system (Version 9.0, Research Triangle Institute, Research Triangle Park, NC), to take into account the complex survey design and design effect in producing point and variance estimates using Taylor series linearization for variance estimation (28). Kaplan-Meier survival curves were computed using PROCAPMEIER. Using attendance categories of a previous national survey (9), estimates of the risk of death for persons with higher frequency relative to those never attending in the past year derive from Cox proportional hazards regression models with time to event as the time scale computed using the SURVIVAL procedure in SUDAAN. Survivors were censored at the date of the last follow-up interview. Interaction terms were initially included for age, gender and ethnicity with attendance. Two models were fit: one controlled for likely confounders only and the second for confounders and likely mediators of the attendance-mortality association. The validity of the proportional hazards assumption was confirmed by inspection of unweighted log negative log survival curves and test-based methods (26). A violation of the assumption necessitated the exclusion of subjects younger than 40 years of age. Further, because an interaction of frequency and age was significant indicating important variation in the association with mortality among age groups, regression analyses were repeated within 10-year age strata to confirm results shown.

RESULTS

At baseline, 11% reported attending religious services > weekly. Table 1 shows the number at risk and number of deaths. Table 1 also shows age-adjusted prevalence of selected characteristics by frequency of attendance category. Frequency of attendance was associated with gender, ethnicity, region, education, self-reported health status, mobility limitation, smoking, alcohol use, physical activity, regular source of care, non-religious social support and systolic blood pressure.

Kaplan Meier survival curves for persons 40 years of and older at baseline showed the poorest survival in those never attending services (not shown). No significant interaction was found for gender ($p = 0.76$) or ethnicity ($p = 0.11$) with attendance. Controlling for confounding by baseline demographic and socioeconomic variables and health status (Model 1), persons attending services at least weekly had significantly lower risk of mortality than never attenders (Table 2). The association was strongest below age 80 (not shown, $p < 0.05$).

To investigate possible mechanisms for this association, the effect was assessed of controlling for variables identified in the literature as potential mediators of a protective health effect of frequent religious attendance (e.g., healthy behaviors, reduced inflammation, high non-congregational social support). Table 2 shows that these variables explained most of the effect of weekly and about half of the effect of > weekly attendance (Model II).

DISCUSSION

NHANES III is the one of the largest studies to provide population-based data on the association of attendance at religious services and survival in a nation-wide representative sample of Americans and the first to incorporate examination and biochemical data. NHANES III data show that risk of mortality was lower among persons who attend religious services weekly or more than weekly than among those never attending even after controlling for confounding by baseline health status and mobility, supporting the hypothesis of an independent association. The association did not differ by gender or ethnicity.

What does this mean in reality? Our population was predominantly Christian. In that faith tradition, the aim of religious practice is not a long life necessarily. Very religious and holy persons have died at young ages. Still, the question of an effect of religious participation on health is of theoretical and practical interest. In this study, part of the apparent residual protective effect after controlling for confounders could be explained statistically by effects of religious practice on likely mediators including health behaviors, nonreligious social support, blood pressure and inflammation. Yet limitations of the data meant that it was not possible to completely tease out effects of all putative mediators, such as social support (given or received) directly associated with membership in religious congregations. Nor could we assess whether effects of such social support are qualitatively or quantitatively different from that obtained in secular settings.

Comparisons With Previous Reports

Several dozen smaller studies that have appeared have been remarkably consistent in finding frequency of attendance religious services inversely related to mortality (10,11,15,23,29–42). Only recent studies have consistently controlled for confounding by socio-demographic, socioeconomic, and health status variables or assessed effect modifiers and mediating variables (29,43,44). Large, nationally-representative cohort studies of religious attendance and mortality with multivariate analyses to control for confounding supporting this finding are few (9). Effect modification by gender, age, and ethnicity was inconsistently found. The other large, national study was a 9-year follow-up of more than 21,000 persons in the Cancer Risk Factor Supplement-Epidemiology Study of the 1987 National Health Interview Survey with more than 2000 deaths, the investigators reported significant inverse associations with death from all causes (9). A population-based cohort of nearly 4000 elderly residents five North Carolina counties with oversampling of blacks was followed from baseline examination in 1986 through 1992 with 1177 deaths at the Duke location of the Established Populations for Studies of the Elderly study (35). Weekly attenders of religious services had a 46% lower unadjusted risk of death that could not be explained statistically by adjusting for baseline demographics, health status, social support, and health practices (adjusted hazard ratio 0.72, 95% confidence interval 0.64–0.81, $p < 0.001$). When analyses were extended to all four Established Populations for Studies of the Elderly study sites, this finding was confirmed overall (once or more/week vs never or 1–2 times/year adjusted risk ratio 0.78, 95% confidence interval 0.70–0.88) and for each site after adjusting for demographics, health and smoking (11). Effect modification by site was noted in models which also included mental status and social involvement variables, with these variables explaining more of the association in Iowa and New Haven, CT than in Duke and East Boston sites for unknown reasons (11). Associations with mortality of other variables, such as marital status and working a paying job, also varied by site. Unfortunately, formal tests for interaction were not reported to assess chance as an explanation for such variation. In a California cohort followed 28 years with 770 deaths analyzed, weekly attenders had a 30% lower risk of death after adjustment for demographics, health conditions, and social connections (10). In women this association was not mediated by health practices or BMI and was stronger than in men. In a cohort of elderly Iowans with 111 deaths, religious attendance > weekly was associated with two-thirds lower unadjusted risk (risk ratio 0.32, 95% confidence interval 0.15–0.72, $p < 0.01$) compared to never attending (19). The association remained significant after controlling multiple confounders and appeared to be mediated by interleukin-6, an inflammatory cytokine. Several studies found a stronger association of attendance with mortality in women (10,35,40) whereas others found the opposite (24,26,45). Weekly attendance was associated with reduced mortality in a Mexican American cohort as in this study (30). Private religious activity, attitudes or beliefs rarely have been studied in large cohorts; available evidence indicates an inconsistent association with mortality (29,35,46). Cohort studies of religious affiliation among Christians or Jews or among faiths as the sole measure of religiousness yield results that are difficult to integrate with studies of attendance

(29,47). A number of studies have been published suggesting that people affiliated with conservative U.S. Christian religious groups have lower mortality risks than people affiliated with other or no religious groups (18).

Limitations and Strengths

NHANES III is only the second cohort study to provide population-based data on the association of attendance at religious services and survival in nationwide representative samples of Americans. Many previous studies of religious involvement and health outcomes have been criticized for their methodological shortcomings (48). The present study attempted to avoid these shortcomings, for example, prespecified study hypotheses, large representative sample, cohort design, and extensive control for confounding. However, several unavoidable limitations of the present study include possible bias arising from survey nonresponse and from missing values for some variables and from possible changes in attendance or other variables over the follow-up period. Several special studies of NHANES III data have indicated little bias attributable to nonresponse (49). Comparison of attendance, vital status and demographics of the analysis sample and those excluded for missing data but eligible for follow-up revealed those excluded were more likely to be female, Mexican American, in poor health, to never attend services and to die during the follow-up. Thus selection bias cannot be excluded. An interaction of age with attendance frequency was investigated by analysis within 10-year age groups, results of which were consistent with the results presented except at age 80 and older (table available from authors by request).

Religion has been variously defined by scholars. At least 12 dimensions of religiousness/spirituality have been specified and instruments developed that measure one or multiple dimensions (50). Attendance at religious services is an indicator of organizational religiousness. Since data on multiple dimensions were unavailable in NHANES III, this variable was used because it is related to health outcomes, it is correlated with other dimensions of public and private religiousness, and it provided data that are directly comparable with a body of research data on this variable spanning many decades (18). Modest over-reporting of religious attendance is likely (18); however, the NHANES III variable should serve well to separate more frequent from less frequent attenders. Different results may have been obtained had other dimensions of religiousness or spirituality been studied. The present study was able to reduce the likelihood of spurious associations due to selection bias and confounding. No measures of religious social support, personality, private religious activity or fatalism were available. Because attendance at religious services may be a poorer measure of religiousness in the elderly due to physical limitations, this study controlled for mobility limitation and health status at baseline. The representativeness of the sample and the use of sample weights provide generalizability of the results to United States non-institutionalized population of the same ages. Further research is needed including longitudinal studies to examine non-Christian populations and multiple dimensions of religiousness not available in NHANESIII.

CONCLUSIONS

In a nationwide cohort of Americans, analyses demonstrated a lower risk of death independent of confounders that was of statistical significance among those reporting at least weekly religious attendance.

Selected Abbreviations and Acronyms

NHANES III, Third National Health and Nutritional Examination Survey.

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Age-adjusted prevalence (%) of selected characteristics by frequency of attendance at religious services in persons ages 40 years and older in NHANES III

TABLE 1

	Never	Frequency			p value
		<weekly	= weekly	>weekly	
<i>n</i>	2603	1978	2927	942	
Female	46.6	51.7	60.3	60.0	<0.001
Male	53.4	48.3	39.7	40.0	
Mexican American	2.6	3.7	4.6	3.1	<0.001
African American	6.1	13.2	9.4	12.0	
European American	91.3	83.1	86.0	84.9	
South region	29.0	36.3	33.8	52.3	<0.001
Metropolitan residence	47.3	48.5	42.2	36.3	0.031
Unmarried	31.4	27.3	29.7	29.9	0.335
Educ < 12 years	32.0	24.3	28.2	28.5	<0.001
Fair-poor health	24.0	17.9	19.2	19.4	0.006
≥ 1 chronic illness	41.6	37.3	42.0	37.7	0.047
Mobility limitation	21.6	13.8	22.1	21.7	<0.001
Current smoking	31.1	26.3	15.4	9.0	<0.001
Alcohol in past month	50.4	55.3	40.8	21.1	<0.001
Low physical activity	23.9	17.1	17.1	14.0	<0.001
No regular physician	27.3	22.4	16.2	21.0	<0.001
Low social support	24.6	19.3	16.7	16.8	<0.001
Systolic BP ≥ 140 mmHg	29.4	21.2	30.1	27.8	<0.001
Body mass index ≥ 25 kg/m ²	63.0	61.8	63.6	67.3	0.354
C-reactive protein >3 ng/L	36.3	33.8	36.2	30.9	0.057
No. of deaths	772	397	695	194	

TABLE 2

Adjusted hazards ratios (95% confidence intervals) of frequency of religious attendance for mortality from all causes among persons ages 40 years and older in NHANES III

Variable	HR	95% CI		HR	95% CI	
		Model I			Model II	
Attendance frequency	Never	1.00		1.00		
	<weekly	0.89	0.75–1.04	0.99	0.84–1.16	
	Weekly	0.82	0.71–0.94 ^a	0.92	0.78–1.08	
	>weekly	0.70	0.59–0.83 ^a	0.84	0.69–1.03	
Age	Yr	1.08	1.07–1.09 ^a	1.08	1.07–1.09 ^a	
Gender	Male	1.58	1.42–1.77 ^a	1.75	1.53–1.99 ^a	
Ethnicity	AA	1.21	1.03–1.43	1.06	0.89–1.25	
	MA	0.88	0.72–1.09	0.86	0.68–1.09	
Education	<HS	1.03	0.88–1.21	1.01	0.86–1.18	
Region	South	0.96	0.78–1.18	0.93	0.76–1.14	
Urbanized	Yes	1.01	0.83–1.24	1.05	0.87–1.26	
SR health	F/P	1.62	1.37–1.90 ^a	1.42	1.19–1.69 ^a	
Morbidity	Yes	1.57	1.34–1.85 ^a	1.46	1.23–1.73 ^a	
Mobility	Limited	1.67	1.42–1.97	1.54	1.33–1.79 ^a	
SBP	mm Hg			1.00	1.00–1.01	
BMI	kg/m ²			0.96	0.95–0.98 ^a	
LN CRP	Ng/L			1.30	1.20–1.41 ^a	
Smoking	Current			1.68	1.41–2.01 ^a	
	Former			1.16	0.98–1.38	
Alcohol	Yes			0.79	0.64–0.98	
LTPA	Low			1.57	1.34–1.85 ^a	
	Average			1.17	1.03–1.32	
Reg. care	Yes			0.99	0.82–1.20	
Married	Yes			0.81	0.71–0.93 ^a	
Support	Low			0.92	0.75–1.123	

SR = self-reported; SBP = systolic blood pressure; BMI = body mass index; F/P = fair-poor; Reg. = regular care by personal physician; HS = high school; Support = nonreligious social support; AA = african american; MA = mexican american; LNCRP = natural log of C-reactive protein; and LTPA = leisure-time physical activity.

^a
 $p \leq 0.01$.