Worship Attendance and the Disability Process in Community-Dwelling Older Adults

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Objectives. We examined the contribution of religious involvement to age-related declines in health by examining the association of worship attendance with measures of different stages in the disability continuum.

Method. Participants included 5,863 Black and White older adults from the Chicago Health and Aging Project. Worship attendance was coded in 3 levels: very frequent (several times a week or more), frequent (several times a month), and infrequent (several times a year or less). Measures of disability included self-reported instrumental activities of daily living (IADL) and activities of daily living (ADL) disability as well as observed physical function.

Results. In multiple regression models adjusted for demographic factors, compared with those with infrequent worship attendance, those with frequent or very frequent attendance had lower levels of IADL and ADL disability and higher levels of physical performance at baseline. These associations remained significant in models that adjusted for health and cognitive status. There was no association between frequency of worship attendance and change in disability or physical function over time.

Discussion. These results suggest that more frequent worship attendance does not contribute to slowing the progress of disability in late life. Future research is needed to better understand the development of the differences in disability associated with worship attendance observed at baseline.

Key Words: ADL—Disability—IADL—Religion—Worship attendance.
& Chatters, 1988) and increased opportunities to give and receive emotional, tangible, and spiritual support (Krause, 2002, 2008). Worship attendance may also affect the health of older adults by promoting a healthier lifestyle. This may occur through religious beliefs about behaviors related to diet, alcohol, or tobacco or about the importance of self-care; or through interactions that reinforce adherence to behavioral norms; or through tangible support for healthy behaviors (Benjamins, 2005; Benjamins & Buck, 2008; Benjamins, Ellison, Krause, & Marcum, 2011; Mahoney et al, 2005; Strawbridge, Shema, Cohen, & Kaplan, 2001). Participation in public worship may also foster psychological resources that contribute to better health including self-esteem, mastery, a sense of meaning, and coping with stressful life events (Ellison & Levin, 1998; George, Ellison, & Larson, 2002; Koenig, George, & Peterson, 1998; Krause, 2008; Pargament, 1997).

Research about religious involvement and mortality provides some of the strongest evidence for the beneficial association between religion and physical health (Hummer, Ellison, Rogers, Moulton, & Romero, 2004; McCullough, Hoyt, Larson, Koenig, & Thoresen, 1999). A meta-analysis of 69 studies of community samples found that religious involvement was associated with a reduced hazard of mortality of 0.82 (95% confidence interval [CI] 0.76, 0.87; Chida, Steptoe, & Powell, 2009). This effect was somewhat stronger for those aged 60 or older (RH 0.79, 95% CI 0.69, 0.90). Similar findings have been reported for other studies of older adults in the United States (Koenig et al., 1997; Lutgendorf et al., 2004; Schnall et al., 2010) and among a cohort of older adults from Denmark, a nation with one of the world’s lowest levels of religious involvement (la Cour, Avlund, & Schultz-Larsen, 2006).

Among older adults, mortality is primarily the result of chronic diseases that develop throughout life, becoming clinically manifest in late life. Given its protective effect on mortality, one would expect religious involvement to be associated with a slower progression of disease in late life. There is some evidence for this for cognitive function (Corsentino, Collins, Sachs-Ericsson, & Blazer, 2009; Hill, Burdette, Angel, & Angel, 2006; Van Ness & Kasl, 2003). However, thus far, there is inconsistent evidence that higher levels of religious involvement slow the progression of diseases like cardiovascular disease or cancer (Feinstein, Liu, Ning, Fitchett, & Lloyd-Jones, 2010; Fitchett & Powell, 2009; Powell, Shahabi, & Thoresen, 2003).

Disability provides a particularly useful outcome for examining whether religious involvement is or is not associated with progression of disease in late life. Disability is typically conceptualized as the functional consequences of the cumulative impact of multiple, chronic disease processes that affect adults as they age and common models of disability emphasize the progressive nature of the disability process (Nagi, 1965; Pope & Tarlov, 1991; Verbrugge & Jette, 1994). Early stages of disability are marked by increasing levels of pathology and organ dysfunction that underlie the development of chronic disease and that cause limitations in basic physical functions. Later stages of disability are marked by losses in the ability to carry out tasks necessary for self-care and independent living. Limitations in instrumental activities of daily living (IADL) and activities of daily living (ADL) result from underlying biological changes and their impact on basic physical functions as well as lack of supportive psychosocial resources and poor person–environment fit (Verbrugge & Jette, 1994). Examining whether the effects of religious involvement are consistent across the disability continuum or whether they vary by stages of the disability process would further our understanding of the relationship between religious involvement and disease progression in late life.

The mechanisms that explain the effects of religious involvement on the disability process may be similar to those that affect mortality described earlier. The increased social connections that come with religious involvement, and especially worship attendance, may be associated with more frequent encouragement to remain active and to adhere to recommended medical regimens, as well as assistance with activities that aid in maintaining functional independence. Religious involvement may also help older adults maintain a sense of meaning and purpose (Krause, 2003). This could lead to less preoccupation with health problems, such as mobility limitations, and increased motivation to remain involved in rewarding activities (Idler, 1995; Idler & Kasl, 1997b). These mechanisms most likely play a role in the early stages of the disability process, normally marked by declines in more complex tasks such as IADLs, when motivational and related psychological mechanisms may be more effective in overcoming the disabling consequences of underlying disease and pathology. Religious involvement and associated mechanisms may be less likely to influence more severe disability such as ADL disability, as religious involvement-associated mechanisms may be much less effective in compensating for more advanced stage with their underlying pathology and organ dysfunction.

Previous investigations of the relationship between religious involvement and disability have yielded mixed findings. For example, inverse associations between frequency of worship attendance and disability have been reported from cross-sectional studies with large, regional cohorts of adults (Strawbridge, Shema, Cohen, Roberts, & Kaplan, 1998) and older adults (Idler & Kasl, 1997a). However, other studies, in representative national samples of older adults, reported no association between attendance and disability (Kelley-Moore & Ferraro, 2001; Krause, 1998). Several studies have examined the longitudinal relationship between worship attendance and composite measures of disability. Using data from the New Haven Established Populations for the Epidemiologic Studies of the Elderly (EPESE), Idler and Kasl (1997b) reported that higher levels of worship attendance at baseline were
associated with lower levels of disability over 6 consecutive years of follow-up. Using data from a large, representative sample of older adults, Benjamins (2004) found similar protective results for an analysis of baseline and 5-year follow-up data. However, using data from older participants in the Americans’ Changing Lives study, Kelley-Moore and Ferraro (2001) found that baseline levels of worship attendance were not associated with functional limitations 3 years later. Nor was there an association between religious attendance among 2,930 older adults in Taiwan and functional limitations 4 years later (Yeager et al., 2006).

Other studies have examined the relationship between worship attendance and stages of the disability continuum, including self-reported IADL disability and ADL disability. Among 784 older adults in Alabama (Park et al., 2008) and 2,924 older adults in North Carolina (Hybels, Blazer, George, & Koenig, 2012), more frequent worship attendance was associated with less IADL and ADL disability at baseline. In both studies, more frequent attendance was associated with less progression of IADL disability, and among the elders in North Carolina but not Alabama, with less progression of ADL disability. The North Carolina study also included a self-reported measure of mobility limitations and found that more frequent worship attendance was associated with fewer mobility limitations at baseline and less progression of mobility limitations. In this study, we also examined the relationship between worship attendance and two stages of the disability process, self-reported IADL and ADL disability. To clarify whether the associations reported in prior research may be influenced by self-report bias, we also examined the relationship between frequency of worship attendance and observed physical performance.

There is well-established evidence of demographic variations in religious involvement (Gallup and Lindsay, 1999), including higher levels of religious involvement among African Americans compared with Whites (Krause, 2002; Taylor, Chatters, & Jackson, 2007). It is less clear whether higher levels of involvement translate into differences in the relationship between religious involvement and health outcomes. Two models for why such differences might occur have been described (Krause, 2002). The first model posits that where religious involvement is protective for health, the benefits will be observed among any subgroups with higher levels of religious involvement. The second model posits that the impact of similar levels of religious involvement on health may be greater for members of one subgroup, for example, those with fewer alternative resources, than for members of more privileged groups (George, Hays, Flint, & Meador, 2004; Musick, Koenig, Hays, & Cohen, 1998). Support for this second model comes from a study of community-dwelling older adults with cancer (Musick et al., 1998) where higher levels of attendance were associated with greater positive affect 3 years later, but only for Blacks, not for Whites. In this study, we examined whether there were any Black–White differences in the religion–disability associations.

To further understand the role of religious involvement in the disability process, we considered three hypotheses. First, we hypothesized negative associations between worship attendance and IADL/ADL disability at baseline and change in IADL/ADL disability over time. Second, we hypothesized positive associations between worship attendance and physical performance at baseline and change in physical performance over time. Finally, we hypothesized that these worship attendance–disability associations would be stronger for Blacks compared with Whites. In summary, the present project sought to extend our understanding of the role of religious involvement in the progression of disease by examining the relationship between frequency of worship attendance and the disability process in a sample of Black and White community-dwelling older adults.

**Method**

**Participants**

The data for this study come from the Chicago Health and Aging Project (CHAP), an ongoing longitudinal, population-based study of risk factors for incident Alzheimer’s disease and other age-related chronic conditions among Black and White community-dwelling older adults. The study design and population characteristics are described elsewhere (Bienias, Beckett, Bennett, Wilson, & Evans, 2003). Briefly, CHAP began with a complete census of three contiguous neighborhoods on the South Side of Chicago; all persons aged 65 and older were invited to participate, resulting in a total of 6,158 residents who completed the baseline interview conducted between 1993 and 1997 (response rate of 78.9%). Follow-up interviews are conducted at 3-year intervals. Two modifications have been made to the original CHAP cohort: (a) successive cohorts of residents who have reached age 65 have been enrolled and (b) a supplemental cohort of primarily White residents aged 65 and older from an adjacent neighborhood has been enrolled to reduce the racial imbalance in the cohort.

CHAP in-home interviews are conducted by trained and certified interviewers and include performance-based tests of physical and cognitive function as well as questions about sociodemographic characteristics, health, and lifestyle. As of the third interview cycle (2000–2002), CHAP added telephone interviews in the years between the in-home interviews. The telephone interviews include standardized measures of IADL and ADL limitations. In this study, for members of the original cohort, baseline data come from their third in-home interview or a subsequent in-home interview if they missed the third. For all members from the successive and supplemental cohorts, baseline data come from their first in-home interview collected between 2000 and 2009. Follow-up outcome data come from subsequent in-home and telephone interviews through April 2010. Participants in this study contributed an average of 5.7
developed prior to study entry. Because frailty is strongly
worship attendance and change in disability/physical func-
consent. Center IRB and all participants provided written, informed
The study was approved by the Rush University Medical
Disability. They contributed an average of 2.5 (SD 0.5, range
2–3) measures of physical performance taken every 3 years.
The study was approved by the Rush University Medical
Center IRB and all participants provided written, informed

A complicating factor in testing the association between
worship attendance and change in disability/physical func-
ting is that infrequent attendance may be either a charac-
teristic pattern of worship or a consequence of frail health
developed prior to study entry. Because frailty is strongly
predictive of disability (Bandeen-Roche et al., 2006; Boyd,
Xue, Simpson, Guralnik, & Fried, 2005), this may cre-
at bias in the relationship between frequency of worship
attendance and changes in disability and physical function-
ing. To remove this source of bias, we excluded participants
who showed signs of frail health at baseline defined as
inability to perform the timed walk test, or a Mini-Mental
State Examination (MMSE) score <18, which is gener-
al considered an indicator for moderate/severe dementia
(Fillenbaum, Hughes, Heyman, George, & Blazer, 1988;

Data from 7,602 CHAP participants were available for
these analyses. Of these, 1,299 (17.1%) who meet crite-
rria for frail health were excluded. Of the remaining 6,303
participants, 431 were dropped for not having at least two
(baseline and at least one follow-up) IADL or ADL data
points and 9 were dropped due to missing covariate data,
leaving 5,863 (93% of 6,303) participants for this analysis.
Compared with those who were dropped, those who were
included in the IADL/ADL disability analyses were slightly
younger, more likely to be White than Black, and more
likely to report very frequent versus infrequent worship
attendance. There were no differences in baseline IADL or
ADL disability between those who were retained and those
who were dropped from these analyses. For the analysis of
physical functioning, the sample was 4,149 (66% of 6,303)
due to higher mortality attrition associated with the longer
(3-year) interval between in-home interviews. Compared
with those who were dropped, those who were included in
the analysis of physical functioning were younger, more
likely to be White than Black, and more likely to report
frequent or very frequent versus infrequent worship atten-
dance. Those retained for this analysis also had slightly
higher levels of baseline physical functioning.

Measures

Frequency of worship attendance.—Participants were
asked to indicate how often they attended religious services.
Using data from their baseline interviews, we created three
levels of worship attendance: very frequent (several times a
week or more), frequent (several times a month), and infre-
quent (several times a year or less).

Disability.—Two different points in the disability contin-
num, IADL and ADL disability, were measured at baseline
and in annual follow-up interviews. For IADL disability,
we employed a 10-item self-report instrument based on
the Duke Older Americans Resources and Services, which
focuses on more complex self-care tasks required for inde-
pendent community living (e.g., preparing meals, light
housekeeping, and shopping; Fillenbaum & Smyer, 1981).
The IADLs were rated on a 3-point degree of difficulty
scale: no difficulty at all, a little difficulty, some difficulty,
a lot of difficulty, and just unable to do it. Scores for these
items were summed into a composite with higher scores
indicating greater disability. For descriptive purposes, we
also constructed a dichotomous IADL measure: those with
no difficulty on any activity versus those with any diffi-
culty. Our measure of late-stage disability was a six-item
self-report ADL instrument based on the work of Branch,
Katz, Kniepmann, and Papsidero (1984), which emphasizes
the ability to perform basic self-care functions (e.g., eating,
bathing, and dressing). The ADLs were rated on a 3-point
scale: need no help, need help, and unable to do. Ratings
for these items were summed into a composite with higher
scores indicating greater disability. Again, for descriptive
purposes, we created a dichotomous ADL measure: those
who needed no help versus those who needed help or were
unable to do any ADL tasks.

Our observer-rated measure of physical functioning was a
lower extremity, performance-based measure adopted from
the EPESE studies (Guralnik et al., 1994; Reuben & Siu,
1990). This measure assesses physical function with tests
of tandem stand, chair stand, and timed walk. Data from
these tests were recoded into ordinal-level scales and then
added to create a summary score with higher scores indicat-
ing fewer limitations in physical performance (Mendes de
Leon, Barnes, Bienias, Skarupski, & Evans, 2005).

Sociodemographics.—For these analyses, we included
measures of age, sex, race (non-Hispanic White and non-
Hispanic Black), and years of education.

Controls.—Because health status may create selection
bias, our study incorporated control for baseline physical
and mental health status, including body mass index (BMI),
comorbid conditions, depressive symptoms, and cognitive
function. BMI is based on measured weight and self-reported
height, and it is computed as weight (kg) divided by height-
squared (m). For comorbid conditions, we counted the
number of self-reported chronic medical conditions from a
list derived from the EPESE (myocardial infarction, stroke,
cancer, diabetes, high blood pressure, Parkinson’s disease,
shingles, thyroid disease, and hip fracture; Cornoni-Huntley,
Brock, Ostfeld, Taylor, & Wallace, 1986). Assessment of
depressive symptoms was based on the 10-item version of
the Center for Epidemiologic Studies Depression (CES-D)
scale (Kohout, Berkman, Evans, & Cornoni-Huntley,
WORSHIP ATTENDANCE AND DISABILITY

1993), with responses coded in a yes–no format, yielding a summary measure with a range from 0 to 10. Higher scores indicate more depressive symptoms. Assessment of cognitive function was based on a summary measure of four brief tests: two measures of episodic memory via immediate and delayed recall of 12 ideas contained in the brief, orally presented East Boston Story (Albert et al., 1991); one test of perceptual speed using a modified form of the oral version of the Symbol Digit Modalities Test (Smith, 1984); and the MMSE (Folstein, Folstein, & McHugh, 1975), a widely used 30-item test to measure cognitive functioning in older adults. We created a global measure of cognitive function by converting the scores on each of the four tests to z-scores and then averaged them to yield a single measure scaled in standard units with higher scores indicating higher cognitive performance (Wilson et al., 1999).

Analysis

We used general regression models to test the association between worship attendance and disability and physical function, after adjusting for control variables. Because the IADL and ADL measures have a very skewed distribution in the general population, we used a generalized linear regression model, specifying a log link function and a negative binomial error function for the analysis of these data. Models were fit using a Generalized Estimating Equations approach to account for the dependency in the sequential outcome data. The physical functioning outcome variable has an approximately normal distribution in our data; therefore, we used a mixed-effects linear regression model to analyze change in physical functioning in relation to worship attendance at baseline and control variables, with random effects specified for the between-subject heterogeneity in initial level (intercept) and rate of change (slope) of physical functioning.

For each outcome, we fit two models. The first model included adjustment for basic demographic and design control variables, including time since baseline, age, sex, race, and education. We added several interaction effects among these variables to more precisely model change in disability and physical functioning as a function of these variables. Worship attendance was added to this model using separate terms for frequent attendance, and frequent attendance × time interaction terms, more frequent worship attendance × time interaction terms, more frequent worship attendance was also associated with increased IADL disability over time. In models that adjusted for baseline health status, including cognitive and physical functioning, the protective association between frequency of worship attendance and baseline IADL disability was reduced, but remained significant (Table 2, Model 2). In this fully

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>SD</th>
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<tr>
<td>Age, mean (SD)</td>
<td>73.3 (6.6)</td>
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<tr>
<td>Male sex, number (%)</td>
<td>2,230 (38.0%)</td>
<td></td>
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<tr>
<td>Black race, number (%)</td>
<td>3,783 (64.5%)</td>
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<tr>
<td>Education in years, mean (SD)</td>
<td>12.8 (3.3)</td>
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<tr>
<td>Body mass index, mean (SD)</td>
<td>28.5 (6.1)</td>
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<tr>
<td>Comorbid conditions, mean (SD, range 0–9)</td>
<td>1.1 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Depression, mean (SD, range 0–10)</td>
<td>1.3 (1.9)</td>
<td></td>
</tr>
<tr>
<td>Global cognitive status, mean (SD, range –2.00 to 1.73)</td>
<td>0.4 (0.6)</td>
<td></td>
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</table>

Note. ADL = activities of daily living; IADL = instrumental ADL.

RESULTS

Table 1 shows the descriptive information for the 5,863 participants included in the analysis of the ADL and IADL outcomes. At baseline, the average age of the study participants was 73.3 years. The sample was 38.0% men and 64.5% Black. Slightly less than one third of the participants reported infrequent worship attendance, 42.1% reported frequent attendance, and 27.7% reported very frequent attendance. At baseline, the average physical function score was 10.8 (SD 3.1). Seventeen percent of the participants required assistance with IADLs and 6% of the participants required assistance with one or more ADLs.

In models adjusted for demographic variables, compared with infrequent worship attendance, frequent and very frequent worship attendance were associated with lower levels of IADL disability at baseline (Table 2, Model 1). In this model, as can be seen by the significant positive worship attendance × time interaction terms, more frequent worship attendance was also associated with increased IADL disability over time. In models that adjusted for baseline health status, including cognitive and physical functioning, the protective association between frequency of worship attendance and baseline IADL disability was reduced, but remained significant (Table 2, Model 2). In this fully
adjusted model, compared with those who reported infrequent worship attendance, those who reported very frequent worship attendance had increased IADL disability over time.

In models adjusted for demographic variables, more frequent worship attendance was associated with lower levels of ADL disability at baseline (Table 3, Model 1). In this model, as can be seen by the significant positive worship attendance x time interaction terms, more frequent worship attendance was also associated with increased ADL disability over time. As with the measures of IADL disability, in models that adjusted for baseline health status including cognitive and physical functioning (Table 3, Model 2), the association between worship attendance and ADL disability at baseline was reduced but remained significant. In this fully adjusted model, the association between frequency of worship attendance and change in ADL disability over time was no longer significant.

In models adjusted for demographic covariates, compared with those who reported infrequent worship attendance, frequent worship attendance was associated with higher levels of physical functioning at baseline (Table 4, Model 1). There was an even stronger positive effect on baseline physical functioning for those who reported very frequent attendance. However, as can be seen by the nonsignificant worship attendance x time interaction terms, there was no association between worship attendance and change in physical functioning over time. The associations between frequency of worship attendance and baseline physical functioning were reduced by adjustment for measures of baseline health status but remained significant (Table 4, Model 2). The association between worship attendance and change in physical functioning over time remained nonsignificant in these models.
For each of the measures of disability and physical functioning, we also tested whether the effects of worship attendance differed for Blacks versus Whites. We tested for these racial differences using race × worship attendance and race × worship attendance × time interaction terms. In models that adjusted for baseline health status, there were no significant racial differences in the effects of worship attendance on baseline disability/physical functioning or change in disability/physical functioning over time (results not shown).

**Discussion**

These results show lower levels of disability at baseline among participants with higher levels of worship attendance. Importantly, this finding was consistent for measures of both stages of the disability continuum, for both self-reported and performance-based measures, and these differences persisted with adjustment for multiple measures of baseline health. However, we found no evidence, in any of our measures, that older adults with more frequent worship attendance experienced any protection against increases in disability over time. In fact, we found some evidence that compared with those who attended worship infrequently, those who attended very frequently had a somewhat greater increase in IADL disability over time. Thus, these results provided only partial support for our hypotheses that more frequent worship attendance would be associated with lower levels of disability and better physical functioning. In addition, we found no support for our hypothesis of race differences in these effects.

Our baseline results are consistent with other investigations that found similar cross-sectional associations between higher levels of religious involvement and lower levels of disability (Hybels et al., 2012; Idler & Kasl, 1997a; Park et al., 2008). Our finding of no effect of frequency of worship attendance on progression of disability is consistent with one prior study (Kelley-Moore & Ferraro, 2001) but differs from several reports that more frequent worship attendance was associated with less progression of disability among older adults (Benjamins, 2004; Hybels et al., 2012; Idler & Kasl, 1997b; Park et al., 2008). Two of the other studies used composite measures of disability (Benjamins, 2004; Idler & Kasl 1997b), whereas the other two (Hybels et al., 2012; Park et al., 2008) tested effects with separate measures of different stages in the disability process, similar to our work. There are a number of differences between these studies and the present investigation, including geographic differences in the samples. In addition, with a maximum of 9 years, follow-up in this study was two to three times longer than in these other investigations. This longer period of observation reduces the likelihood that residual confounding associated with unmeasured baseline differences in health would contribute to our findings. There are also differences in the analytic approach among the studies that may account for some of the discrepancies in these findings. Unlike previous work in this area, our analytic approach was specifically designed to account for the non-normal distribution of self-reported disability scores. In addition, the residualized change score analysis employed by Hybels and colleagues (2012), may, in certain circumstances, lead to biased estimates of prospective effects (Glymour, Weuve, Berkman, Kawachi, & Robins, 2005).

Contrary to our hypotheses and the evidence reported in other investigations (Hybels et al., 2012; Park et al., 2008), we found that, compared with those whose worship attendance was infrequent, older adults in CHAP who reported very frequent attendance had a greater increase in IADL disability over time. Our analysis provided no explanation for this finding. However, it is consistent with other reports (Mendes de Leon, Glass, & Berkman, 2003; Mendes de Leon, 2007) that found that, compared with those with moderate or high levels of disability, those with the lowest levels tended toward greater rates of increase in disability over time.

In this study, we found no evidence for Black–White differences in the relationship between worship attendance and disability. This is consistent with a prior investigation of religion and disability in older adults (Kelley-Moore & Ferraro, 2001) and with studies of the relationship between religious involvement and mortality (Hummer, Rogers, Nam, & Ellison, 1999; Musick, House, & Williams, 2004). However, there are reports of Black–White differences in the association between religious coping and blood pressure (Steffen, Hinderliter, Blumenthal, & Sherwood, 2001), suggesting this is a topic for continued investigation.

As with any observational study, alternative explanations for these results must be considered (Regnerus & Smith, 2005). Reverse causation, the possibility that frequency of worship attendance is determined by physical functioning and disability, is an alternative explanation for the baseline associations we have reported. This explanation is consistent with investigations that have reported higher levels of functional limitations were a barrier to participation in religious activities (Benjamins, Musick, Gold, & George, 2003; Kelley-Moore & Ferraro, 2001), but Idler and Kasl (1997b) reported that baseline levels of disability did not predict subsequent worship attendance and new disability only accounted for short-term decreases in worship attendance. In this study, we attempted to minimize the influence of poor health on frequency of worship attendance by excluding the frailest participants and, for those remaining, by controlling for a comprehensive set of indicators of physical and mental health status. However, we cannot rule out the possibility that our findings are due to residual confounding by an unmeasured health factor or an unmeasured common determinant of worship attendance and disability.

Another explanation for our findings is selection effects. That is, if, as the evidence suggests (Chida et al., 2009), lower levels of worship attendance are associated with...
greater risk of mortality, adults with low worship attendance would be less likely to survive into old age and those in our cohort who did survive may be less prone to health risks such as increased disability that may be associated with infrequent worship attendance. Such selection effects would have occurred prior to enrollment in CHAP. Lacking data on the members of this population who died prior to becoming eligible for participation in CHAP, or on those who did not participate in CHAP, we were unable to control for such effects. This issue should be addressed in future studies that focus on middle-aged populations, rather than older adults, before such selection effects have affected the composition of the population.

The small number of participants (7%) omitted from the analysis of IADL and ADL disability due to missing data was unlikely to lead to biased estimates for these outcomes. We did have to exclude a larger proportion of cases for the analysis of physical functioning (34%) due to the higher mortality associated with the longer interval (3 years) between in-home interviews. The bias created by the participants retained in this analysis, those who were younger, had better baseline physical functioning and reported higher levels of worship attendance, should have increased the likelihood of finding an association between frequency of worship attendance and less change in physical functioning over time. Thus, we conclude that the null association we observed was unlikely caused by bias associated with the cases excluded from this analysis.

Our findings suggest two interpretations about the relationship between religious involvement and disability among older adults. First, our finding of an inverse association between worship attendance and disability at baseline points to the possibility that long-term religious involvement earlier in life may postpone the onset of disease and associated disability. Second, our finding that more frequent worship attendance was not associated with the progression of disability points to the likelihood that once the functional consequences of aging-related declines in health have become manifest, religious involvement has little impact on their progress. This interpretation is consistent with evidence that religious involvement does not protect against the development of hypertension (Fitchett & Powell, 2009) or cardiovascular disease (Feinstein et al., 2010), that it does not alter the progression of cancer (Powell et al., 2003), and that it has no association with mortality among clinical samples (Chida et al., 2009).

Several factors contribute to the methodological rigor of this investigation and to our confidence in these findings. We examined the association between worship attendance and different stages of the disability process. We employed both self-reported and observed measures of disability. Our assessments of disability came from up to 9 yearly interviews and our analytic procedures took advantage of the longitudinal nature of these data. Our models also took account of the skewed, non-normal distribution of the IADL and ADL measures. Further, we addressed the possibility of reverse causation by excluding the most disabled participants and by including multiple measures of baseline physical and emotional health in the regression models.

The strengths of our investigation notwithstanding, these findings should be interpreted in light of its limitations. While CHAP is a population-based study of older adults, all the participants live in a Midwestern urban setting; it is unknown whether these findings can be generalized to older adults from other geographic contexts. In addition, the context for CHAP participants’ reports of their worship attendance is not known because the study does not include information about participants’ religious affiliation. Nor were we able to take into account the diversity in support that congregations may provide to assist members who have disabilities to remain active. Compared with those aged 60 or older in nationally representative data (General Social Survey, 2010), CHAP participants reported more very frequent worship attendance (CHAP 28%, GSS 10%) and less infrequent worship attendance (CHAP 30%, GSS 51%).

Our study examined frequency of worship attendance, which is only one of many dimensions of religious involvement that may have different patterns of association with disability among older adults. Further, knowing that more frequent worship attendance is associated with baseline disability provides limited information about what it is about worship attendance that may influence health or disability. Further investigation of the specific components of the worship experience, for example, Sense of Belonging and Positive and Sad Worship Emotions (Idler et al., 2009), would advance our understanding of this relationship. It should also be underscored that our baseline measure of worship attendance provided no information about participants’ religious involvement over their life course where the influence of religious involvement on health may occur, a serious but common limitation of much of the existing epidemiological research about religious involvement and health (George et al., 2002).

The findings from this study suggest directions for future investigations including research that examines when in the life course, and how, religious involvement develops its association with physical disability or other health outcomes. Investigating these questions will require following healthy young and middle age adults over the years that are needed to observe the development of diseases such as cardiovascular disease, diabetes, cancer, and physical disability. Information about multiple dimensions of religious involvement should be gathered, across the whole study, to permit a more precise estimate of its influence on health. Including measures of health behavior, social networks, and psychological factors would permit testing the role of those factors in mediating the relationship between religious involvement and health. Moreover, personality factors, including conscientiousness, risk avoidance, and sociability, may be related to both the development of disease and
disability (Krueger, Wilson, Shah, Tang, Bennett, 2006; Wilson et al., 2006) and levels of religious involvement. However, their contribution to the relationship between religion and health has received little attention (George et al., 2002; Regnerus & Smith, 2005). Well-designed future studies would permit us to advance our understanding of the relationship between religious involvement and the development of disability and other diseases.

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