# Longitudinal Associations of Religiosity and Physical Function in Older Irish Adults

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**OBJECTIVES:** Research into the link between religion and physical function has shown inconsistent results. Most studies have used self-reported measures of physical function, and many have excluded those who are not religious and only compared levels of religious engagement within those groups that are religious. We aimed to assess the longitudinal associations of religious affiliation and religious attendance on two objective measures of physical function.

**DESIGN:** Longitudinal study using five waves of data from the Irish Longitudinal Study on Ageing (TILDA).

**SETTING:** Community-dwelling adults in Ireland.

**PARTICIPANTS:** Adults aged 50 and over who participated in two or more waves of TILDA (n = 6,122),and a supplementary analysis of a sub-sample aged 65 and over (n = 2,359).

**MEASUREMENTS:** Timed Up and Go (TUG) and grip strength were measured on at least two occasions. Data were collected approximately every 2 years over 10 years. Longitudinal linear mixed effects models were estimated to calculate the effect of religious affiliation and attendance on TUG and grip strength over time.

**RESULTS:** TUG scores increased by an average of .1 seconds with each year of age, which increased to .3 seconds by age 72 years. Grip strength scores decreased by .2 kg with each year of age and increased to −.3 kg per year by age 72. No overall differences were observed between religious affiliations in scores of TUG or grip strength.

**CONCLUSION:** Religious affiliation does not predict performance on objective physical function measures. Results are discussed with reference to the changing religious characteristics of the Irish population. **J Am Geriatr Soc 68:1998-2005, 2020.**

**Keywords: Timed Up and Go; grip strength; religion; longitudinal**

Results of studies on religion and physical health have been mixed.[1] This link is complicated because membership of a religious group is often entangled with other characteristics that contribute to health, such as socioeconomic status, ethnicity, education, and social standing.[2] Demographic changes have seen an increase in those with no religious affiliation in younger age groups in Ireland.[3] As the population ages, and with increasing secularization, an increasing proportion of adults in older age groups will be religiously unaffiliated. If health implications are associated with religious affiliation, these should be understood so appropriate health and social planning can be developed and put in place. The large proportion of religiously affiliated in Ireland, as well as the fast rate of change in religious affiliation and practice, make this a pertinent question in this context.

Some longitudinal studies have shown disability and physical function limitations to be lower in older adults who are more religious, in particular those who attend religious services.[4-6] However, other longitudinal studies have found complex associations. The work of Ahrenfeldt and colleagues on European older adults found that being involved in a religious organization, as well as being religiously educated, was associated with fewer health limitations, although those who prayed but were not involved in other aspects of religious participation had poorer health outcomes.[7] Similar results were found by others, with religious service attendance associated with lower physical limitations and religious salience associated with worse physical limitations.[8] Reverse causality mechanisms have also been suggested between attendance and physical limitations, where increased physical limitations led to a decline in religious attendance.[9,10] The literature has concentrated on specific religious behaviors and often ignored affiliation to different religions or no affiliation as an explanatory factor. Those not affiliated with a religion have been understudied in this context.

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We aimed to test longitudinally whether older adults differ in their performance on two objective measures of physical function (Timed Up and Go [TUG] and grip strength) by religious affiliation, using data from The Irish Longitudinal Study on Aging (TILDA). We further investigated whether these results can be explained through the effect of religious service attendance.

We tested these hypotheses: (1) Religious affiliation will not be associated with scores on the TUG or grip strength tests, and (2) Religious attendance will be positively associated with better performance on the TUG and grip strength tests.

## METHODS

TILDA is a large-scale longitudinal study using a nationally representative sample of adults aged 50 and older living in Ireland. A total of 8,174 participants were recruited at baseline. Baseline data were collected in 2009 and 2010, and participants were followed up approximately every 2 years. Participants were interviewed in their own homes using the Computer-Assisted Personal Interview. Informed consent was obtained from all participants, and ethical approval for TILDA was granted by the Trinity College Dublin research ethics committee. Detailed information on the study design and sampling is given elsewhere.[11,12] The current analyses use data from the first five waves of data collection for the TUG measure and from the first four waves for the grip strength measure. The sample includes participants who had valid data at two or more waves on the measures of interest (n = 6,122). Using longitudinal data from respondents aged 50 and older allows the observation of physical function trajectories before the onset of functional limitations for most of the sample. We further explored the same effects in a subsample aged 65 and older (n = 2,359). Details on missingness are in Supplementary Table S1; deaths are listed in Supplementary Table S2.

Measures

Religious affiliation measured at baseline was used to assess differences in physical function. Affiliation was collected using the question "What is your religion?" Possible responses were Roman Catholic, Anglican/Church of Ireland/Episcopalian, Methodist, Presbyterian, Other Christian, Other religion, and No religion. These responses were recoded into "Catholic," "Other religion," and "No religion." Attendance was measured using the question "About how often do you go to religious services?" Possible responses were Never/Almost never, Once or twice a year, Every few months, Once or twice a month, Once a week, and More than once a week. Nonreligious respondents were routed past this question. To include the effects of attendance without excluding the nonreligious, we split the Catholic group (comprising 88% of the sample) into two attendance levels: high attenders (attended at least once a month) and low attenders (attended less than once a month). We did not include attendance levels for those affiliated with other religions due to small numbers.

Two measures of physical function were examined. The TUG test is a widely used measure of functional mobility, with predictive power for disabilities and frailty in older adults.[13,14] TUG is measured by having the participant stand up from a standard chair, walk 3 meters, turn around, walk back, and sit down again. TUG scores are presented in seconds. A lower score indicates a faster time to complete the test. TUG was measured in two different settings; in the first and third waves of data collection, respondents were invited to complete a health assessment, carried out by a research nurse in a dedicated health assessment center or at the respondent's home. TUG was measured during this health assessment. In the second, fourth, and fifth waves of data collection, TUG was measured by a trained interviewer during the home interview. Interviewers and health assessment research nurses followed the same protocol at each wave when measuring TUG. For the current analyses, TUG observations were winsorized at the top and bottom .5% to avoid undue influence from extreme values.

Grip strength, used as a measure of general body strength and frailty, is a predictor for physical function and decline.[15-17] Grip strength was also measured in two settings: during health assessment (waves 1 and 3), and during a home interview (waves 2 and 4). Grip strength measures were only available for the first four waves of TILDA. Grip strength was measured in kilograms using a hydraulic hand dynamometer (Baseline, Fabrication Enterprises, Inc, White Plains, NY). Participants were asked to squeeze the dynamometer as hard as possible for a few seconds. The same protocols were used in each setting, with the exception that four readings were taken during the health assessment (two on each hand), and only two were taken during the at-home interview (two on the dominant hand only). The maximum reading was taken from each set of tests at each wave. Grip strength observations were winsorized at the top and bottom 1%.

Covariates measured at baseline were selected based on theory and existing literature. Covariates included were age (centered around the mean age, 62, for ease of interpretation of results), centered age squared ($age^2$), centered age cubed ($age^3$) (to account for the possible nonlinear association with age),[18,19] self-rated health (excellent, very good, good, fair, poor),[20] number of medications,[21,22] marital status (married/cohabiting, never married, separated/divorced, widowed),[23] highest level of education achieved (none/primary, secondary, third level),[24] father's highest level of education (less than primary, primary, more than primary, do not know),[25] smoking status,[26] number of limitations of activities of daily living (ADLs),[27] days of vigorous physical activity ("During the last 7 days, on how many days did you do vigorous physical activity?"), and depressive symptoms, measured using the Center for Epidemiologic Studies Depression (CES-D) scale, where a higher score indicates higher depressive symptomatology.[28-30] Height at baseline was also included as a covariate.[18,19] Height was measured in the wave 1 health assessment and was also self-reported. We use measured height, and where this was not available, self-reported height.

Analysis Strategy

We first explored the cross-sectional associations between measures of physical function and covariates by religious affiliation at baseline. Means and standard deviations are presented for continuous covariates, and percentages are presented for categorical covariates. We used linear mixed effects regression models to assess the effect of baseline religious affiliation and attendance on TUG and grip strength and TUG and grip strength change, using the Stata mixed command. Data with repeated measures are highly correlated within individuals; mixed effects models use both fixed and random effects and are thus able to take this

correlation into account. Linear mixed effects regression uses all available data to fit models, maximizing sample sizes. In this analysis we included all individuals with observations at two or more time points. We present robust standard errors obtained using Stata's vce(robust) command.

We tested whether the effects of time on the outcomes were nonlinear by testing models using $age^2$ and $age^3$, and the model with the best fit was selected. We included interactions in each model between religious affiliation and age/$age^2$/$age^3$, to account for the effect of time on the outcome. We chose an unstructured covariance for all models as a conservative approach that does not impose a covariance structure on the model. We present initial models adjusted only for religious affiliation, sex, and age. All further analyses were stratified by sex to better understand sex-specific trajectories, and to avoid the models being overburdened with interactions.

Finally, we repeated all models replacing the religious affiliation measure with the measure accounting for high and low attendance among Catholics, to test whether the observed effects could be explained by attendance. We produced plots of predicted scores using Stata's fitted command that uses both random and fixed coefficients to generate predicted values, by sex, age, and religious affiliation/attendance to aid the interpretation of results. All analyses were carried out in Stata v.15.1.

### Supplementary Analyses

All analyses were repeated in a subsample aged 65 and over (n = 2,363), to assess whether results were sensitive to the use of the relatively young TILDA sample.

## RESULTS

Most of the sample were regular attenders. Most attended once a week, and a substantial minority attended more often. Men were more likely than women to be nonreligious or to never attend, whereas women were more likely than men to attend more than once a week. Frequency of attendance within our sample did not markedly change over time. Details on frequency of attendance and change in frequency over time are listed in Supplementary Table S3 and Supplementary Figure S1.

Univariate associations between health and physical function measures and religious categories (high-attendance Catholics who attend at least once a month vs low-attendance Catholics who attend less frequently, as well as the other religious and the nonreligious) were examined and are presented in Table 1. The nonreligious had lower TUG scores and higher grip strength scores. High-attendance Catholics had the lowest CES-D scores; low-attendance Catholics had the highest. The nonreligious had slightly higher frequency of vigorous physical activity, and they were the most likely to report their health as excellent, whereas low-attendance Catholics were most likely to self-report poor health. Half of high-attendance Catholics and those with other religions had never smoked; low-attendance Catholics were those most likely to be current smokers.

Sociodemographic differences by religious affiliation and attendance were also examined univariately (Table 2). Low-attendance Catholics and the nonreligious were the youngest groups. More than half the sample were women, although men were overrepresented in the nonreligious group. High-attendance Catholics were less likely to be separated or divorced. High- and low-attendance Catholics had similar levels of

**Table 1. Sample Health and Physical Function Characteristics at Baseline (n = 6,122)[a]**

| Measures %/Mean (SD) | Total | Catholic high attender (n = 3,848) | Catholic low attender (n = 1,560) | Other religion (n = 372) | Nonreligious (n = 342) |
|---|---|---|---|---|---|
| TUG, s, mean (SD) | 9.0 (2.6) | 9.2 (2.6) | 8.9 (2.7) | 9.1 (2.6) | 8.4 (1.7) |
| Grip strength, kg, mean (SD) | 27.8 (9.9) | 27.1 (9.7) | 29.1 (10.1) | 27.7 (9.3) | 30.6 (9.5) |
| Height, cm, mean (SD) | 166.0 (9.3) | 165.3 (9.2) | 167.0 (9.5) | 166.6 (9.4) | 169.5 (8.7) |
| CES-D, mean (SD) (scale range: 0-48) | 5.6 (7.0) | 5.1 (6.4) | 6.6 (8.0) | 6.2 (7.0) | 6.1 (7.5) |
| ADLs, mean (SD) (scale range 0-6) | .10 (.44) | .09 (.43) | .11 (.46) | .12 (.45) | .12 (.40) |
| No. of medications, mean (SD) | 2.5 (2.6) | 2.5 (2.6) | 2.4 (2.7) | 2.7 (2.8) | 2.2 (2.5) |
| Physical activity, mean (SD) | 1.0 (2.0) | .9 (1.9) | 1.1 (2.0) | 1.2 (2.2) | 1.5 (2.3) |
| Self-rated health, % | | | | | |
| Excellent | 17.4 | 17.2 | 16.6 | 17.2 | 23.4 |
| Very good | 30.2 | 30.6 | 29.2 | 34.4 | 26.3 |
| Good | 32.3 | 33.4 | 32.1 | 26.6 | 27.5 |
| Fair | 16.2 | 15.7 | 16.3 | 18.6 | 19.6 |
| Poor | 3.9 | 3.2 | 5.8 | 3.2 | 3.2 |
| Smoking status, % | | | | | |
| Never | 44.9 | 50.1 | 33.0 | 49.7 | 36.0 |
| Past | 38.8 | 38.0 | 39.6 | 38.2 | 45.9 |
| Current | 16.3 | 12.0 | 27.5 | 12.1 | 18.1 |

Abbreviations: ADL, activities of daily living; CES-D, Center for Epidemiologic Studies Depression scale; SD, standard deviation; TUG, Time Up and Go.
[a]TUG and grip strength values are for individual baselines. Because some of the sample did not have TUG or grip strength data for wave 1, their baseline is taken as the first observation taken for each measure (TUG wave 1, n = 5,224; wave 2, n = 865; wave 3, n = 28; wave 4, n = 5; grip strength wave 1, n = 5,228; wave 2, n = 870; wave 3, n = 24).

**Table 2. Sample Sociodemographic Characteristics at Baseline (n = 6,122)**

| Measures %/Mean (SD) | Total | Catholic high attender (n = 3,848) | Catholic low attender (n = 1,560) | Other religion (n = 372) | Nonreligious (n = 342) |
|---|---|---|---|---|---|
| Female, % | 53.8 | 56.9 | 48.6 | 56.2 | 40.4 |
| Age, y, mean (SD) | 62.7 (9.0) | 64.1 (9.3) | 59.5 (7.6) | 63.1 (9.4) | 60.2 (7.1) |
| Marital status, % | | | | | |
| Married | 72.5 | 73.1 | 71.7 | 71.2 | 70.2 |
| Never married | 8.9 | 9.1 | 8.3 | 7.3 | 9.9 |
| Separated/ Divorced | 6.8 | 4.1 | 11.1 | 10.2 | 14.3 |
| Widowed | 11.8 | 13.6 | 8.9 | 11.3 | 5.6 |
| Education, % | | | | | |
| Primary/None | 25.7 | 27.8 | 26.9 | 14.0 | 10.2 |
| Secondary | 41.2 | 41.9 | 42.2 | 38.7 | 31.0 |
| Third level | 33.1 | 30.3 | 31.0 | 47.3 | 58.8 |
| Father's education, % | | | | | |
| Less than primary | 10.9 | 11.3 | 11.3 | 8.1 | 7.0 |
| Primary | 56.9 | 62.4 | 50.6 | 40.9 | 42.1 |
| More than primary | 24.4 | 19.7 | 27.8 | 42.5 | 41.8 |
| Unknown | 7.8 | 6.6 | 10.3 | 8.6 | 9.1 |

Abbreviation: SD, standard deviation.

education, with high proportions of no/primary education and secondary education. Those with other religions and the nonreligious were more likely to have third-level education.

Adjusted TUG mixed effects models showed that once all covariates were held constant, average TUG completion time at baseline was 8.3 seconds for men and 8.4 seconds for women at age 62, and this time increased by .1 seconds for both men and women with each year of age. The rate of change increased over time. TUG trajectories by religious affiliation and attendance are presented in Figure 1. Full model results are given in Supplementary Table S4. Religious affiliation was not associated with TUG scores or TUG score trajectories for men or women.

When accounting for the level of attendance in Catholics, we found that low-attendance Catholic women had slower TUG scores. Holding all other covariates constant, Catholic low-attendance women had TUG scores about one-third of a second slower than scores for high-attendance Catholic women with the same characteristics otherwise at age 62 (8.63 vs 8.29, a difference of .34 seconds; 95% confidence

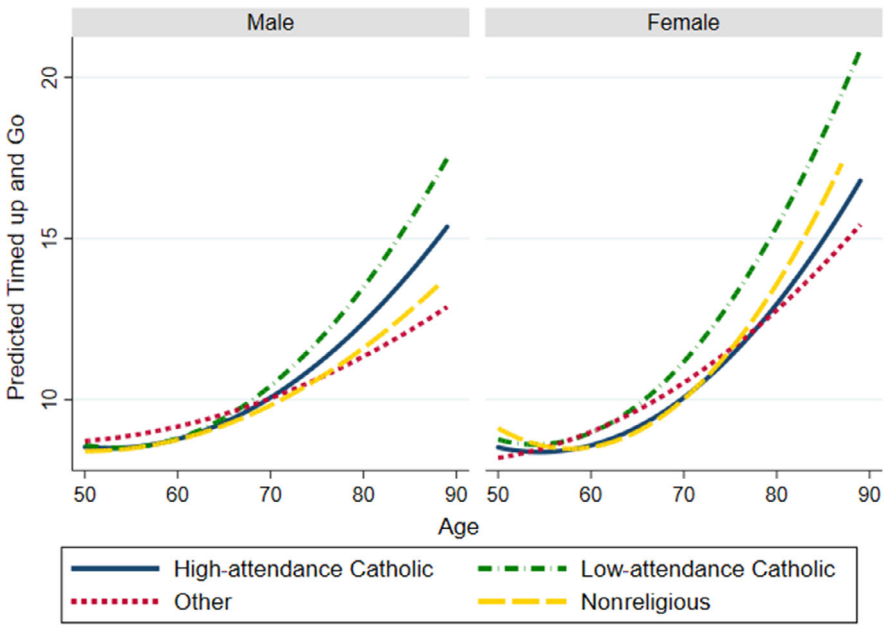


**Figure 1.** Predicted Timed Up and Go (TUG) scores by religious affiliation and religious attendance, men and women (n = 6,122).

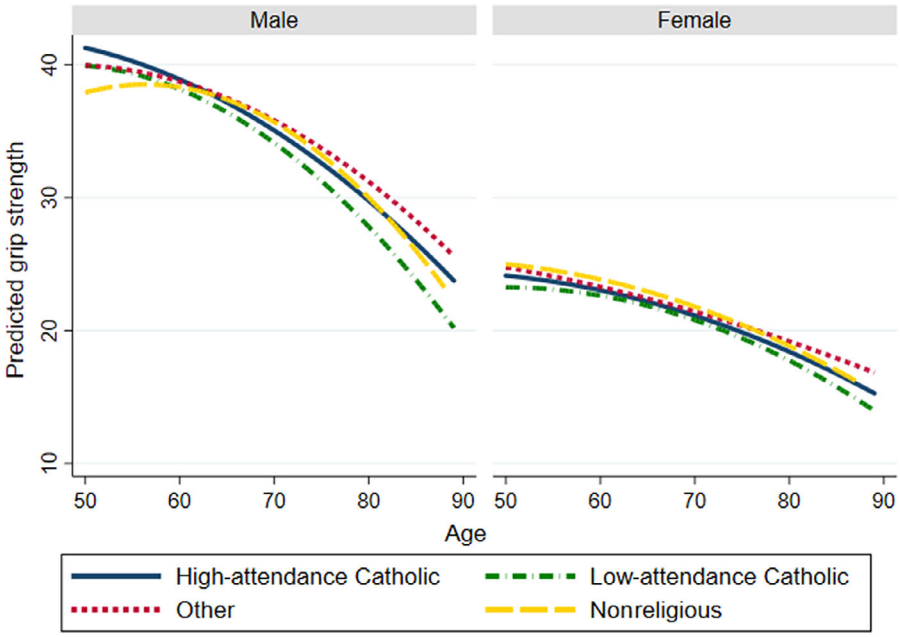


**Figure 2.** Predicted grip strength scores by religious affiliation and religious attendance, men and women (n = 6,122).

interval [CI] = .15-52). Interactions with age were significant for low-attendance Catholic women, suggesting a greater rate of change in their TUG scores; the average high-attendance Catholic woman had a TUG score of 12.72 seconds at age 80 compared with low-attendance women, who at age 80 had an average score of 15.90 seconds. There were no main effects of religious attendance for men, although there was a significant interaction effect for Catholic low attenders and age.[3] Catholic low- and high-attendance men who were otherwise similar at age 62 only differed by .13 seconds in their TUG scores (95% CI = −.03 to .29) but had significantly different rates of change after the age of about 70. Low-attendance Catholic men at age 80 had predicted fitted scores of 13.49 seconds compared with 12.05 for high-attendance Catholic men of the same age with otherwise identical characteristics.

Adjusted grip strength mixed effects models showed that, holding all other variables constant, men had an average grip strength score of 37.0 kg at age 62 that declined by about .3 kg per year, and women scored 24.3 kg on average and declined by about .1 kg per year. The rate of change increased over time for both men and women. Detailed model results are given in Supplementary Table S5. A model adjusting for age and sex only showed that the nonreligious had slightly stronger grip strength by .7 kg (95% CI = .01-1.41). However, this effect did not remain after stratifying by sex and adjusting for covariates. Otherwise, religious affiliation was not associated with grip strength, with the exception that for nonreligious men the change in grip strength was slightly slower. Examination of plotted predicted values suggests this may be in part because nonreligious men had slightly (but not significantly) lower grip strength scores at younger ages (Figure 2).

### Supplementary Analysis

Results for the older than age 65 population did not markedly differ from those of the full sample. In TUG models, low-attendance Catholic women were slower, but this did not reach significance, although they did have a significantly faster rate of change. Other religion men had a slightly slower TUG rate of change. An unadjusted grip strength model showed stronger grip strength in the nonreligious; however, this was not significant. Full results for the sample aged 65 and older are presented in Supplementary Tables S6 and S7 and Supplementary Figures S2 and S3.

## DISCUSSION

This study used longitudinal data from a large nationally representative sample of adults aged 50 and older to explore differences in objective physical function measures by religious affiliation and attendance. We found that physical function does not differ across religious affiliation in the older 50s in men or women. A supplementary analysis of the sample aged 65 and older supported this conclusion in the older age group. However, we did find that Catholic women who regularly attended religious services had slightly faster TUG speeds than Catholic women who did not attend services in the full sample analysis.

That scores on physical function measures do not differ by religious affiliation is in line with the literature on religious affiliation and health. Studies looking at affiliation have often found that being nonaffiliated is not associated with self-reported measures of health.[31-33] Studies that differentiated between different types of nonaffiliation (atheists, agnostics, nonreligious, etc) found that these effects are complex, often with some nonaffiliated groups having better health outcomes than other nonaffiliates and the religiously affiliated.[31,32,34,35]

Recent studies using European population data from the Survey of Health, Aging and Retirement in Europe (SHARE) found that religious education and participation in a religious organization are associated with lower rates of noncommunicable diseases, disabilities, depressive symptoms, health

behaviors, and poor self-rated health.[7,39-41] These positive associations, in particular those relating to disabilities, somewhat conflict with our findings. It is plausible that the self-reported nature of the SHARE data on disabilities creates a stronger association between religiosity and disabilities than we found using objective measures; religiosity was shown to be associated with optimism and positive mental health,[42,43] which may lead more religious respondents to report fewer difficulties with ADLs, for example. Further research into differences between religious groups on self-reported and objective measures, and the possible role of optimism and mental health, would be beneficial.

Another plausible explanation for these conflicting findings is the differences in the "nonreligious" category. The SHARE studies defined as nonreligious those who did not pray, did not take part in a religious organization, and were not religiously educated. By this definition, some of the low-attendance Catholic sample in TILDA could be considered nonreligious. This highlights the implications of the use of different definitions in the religion-health literature.

Our finding that religious attendance, rather than religious affiliation, was a predictor for TUG performance in women is consistent with much of the literature, which found that attendance is associated with better physical function.[1] It is intuitive that TUG, rather than grip strength, may be associated with attendance; attendance involves physical movement and practice that could be associated with maintaining functional mobility and walking speed (walking to and from church, kneeling and standing during services, etc). Attendance also involves cognitive and social aspects that may help maintain cognition (having conversations with other congregation members, singing, following a sermon, etc). Completion of the TUG requires cognitive processing and has been associated with measures of cognitive function.[36] Recent findings from the English Longitudinal Study on Aging also found that loneliness and social isolation are associated with decreased gait speed.[37] Previous findings from TILDA show that religious attendance is associated with a larger social network and thus lower social isolation.[38] Why these effects should be inconsistent in men is less clear. In contrast, grip strength measures muscular and upper body strength, which may be less directly related to religious attendance.

The religious context is another important latent variable that is not yet well understood in the study of religion and health. It has been hypothesized that the religious do better in more religious contexts.[44] However, evidence for this has been mixed.[7,44] Our findings only show weak support for an association between higher religiosity and better physical function, even though Ireland is a relatively religious country. It is important to consider what religious participation looks like in each of these contexts; in Ireland, most of the older than age 50 population attends religious services once a week. This is not true of other European contexts, where most countries have low participation in religious activities even in this age group.[45] However, the marked decline in Catholicism in the country could have an unobserved effect on the relationship, weakening the overall position of Catholics and indirectly impacting on their health.

Our findings give further motivation to research which includes the nonreligious; within a population which is experiencing secularization, it is plausible that those who self-describe as religious but who do not attend services may themselves be in a process of secularization. We have seen that the nonreligious generally perform no differently than those who are religiously affiliated, yet Catholics with low religious attendance may be experiencing poorer health. If this population is in the process of secularization, this may have an impact on the health of the nonreligious as a group. More clarity on the different types of nonreligious individuals (including the ex-affiliated) would serve to disentangle the religion and health relationship.

Our study does have some limitations. Although the large percentage of Catholics in the population of interest is conducive for research into differences between levels of religious engagement among Catholics, it is not ideal for researching differences among different affiliations. Low numbers in these groups may mean a lack of power to identify effects.

Although the use of longitudinal fixed effects models allows us to include some respondents who have died and respondents who have not participated in every wave, we are not able to fully account for the effect of death or attrition on the sample. Examining the included and excluded deceased samples showed there were some differences including worse health outcomes in the excluded sample; this probably introduced some bias into our estimates.

The use of ADLs and physical activity measures may not sufficiently capture the level of disability or overall physical function at baseline, making it difficult to disentangle the directionality of the effect observed for attendance level and TUG speed in women. Importantly, our results are only generalizable to the Irish population. Research into physical function in other populations could help clarify whether these results are universal or context specific.

Finally, it is possible that the use of different assessors at each wave (research nurses or interviewers) could have an unmeasured impact on results. However, this is the largest study of its kind to date in this population, and the nationally representative nature of the data makes this a robust contribution to the field.

In conclusion, we do not find evidence of differences in TUG or grip strength scores by religious affiliation in the older population in Ireland. But we found some evidence that frequent religious service attendance for Catholic women is associated with faster TUG speeds and a slower decline in speed with age.

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**Author Contributions:** Joanna Orr created research questions and reviewed the literature, designed the study, prepared the data and data analysis, interpreted results, drafted the

manuscript, and edited the final manuscript. Rose Anne Kenny was the principal investigator of the study, devised and designed the TILDA study and data collection, and contributed to writing and editing the final manuscript. Christine Ann McGarrigle supervised, contributed to research questions and study design, interpreted results, and contributed to writing and editing the final manuscript.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

**Supplementary Table S1:** Missingness by Variable

**Supplementary Table S2:** Deaths: Characteristics of Included and Excluded Deceased Sample

**Supplementary Table S3:** Frequency of Religious Attendance

**Supplementary Table S4:** Mixed Effects Model Results TUG Full Sample Aged 50 and Older

**Supplementary Table S5:** Mixed Effects Model Results Grip Strengtn Full Sample Aged 50 and Older

**Supplementary Table S6:** Mixed Effects Model Results TUG Sample Aged 65 and Older

**Supplementary Table S7:** Mixed Effects Model Results Grip Strength Sample Aged 65 and Older

**Supplementary Figure S1:** Change in religious atttendance over five waves.

**Supplementary Figure S2:** Predicted TUG scores by religious affiliation sample aged 65 and older.

**Supplementary Figure S3:** Predicted grip strength scores by religious affiliation sample aged 65 and older.