HHS Public Access
Author manuscript
J Aging Health. Author manuscript; available in PMC 2022 July 13.

Published in final edited form as:
J Aging Health. 2017 September ; 29(6): 951–972. doi:10.1177/0898264317716244.

Religious Participation and Biological Functioning in Mexico

Terrence D. Hill, PhD[1], **Sunshine M. Rote, PhD**[2], **Christopher G. Ellison, PhD**[3]

[1]The University of Arizona, Tucson, USA

[2]University of Louisville, KY, USA

[3]The University of Texas at San Antonio, USA

Abstract

Objective: Although several studies suggest that religious involvement tends to favor healthy biological functioning, most of this work has been conducted in the United States. This study explores the association between religious participation and biological functioning in Mexico.

Method: The data are drawn from two waves of the Mexican Health and Aging Study (2003–2012) to assess continuous and categorical biomarker specifications.

Results: Across specifications, religious participation in 2003 is associated with lower levels of waist-to-hip ratio, total cholesterol, pulse rate, and overall allostatic load in 2012. Respondents who increased their participation over the study period also exhibit a concurrent reduction in pulse rate. Depending on the specification, participation is also associated with lower levels of diastolic blood pressure and C-reactive protein. Participation is generally unrelated to body mass index, glycosylated hemoglobin, and systolic blood pressure.

Discussion: Our results confirm that religious participation is associated with healthier biological functioning in Mexico.

Keywords

religion; Mexico; biomarkers; epidemiology

Over the past three decades, numerous studies have shown that religious involvement —indicated by observable feelings, beliefs, activities, and experiences in relation to spiritual, divine, or supernatural entities—tends to favor health and longevity in the elderly population. These patterns are remarkably consistent across a range of health indicators, including anger (Carr, 2003), depression (Idler, 1987; Idler & Kasl, 1997a; Strawbridge, Shema, Cohen, Roberts, & Kaplan, 1998), anxiety (Cicirelli, 2002; Krause, 2005), nonspecific psychological well-being (Fry, 2001; Idler & Kasl, 1997a), life satisfaction (Krause, 2003, 2005; Levin, Markides, & Ray, 1996), cognitive functioning (Hill, Burdette, Ellison, & Music, 2006; Reyes-Ortiz et al., 2008; Van Ness & Kasl, 2003), self-rated health

---

Corresponding Author: Terrence D. Hill, School of Sociology, The University of Arizona, Social Sciences Building, Room 400, 1145 E. South Campus Drive, Tucson, AZ 85721, USA. tdhill@email.arizona.edu.

Declaration of Conflicting Interests
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

(Idler, McLaughlin, & Kasl, 2009; Krause, 1998, 2006), functional status (Benjamins, 2004; Hill et al., 2016a; Idler, 1987; Idler & Kasl, 1997b; Park et al., 2008), and stroke (Wolinsky et al., 2009). Not surprisingly, religious involvement is also associated with lower risk of all-cause mortality (Ellison, Hummer, Cormier, & Rogers, 2000; Gillum, King, Obisesan, & Koenig, 2008; Hill, Angel, Ellison, & Angel, 2005; Strawbridge, Cohen, Shema, & Kaplan, 1997) and mortality linked to circulatory diseases, respiratory diseases, and other specific causes (Hummer, Rogers, Nam, & Ellison, 1999; Oman, Kurata, Strawbridge, & Cohen, 2002; Rogers, Krueger, & Hummer, 2010).

In the past two decades, researchers have also established links between religious involvement and a wide range of biological markers. Biological markers (biomarkers) are objective indicators (derived from independent assessments like blood and saliva, not self-reports) of physiological functioning (e.g., cardiovascular and immune functioning) that are known to predict health and mortality outcomes (Crimmins, Kim, & Vasunilashorn, 2010; Crimmins & Seeman, 2001; McDade, Williams, & Snodgrass, 2007). Like most health indicators, biomarkers are not randomly distributed in society. They are shaped by social, psychological, and behavioral processes (Beltrán-Sánchez & Crimmins, 2013; Crimmins et al., 2010; Crimmins & Seeman, 2001; Crimmins, Soldo, Ki Kim, & Alley, 2005; McDade et al., 2007; McEwen, 1998, 2002; Seeman, Dubin, & Seeman, 2003).

In general, research shows that various indicators of religious involvement are associated with favorable biomarker profiles across sympathetic nervous, hypothalamic-pituitary-adrenal (HPA), cardiovascular, immune, and metabolic systems (Hill, 2010; Hill et al., 2016b; Seeman et al., 2003; Seybold, 2007). When limited to studies of older adults, there is evidence that religious involvement is associated with lower levels of blood pressure (Das & Nairn, 2016; Hill, Rote, Ellison, & Burdette, 2014; Koenig et al., 1998; Krause et al., 2002; Maselko, Kubzansky, Kawachi, Seeman, & Berkman, 2007), pulse rate (Hill et al., 2014), C-reactive protein (CRP; Das & Nairn, 2016; Ferraro & Kim, 2014; Gillum et al., 2008; Hill et al., 2014; King, Mainous, & Pearson, 2002; King, Mainous, Steyer, & Pearson, 2001), interleukin-6 (Koenig et al., 1997; Lutgendorf, Russell, Ullrich, Harris, & Wallace, 2004), white blood cells (King et al., 2001), Epstein-Barr virus (Das & Nairn, 2016; Hill et al., 2014), epinephrine (Maselko et al., 2007), cortisol (Ironson et al., 2002; Tobin & Slatcher, 2016), and overall allostatic load (Hill et al., 2014; Maselko et al., 2007). Evidence concerning the metabolic system is weak and mixed. Research suggests that religious involvement is unrelated to glycosylated hemoglobin (Das & Nairn, 2016; Hill et al., 2014). Several other studies demonstrate that religious adults tend to weigh more, not less, than their less religious counterparts (Bruce, Sims, Miller, Elliott, & Marian Ladipo, 2007; Idler & Kasl, 1997a; Kim, Sobal, & Wethington, 2003; Oman & Reed, 1998; Strawbridge et al., 1997). However, research also suggests that religious adults are less likely to be underweight (Hill et al., 2014; Musick, House, & Williams, 2004), which is especially important for health and well-being in old age (e.g., Sergi et al., 2005).

We currently know very little about how religious involvement gets “under the skin” to contribute to favorable biomarker profiles. Nevertheless, previous research has proposed several potential social (e.g., social integration and social support), psychological (e.g., meaning and control beliefs), behavioral (e.g., drinking and smoking), and biological (e.g., stress) mechanisms (Hill, 2010; Hill et al., 2016b; Koenig, King, & Carson, 2012; Seybold, 2007). Religious involvement and religious meaning systems may help to buffer appraisals of stressful life conditions and, by extension, their physiological consequences. Social support, the sense of control, and moderate drinking practices could help adults to avoid stress appraisals, stressful life events, and chronic activation of the physiological stress response. In the event of stressful life conditions (and the activation of sympathetic systems), religious beliefs and practices, supportive relationships, strong self-concepts, and healthy lifestyles may also favor healthy coping strategies (and efficient activation of parasympathetic systems and various growth responses).

Because stress, mental health, and unhealthy behaviors are reliably linked to religious involvement and the activation of nervous, HPA, cardiovascular, immune, and metabolic systems (McEwen, 1998, 2002), these factors (among others) may function as general mechanisms across markers of allostatic systems. We should note that these mechanisms cannot explain the anomalous positive association between religious attendance and body mass (an important marker of the metabolic system). Explanations for why religious adults tend to weigh more are not firmly established in the literature. However, there is some speculation that poor eating habits, lower rates of smoking, and the sedentary practice of religious media consumption may play a role (Cline & Ferraro, 2006; Kim et al., 2003).

Although previous research has made significant contributions to our understanding of the social distribution of biological functioning in later life, most of this work has been conducted in the United States. In this article, we examine the association between religious participation and biological functioning in Mexico. Our focus on Mexico is driven by two general observations. The first observation is that religion is a powerful institution and sociocultural force in Mexico. Approximately 81% of adults in Mexico identify as Catholic (Pew Research Center, 2014a). In fact, Mexico has the second largest Catholic population in the world (Pew Research Center, 2011). Catholics in Mexico also exhibit strong religious beliefs and behaviors. For example, only 31% of Catholics in Mexico believe that the Catholic Church should allow priests to be married or women to become priests (Pew Research Center, 2014b). According to the 2012 Mexican Health and Aging Study (MHAS), large percentages of Mexicans aged 50 and older participate in activities organized by their church “once or more per week” (39%) and rate their religion as “very important” (74%).

The second observation is that previous studies have linked religion and health in Mexican and Mexican American populations. A growing body of research shows that religious involvement can promote mental health (depression, death, anxiety, life satisfaction, somatization, and cognitive functioning), physical health (self-rated health and functional mobility), and longevity (all-cause mortality) in older Mexican American populations (Berges, Kuo, Markides, & Ottenbacher, 2007; Berges, Kuo, Peek, & Markides, 2010; Hill et al., 2005; Hill et al., 2006; Hill et al., 2016a; Krause, 2012; Krause & Bastida, 2011a, 2011b, 2011c, 2011d, 2012a, 2012b; Krause & Hayward, 2014a, 2014b; 2015; Levin et al., 1996; Reyes-Ortiz et al., 2008). Although we could find only two studies of religion and health in Mexico, the patterns tend to support those observed for Mexican Americans. Specifically, studies using data from the MHAS (2001–2003) show that religious involvement is associated with *higher* rates of screenings for blood pressure, cholesterol, and diabetes and *lower* rates of smoking, but not heavy drinking (Benjamins, 2007; Benjamins & Buck, 2008).

Based on previous research conducted in the United States and Mexico, we expect to find that religious participation will be associated with *healthier* biological functioning among older adults in Mexico.

Method

Data

The data for this investigation come from the MHAS. The MHAS is based on a probability sample of older adults born prior to 1951 and their spouses or partners living in Mexico (http://mhasweb.org/StudyDescription.aspx). The sample was distributed in all 32 states of the country in urban and rural areas. Households in the six states which account for 40% of all migrants to the United States were oversampled. All interviews were conducted face-to-face by trained interviewers of the Instituto Nacional de Estadistica y Geografia (INEGI) of Mexico. During the first wave of data collection (2001), a total of 15,186 interviews were completed with a 92% response rate. During the second wave (2003), 14,250 interviewed were completed with a 93% response rate. During the third wave (2012), 18,465 interviews were completed with an 88% response rate (Wong, Michaels-Obregon, & Palloni, 2015). Third wave participants included those remaining from the 2001 and 2003 waves and a new cohort born between 1952 and 1962. Religious participation was measured in Waves 2 and 3 (2003 and 2012). During Wave 3 (2012), 2,089 respondents were selected for blood samples and anthropometric measures through the Instituto Nacional de Salud Pública (INSP). Only 1,059 of these respondents were interviewed in the first wave (2003), and only 964 respondents were aged 50 or older. The largest portion of respondents were missing data on CRP and total cholesterol (n = 47), self-rated health at baseline (n = 105), and religious participation (n = 86). After listwise deletion, our final analytic sample included 772 older adults who participated in Wave 2 and completed biomarker collection in Wave 3.

In supplemental analyses (not shown), we compared our biomarker sample (i.e., respondents who were included in Waves 2 and 3) with the non-biomarker sample (i.e., respondents from Wave 2 who were not selected for biomarker collection). In these analyses, we used binary logistic regression to model the odds of being selected in the biomarker sample versus not being selected as a function of our focal Wave 2 predictor variables. Although selection was mostly random, we observed that the odds of being selected into the biomarker sample were *lower* for respondents who participated in religious events “once in a while” (odds ratio [OR] = 0.71, $p < .001$) and “once or more per week” (OR = 0.70, $p < .001$) than for respondents who “never” participated. We also found that the odds of being selected into the biomarker sample were *lower* for respondents with more activity limitations (OR = 0.78, $p < .05$) and *higher* for respondents who described their health as “excellent,” “very good,” or “good” (OR = 1.25, $p < .01$). The odds of selection did not vary according to the changes in religious participation, age, gender, education, household income, and marital status. Taken together, these results suggest that our final analytic biomarker sample was healthier and less religiously involved than the non-biomarker sample.

Measures

Religious participation (2003–2012).—Religious involvement is indicated by religious participation, the most commonly used measure of religiousness. Religious participation is measured with a single item. Respondents were asked, “How frequently do you participate in events organized by your church?” Original response categories for this item included (0) never, (1) once in a while, and (2) once or more per week. We coded religious participation in two ways. We created dummy variables for each level of religious participation. In our multivariate analyses, the categories for “once in a while” and “once or more per week” are contrasted with “never” (the reference). We also computed change (Δ) scores by subtracting baseline (2003) religious participation from follow-up (2012) religious participation. Change scores are continuous variables that range from negative numbers to positive numbers. In this case, negative numbers indicate lower levels of participation in 2012 than in 2003 (i.e., decreased participation). Positive numbers suggest higher levels of participation in 2012 than in 2003 (i.e., increased participation). Many respondents exhibit a change score of zero, which indicates no change in participation between waves.

Biological functioning (2012).—Our analyses include eight individual biomarkers (see http://mhasweb.org/Resources/DOCUMENTS/2012/MHAS_Procedures_for_Biomarkers_2012.pdf). Metabolic functioning is indicated by (a) body mass index (BMI), (b) waist-to-hip ratio (WTHR), (c) total cholesterol, and (d) glycosylated hemoglobin (HbA1c). BMI is measured using direct measurements of height and weight. We calculated BMI by dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703 (Formula = weight (lb) / [height (in)]2 × 703). WTHR is measured using direct measurements of waist and hip circumference. Total cholesterol is measured through a venous blood draw. HbA1c, the ratio of glycosylated to non-gylcosylated hemoglobin, is measured through the use of dried blood spot technology. The dried blood spots were taken from the respondents’ finger with a lancet, applied to filter paper, and transported to laboratories for assessment. Cardiovascular functioning is indicated by (e) diastolic blood pressure, (f) systolic blood pressure, and (g) pulse rate. These markers were obtained through the use of a blood pressure cuff. Blood pressure and pulse rate measurements are based on the average of two readings. Immune functioning and inflammation are indicated by CRP. CRP is also measured through a venous blood draw.

Following recent work (Hill et al., 2014), we employ a multiple specification approach to overcome the limitations of any particular coding scheme (e.g., categorical assessments can be arbitrary and insensitive, while continuous or dimensional assessments ignore regions of clinical significance). We examine two specifications of overall allostatic load (i.e., an index of the individual biomarkers) and two specifications of each individual biomarker. Our first specification treats each individual biomarker and overall allostatic load as continuous variables (Karlamangla, Singer, McEwen, Rowe, & Seeman, 2002; Maselko et al., 2007). Each individual biomarker was standardized and averaged to create the continuous measure of overall allostatic load. We use ordinary least squares (OLS) regression to estimate associations with all continuous specifications.

Our second specification employs a high-risk cutoff criterion (Crimmins, Johnston, Hayward, & Seeman, 2003; Geronimus, Hicken, Keene, & Bound, 2006; Seeman, McEwen, Rowe, & Singer, 2001). Respondents who scored in the top 25th percentile of each biomarker are coded (1) and all others (0). We use binary logistic regression to estimate associations with all binary specifications. We created another overall allostatic load index by taking the sum of the number of biomarkers for which the respondent exceeded the high-risk criterion. In this case, higher scores indicate greater biological risk. We used negative binomial regression to estimate associations with this count specification.

Control variables (2003).—Subsequent analyses control for factors that may influence the relationship between religious participation and biological risk, including *age* (continuous years), *gender* (1 = female; 0 = male), *education* (1 = 12 or more years; 0 = less than 12 years), and *marital status* (1 = married; 0 = not married). *Household income* (monthly pesos) is based on family help, businesses, property rent, earned, pension, and transfer income and includes imputations of missing values provided by MHAS researchers. We compare those in the top quarter of the distribution (1 = 4,000 pesos or more per month) to the rest of the distribution (0 = less than 4,000 pesos per month). *Self-rated health* is coded to compare those with (1) excellent, very good, or good health to respondents with (0) fair or poor health.

Results

Descriptive Statistics

Table 1 provides descriptive statistics, including variable ranges, means or percentages, and standard deviations. According to Table 1, 23% of respondents “never” participate in religious activities, 41% participate “once in a while,” and 36% participate “once or more per week.” This means that just over three quarters of respondents participate in religious activities. The estimate for the change (Δ) in participation has a positive sign. This indicates a slight increase in religious participation from 2003 to 2012. We observe moderate to high levels of systolic blood pressure, moderate BMIs and pulse rates, low to moderate WTHRs and diastolic blood pressure, and low levels of cholesterol, glycosylated hemoglobin, and CRP. With respect to overall allostatic load, we find low to moderate levels in the sample. In fact, the average respondent exhibits only two high-risk biomarkers.

Allostatic Load

The first two columns of Table 2 present the OLS regression of the continuous specification of the full allostatic load index. In this analysis, the dependent variable is a mean of the continuous individual biomarkers. We show unstandardized OLS coefficients that are interpreted as the difference in the expected mean of allostatic load for each one-unit change in an independent variable, while all other variables in the model are held constant. In the first column, the coefficients for religious participation are statistically significant and negative. These results indicate that respondents who report participating in religious activities once in a while and once or more per week in 2003 tend to exhibit lower levels of allostatic load in 2012 than respondents who report never participating in religious activities. The second column of Table 2 adds the change in religious participation to the previous regression model. Although a similar pattern emerges for baseline religious participation, the change in religious participation is unrelated to allostatic load.

The last two columns of Table 2 present the negative binomial regression of the count specification of the full allostatic load index. In this analysis, the dependent variable is a count of individual biomarkers that have been dummy-coded to indicate high risk (i.e., the high-risk quarter of the continuous biomarker distribution). We show unstandardized negative binomial coefficients that are interpreted as the difference in the expected log count of allostatic load for each one-unit change in an independent variable, while all other variables in the model are held constant. In column 3, the coefficients are statistically significant and negative. These results confirm the results of our OLS models. Respondents who report participating in religious activities once in a while and once or more per week ($p < 0.10$) in 2003 tend to exhibit lower counts of high-risk biomarkers in 2012 than respondents who report never participating in religious activities. When negative binomial coefficients are exponentiated (e^b), the result is an incidence rate ratio (IRR). IRRs are interpreted as the difference in the expected allostatic load count for each one-unit change in an independent variable, while all other variables in the model are held constant. IRRs can be further manipulated ([IRR − 1] × 100) to describe the percent difference in the expected allostatic load count for each one-unit change in an independent variable. The IRR for participating once in a while is 0.84 ($e^{-0.18}$). Because the IRR is less than one, the association between religious participation and allostatic load is inverse. More specifically, the expected allostatic load count is 16% ([0.84 − 1] × 100) lower for respondents who participate once in a while and 12% lower for respondents who participate once or more per week than for those who never participate. The last column of Table 2 shows a similar pattern for those who participate once in a while, but weekly participation and the change in participation are unrelated to allostatic load.

We note that religious participation is among the strongest correlates of allostatic load. Across continuous and count specifications, only religious participation, age, and activities of daily living are associated with allostatic load. A comparison of standardized parameter estimates from our OLS regression models (not shown) suggests that religious participation may be more strongly associated with allostatic load than age and activities of daily living. The standardized estimates for participating once in a while ($\beta = -0.18$) and weekly ($\beta = -0.11$) are both larger in magnitude than the standardized estimate for activities of daily living ($\beta = 0.07$). The estimate for participating once in a while is also larger than the estimate for age ($\beta = -0.14$).

Individual Biomarkers

Our multivariate analysis of allostatic load consistently shows that respondents who participate in religious activities tend to exhibit lower levels of overall allostatic load than respondents who never participate. The regression results presented in Tables 3 and 4 are intended to test whether the general associations between religious participation and overall allostatic load are driven by specific biomarkers. To accomplish this, Tables 3 and 4 present associations between religious participation and each of the eight biomarkers under study. The substantive association between religious participation and allostatic load does not appear to depend on the specification of allostatic load. However, associations between religious participation and individual biomarkers do depend on the specification of the biomarker.

Tables 3 and 4 show that religious participation is unrelated to BMI, systolic blood pressure, and glycosylated hemoglobin across specifications. However, there is at least some evidence to suggest that religious participation is inversely associated with WTHR, diastolic blood pressure, pulse rate, total cholesterol, and CRP. In Table 3, respondents who participate in religious activities once in a while and weekly tend to exhibit smaller WTHRs in the OLS specification (columns 5 and 6). There is some confirmation of this pattern in the binary logit specification (column 7). We show ORs that are interpreted as the estimated difference in the odds of high biological risk for each one-unit change in an independent variable, while all other variables in the model are held constant. ORs can be manipulated ([OR − 1] × 100) to describe the percent difference in the odds of high biological risk for each one-unit change in an independent variable. The odds of being classified in the high-risk quarter of the WTHR distribution are lower for respondents who participate in religious activities than for respondents who never participate. More specifically, the odds of having a high WTHR are 40% ([0.60 − 1] × 100) lower for respondents who participate once in a while and 37% lower for respondents who participate weekly or more as compared with respondents who never participate. Respondents who participate in religious activities once in a while tend to exhibit lower levels of total cholesterol in the OLS and logit specifications (columns 5–7). However, weekly participation is unrelated to cholesterol levels across specifications.

In Table 4, the evidence for diastolic blood pressure is primarily observed in OLS models (columns 1 and 2). Respondents who participate in religious activities once in a while and weekly ($p < 0.10$) tend to exhibit lower levels of diastolic blood pressure. We observe the strongest and most consistent evidence for pulse rate. Respondents who participate in religious activities once in a while and weekly tend to exhibit lower pulse rates in the OLS specification (columns 1 and 2). Although the change in religious participation is generally unrelated to biological functioning, we find that it is inversely associated with pulse rate. In other words, respondents who increased their religious participation from 2003 to 2012 tend to exhibit lower pulse rates than respondents who either decreased their participation or did not change their participation. These patterns are replicated in the binary logit specification (columns 3 and 4). The odds of being classified in the high-risk quarter of the pulse rate distribution are lower for respondents who participate in religious activities and for those who increase their participation over time. More specifically, the odds of having a high pulse rate are 51% lower for respondents who participate once in a while and 64% lower for respondents who participate weekly or more as compared with respondents who never participate. Each unit increase in the change in religious participation (as participation increases) reduces the odds of having a high pulse rate by 22%. Finally, we observe a nonlinear association with CRP. While there is some indication that respondents who participate in religious activities weekly tend to exhibit lower levels of CRP than respondents who never participate (column 5), sporadic participation is unrelated to CRP across specifications.

Discussion

Although several studies suggest that religious involvement tends to favor healthier biological functioning, most of this work has been conducted in the United States. There is some evidence to suggest that religious involvement is associated with healthier behaviors like smoking and preventive health care in Mexico; however, it is unclear whether these general patterns extend to indicators of biological risk. We aimed to extend previous work by examining the association between religious participation and biological functioning in Mexico.

Based on previous research conducted in the United States and Mexico, we expected that religious participation would be associated with healthier biological functioning among older adults in Mexico. With some predictable exceptions, this is what we found. Across continuous and high-risk specifications, religious participation in 2003 was associated with lower levels of WTHR, total cholesterol, pulse rate, and overall allostatic load in 2012. Respondents who increased their participation over the study period also exhibited a concurrent reduction in pulse rate. Depending on the specification, participation was also associated with lower levels of diastolic blood pressure and CRP. Participation was generally unrelated to BMI, glycosylated hemoglobin, and systolic blood pressure.

The patterns for pulse rate, diastolic blood pressure, CRP, and overall allostatic load support previous studies conducted in the United States (Das & Nairn, 2016; Gillum et al., 2008; Hill et al., 2014; King et al., 2002; King et al., 2001; Koenig et al., 1998; Krause et al., 2002; Maselko et al., 2007). Our findings for cardiovascular health (pulse rate and diastolic blood pressure) are also consistent with previous research linking religious involvement with preventive screenings for blood pressure in Mexico (Benjamins, 2007). At first glance, our results for WTHR and total cholesterol may seem surprising. We have already noted that evidence linking religious involvement and metabolic functioning is weak and mixed. Our results for WTHR are clearly inconsistent with previous studies showing a positive association between religious involvement and body mass (Bruce et al., 2007; Idler & Kasl, 1997a; Kim et al., 2003; Oman & Reed, 1998; Strawbridge et al., 1997). Our results are more consistent with studies showing an inverse association (Cline & Ferraro, 2006; Hill et al., 2014). The mechanisms through which religious attendance might be associated with lower body mass (e.g., congregational support for healthy lifestyles, sanctification of the body, self-control, lower stress, better mental health, lower consumption of alcohol, and greater physical activity) would seem to exceed the mechanisms in favor of greater body mass (e.g., poor eating habits, lower rates of smoking, and religious media consumption; Hill et al., 2006, 2007; McCullough & Willoughby, 2009). We would add that WTHR is more sensitive to the physiological stress response than more general measures of body mass. In this context, our findings are also consistent with previous studies linking religious involvement with lower cortisol levels (Ironson et al., 2002; Tobin & Slatcher, 2016).

It is unclear why religious participation is associated with lower levels of total cholesterol. Although previous research suggests that religious involvement is unrelated to glucose metabolism (Das & Nairn, 2016; Hill et al., 2014), this pattern may not extend to fat (triglycerides and lipoproteins). Our findings for cholesterol are consistent with our findings for WTHR. They also fit previous research linking religious involvement with higher rates of cholesterol screens in Mexico (Benjamins, 2007).

Our null findings for BMI, glycosylated hemoglobin, and systolic blood pressure are consistent with several studies from the United States (Bruce et al., 2007; Cline & Ferraro, 2006; Das & Nairn, 2016; Hill et al., 2014; Idler & Kasl, 1997a; Kim et al., 2003; Oman & Reed, 1998; Strawbridge et al., 1997). We note some internal inconsistency with our findings for WTHR, total cholesterol, and diastolic blood pressure. We also note some inconsistency with previous research showing that religious involvement is associated with higher rates of preventive screens for diabetes and blood pressure in Mexico (Benjamins, 2007).

Although we observed a linear association between religious participation and pulse rate, our data were characterized by nonlinear associations with overall allostatic load, WTHR, total cholesterol, diastolic blood pressure, and CRP. With the exception of CRP, these nonlinear associations revealed bigger differences between respondents who participated once in a while and never than between respondents who participated once or more per week and never. In the case of CRP, the biggest difference was observed between respondents who participated once or more per week and never. This is what we would expect when significant differences are observed. We suspect that the once or more per week group is contaminated by respondents who are participating more than once in a while to cope with unspecified adverse conditions (e.g., chronic stress or other unmeasured health concerns). We note that these nonlinear patterns are consistent with previous studies of older Mexican and Mexican American populations (e.g., Benjamins, 2007; Hill et al., 2005; Hill et al., 2016a)

Our analyses contribute to previous research in several ways. First and foremost, we enhance the external validity of previous research by linking religious participation and a range of biomarkers in Mexico. Second, we replicate previous studies by observing biomarkers that have been emphasized in the literature (body mass, blood pressure, CRP, and overall allostatic load). Third, we extend previous research by exploring biomarkers that have been unstudied (WTHR and cholesterol) or understudied (pulse rate and glycosylated hemoglobin). Fourth, while most studies of religious involvement and biological functioning employ cross-sectional designs, we employ a longitudinal design to establish temporal order. We also explore dynamic changes in religious participation over time. Acknowledging different coding conventions in the literature, we confirm (in the same analysis) that associations with religious participation can vary depending on how biological functioning is specified.

Our analyses are also limited in three key respects. First, we acknowledge the restricted content validity of our allostatic load measure. Our measure includes indicators of metabolic function (BMI, WTHR, total cholesterol, and glycosylated hemoglobin), cardiovascular function (diastolic blood pressure, systolic blood pressure, and pulse rate), and immune function (CRP). However, to fully represent the concept, we would also need indicators of the HPA axis (e.g., cortisol and DHEAS) and autonomic nervous system (e.g., epinephrine and norepinephrine).

Second, our analyses are limited to a single item indicator of religious involvement—participation in religious activities. Although this measure is common and comparable with previous research, single items are generally low in reliability. As a consequence, our analyses are likely to underestimate the role of religious participation in later life. At the same time, we should not overstate the importance of religious involvement. Our analyses are characterized by modest effect sizes for religious participation and small R^2 estimates.

Finally, because our analytic biomarker sample was healthier and less religiously involved than the non-biomarker sample, the direct external validity of our results are constrained by these parameters. These sample features raise the possibility that our focal associations could be conservative because religion–health associations are often more pronounced among adults who have poorer health (e.g., Ellison & Henderson, 2011; Hill, 2010). We also suspect that limited variability in religious participation and health may have reduced the power of our focal statistical tests.

Conclusion

Despite these important limitations, our results confirm that religious participation is associated with healthier biological functioning among older adults in Mexico. Additional research is needed to verify the patterns we have observed with other data sources, especially longitudinal biomarker data and data collected from other regions of the world like South America (e.g., Brazil). We must also begin to test viable mediators of the association between religious participation and biological risk (e.g., social support, smoking, and perceived stress). Although some studies have considered indicators of biological risk (e.g., interleukin-6 and CRP) as mechanisms linking religious involvement and longevity, future work should also explore biological links to mental and physical health. Because substantive interpretations often depend on the choice of several valid biomarker specifications, we recommend that researchers continue to employ a multiple specification approach instead of focusing on any particular coding scheme. This strategy is the best way to represent the conceptual definition of allostatic load and to avoid any misleading conclusions. Research along these lines would provide a more thorough and extensive understanding of religious variations in late life biological functioning.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

Beltrán-Sánchez H, & Crimmins EM (2013). Biological risk in the Mexican population at the turn of the 21st century. Journal of Cross-Cultural Gerontology, 28, 299–316. [PubMed: 23812952]

Benjamins MR (2004). Religion and functional health among the elderly: Is there a relationship and is it constant? Journal of Aging and Health, 16, 355–374. [PubMed: 15155067]

Benjamins MR (2007). Predictors of preventive health care use among middle-aged and older adults in Mexico: The role of religion. Journal of Cross-Cultural Gerontology, 22, 221–234. [PubMed: 17340204]

Benjamins MR, & Buck AC (2008). Religion: A sociocultural predictor of health behaviors in Mexico. Journal of Aging and Health, 20, 290–305. [PubMed: 18263855]

Berges IM, Kuo YF, Markides KS, & Ottenbacher K (2007). Attendance at religious services and physical functioning after stroke among older Mexican Americans. Experimental Aging Research, 33, 1–11. [PubMed: 17132561]

Berges IM, Kuo YF, Peek MK, & Markides KS (2010). Religious involvement and physical functioning among older Mexican Americans. Hallym International Journal of Aging, 12, 1–10. [PubMed: 21318083]

Bruce M, Sims M, Miller S, Elliott V, & Ladipo M (2007). One size fits all? Race, gender and body mass index among U.S. adults. Journal of the National Medical Association, 99, 1152–1158. [PubMed: 17987919]

Carr D (2003). A “good death” for whom? Quality of spouse’s death and psychological distress among older widowed persons. Journal of Health and Social Behavior, 44, 215–232. [PubMed: 12866391]

Cicirelli V (2002). Fear of death in older adults: Predictions from terror management theory. The Journals of Gerontology, Series B: Psychological Sciences & Psychological Sciences, 57, P358–P366.

Cline K, & Ferraro K (2006). Does religion increase the prevalence and incidence of obesity in adulthood? Journal for the Scientific Study of Religion, 45, 269–281. [PubMed: 22639467]

Crimmins EM, Johnston M, Hayward M, & Seeman T (2003). Age differences in allostatic load: An index of physiological dysregulation. Experimental Gerontology, 38, 731–734. [PubMed: 12855278]

Crimmins EM, Kim J, & Vasunilashorn S (2010). Biodemography: New approaches to understanding trends and differences in population health and mortality. Demography, 47, S41–S64. [PubMed: 21302421]

Crimmins EM, & Seeman T (2001). Integrating biology into demographic research on health and aging (with a focus on the MacArthur Study of Successful Aging). In Finch C, Vaupel J, & Kinsella K (Eds.), Cells and surveys: Should biological measures be included in social science research? (pp. 9–41). Washington, DC: National Academies Press.

Crimmins EM, Soldo BJ, Ki Kim J, & Alley DE (2005). Using anthropometric indicators for Mexicans in the United States and Mexico to understand the selection of migrants and the “Hispanic paradox.” Social Biology, 52, 164–177. [PubMed: 17619609]

Das A, & Nairn S (2016). Religious attendance and physiological problems in late life. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 71, 291–308. [PubMed: 25098525]

Ellison C, & Henderson A (2011). Religion and mental health: Through the lens of the stress process. In Blasi A (Ed.), Toward a sociological theory of religion and health (pp. 11–44). Leiden, The Netherlands: Brill.

Ellison C, Hummer R, Cormier S, & Rogers R (2000). Religious involvement and mortality risk among African American adults. Research on Aging, 22, 630–667.

Ferraro KF, & Kim S (2014). Health benefits of religion among black and white older adults? Race, religiosity, and C-reactive protein. Social Science & Medicine, 120, 92–99. [PubMed: 25226450]

Fry P (2001). The unique contribution of key existential factors to the prediction of psychological well-being of older adults following spousal loss. The Gerontologist, 41, 69–81. [PubMed: 11220817]

Geronimus A, Hicken M, Keene D, & Bound J (2006). “Weathering” and age patterns of allostatic load scores among blacks and whites in the United States. American Journal of Public Health, 96, 826–833. [PubMed: 16380565]

Gillum R, King D, Obisesan T, & Koenig H (2008). Frequency of attendance at religious services and mortality in a U.S. national cohort. Annals of Epidemiology, 18, 124–129. [PubMed: 18083539]

Hill TD (2010). A biopsychosocial model of religious involvement. In Whitfield K (Ed.), Annual review of gerontology and geriatrics (pp. 179–200). New York, NY: Springer.

Hill TD, Angel J, Ellison C, & Angel R (2005). Religious attendance and mortality: An 8-year follow-up of older Mexican Americans. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 60, S102–S109. [PubMed: 15746025]

Hill TD, Burdette AM, Taylor J, & Angel JL (2016a). Religious attendance and the mobility trajectories of older Mexican Americans: An application of the growth mixture model. Journal of Health and Social Behavior, 57, 118–134. [PubMed: 26957138]

Hill TD, Burdette AM, & Bradshaw M (2016b). Health and biological functioning. In Yamane D (Ed.), Handbook on religion and society (pp. 11–28). New York, NY: Springer.

Hill TD, Burdette AM, Ellison C, & Music M (2006). Religious attendance and the health behaviors of Texas adults. Preventive Medicine, 42, 309–312. [PubMed: 16445971]

Hill TD, Burdette AM, Ellison C, & Music M (2007). Religious involvement and healthy lifestyles: Evidence from the Survey of Texas Adults. Annals of Behavioral Medicine, 34, 217–222. [PubMed: 17927560]

Hill TD, Rote SM, Ellison CG, & Burdette AM (2014). Religious attendance and biological functioning: A multiple specification approach. Journal of Aging and Health, 26, 766–785. [PubMed: 24733752]

Hummer R, Rogers R, Nam C, & Ellison C (1999). Religious involvement and U.S. adult mortality. Demography, 36, 273–285. [PubMed: 10332617]

Idler E (1987). Religious involvement and the health of the elderly: Some hypotheses and an initial test. Social Forces, 66, 226–238.

Idler E, & Kasl S (1997a). Religion among disabled and nondisabled persons I: Cross-sectional patterns in health practices, social activities, and well-being. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 52, S294–S305. [PubMed: 9403523]

Idler E, & Kasl S (1997b). Religion among disabled and nondisabled persons II: Attendance at religious services as a predictor of the course of disability. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 52, S306–S316. [PubMed: 9403524]

Idler E, McLaughlin J, & Kasl S (2009). Religion and the quality of life in the last year of life. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 64, S528–S537.

Ironson G, Solomon G, Balbin E, O’Cleirigh C, George A, Kumar M, . . .Woods TE (2002). The Ironson-Woods Spirituality/Religiousness Index is associated with long survival, health behaviors, less distress, and low cortisol in people with HIV/AIDS. Annals of Behavioral Medicine, 24, 34–48. [PubMed: 12008793]

Karlamangla A, Singer B, McEwen B, Rowe J, & Seeman T (2002). Allostatic load as a predictor of functional decline: MacArthur studies of successful aging. Journal of Clinical Epidemiology, 55, 696–710. [PubMed: 12160918]

Kim K, Sobal J, & Wethington E (2003). Religion and body weight. International Journal of Obesity, 27, 469–477. [PubMed: 12664080]

King D, Mainous A, & Pearson W (2002). C-reactive protein, diabetes, and attendance at religious services. Diabetes Care, 25, 1172–1176. [PubMed: 12087015]

King D, Mainous A, Steyer T, & Pearson W (2001). The relationship between attendance at religious services and cardiovascular inflammatory markers. International Journal of Psychiatry in Medicine, 31, 415–425. [PubMed: 11949739]

Koenig H, Cohen H, George L, Hays J, Larson D, & Blazer D (1997). Attendance at religious services, interleukin-6, and other biological parameters of immune function in older adults. International Journal of Psychiatry in Medicine, 27, 233–250. [PubMed: 9565726]

Koenig H, George L, Hays J, Larson D, Cohen H, & Blazer D (1998). The relationship between religious activities and blood pressure in older adults. International Journal of Psychiatry in Medicine, 28, 189–213. [PubMed: 9724889]

Koenig H, King D, & Carson V (2012). Handbook of religion and health (2nd ed.). New York, NY: Oxford University Press.

Krause N (1998). Neighborhood deterioration, religious coping, and changes in health during late life. The Gerontologist, 38, 653–664. [PubMed: 9868846]

Krause N (2003). Religious meaning and subjective well-being in late life. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 58, S160–S170. [PubMed: 12730317]

Krause N (2005). God-mediated control and psychological well-being in late life. Research on Aging, 27, 136–164.

Krause N (2006). Gratitude toward God, stress, and health in late life. Research on Aging, 28, 163–183.

Krause N (2012). Religious doubt, financial strain, and depressive symptoms among older Mexican Americans. Mental Health, Religion & Culture, 15, 335–348.

Krause N, & Bastida E (2011a). Church-based social relationships, belonging, and health among older Mexican Americans. Journal for the Scientific Study of Religion, 50, 397–409. [PubMed: 21687808]

Krause N, & Bastida E (2011b). Financial strain, religious involvement, and life satisfaction among older Mexican Americans. Research on Aging, 33, 403–425.

Krause N, & Bastida E (2011c). Prayer to the saints or the Virgin and health among older Mexican Americans. Hispanic Journal of Behavioral Sciences, 33, 71–87. [PubMed: 21415935]

Krause N, & Bastida E (2011d). Religion, suffering, and self-rated health among older Mexican Americans. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 66, 207–216. [PubMed: 21076086]

Krause N, & Bastida E (2012a). Contact with the dead, religion, and death anxiety among older Mexican Americans. Death Studies, 36, 932–948. [PubMed: 24563948]

Krause N, & Bastida E (2012b). Religion and health among older Mexican Americans: Exploring the influence of making mandas. Journal of Religion & Health, 51, 812–824. [PubMed: 20838897]

Krause N, & Hayward RD (2014a). Church-based social support, religious commitment, and health among older Mexican Americans. Journal of Social and Personal Relationships, 31, 352–365.

Krause N, & Hayward RD (2014b). Trust-based prayer expectancies and health among older Mexican Americans. Journal of Religion & Health, 53, 591–603. [PubMed: 24162161]

Krause N, & Hayward RD (2015). Acts of contrition, forgiveness by God, and death anxiety among older Mexican Americans. The International Journal for the Psychology of Religion, 25, 57–73.

Krause N, Liang J, Shaw B, Sugisawa H, Kim H, & Sugihara Y (2002). Religion, death of a loved one, and hypertension among older adults in Japan. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 57, S96–S107. [PubMed: 11867670]

Levin J, Markides K, & Ray L (1996). Religious attendance and psychological well-being in Mexican Americans: A panel analysis of three generations data. The Gerontologist, 36, 454–463. [PubMed: 8771973]

Lutgendorf S, Russell D, Ullrich P, Harris T, & Wallace R (2004). Religious participation, interleukin-6, and mortality in older adults. Health Psychology, 23, 465–475. [PubMed: 15367066]

Maselko J, Kubzansky L, Kawachi I, Seeman T, & Berkman L (2007). Religious service attendance and allostatic load among high-functioning elderly. Psychosomatic Medicine, 69, 464–472. [PubMed: 17567709]

McCullough M, & Willoughby B (2009). Religion, self-regulation, and self-control: Associations, explanations, and implications. Psychological Bulletin, 135, 69–93. [PubMed: 19210054]

McDade T, Williams S, & Snodgrass J (2007). What a drop can do: Dried blood spots as a minimally invasive method for integrating biomarkers into population-based research. Demography, 44, 899–925. [PubMed: 18232218]

McEwen B (1998). Protective and damaging effects of stress mediators. The New England Journal of Medicine, 338, 171–179. [PubMed: 9428819]

McEwen B (2002). The end of stress as we know it. Washington, DC: Joseph Henry Press.

Musick M, House J, & Williams D (2004). Attendance at religious services and mortality in a national sample. Journal of Health and Social Behavior, 45, 198–213. [PubMed: 15305760]

Oman D, Kurata J, Strawbridge W, & Cohen R (2002). Religious attendance and cause of death over 31 years. International Journal of Psychiatry in Medicine, 32, 69–89. [PubMed: 12075917]

Oman D, & Reed D (1998). Religion and mortality among the community-dwelling elderly. American Journal of Public Health, 88, 1469–1475. [PubMed: 9772846]

Park N, Klemmack D, Roff L, Parker M, Koenig H, Sawyer P, & Allman RM (2008). Religiousness and longitudinal trajectories in elders' functional status. Research on Aging, 30, 279–298. [PubMed: 20485460]

Pew Research Center. (2011). Global Christianity: A report on the size and distribution of the world's Christian population. Washington, DC: Author.

Pew Research Center. (2014a). Catholic affiliation in Latin American. Washington, DC: Author.

Pew Research Center. (2014b). On religion: Mexicans are more Catholic and often more traditional than Mexican Americans. Washington, DC: Author.

Reyes-Ortiz CA, Berges IM, Raji MA, Koenig HG, Kuo YF, & Markides KS (2008). Church attendance mediates the association between depressive symptoms and cognitive functioning among older Mexican Americans. The Journals of Gerontology, Series A: Biological Sciences & Medical Sciences, 63, 480–486. [PubMed: 18511751]

Rogers R, Krueger P, & Hummer R (2010). Religious attendance and cause-specific mortality in the United States. In Ellison C & Hummer R (Eds.), Religion, families, and health: Population-based research in the Unites States (pp. 292–320). New Brunswick, NJ: Rutgers University Press.

Seeman T, Dubin L, & Seeman M (2003). Religiosity/spirituality and health: A critical review of the evidence for biological pathways. American Psychologist, 58, 53–63. [PubMed: 12674818]

Seeman T, McEwen B, Rowe J, & Singer B (2001). Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. Proceedings of the National Academy of Sciences of the United States of America, 98, 4770–4775. [PubMed: 11287659]

Sergi G, Perissinotto E, Pisent C, Buja A, Maggi S, Coin A, . . . ILSA Working Group. (2005). An adequate threshold for body mass index to detect underweight condition in elderly persons: The Italian Longitudinal Study on Aging (ILSA). The Journals of Gerontology, Series A: Biological Sciences & Medical Sciences, 60, 866–871. [PubMed: 16079209]

Seybold K (2007). Physiological mechanisms involved in religiosity/spirituality and health. Journal of Behavioral Medicine, 30, 303–309. [PubMed: 17549618]

Strawbridge W, Cohen R, Shema S, & Kaplan G (1997). Frequent attendance at religious services and mortality over 28 years. American Journal of Public Health, 87, 957–961. [PubMed: 9224176]

Strawbridge W, Shema S, Cohen R, Roberts R, & Kaplan G (1998). Religiosity buffers effects of some stressors on depression but exacerbates others. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 53, S118–S126. [PubMed: 9602836]

Tobin ET, & Slatcher RB (2016). Religious participation predicts diurnal cortisol profiles 10 years later via lower levels of religious struggle. Health Psychology, 35, 1356–1363. [PubMed: 27280366]

Van Ness P, & Kasl S (2003). Religion and cognitive dysfunction in an elderly cohort. The Journals of Gerontology, Series B: Psychological Sciences & Social Sciences, 58, S21–S29. [PubMed: 12496305]

Wolinsky F, Bentler S, Cook E, Chrischilles E, Liu L, Bright K, . . .Rosenthal GE (2009). A 12-year prospective study of stroke risk in older Medicare beneficiaries. BMC Geriatrics, 9, Article 17.

Wong R, Michaels-Obregon A, & Palloni A (2015). Cohort profile: The Mexican Health and Aging Study (MHAS). International Journal of Epidemiology, 46, e2.

Table 1.

Descriptive Statistics for Study Variables (*N* = 772).

	Minimum	Maximum	*M*	*SD*
Religious participation				
Never	0.00	1.00	0.23	
Once in a while	0.00	1.00	0.41	
≥ once per week	0.00	1.00	0.36	
Attendance Δ (2012–2003)	0.00	1.00	0.13	0.92
BMI				
Continuous	15.74	48.05	28.18	5.17
High-risk BMI	0.00	1.00	0.25	
WTHR				
Continuous	0.66	1.64	0.95	0.08
High-risk WTHR	0.00	1.00	0.25	
Total cholesterol				
Continuous	85.00	502.00	197.98	44.68
High-risk cholesterol	0.00	1.00	0.25	
HbA1c				
Continuous	4.00	14.70	6.70	1.59
High-risk HbA1c	0.00	1.00	0.25	
DBP				
Continuous	48.50	115.00	77.09	10.93
High-risk diastolic DBP	0.00	1.00	0.25	
SBP				
Continuous	89.00	190.00	143.07	20.88
High-risk systolic SBP	0.00	1.00	0.25	
Pulse rate				
Continuous	50.00	108.50	74.42	10.90
High-risk pulse rate	0.00	1.00	0.25	
CRP				
Continuous	1.00	10.00	3.37	2.86
High-risk CRP	0.00	1.00	0.25	
Allostatic load				
Continuous	−8.63	12.44	−0.17	3.50
High-risk count	0.00	8.00	1.95	1.46
Age	50.00	91.00	61.38	7.18
Female	0.00	1.00	0.60	
≥ high school degree	0.00	1.00	0.07	
Household income	0.00	1.00	0.25	
Married	0.00	1.00	0.68	
Activities of daily living	0.00	5.00	0.07	0.41
Health (excellent/good)	0.00	1.00	0.39	

Source. Mexican Health and Aging Study (2003–2012).

Note. Predictors measured in 2003. Outcomes measured in 2012. BMI = body mass index; WTHR = waist-to-hip ratio; HbA1c = glycosylated hemoglobin; DBP = diastolic blood pressure; SBP = systolic blood pressure; CRP = C-reactive protein.

Table 2.

Regression Estimates for Allostatic Load Regressed on Religious Participation (*N* = 772).

	Continuous		High-risk count	
Participation (once in a while)	−1.27*** (0.32)	−1.24** (0.37)	−0.18** (0.07)	−0.17* (0.08)
Participation (≥ once per week)	−1.03** (0.33)	−0.98)* (0.45)	−0.13† (0.07)	−0.11 (0.09)
Participation Δ (2012–2003)		0.03 (0.18)		0.01 (0.04)
Age	−0.07*** (0.02)	−0.07*** (0.02)	−0.01** (0.00)	−0.01** (0.00)
Female	0.32 (0.27)	0.32 (0.27)	0.08 (0.06)	0.08 (0.06)
≥ high school degree	−0.18 (0.50)	−0.17 (0.50)	−0.14 (0.11)	−0.14 (0.11)
household income	0.55 (0.31)	0.55 (0.31)	0.11 (0.06)	0.10 (0.06)
Married	0.49 (0.29)	0.49 (0.29)	0.09 (0.06)	0.09 (0.06)
Health (excellent/good)	0.34 (0.26)	0.34 (0.26)	0.05 (0.05)	0.05 (0.05)
Activities of daily living	0.63* (0.30)	0.63* (0.30)	0.11* (0.05)	0.11* (0.05)
Model $F(\chi^2)$	5.79***	5.21***	31.26***	31.32***
R^2 (pseudo R^2)	.06	.06	(.01)	(.01)

Source. Mexican Health and Aging Study (2003–2012).

Note. Predictors are measured in 2003. Outcomes are measured in 2012. Presented are unstandardized OLS (continuous) and negative binomial (high-risk count) regression coefficients with standard errors in parentheses. OLS = ordinary least squares.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3.

Regression Estimates for Individual Biomarkers Regressed on Religious Participation (N = 772).

	Body mass index				Waist-to-hip ratio				Total cholesterol				Glycosylated hemoglobin (HbA1c)			
	Continuous		High risk		Continuous		High risk		Continuous		High risk		Continuous		High risk	
Participation (once in a while)	−0.21	−0.01	1.29	1.41	-0.03^{***}	-0.03^{**}	0.60^{*}	0.67	-0.04^{*}	−0.04	$0.65^{\dagger}$	0.76	0.00	0.00	0.87	0.75
Participation (≥ once per week)	−0.39	−0.05	1.12	1.30	-0.03^{**}	$-0.02^{\dagger}$	$0.63^{\dagger}$	0.73	−0.00	0.01	1.07	1.39	0.00	0.01	0.88	0.68
Participation Δ (2012–2003)		0.20		1.09		0.00		1.10		0.01		1.17		0.00		0.85

Source. Mexican Health and Aging Study (2003–2012).

Note. Predictors are measured in 2003. Outcomes are measured in 2012. Presented are unstandardized coefficients (continuous OLS models) and odds ratios (high-risk logit models). All regression estimates are adjusted for age, gender, education, household income, marital status, activities of daily living, and self-rated health.

HbA1c = glycosylated hemoglobin; OLS = ordinary least squares.

$^{\dagger}p < .10$.

$^{*}p < .05$.

$^{**}p < .01$.

$^{***}p < .001$.

Table 4.

Regression Estimates for Individual Biomarkers Regressed on Religious Participation ($N = 772$).

	Diastolic blood pressure				Systolic blood pressure				Pulse rate				C-reactive protein			
	Continuous		High risk		Continuous		High risk		Continuous		High risk		Continuous		High risk	
Participation (once in a while)	−2.66**	−2.45*	0.68†	0.76	−1.59	−0.87	0.74	0.77	−2.65*	−3.86**	0.63*	0.49*	−0.10	−0.05	0.94	1.01
Participation (≥ once per week)	−1.96†	−1.59	0.83	1.01	0.83	2.11	1.11	1.18	−3.80***	−5.92***	0.55**	0.36**	−0.22*	−0.13	0.69	0.79
Participation Δ (2012–2003)		0.22		1.12		0.76		1.03		−1.26*		0.78*		0.06		1.08

Source. Mexican Health and Aging Study (2003–2012).

Note. Predictors are measured in 2003. Outcomes are measured in 2012. Presented are unstandardized coefficients (continuous OLS models) and odds ratios (high-risk logit models). All regression estimates are adjusted for age, gender, education, household income, marital status, activities of daily living, and self-rated health. OLS = ordinary least squares.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.