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Dimensions of religious involvement and leukocyte telomere length

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ABSTRACT

Although numerous studies suggest that religious involvement is associated with a wide range of favorable health outcomes, it is unclear whether this general pattern extends to cellular aging. In this paper, we tested whether leukocyte telomere length varies according to several dimensions of religious involvement. We used cross-sectional data from the Nashville Stress and Health Study (2011–2014), a large probability sample of 1252 black and white adults aged 22 to 69 living in Davidson County, TN, USA. Leukocyte telomere length was measured using the monochrome multiplex quantitative polymerase chain reaction method with albumin as the single-copy reference sequence. Dimensions of religious involvement included religiosity, religious support, and religious coping. Our multivariate analyses showed that religiosity (an index of religious attendance, prayer frequency, and religious identity) was positively associated with leukocyte telomere length, even with adjustments for religious support, religious coping, age, gender, race, education, employment status, income, financial strain, stressful life events, marital status, family support, friend support, depressive symptoms, smoking, heavy drinking, and allostatic load. Unlike religiosity, religious support and religious coping were unrelated to leukocyte telomere length across models. Depressive symptoms, smoking, heavy drinking, and allostatic load failed to explain any of the association between religiosity and telomere length. To our knowledge, this is the first population-based study to link religious involvement and cellular aging. Although our data suggest that adults who frequently attend religious services, pray with regularity, and consider themselves to be religious tend to exhibit longer telomeres than those who attend and pray less frequently and do not consider themselves to be religious, additional research is needed to establish the mechanisms underlying this association.

1. Introduction

Over the past three decades, numerous studies have documented that various indicators of religious involvement are associated with a wide range of favorable health-related outcomes, including better mental health (e.g., lower rates of depression and anxiety), better physical health (e.g., lower levels of allostatic load and disability), healthier lifestyles (e.g., abstaining from heavy drinking and smoking), and lower mortality risk (Ellison and Levin, 1998; George et al., 2002; Hill et al., 2011, 2016; Idler, 2004; Koenig, 2014; Koenig et al., 2001, 2012; Oman and Thoresen, 2002; Powell et al., 2003; Seeman et al., 2003). Although this body of work is impressive and has made significant contributions to our understanding of the social distribution of health, it is unclear whether these general patterns might also extend to healthy cellular aging (Hill et al., 2016; Koenig, 2014; Koenig et al., 2016).

Cellular aging is often indicated by telomere length. According to Hoen and colleagues (2001:541), telomeres are "specialized tandem deoxyribonucleic acid (DNA) repeat sequences $(TTAGGG)_n$ located at the ends of eukaryotic chromosomes, which protect somatic cells from genomic instability during mitotic cell proliferation." Telomeres are *markers of cellular aging* because they shorten with cell replication (Blackburn, 2000, 2005; Epel et al., 2004, 2006). Telomeres gradually shorten during mitosis (with each cell

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division) because the mechanisms of DNA replication are unable to copy the entire ends of chromosomes (the so-called end-replication problem). Most age-related shortening occurs during the period of accelerated human growth and development from birth to puberty (Sanders and Newman, 2013). After puberty, telomere shortening primarily occurs as a result of oxidative stress (an imbalance between free radicals and antioxidants) and inflammation (dysregulation of the immune system) (Correia-Melo et al., 2014; Finkel and Holbrook, 2000; Sanders and Newman, 2013; Wolkowitz et al., 2011).

Telomeres are also *mechanisms of cellular aging* because cellular senescence increases oxidation and inflammation, which hastens aging processes and telomere erosion through positive feedback loops (Chung et al., 2009; Correia-Melo et al., 2014; Finkel and Holbrook, 2000; Pawelec et al., 2014). The biological consequences of shortened telomeres can be devastating, contributing to genomic instability (genetic mutations), chromosome instability (end-to-end chromosome fusion), altered organ homeostasis, inefficient mitosis, cellular senescence (cell-cycle arrest), cellular apoptosis (programmed cell death), early onset of age-related diseases (or telomere syndromes), and premature death (Blackburn, 2000, 2005; Campisi and Fagagna, 2007; Cawthon et al., 2003; Epel et al., 2004, 2006; Fitzpatrick et al., 2007, 2011; Haycock et al., 2014; Needham et al., 2015a; Rode et al., 2015).

Although telomere research is primarily driven by biologists, medical sociologists, social epidemiologists, and health demographers are also invested because telomere length is unequally distributed in the U.S. population. Telomeres tend to be shorter among adults who are older, male, non-Hispanic white, and of low socioeconomic status (Adler et al., 2013; Carroll et al., 2013a; Needham et al., 2012, 2013, 2014a). Stressful life conditions, social isolation, psychological distress, unhealthy lifestyles, and allostatic load have also been linked with shorter telomeres (Adler et al., 2013; Carroll et al., 2013ab; Cherkas et al., 2008; Du et al., 2012; Epel et al., 2004, 2006; Hoen et al., 2011; Kiecolt-Glaser et al., 2011; Leung et al., 2014; Needham et al., 2014b, 2015b; Pavanello et al., 2011; Phillips et al., 2013; Savolainen et al., 2014; Simon et al., 2006; Theall et al., 2013; Valdes et al., 2005; Verhoeven et al., 2015; Zalli et al., 2014). The question addressed here is whether telomere length might also vary according to level of religious involvement.

Theoretically, religious involvement should be positively associated with telomere length because religious involvement is generally protective against known risk factors for shorter telomeres, including, for example, psychological distress, smoking, heavy drinking, and allostatic load (Ferraro and Kim, 2014; Gillum, 2005; Hackney and Sanders, 2003; Hill et al., 2006, 2014; Koenig et al., 1998; Maselko et al., 2007; McFarland, 2009; Strawbridge et al., 1998). Religious involvement may benefit mental health by promoting church-based social support and psychological resources (e.g., optimism and a sense of meaning and purpose) (George et al., 2002; Koenig et al., 2001). Religious involvement may discourage smoking and risky drinking practices through internalized moral codes (from religious traditions and sacred texts), sanctification of the body (imbuing the body with divine significance), social control (from like-minded peer networks), and self-control (from years of ritual adherence, moral socialization, and social control) (Ellison and Levin, 1998; Hill et al., 2011). Through the cultivation of psychosocial resources and healthy lifestyles, religious involvement may also protect against allostatic load by reducing stress appraisals (and chronic activation of sympathetic systems) and limiting exposure to stress hormones (through efficient activation of parasympathetic systems) (Hill et al., 2011; Seeman et al., 2003).

In our review of the literature, we could find only one empirical study of the association between religious involvement and cellular aging. Using data collected from a convenience sample of 251 women who were caring for a family member with a disabling neurological condition or chronic illness and living in Durham County, NC and Los Angeles County, CA, Koenig et al. (2016) examined the association between religious involvement (a 41-item index measuring religiosity, religious beliefs, religious support, and religious coping) and leukocyte telomere length. The authors also considered several potential mediators, including social support, caregiver burden, depression, perceived stress, body mass, smoking, and exercise. In the full sample of women caregivers, religious involvement was *unrelated* to telomere length. When the sample was limited to respondents who identified as at least somewhat religious (90% of the full sample), religious involvement was *positively* associated with telomere length, even with adjustments for age, race, education, caregiver health, and the health of the family member. Because none of the proposed mediators were associated with telomere length, they failed to account for any significant portion of the association between religious involvement and telomere length. In the end, the authors showed that religious involvement can be associated with longer leukocyte telomeres among religious women caregivers living in two counties.

In this paper, we replicate Koenig and colleagues' (2016) seminal study by testing whether leukocyte telomere length varies according to level of religious involvement. We also extend this important work in several respects. We use data collected from a large community-based probability sample of women and men. We examine multiple dimensions of religious involvement, including general religiosity, religious support, and religious coping. In addition to exploring the direct effects of religious involvement, we explore several potential mediators linking religious involvement and telomere length, including those examined by Koenig and colleagues (depressive symptoms and smoking) and those unexamined in previous research (heavy drinking and allostatic load).

2. Methods

2.1. Data

The data for this investigation come from the Nashville Stress and Health Study (NSAHS). The NSAHS is based on a probability sample of non-Hispanic black and white women and men aged 22 to 69 living in Davidson County, TN (http://vanderbilt.edu/stressandhealthstudy/). Survey Sampling International generated a random sample of 199 block groups in Davidson County. To adequately sample black households, block groups were stratified by the percentage of black residents (2010 Census). The study design included a random sample of 1252 adults living in the sampled and stratified block groups. The sampling frame included 2400 randomly sampled households. Only 2065 of the 2400 randomly sampled households were eventually contacted. Approximately 61% of contacted households agreed to participate in the study.

The average computer-assisted interview lasted approximately 3 h. All interviews were conducted by trained interviewers of the same race in the respondent's home or on Vanderbilt University's campus. All respondents received $50 to participate in the interview phase of the study. The primary purpose of the NSAHS is to examine racial and socioeconomic disparities in health. Toward this end, the interviews collected detailed information concerning general sociodemographic characteristics, stress, discrimination experiences, neighborhood environments, psychosocial resources, religious involvement, physical health, health care, mental health, and substance use.

During the interview phase, respondents were also given instructions and materials for biomarker collection. The morning

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