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Religious Social Support and Hypertension Among Older North American Seventh-Day Adventists

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Abstract

Seventh-day Adventists have been noted for their unique lifestyle, religious practices and longevity. However, we know little about how religion is directly related to health in this group. Specifically, we know nothing about how religious social support is related to hypertension. Using data from the Biopsychosocial Religion and Health Study, we carried out a cross-sectional study of 9581 and a prospective study of 5720 North American Seventh-day Adventists examining new 534 cases of hypertension occurring up to 4 years later. We used binary logistic regression analyses to examine study hypotheses. Of the religious social support variables, in both the cross-sectional and prospective study only anticipated support significantly predicted hypertension, but the relationship was mediated by BMI. There were no significant race or gender differences. The favorable relationships between anticipated support and hypertension appear to be mediated by BMI and are an indication of how this dimension of religion combined with lifestyle promotes good health, specifically, reduced risk of hypertension.

Keywords

Seventh-day Adventists; Hypertension; Anticipated support; BMI; Religious social support

Introduction

The relationship between religion and hypertension has received much attention in the literature. Key findings on this relationship are presented by Koenig et al. (2012) in the Handbook of Religion and Health and suggest that religion has salutary effects on hypertension. Identification and understanding of the predictors of hypertension are particularly important because of the high prevalence rates and devastating effects of hypertension on health, particularly among Blacks and the differential impact by gender. Hypertension is the most common of all cardiovascular diseases (Fischer and Avorn 2004), one in every three adults in the USA is affected by it (Chobanian et al. 2003), and it carries a

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yearly estimated financial burden of \$93.5 billion (Heidenreich et al. 2011). Hypertension has also been shown to be responsible for almost half of all cardiovascular disease-related deaths and one in every seven deaths in the USA (Chobanian et al. 2003).

Seventh-day Adventists (SDA) are noted for having lower blood pressure when compared to non-SDAs, a phenomenon thought to be related to their vegetarian diet (Armstrong et al. 1977; Rouse et al. 1982; Webster and Rawson 1979). Beyond simply lower blood pressure, SDAs, live longer than their non-SDA counterparts, a phenomenon shown to be predicted by lifestyle factors such as exercise, vegetarian diet, smoking abstinence, nut consumption, and social support, all influenced by religious beliefs (Fraser 2003). The discovery and understanding of what predicts health in this group could provide important clues to policy makers, researchers, and health practitioners in their efforts to advance health equity by leveraging the religious social support system of those disproportionately affected by the burden of hypertension. Therefore, we aim to examine the relationship between religious social support and hypertension among SDAs.

Religious Social Support and Health

Although not widely studied, the relationship between religious social support and health has received some attention in the literature (e.g., Krause 2002, 2006, 2008; Krause et al. 2002; Maselko et al. 2011). Studies examining religious social support and health suggest that greater religious social support is associated with better health. For instance, Krause (2006) found that anticipated support, defined as “the belief that assistance will be forthcoming in the future should the need arise” was associated with better self-rated health cross-sectionally and over time (p. 125). This relationship was partially mediated by feelings of personal control. Likewise, Krause et al. (2002) studied the relationship between religious social support and self-rated health overtime by gender and concluded that religious social support, specifically emotional support received, was associated with better health, but only among men. They suggested that religious social support may be especially beneficial to men because men may capitalize on the formalized social support system in church since they typically experience difficulty asking for needed help in secular settings (Krause et al. 2002).

Religious Social Support and Hypertension

Koenig et al. (2012) noted that among the many studies on religion (religious affiliation, religious attendance, private religious activity, religiousness, and eastern meditation) and blood pressure, few examined the relationship between religious social support and blood pressure. Studies instead have focused on the interaction of social support and religious involvement (religiousness attendance, prayer, self-rated religiousness, and degree of strength and comfort derived from religion) on blood pressure (Chen and Contrada 2007), or religious social support as a mediator of the relationship between church attendance (as well as other religious variables) and blood pressure or hypertension (Buck et al. 2009; Olphen et al. 2003).

The findings of these studies are inconsistent. To illustrate, Chen and Contrada (2007) examined the relationship between religious involvement (on a four-item scale containing

single-item measures of attendance, prayer, self-rated religiousness, and the degree of strength and comfort derived from religion), perceived social support, hostility, and hypertension, and although they did not make use of a multidimensional social support measure, or examine differences by race, their study did elucidate some relationships. Participants with both high levels of religious involvement and high social interaction had lower systolic blood pressure. However, no such relationship was observed when Olphen et al. (2003) explored the relationships of religious involvement and religious social support with general health, asthma, arthritis, and hypertension/diabetes.

Finally, Buck et al. (2009) also failed to find any relationship between church-based social support and hypertension. They studied various aspects of religiosity, blood pressure, and hypertension and included congregational support ("how much help and comfort would people in their congregation give them if they had a problem or were faced with a difficult situation," p. 317) as a mediating variable between service attendance and blood pressure and hypertension. In a logistic regression model, congregational support was not significantly related to diastolic blood pressure, systolic blood pressure, or hypertension.

Olphen et al. (2003) and Buck et al. (2009) both investigated whether church-based support mediated the relationship between church attendance and hypertension and found no such relationship. Additionally, Buck et al. (2009) found that congregational support was not related to blood pressure of hypertension. Chen and Contrada (2007) found that only participants with high levels of religious involvement and high secular social support had lower systolic blood pressure. Based on the literature, it appears that the research on the relationship between religious social support and hypertension is inconsistent. Social support may mediate the relationship between church attendance and hypertension or it may interact with church attendance to influence hypertension, or be completely unrelated to hypertension. The inconsistency of the findings sheds no light on the relationship between religious social support and blood pressure.

Although there seems to be some empirical support for religious social support as a mediating factor between religious involvement and blood pressure, the literature inconsistently shows a relationship between religious social support and blood pressure, a relationship necessary even when testing a mediation hypothesis. Koenig et al. (2012) in the Handbook of Religion and Health reported finding 74 studies examining the relationship between religion and hypertension. The review showed that 61 (82%) of them reported a positive relationship between religion and social support. The literature suggests that religion influences social support, one of the several other factors such as diet, alcohol consumption, smoking (Phillips et al. 1980), which are related to hypertension. The dimension of religious involvement that increases social support can influence the level of psychological stress as well as lifestyle risk factors for hypertension. Other research suggests that religious teachings and family responsibility are likely to affect substance use and abuse, which are known to influence blood pressure.

Blacks have been shown to be disproportionately affected by hypertension (Fields et al. 2004; Ong et al. 2007). In fact, the rate of hypertension among American Blacks is among the highest worldwide and continues to increase (Go et al. 2013). American Blacks also

seem to develop hypertension earlier in life (Ong et al. 2007). Blacks are disproportionately affected by hypertension but are also generally more spiritual (Chatters et al. 2009) than other ethnic groups. Therefore, an understanding of how religion affects hypertension will be particularly salient to this group.

In addition to differences in the prevalence of hypertension by race, there is also evidence that there may be gender differences in hypertension prevalence. These gender differences appear to exist for various age groups even though prevalence rates among men and women appear to be equal overall. Up to age 45, hypertension prevalence rates are higher among men but equal for men and women between Age 45 and 64. Interestingly, after age 64, prevalence rates of hypertension are higher among women (Go et al. 2013).

Based on the literature, we examined whether religious social support is related to hypertension in a sample of high-frequency church attenders, who presumably adhere to the faith recommendations on diet and lifestyle which then influences hypertension. Also, we examined religious social support multidimensionality in an effort to elucidate relationships between different kinds of religious social support and hypertension among frequent church goers. Seventh-day Adventist vegetarians are noted for having a lower risk of hypertension (Phillips et al. 1978); therefore, we will need to know whether religious social support is responsible in part for this lower risk of hypertension.

Aims and Hypotheses

We aim to examine the relationship between religious social support and hypertension. Specifically, we will validate our self-report measure of hypertension in a subsample with clinical data and then examine whether giving emotional support, receiving emotional support, negative social interactions in church, and anticipated support from church members are related to self-reported hypertension and whether these relationships differ by race and gender.

We will test the following hypotheses: more emotional support given, emotional support received, and anticipated supported will be associated with lower hypertension risk; more negative social interactions will be associated with higher hypertension risk. Blacks and males will benefit most from religious social support.

Methods

Sample

We used data from the Psychological Manifestations of Religion Sub-study (PsyMRS) of the Biopsychosocial Religion and Health Study (Lee et al. 2009). PsyMRS is a prospective study of 11,052 out of about 21,000 Seventh-day Adventists in North America who were randomly sampled from the Adventist Health Study-2 (AHS-2). The AHS-2 is the parent study and is comprised of 96,000 participants (Butler et al. 2008). PsyMRS participants completed the first religion and health questionnaire between September 2006 and August 2007 (wave 1, $N = 10,695$) and completed a second questionnaire between 2009 and 2010 (wave 2, $N = 6427$). Compared to the original 21,000, the responders in the first wave were more likely to be female (68.0 vs. 65.6%), White (63.5 vs. 31.6%), have a college degree

(42.6 vs. 33.3%), and be less than 65 years of age (40.6 vs. 31.6%). Compared to those who *only* responded to the first wave, the second wave responders were no different in gender (male 32.8 vs 32.1 %, not significant), White (71.2 vs. 52.4%), have a college degree (46.7 vs. 36.8%), and be 65 years of age or older (42.8 vs. 40.5%).

Table 1 presents the descriptive statistics for all study variables first for the entire sample and then by race and gender. The sample consists primarily of Black and White participants. Because of small frequencies for participants who identified as Hispanic and other race, our analyses are only conducted on Blacks and Whites. Participants were 61 years old on average the majority of whom were White (63%), female (67%), had an undergraduate or graduate education (43%).

Because we had a great deal of missing data on household income in our dataset, it was not feasible to use this variable in the analyses. We therefore made use of a proxy variable “difficulty meeting household expenses within the last year” to provide some insight into the financial situation of our sample. While our proxy variable does not indicate the participant income range for example, we believe that one’s ability to afford household expenses is a valuable dimension of wealth which provides insight into participant economic difficulty or success. We found that 29% of our participants had difficulty meeting household expenses within the last year.

Overall, 35% of participants reported receiving a hypertension diagnosis. A larger proportion of Blacks (44%) reported having a hypertension diagnosis when compared to Whites (30%). Participants had an average BMI of 27.32 (SD = 6.12), the majority were vegetarian, less than half had a regular exercise program, and very few consumed alcoholic beverages at the time of data collection. The vast majority of respondents attended church once weekly or more. On a scale with a maximum of 5, respondents on average gave and received emotional support *fairly often* (3.34 and 3.11), had negative interactions with church members never or once in *a while* (1.50 on a scale ranging from 1 to 5), and anticipated *some* support from church members if they were ill or were faced with a problem (3.22 on a scale with a maximum of 4).

There are a few unique characteristics of this sample that are noteworthy because of their implications for the relationships under investigation. First, SDAs are noted for having lower rates of hypertension when compared to non-SDAs (Armstrong et al. 1977; Rouse et al. 1982; Webster and Rawson 1979). Second, there are no significant differences in household income by race in this sample (Montgomery et al. 2007), a characteristic noted to be linked to health and health inequities. Third, the health-related behaviors of this sample are uniquely characterized by high proportions of vegetarians, almost no alcohol use, and very high levels of church attendance for 90% of the sample. Given these health-related behaviors and their known relationships to hypertension, it will be interesting to see whether religious social support is related to hypertension in any way over and beyond the lifestyle factors in this sample.

Measures

Self-reported Hypertension—Hypertension diagnosis was self-reported at both waves of data collection. Participants were asked whether they had ever been diagnosed with hypertension by a physician (*yes* or *no*). For the prospective analyses, we used the occurrence of a new diagnosis of hypertension in the wave 2 self-report.

Validation of Self-reported Hypertension—Validity of these self-reports was assessed in a subsample ($N = 495$) of PsyMRS participants who had undergone more extensive biological screening. *T* tests were used to examine differences of measured systolic and diastolic blood pressure (mean based on three measurements within a 10-minute time interval) for those who reported that they had versus had not been diagnosed with hypertension. The mean systolic blood pressure and diastolic blood pressure were significantly, $t(493) = 8.43, p < .0005$ and $t(493) = 4.80, p < .0005$, higher for those with self-reported hypertension diagnosis ($M_{sys} = 133.8, SD = 22.1$; $M_{dya} = 75.3, SD = 11.6$) than for those who reported not having a hypertension diagnosis ($M_{sys} = 119.1, SD = 16.7$; $M_{dya} = 70.6, SD = 10.2$). While the mean blood pressure values are under the accepted cutoffs for high blood pressure (systolic 140, diastolic 90), this is likely because of medical interventions to bring the hypertension under control. Based on self-reported lists of medications taken which were then categorized by study personnel into medication types, 74.9% of those who reported being diagnosed with hypertension were taking an antihypertensive, while only 2.9% of those who did not report being diagnosed with hypertension were taking such a medication. Additionally, we created a dichotomous variable indicating whether participants had mean systolic blood pressure >140 or mean diastolic blood pressure >90 to categorize them as hypertensive. Then, using binary logistic regression this categorization was regressed on self-reported hypertension and on hypertensive medication use. Those who reported a hypertension diagnosis were eight times as likely to be categorized as hypertensive as those who did not report such a diagnosis ($OR = 8.22$; 95% CI 3.01, 22.42; $p < .0005$). These findings support the validity of the self-reported hypertension diagnosis in this study.

Religious Support—The religious social support construct was multidimensional in nature and was measured using four subscales, each with three items taken from Krause (1999).

With the exception of the anticipated support scale, the scales were coded as *never* (1) to *always* (5). Response options for anticipated support were *none* (1) to *a great deal* (4). To obtain the scores used in the analyses, the mean was calculated for each set of three items. The four subcomponents of religious support were assessed as follows:

1. *Emotional support given* was measured using the following three items: (a) “How often do you make the people you worship with feel loved and cared for?” (b) “How often do you listen to people you worship with talk about their private problems or concerns?” and (c) “How often do you express interest and concern in the well-being of people you worship with?” This scale had a Cronbach’s alpha of 0.82 in our sample.

2. *Emotional support received* was measured using the following three items: (a) “How often do people you worship with make you feel loved and cared for?” (b) “How often do people you worship with listen to you talk about your private problems and concerns?” and (c) “How often do people you worship with express interest and concern in your well-being?” This scale had a Cronbach’s alpha of 0.78 in our data.
3. *Negative interaction* was measured using the following three items: (a) “How often do people you worship with make too many demands on you?” (b) “How often are people you worship with critical of you and the things you do?” and (c) “How often do people you worship with try to take advantage of you?” This scale had a Cronbach’s alpha of 0.74 in our sample.
4. *Anticipated support* was measured using the following three items: (a) “If you were ill, how much would the people in your congregation be willing to help out?” (b) “If you had a problem or were faced with a difficult situation, how much comfort would the people in your congregation be willing to give you?” and (c) “If you needed to know where to go to get help with a problem you were having, how much would the people in your congregation be willing to help out?” This scale had a Cronbach’s alpha of 0.91 in our sample.

Demographics Controls—The relationship between religious social support and hypertension was examined while statistically controlling for the following demographic variables: participant age (continuous), race (White/Black), gender (female/male), highest level of education (high school or less, trade school or some college, and bachelor’s degree or more), and ability to meet household expenses within the past year (yes/no).

Church Attendance—Church attendance was measured using a single-item question of attendance frequency from the DUREL (Koenig et al. 1997): “How often do you attend church or religious meetings?” Response options ranged from *never* (0) to *more than once a week* (5). Because of small frequencies in some categories, we collapsed *never*, *once a year or less*, and *a few times a year* into one category we called *seldom* (0) and collapsed *a few times a month*, *once a week*, and *more than once a week* into one category we called *often* (1).

Body Mass Index—Body mass index has been shown to be positively associated with the risk of developing hypertension (e.g., Bell et al. 2002; Brown et al. 2000; Shihab et al. 2012) and therefore was controlled for in the analyses. BMI ratios were calculated using self-reported weight and height.

Physical Exercise—Physical exercise has been shown to reduce blood pressure (Wallace 2003), and so, it was controlled for in the analyses. Exercise program was measured using a single question “Do you have a regular exercise program?” with responses of *yes* or *no*.

Alcohol Consumption—To increase the confidence in the study findings, it was necessary to control for several well-known predictors of hypertension the first of which is alcohol consumption. Taylor et al. (2009) conducted a meta-analysis using 12 cohort studies

and reported a positive relationship between alcohol consumption and risk of hypertension. Alcohol consumption was measured using a single question on whether respondents currently consumed alcohol beverages.

Diet—Several researchers have noted that diets high in fruits and vegetables and low in fats, sweets, etc., are associated with lower blood pressure (e.g., Conlin et al. 2000; Dauchet et al. 2007). Dietary classification was obtained using data for our sample from the food frequency (FFQ) questionnaire portion of our parent study AHS-2. The FFQ contains data on over 200 foods and respondents reported the frequency of consumption and the serving size over the last year. Respondents were classified as vegan (consumed red meat, poultry, fish, eggs, and dairy < 1 monthly), lacto-ovo vegetarian (consumed red meat, poultry, and fish < 1 monthly and eggs and dairy 1 monthly), pesco-vegetarian (consumed red meat and poultry < 1 monthly, and fish 1 monthly), semi-vegetarian (consumed red meat, poultry, fish 1 monthly to 1 weekly, and eggs and dairy at any frequency), and nonvegetarian (consumed red meat, poultry, fish > 1 weekly, and eggs and dairy at any frequency) (Tantamango-Bartley et al. 2013; Tantamango et al. 2011). Because of small frequencies in some categories, we collapsed the four vegetarian categories into one vegetarian group, and the nonvegetarians remained as the second category.

Statistical Analysis

A binary logistic regression analysis using SPSS 21 was employed to test the study hypotheses. This analytic approach was suitable because the dependent variable for both the cross-sectional study and the prospective study was dichotomous.

Before conducting our analysis, we needed to exclude some cases with small frequencies in some categories, cases with missing data on the dependent variable, and cases that were not needed in the current analysis. From our original sample of 11,052, we excluded 700 (6%) cases categorized as *other* on the race variable because of small frequencies, 369 (3%) cases with missing data on the dependent variable, 182 (2%) non-Adventist respondents, and 220 (2%) persons under age 30 who were not the original target of the studies. After all deletions, the analytic sample size was 9581 for the cross-sectional study and 5720 for the prospective study. Although none of the predictor variables had more than 5% of missing data, listwise deletion would have resulted in the exclusion of 1734 (18%) of cases, we conducted a multiple imputations procedure to preserve the sample size. The procedure was set to conduct five imputations using the analytic variables and 49 additional variables (e.g., positive religious coping, negative religious coping, congregational sense of community, spiritual meaning, positive social support, negative social support, perceived stress). These variables were chosen because they were known to be related to the analytic variables which provided useful information for predicting missing data in the multiple imputation procedure. The pooled results of these five imputations were reported as they correct the biases inherent in any single imputation. We also conducted a test for multi- collinearity among the religious social support predictor variables and found that tolerance for all variables exceeded .1; therefore, multicollinearity was not a problem.

Results

Sample Characteristics

Table 1 presents the descriptive statistics for all study variables first for the entire sample and then by race and gender. Participants had an average BMI of 27.32 (SD = 6.12), the majority were vegetarian, less than half had a regular exercise program, and very few consumed alcoholic beverages at the time of data collection. The vast majority of respondents attended church often. On a scale with a maximum of 5, respondents on average gave and received emotional support *fairly often* (3.34 and 3.11), *never or once in a while* had negative interactions with church members (1.50 on a scale ranging from 1 to 5), and anticipated *some* support from church members if they were ill or were faced with a problem (3.22 on a scale with a maximum of 4).

Religious Social Support and Hypertension: Cross-Sectional Analyses

In order to understand how the covariates affected the relationship between the religious social support variables and hypertension, we tested a series of four models which are presented in Table 2.

Controlling for Demographic Variables—In model 1, we examined the relationship between the religious social support variables and hypertension when controlling only for demographics. Age, being Black, having no college degree, and having difficulty meeting expenses in the last year were all associated with greater odds of hypertension. For religious support, only anticipated support significantly predicted lower hypertension. For every unit increased in anticipated support, the odds of hypertension decreased by 15%.

Adding Church Attendance—In model 2, we added church attendance to model 1. The association of the demographic variables with hypertension did not change. Attending church often, rather than seldom, was associated with a 37% decrease in the odds of hypertension. Of the religious social support variables, anticipated support remained significantly inversely associated with hypertension. A one unit increase in anticipated social support was associated with a 14% drop in the odds of hypertension.

Adding Health Behavior—For model 3, we added three health behavior variables—alcohol use, exercise, and vegetarian diet. Having a regular exercise program was associated with a 25% decrease in the odds of hypertension and a vegetarian diet with a 42% decrease. Alcohol use was not related to hypertension in this sample. Church attendance and anticipated support remained statistically significant with attending church often being associated with a 25% reduction in the odds of hypertension and a one unit increase in anticipated support associated with an 11% decrease.

Adding BMI—In model 4, we added BMI as a control variable. A one unit increase in BMI was associated with a 12% increase in the odds of hypertension. Regarding the other variables, difficulty meeting expenses, church attendance, and anticipated support were now not significantly related to hypertension.

Testing for Nonlinear Effects

Quadratic Effects—We also tested possible nonlinear effects in the model by adding the square of each religious support variable to each of the four models in Table 2. These four analyses (not shown) resulted in no changes in the statistical significance of religious support.

Anticipated support was still significant in predicting hypertension except when BMI was added to the model, none of the other support variables were related to hypertension, and no quadratic term was statistically significant.

Interactions with Gender and Ethnicity—We also tested interactions of ethnicity and gender with the four religious support variables in all four models. The interaction tests for model 3 and 4 are found in Table 3. No interaction was found to be significant, and the other associations did not change.

Does BMI Mediate the Association of Anticipated Support and Hypertension?

Model 4—the model with demographics, church attendance, health behavior, and BMI shown in Table 2—contrasted with model 3 without BMI suggests that BMI could be mediating the relationship between anticipated support and hypertension. We used Hayes (2013) PROCESS macro for SPSS to test mediation effects. While there were no direct effects of anticipated support on hypertension (effect = -0.059 ; 95% CIs [$-0.140, 0.021$]), there was an indirect effect of anticipated support on high blood pressure mediated by BMI (effect = -0.057 ; 95% CIs [$-0.080, -0.035$]). A one unit change in anticipated support was associated with a 6% decrease in the likelihood of hypertension. Anticipated support was associated with lowered BMI and lower BMI was associated with reduced likelihood of hypertension.

Religious Social Support and Hypertension: Prospective Analyses

On the wave 2 questionnaire, 534 individuals who had not reported a diagnosis of hypertension at wave 1 reported that they now had been diagnosed with hypertension. Table 4 shows the same logistic regression analyses as shown in Table 2 but this time using the occurrence of a new diagnosis of hypertension as the dependent variable. The pattern is much the same as we found in the cross-sectional analyses with anticipated church support being the only religious support variable that predicted a new case of hypertension but with the association no longer being statistically significant at the .05 level when BMI was added to the analysis. Interestingly, the p value for anticipated church support now did approach significance ($p = .065$) even after BMI was controlled.

Discussion

We used a multidimensional approach to measuring the religious social support construct (emotional support given, emotional support received, negative interaction, and anticipated social support) in our analyses. The use of multiple indicators of religious social support was an attempt to provide insight into their unique relationships to hypertension, thereby filling in a gap in the relevant knowledge base. After controlling for demographic factors, lifestyle

factors, church attendance, and BMI none of the religious social support variables were significantly associated with hypertension.

What we did find was that of our four religious social support variables, anticipated support significantly predicted hypertension both cross-sectionally and prospectively but that this relationship appeared to be mediated by BMI. We found that higher anticipated support was associated with lower BMI and that lower BMI was, in turn, associated with less likelihood of hypertension. It should be noted that although Chen and Contrada (2007) and Olphen et al. (2003) found religious social support to be significantly related to hypertension, BMI was not controlled in their models. When Buck et al. (2009) examined the same relationships but controlled for BMI, they found no significant relationship between religious social support and hypertension.

A search of the literature on the relationship between anticipated support and BMI did not yield any results, but we did find a few studies which examined the relationship between religious social support and BMI. We encountered a similar challenge, as noted in the introduction, when we were unable to find studies examining specific dimensions of religious social support and health. Kim et al. (2003) examined the relationship between religious social support and BMI and found, among other things, a significant positive relationship between religious social support and BMI among men. This relationship, however, disappeared after controlling for smoking, suggesting that smoking mediated the positive relationship between religious social support and BMI.

The first possible explanation for the difference in the direction of the relationship when comparing these two studies is that Kim et al. (2003) looked at what they called religious social support measured using the question “how often do you seek religious comfort.” For one thing, it is not clear that *seeking religious comfort* means seeking social support from other people. One might seek religious comfort through reading scripture or prayers. In contrast our measure of anticipated religious social support was explicitly from other church members and provided information on the religious support one expects to receive if a problem arises (see methods section for all questions making up this scale). These fundamental differences in operationalization of the religious social support constructs may account for the different relationships observed between studies. Although Kim et al. (2003) is a less than ideal study to compare with ours, we do so nonetheless because of the absence of literature on anticipated support and BMI.

A second possible reason for the differences we observed when comparing the studies may have to do with differences in study samples. The main difference has to do with smoking, in that only .8% of our sample smoked compared to 25% men and 24% women who were smokers in Kim et al. (2003) study. The big difference in the proportion of smokers between the two samples may have much to do with the fact that our sample is all SDA, a group with strong teachings against smoking therefore having few smokers. The sample used by Kim et al. (2003), however, was comprised of participants from several denominations which may be indicative of varying teachings on smoking and much higher proportions of smokers. The mediating role of smoking is responsible for the positive relationship observed between religious social support and BMI because more social support was associated with less

smoking which was associated with higher BMI (Kim et al. 2003). It appears that in the study conducted by Kim et al. (2003) the participants may have substituted food for smoking, thereby still having higher BMI. In direct contrast, in our largely nonsmoking group more anticipated religious social support was associated with lower BMI.

Like us, Cline and Ferraro (2006) found an inverse relationship between obesity (derived from calculation of BMI) and “religious consolation” which they also referred to as religious social support. This effect was weakened once controls, including smoking, were added to the model. They also found that men reporting higher levels of religious consolation were less likely to become obese. The authors suggest that men may be seeking comfort in religion instead of food, thus escaping obesity. Despite the differences in measuring religious social support and in sample composition, mixed denominations versus all SDAs, the similarity in Cline and Ferraro (2006) results is interesting particularly considering divergent findings from Kim et al. (2003).

The above-presented studies provide support for the relationship we found between anticipated support and BMI as a means of understanding the mediating role of BMI in the relationship between anticipated religious social support and hypertension. The importance of assessing the mediating role of BMI in the relationship between religious social support and hypertension cannot be overstated. The absence of BMI in the work of Chen and Contrada (2007) and Olphen et al. (2003) indicates an important shortcoming in some studies examining the relationship between religious social support and hypertension. Chen and Contrada (2007) did not control for physical health in any way, and although Olphen et al. (2003) controlled for physical functioning, they did not control for BMI. Our findings suggest that this approach is a less successful one when attempting to elucidate the kind of relationship that exists between religious social support and hypertension. BMI is an important physical variable that is a strong and consistent significant predictor of hypertension and should therefore not be overlooked in studying the relationship between religious social support and hypertension as the results of studies excluding BMI may be misleading. Also, differences in our study findings are significant in that we were able to measure the concept of religious social support multidimensionally, we were successful in elucidating the mediating effect of BMI on the relationship between anticipated support and hypertension, and we added to the knowledge base by reporting on and attempting to explain the relationship between anticipated religious social support and BMI and showed that similar relationships regarding anticipated support and hypertension existed in both a cross-sectional and a longitudinal study.

Although not a primary predictor of interest in this study, it is noteworthy that church attendance was significantly inversely related to hypertension in the cross-sectional sample; however, this relationship may be mediated by diet. The significant inverse relationship we note between church attendance and hypertension in models 1, 2, and 3 of Table 2 is not surprising particularly because church attendance has been linked to longevity in this group (Lee et al. 2003). What is surprising is that this relationship disappears once BMI, a known strong predictor of hypertension, is controlled suggesting that church attendance may be related to hypertension through lowered BMI in our sample.

The general literature on the relationship between church attendance and hypertension is inconsistent—some have found significant inverse associations while others have not (see Koenig et al. 2012 for a list of these studies). It is possible that church attendance may carry different meaning across different religious groups in that it may not always be an indication of adherence to church endorsed lifestyle which can influence hypertension. Additionally, this relationship may be mediated by other variables which may be different across religious groups.

Stratification of the full models by race and gender did not reveal any different relationships between the religious social support variables and hypertension for any subgroup. Although Chen and Contrada (2007) and Olphen et al. (2003) both found direct significant relationships between religious social support variables and hypertension, Buck et al. (2009) found no such relationship between religious social support and hypertension.

There are a few caveats to keep in mind when determining the generalizability of the study findings. First, the analyses were conducted using older Black and White Seventh-day Adventists only, and although the findings provide insight into the relationship among these variables, they may be less applicable to younger persons, persons of other races, or even persons of other denominations or religions. Second, because the study was conducted on North Americans, it may not be applicable to persons of the same faith or different faiths who live in other parts of the world. Third, we did not control for access to care or sodium intake and controlled for blood pressure medication use only with our validation sample. Finally, even though we did find evidence that the self-report of a hypertension diagnosis tended to be accurate, high blood pressure diagnosis was self-reported.

Conclusions

Religion is an important aspect of life for most Americans as evidenced by reports showing that 83% of Americans have some religious affiliation and 82% believe that religion is an important part of one's life (Forum 2012). Research studies have successfully demonstrated the direct positive health effects of religious social support, although this relationship seems to be mediated by BMI among older North American Seventh-day Adventist Whites and Blacks. This study showed the mediating role of BMI in the relationship between anticipated religious social support and hypertension. The study also importantly showed the absence of a relationship between emotional support given, emotional support received, negative social interactions, and hypertension, thereby suggesting that religious social support is not a very important predictor of hypertension among the SDAs in our sample. Interestingly, the study pointed to an indirect relationship between anticipated support and hypertension through BMI. Further research needs to be done to understand the relationship between anticipated support and hypertension and to identify other religious factors associated with hypertension in this sample.

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Table 1
Percentages, for all study variables: comparison among whole sample, ethnicity, and gender

	Whole sample		Whites		Blacks		Females		Males	
	N (9581)	% or M(SD)	N (6075)	% or M (SD)	N (3506)	% or M (SD)	N (6431)	% or M (SD)	N (3150)	% or M (SD)
High blood pressure diagnosis										
No	6209	65.00	4247	70	1962	56	4094	64	2115	67
Yes	3372	35.00	1828	30	1544	44	2337	36	1035	33
Age	9581	61.45 ± 13.57	6075	63.58 ± 13.54	3506	57.76 ± 12.80	6431	60.98 ± 13.62	3150	62.41 ± 13.40
Education										
High school or less	1816	19	1136	19	680	19	1302	20	515	16
Trade school or some college	3676	38	2290	38	1386	40	2714	42	963	31
Undergraduate or Graduate	4089	43	2649	43	1440	41	2415	38	1672	53
Difficulty meeting expenses										
No	6770	71	4438	73	2332	67	4376	68	2393	76
Yes	2811	29	1637	27	1174	33	2055	32	757	24
Church attendance										
Seldom	392	4.6	316	5	76	2.1	268	4.6	121	5
Often	9189	96.0	5759	94	3430	98	6163	96	3026	95
Body mass index (BMI)	9581	27.32 ± 6.12	6075	26.56 ± 5.90	3506	28.64 ± 6.25	6431	27.65 ± 6.66	3150	26.65 ± 4.73
Regular exercise program										
No	5326	56	3398	56	1929	55	3555	55	1771	56
Yes (reference)	4255	44	2677	44	1577	45	2876	45	1379	44
Current alcohol use										
No	9036	94	5677	93	3359	96	6091	95	2945	93
Yes (reference)	545	6	398	7	147	4	340	5	205	7
Diet										
Vegetarians	5316	56	3759	62	1557	44	3562	55	1754	56
Non vegetarians	4265	44	2316	38	1949	56	2869	45	1396	44
Emotional support given	9581	3.34 ± .86	6075	3.25 ± .84	3506	3.50 ± .87	6431	3.38 ± .86	3150	3.26 ± .87
Emotional support received	9581	3.11 ± .89	6075	3.06 ± .87	3506	3.21 ± .91	6431	3.14 ± .90	3150	3.06 ± .85
Negative interactions at church	9581	1.50 ± .57	6075	1.44 ± .52	3506	1.61 ± .65	6431	1.50 ± .58	3150	1.52 ± .56

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	Whole sample		Whites		Blacks		Females		Males	
	N (9581)	% or M(SD)	N (6075)	% or M (SD)	N (3506)	% or M (SD)	N (6431)	% or M (SD)	N (3150)	% or M (SD)
Anticipated church support	9581	3.22 ± .76	6075	3.19 ± .77	3506	3.27 ± .74	6431	3.20 ± .78	3150	3.27 ± .72

Only valid percentages are reported. Totals of percentages are not 100 for every variable because rounding age was continuous. Dummy codings were—gender: 1 = female, 2 = male. Race: 0 = White, 2 = Black. Education: 1 = high school or less, 2 = trade school or some college, 0 = undergraduate or graduate. Difficulty meeting expenses: 0 = no, 1 = yes. Diet was coded as 1 = vegetarian, 0 = nonvegetarian. Regular exercise program: 0 = no, 1 = yes. Church Attendance: 0 = seldom and 1 = often (at least several times a month). Emotional support given, emotional support received, and negative interaction: 1 = never, 2 = once in a while, 3 = fairly often, 4 = very often, 5 = always. Anticipated support was coded as 1 = none, 2 = a little, 3 = some, 4 = a great deal

Logistic regression of hypertension diagnosis on religious social support and control variables (Time 1 only, N = 8824)

	Model 1			Model 2			Model 3			Model 4		
	Demographics and support			Church attend, added			Health behavior added			BMI		
	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P
Age	1.06	[1.05, 1.06]	.000***	1.06	[1.05, 1.06]	.000***	1.06	[1.06, 1.07]	.000***	1.07	[1.07, 1.08]	.000***
Female	0.96	[0.87, 1.06]	.437	0.96	[0.87, 1.06]	.427	0.93	[0.83, 1.03]	.148	1.01	[0.90, 1.12]	.907
Black ^a	2.75	[2.48, 3.06]	.000***	2.79	[2.51, 3.10]	.000***	2.57	[2.31, 2.86]	.000***	2.42	[2.17, 2.71]	.000***
Education ^b												
High school or less	1.43	[1.25, 1.64]	.000***	1.42	[1.24, 1.62]	.000***	1.23	[1.07, 1.41]	.003**	1.20	[1.04, 1.38]	.014*
Trade school/some college	1.39	[1.25, 1.55]	.000***	1.38	[1.24, 1.54]	.000***	1.26	[1.13, 1.40]	.000***	1.20	[1.07, 1.35]	.001**
Difficulty meeting expenses ^c	1.23	[1.11, 1.37]	.000***	1.23	[1.10, 1.37]	.000***	1.20	[1.07, 1.33]	.001**	1.11	[0.99, 1.25]	.067
Church attendance ^d				0.63	[0.49, 0.82]	.001**	0.75	[0.57, 0.97]	.031*	0.87	[0.66, 1.14]	.300
Current alcohol use							1.09	[0.87, 1.35]	.460	1.17	[0.93, 1.47]	.178
Regular exercise program							0.75	[0.68, 0.83]	.000***	0.89	[0.81, 0.99]	.031*
Vegetarian diet							0.58	[0.52, 0.64]	.000***	0.75	[0.67, 0.83]	.000***
BMI										1.12	[1.11, 1.13]	.000***
Religious social support												
Emotional support given	1.03	[0.95, 1.13]	.454	1.05	[0.96, 1.14]	.295	1.08	[0.99, 1.18]	.093	1.05	[0.96, 1.15]	.322
Emotional support received	1.07	[0.98, 1.17]	.139	1.07	[0.97, 1.17]	.168	1.02	[0.93, 1.12]	.617	1.01	[0.92, 1.12]	.781
Negative social interactions	0.97	[0.89, 1.06]	.501	0.98	[0.89, 1.07]	.591	0.99	[0.90, 1.08]	.803	0.95	[0.87, 1.05]	.313
Anticipated support	0.85	[0.78, 0.92]	.000***	0.86	[0.80, 0.94]	.000***	0.89	[0.82, 0.96]	.005**	0.93	[0.86, 1.02]	.120

* $p < .05$

** $p < .01$

*** $p < .001$

^aWhites are reference group

^bCollege Degree is the reference group

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Table 3

Models 3 and 4 from Table 2 with interactions

	Model 3			Model 4		
	Without BMI			With BMI		
	OR	[95 % C.I.]	p	OR	[95 % C.I.]	p
Age	1.06	[1.06, 1.07]	.000 ***	1.07	[1.07, 1.08]	.000 ***
Female	0.92	[0.83, 1.03]	.139	1.01	[0.90, 1.12]	.925
Black ^a	2.59	[2.32, 2.88]	.000 ***	2.43	[2.17, 2.72]	.000 ***
<i>Education^b</i>						
High school or less	1.23	[1.07, 1.41]	.003 **	1.19	[1.04, 1.37]	.015 *
Trade school/some college	1.26	[1.13, 1.40]	.000 ***	1.20	[1.07, 1.34]	.002 **
Difficulty meeting expenses ^c	1.20	[1.07, 1.34]	.001 **	1.12	[0.99, 1.25]	.062
Church attendance ^d	0.75	[0.58, 0.98]	.038 *	0.88	[0.67, 1.16]	.357
Current alcohol use	1.09	[0.87, 1.35]	.455	1.17	[0.93, 1.47]	.175
Regular exercise program	0.75	[0.68, 0.83]	.000 ***	0.89	[0.80, 0.99]	.026 *
Vegetarian diet	0.58	[0.52, 0.64]	.000 ***	0.74	[0.67, 0.83]	.000 ***
BMI				1.12	[1.11, 1.13]	.000 ***
<i>Religious social support</i>						
Emotional support given	1.08	[0.99, 1.18]	.103	1.04	[0.95, 1.14]	.369
Emotional support received	1.02	[0.93, 1.12]	.698	1.01	[0.92, 1.11]	.812
Negative social interactions	1.01	[0.92, 1.11]	.853	0.97	[0.88, 1.07]	.521
Anticipated support	0.89	[0.82, 0.97]	.006 **	0.94	[0.86, 1.02]	.135
<i>Interactions</i>						
Gender by ethnicity	1.02	[0.81, 1.27]	.895	1.13	[0.90, 1.43]	.292
<i>Gender by</i>						
Emotional support given	0.91	[0.76, 1.10]	.327	0.91	[0.75, 1.09]	.298
Emotional support received	0.9	[0.79, 1.16]	.658	0.99	[0.81, 1.21]	.945
Negative social interactions	1.08	[0.88, 1.32]	.456	1.08	[0.88, 1.33]	.454
Anticipated support	1.07	[0.90, 1.28]	.434	1.05	[0.87, 1.26]	.611
<i>Ethnicity by</i>						
Emotional support given	0.94	[0.78, 1.12]	.482	1.00	[0.83, 1.21]	.995
Emotional support received	1.15	[0.9, 1.39]	.138	1.10	[0.91, 1.34]	.328
Negative social interactions	0.90	[0.74, 1.08]	.242	0.92	[0.76, 1.12]	.411
Anticipated support	0.97	[0.82, 1.15]	.717	0.96	[0.80, 1.14]	.613
<i>Gender by ethnicity by</i>						
Emotional support given	0.80	[0.55, 1.17]	.242	0.75	[0.51, 1.11]	.147
Emotional support received	1.26	[0.84, 1.88]	.261	1.34	[0.89, 2.03]	.162
Negative social interactions	1.08	[0.73, 1.62]	.694	1.15	[0.75, 1.74]	.521
Anticipated support	0.85	[0.58, 1.23]	.378	0.87	[0.59, 1.28]	.473

*
p < .05

^{**}
 $p < .01$

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

^a Whites are reference group

^b College Degree is the reference group

^c In the last year

^d Several times a month or more often

Logistic regression of new cases of hypertension in 2010–2011 on 2006–2007 social support and control variables (N = 5720; new cases n = 534)

	Model 1			Model 2			Model 3			Model 4		
	Demographics and support			Church attend, added			Health behavior added			BMI added		
	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P	OR	[95 % C.I.]	P
Age	1.01	[1.01, 1.02]	.001**	1.01	[1.01, 1.02]	.001**	1.02	[1.01, 1.02]	.000***	1.02	[1.01, 1.03]	.000***
Female	1.14	[0.93, 1.39]	.215	1.14	[0.93, 1.39]	.215	1.12	[0.91, 1.37]	.294	1.15	[0.93, 1.41]	.193
Black ^a	1.19	[0.97, 1.47]	.096	1.20	[0.97, 1.48]	.093	1.16	[0.94, 1.43]	.173	1.12	[0.90, 1.38]	.317
Education ^b												
High school or less	1.19	[0.91, 1.56]	.209	1.19	[0.91, 1.55]	.213	1.13	[0.86, 1.49]	.374	1.11	[0.84, 1.46]	.461
Trade school/some college	1.05	[0.85, 1.29]	.669	1.05	[0.85, 1.29]	.676	1.00	[0.81, 1.24]	.976	0.98	[0.79, 1.21]	.839
Difficulty meeting expenses ^c	0.93	[0.75, 1.16]	.533	0.93	[0.75, 1.16]	.525	0.93	[0.75, 1.16]	.533	0.89	[0.72, 1.12]	.325
Church attendance ^d				0.89	[0.54, 1.46]	.639	1.02	[0.61, 1.71]	.926	1.08	[0.65, 1.82]	.759
Current alcohol use							1.39	[0.95, 2.04]	.091	1.45	[0.99, 2.13]	.055
Regular exercise program							1.00	[0.83, 1.21]	.998	1.07	[0.88, 1.29]	.521
Vegetarian diet							0.74	[0.61, 0.90]	.003**	0.81	[0.67, 0.99]	.043*
BMI										1.04	[1.02, 1.05]	.000***
Religious social support												
Emotional support given	1.09	[0.92, 1.30]	.316	1.10	[0.92, 1.31]	.298	1.12	[0.94, 1.34]	.202	1.11	[0.93, 1.33]	.232
Emotional support received	1.05	[0.88, 1.26]	.598	1.05	[0.87, 1.26]	.607	1.02	[0.85, 1.23]	.841	1.02	[0.85, 1.22]	.864
Negative social interactions	1.01	[0.84, 1.22]	.912	1.01	[0.84, 1.22]	.894	1.02	[0.85, 1.23]	.825	1.01	[0.83, 1.21]	.953
Anticipated support	0.83	[0.70, 0.97]	.021*	0.83	[0.71, 0.98]	.024*	0.84	[0.72, 0.99]	.040*	0.86	[0.73, 1.01]	.065 [†]

[†] $p < .1$

* $p < .05$

** $p < .01$

*** $p < .001$
^aWhites are reference group

^bCollege Degree is the reference group

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