The Relation between Religiosity, Selected Health Behaviors, and Blood Pressure among Adult Females

By: Karen A. Hixson, Ph.D., Harvey William Gruchow, Ph.D., and Don W. Morgan, Ph.D

Hixson KA, Gruchow HW, Morgan DW. The relation between religiosity, selected health behaviors, and blood pressure among adult females. *Preventive Medicine* 27:545-552 (1998).

Abstract:

Background. This study examined the association between blood pressure (BP), selected health behaviors, and various dimensions of religiosity among females.

Methods. Data were obtained on 112 females who were at least 35 years of age and of Judeo-Christian faiths. Resting BP measures were taken with an automated sphygmomanometer, height and weight were measured to determine body mass index (BMI), and intermediate health variables (e.g., physical activity, smoking, diet, and alcohol consumption) were measured by questionnaire. A multifactorial questionnaire was used to assess various dimensions of religiosity. Multiple regression path analyses were conducted to determine the direct and indirect effects of religiosity on BP with age and BMI controlled statistically.

Results. The direct effects of religiosity on SBP and DBP were more substantial than the indirect effects through the intermediate health variables, suggesting that religiosity may be associated with lower levels of BP via a direct pathway, such as improving the ability to cope with stress. In general, DBP was more influenced by religiosity than SBP and the dimensions of "intrinsic religiosity" and "religious coping" were most influential. Results also indicated that "religious experiences" may exert a greater beneficial effect on DBP in older (50–80 years) age groups.

Conclusions. These results support a direct relationship between religiosity and BP, rather than an indirect effect through intermediate health behaviors.

Key Words: blood pressure; religion; diet; exercise; smoking; alcohol drinking; stress; women.

Article:

INTRODUCTION

Hypertension is a serious health problem affecting 58 million Americans or approximately 25%ofthe adult population [*1*,*2*]. In young adulthood and early middle age, the prevalence of hypertension is greater for men than for women; thereafter, the reverse is true [*3*]. Uncontrolled hypertension is linked to the onset of heart disease, stroke, and kidney disease [*4*]. In population studies, the strongest risk factors for hypertension are age and body mass index (BMI). Alcohol consumption has been related to higher blood pressure, and intake of calcium, magnesium, and potassium appear to be protective for hypertension [*5*]. Results from epidemiologic and longitudinal investigations also support the view that exercise may have a positive influence on blood pressure [*2*].

Although not typically studied, one variable that may exert a beneficial effect on blood pressure (BP) is religiosity or the quality of being religious. Several recent reviews have documented studies reporting associations between health and various aspects of religion (i.e., prayer, church activities, religious attitudes, etc.) [*6–8*]. A survey of four studies that included the effects of religious beliefs and practices on BP revealed that churchgoers have lower BP than nonchurchgoers [*9– 12*]. Graham et al. [*9*], for instance, observed a consistent association between frequent church attendance and lowered mean age-adjusted systolic and diastolic blood pressure levels in white males. Larson and colleagues [*10*] also found that a religious importance variable considered separately and together with a frequency of attendance variable exhibited an inverse association with systolic and diastolic blood pressure in a group of rural white males. More frequent church attendance has also been linked to a greater prevalence of normal blood pressure or lower blood pressure in studies of rural Zulu communities [*11*] and also of immigrants to the United States [*12*]. Lastly, Koenig et al.

[*13*], in a study examining multiple aspects of religiosity, reported that levels of religious activity and intrinsic religiosity were generally lower among male and female geriatric patients with mental and physical health problems and intrinsic religiosity was lower among men with hypertension.

To explain the potential effects of religious beliefs and practices on blood pressure, investigators have suggested two possible theories. One theory focused on the possible indirect effect on blood pressure, perhaps mediated by the influence of religious beliefs and practices on health behaviors. In epidemiological surveys of Seventh-Day Adventists [*14*], Mormons [*15,16*], and other Christian religions [*13*], lower frequencies of adverse health behaviors, such as smoking and excessive alcohol consumption, and higher frequencies of positive health behaviors, such as physical activity and good eating habits, which may contribute to a lower blood pressure, were observed among religiously active persons. The second theory proposes that religious involvement may also function more directly as a coping mechanism in response to a perceived stressor [*17*]. According to this theory, religious involvement may reduce stress and despair (and hence, blood pressure) by providing a sense of inner peace, socioemotional support, crisis intervention resources, and counseling [*9*].

In many of these earlier studies, religiosity was measured by church attendance or some other single aspect of religion, and other risk factors for hypertension were often not controlled for adequately. In addition, the distinction between possible direct and indirect effects of religiosity on blood pressure was not made. Finally, no study has focused exclusively on the association between religiosity and blood pressure among adult females, a cohort generally underrepresented in the health literature.

In an attempt to test the competing hypotheses, the focus of the present study was to quantify direct and indirect relationships between religiosity (the quality of being religious conceptualized as a multidimensional variable [*17*]) and blood pressure in a group of adult women, while controlling statistically for potential confounding variables such as age and bodymass index and accounting for intermediate health behavior variables such as alcohol consumption, smoking, physical activity, and diet. Specifically, two research questions were asked: (1) Which dimension(s) of religiosity most strongly relates to blood pressure? and (2) Do direct or indirect effects of religiosity have a greater influence on blood pressure?

METHODOLOGY

Subjects

One hundred twelve white female alumni, age 35 or older, from Salem College (Winston-Salem, NC) and the University of North Carolina at Greensboro agreed to participate in this study. They were part of a group of 600 of these institutions' alumni, living in Guilford and Forsyth Counties (NC), who were sent a letter describing the proposed study and invited to participate. Information concerning the study for recruitment also appeared in alumni publications and area church newsletters.

Phone calls to schedule data collection were made to individuals who agreed to participate. A consent form and survey were completed at home. The survey consisted of questions regarding demographic information, medical history, religiosity, physical activity, food intake, and smoking. Each participant visited the laboratory once to confirm proper completion of the survey and for measurement of blood pressure, height, and body mass.

Procedures

Measurement of blood pressure. To determine systolic and diastolic blood pressure, the first and fifth Korotkoff components were used [*18*]. The same automatic sphygmomanometer monitor (Colins STBP-780) was used for all blood pressure measurements [*19*]. Three readings of systolic and diastolic blood pressure were taken at 5-min intervals after subjects had been seated for a 10-min period of quiet rest [*20*]. Since post hoc comparison of means (Tukey's test) [*21*] showed that the first systolic blood pressure reading was significantly greater ($P < 0.05$) than the second and third systolic blood pressure readings, only the second and third readings were averaged. Although there were no significant differences between the three diastolic blood pressure readings, for consistency, the reported diastolic blood pressure was matched to the systolic blood pressure values by averaging the second and third diastolic blood pressure measures.

In preparation for the blood pressure measurement, subjects were instructed to empty their bladder and bowels. Subjects abstained from eating, drinking (especially alcohol and caffeine), and smoking for at least 60 min before blood pressure measurement because these activities can alter blood pressure [*22*]. Participants also refrained from exercising at least 4 h prior to testing, since recently performed activity can alter blood pressure [*20*]. Prior to blood pressure measurement, subjects sat and rested for 10 min. To measure blood pressure, three electrodes were attached to the subject in the CM-5 position. The blood pressure cuff was inflated to a preset pressure of 180 mm Hg and blood pressure was measured automatically during cuff deflation.

Measurement of religiosity. To assess religiosity, a 33-question multidimensional religiosity schedule constructed by Koenig and his colleagues [*17*] was utilized.

In a validation study, Koenig's religiosity instrument was administered to 87 pastors of all ages (mean age of 47). Mean scores obtained on three different subsets of questions (organizational religious activities, nonorganizational activities, and intrinsic religiosity) were compared between the ministers and three community groups. This comparison revealed that the scores consistently were significantly higher for the ministers than for community groups [*17*]. Reliability was tested by computing Cronbach's α for the data collected from surveying a sample with the religiosity schedule. Cronbach's α ranged from 0.61 to 0.87 for different parts of the schedule. Test–retest reliability was determined with 11 subjects and revealed an overall agreement of 91.7% [*17*].

In the current study, a total religiosity score and scores on the following nine religiosity dimensions were determined [*17*]:

1. Intrinsic religiosity: a way of being religious that regards faith as a supreme value in its own right; the person finds motivation and meaning for life in their religion.

2. Extrinsic religiosity: a way of being religious that is utilitarian: useful for the self in granting safety, social standing, solace, and endorsement for one's chosen way of life.

3. Belief factor: the degree of acceptance of the prescribed doctrines of the Judeo-Christian religious tradition.

4. Religious well-being: religious satisfaction; a concept that cuts across all other dimensions of religion.

5. Organized religious activity: religious activities of an organizational nature such as church attendance and participation in Bible study or prayer groups; reflects in part the social aspects of religion.

6. Nonorganized religious activity: religious activities of nonorganizational nature such as private prayer, reading devotional literature, and watching and listening to religious programs on television or radio.

7. Religious knowledge: reflects knowledge about beliefs, writings, and rituals that make up one's religious tradition.

8. Religious experiences: occasions defined by those undergoing them as an encounter between themselves and some supernatural consciousness.

9. Religious coping: ways in which religion acts as a resource to help deal with stress, problems, or difficulties.

Measurement of intermediate health variables and control variables. Physical activity was determined from a modified version of the Minnesota Leisure Time Physical Activity Questionnaire, an assessment tool that is widely used and has high test–retest reliability [*23*±*25*]. Dietary intake of nutrients related to blood pressure

(e.g., sodium, potassium, calcium, and alcohol) was determined using a food frequency questionnaire. Data were analyzed using the Nutritionist III program (N^2 Computing, Salem, OR) and the interactive dietary variable of interest [(K:Na) X Ca] was computed. This ratio was selected for analysis based on data revealing that low K (potassium) and high Na (sodium) in the presence of low Ca (calcium) is associated with high blood pressure in females [*5*]. In view of these findings, an inverse relationship would be expected between this interactive dietary variable and blood pressure. A smoking index was determined from subject responses to four questions included on the survey [*26*]. Height (recorded to the nearest 0.25 in.) and weight (recorded to the nearest 0.25 lb) were obtained using an anthropometer and balance beam scale, respectively, while subjects' shoes were removed.

Statistical analyses. Multiple regression analyses provided estimates of the strengths of association (path coefficients) along each path of the hypothesized models. Standardized partial regression coefficients were used to estimate all path coefficients [*27*]. In each regression equation, age and BMI were controlled statistically. Only subjects not on BP medication were included in this analysis (n = 98) because unmedicated blood pressures were unknown for the other 14 subjects who were on blood pressure medication. Figure 1 illustrates the model used for the path diagram analyses. In this figure, the direct effect of religiosity on blood pressure is represented by the bottom arrow connecting religiosity with blood pressure, while the indirect effects of religiosity on blood pressure are represented by the other arrows delineating paths through intermediate health variables.

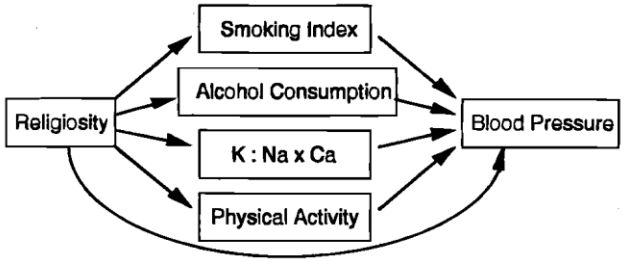
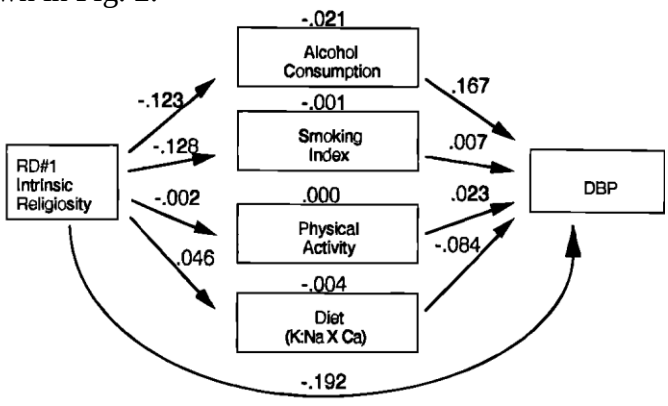


FIG. 1. General model for study of relationships between religiosity and blood pressure (controlling for age and BMI).

For systolic and diastolic blood pressure, path analyses were constructed for each of the nine dimensions of religiosity and for the total religiosity score. For each path diagram, direct, indirect, and total effects of the religiosity dimension on the blood pressure variable were calculated. An example of how the direct and indirect effects were determined is shown in Fig. 2.



Indirect effect through	
Alcohol	−0.021
Smoking index	−0.001
Physical activity	0.000
Diet	−0.004
Direct effect	−0.192
Total effect	−0.218

FIG. 2. Effects of intrinsic religiosity on DBP (controlling for age and BMI).

As illustrated in this diagram, the direct effect was equal in magnitude to the path coefficient between the religiosity variable and blood pressure. The indirect effect of a religiosity variable, through a particular intermediate health variable, was calculated as the product of the path coefficient between the religiosity variable and the health behavior variable and the path coefficient between the health behavior variable and blood pressure. The overall indirect effect was equal to the sum of the indirect effects for all paths leading through health behavior variables. The total effect of the religiosity variable on blood pressure was the sum of its direct effect and overall indirect effect [*27*].

To further examine the effects of religiosity on BP, BP by religiosity dimension one-way analysis of variance (ANOVA) procedures with age, BMI, smoking index, alcohol consumption, diet, and physical activity as covariates were conducted for each religiosity variable and for SBP and DBP separately. A total of 20 ANOVAs were performed. This additional analysis, which categorized BP, was conducted in order to include all 112 subjects, even those on BP medication. The SBP and DBP variables were categorized into normotensive and hypertensive groups. For the SBP analyses, 89 subjects had normal SBP and 23 were categorized as hypertensive (having elevated SBP of at least 140 mm Hg or taking antihypertension medication). For the DBP analyses, 95 subjects had normal DBP and 17 subjects were categorized as hypertensive (having elevated DBP of at least 90 mm Hg or taking antihypertension medication). The data for each religiosity dimension were categorized into high, medium, and low groups for the purpose of performing ANOVAs only (recall that each religiosity dimension was treated as a continuous variable for the multiple regression equations for the path diagrams). The boundaries to establish the religiosity dimension categories were chosen as close as possible to the 33rd and 67th percentiles. ANOVAs were also performed separately for three age groups (35 to 49, 50 to 64, and 65 to 80 years) to determine whether religiosity affected blood pressure differently at different stages of life.

RESULTS

Comparison with normative U.S. data (Table 1) for selected characteristics showed that among participants in this study, there were slightly fewer obese women, slightly more who consumed alcohol, slightly fewer who were current smokers, and approximately the same percentage who were hypertensive. Furthermore, the relationships of systolic and diastolic blood pressure to age, BMI, alcohol, and smoking status in the present study were similar in magnitude to those cited by the National Center for Health Statistics (Table 2) [*28*]. Subject characteristics, selected health variables, resting blood pressures, and religious affiliations are summarized in Tables 3 and 4.

TABLE 1

Selected Subject Characteristics Compared to U.S. Norms

Characteristics	This Study	U.S. normal[a] (white females)
% with BMI indicating obesity[b]	25.9%	32.4% ages 20+ years in 1988 to 1991
% who consume alcohol	69.6%	65% ages 25 to 44 years; 44% ages 45+ years in 1990
% hypertensive[c]	20.5%	19.0% ages 20 to 74 years in 1988-1991
% who currently smoke	8%	12.5% ages 16+ years in 1993

***a* Source: National Center for Health Statistics. Health, United States, 1993. Hyattsville (MD): Public Health Service, 1994.**

***b* A BMI of 27.3 or more in metric units of kg/m^2 or 3.6 or more in English units of $(lb/in.^2)$ X 100 indicates obesity.**

***c* A person with hypertension is defined as either having elevated blood pressure (systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg) or taking antihypertensive medication.**

TABLE 3

Subject Characteristics, Selected Health Variables, and Blood Pressure for All Subjects

Variable	Mean (± SD) or percentage
Height (m)	1.64 ± 0.06
Weight (kg)	64.0 ± 11.0
BMI(kg/m^2)	23.7 ± 3.7
Age (years)	50.1 ± 10.3
Alcohol (g of pure alcohol/day)	7.6 ± 9.4
Physical activity index (kcal/day)	813.46 ± 497.95
Diet [$(K \times Na^{-1}) \times Ca$] (mg/day)	1,109 ± 668
Smoking index[a]	26.6 ± 46.3
SBP (mm Hg)	121 ± 15
DBP (mm Hg)	73 ± 9
Married (%)	80.4%
College graduate (%)	100.0%
Graduate work (%)	53.6%

[a] Smoking index is a composite number determined from answers to four questions:

(1) Have you ever smoked cigarettes during any period of your life (aside from possibly trying them once or twice)?
_____ Yes, I currently smoke. 2 pts
_____ Yes, smoked in the past, but not now. 1 pt
_____ No, never smoked cigarettes. 0 pts

(2) What is the greatest number of cigarettes that you have ever regularly smoked?
_____ 1/4 pack per day. 1 pt
_____ 1/2 pack per day. 2 pts
_____ 1 pack per day. 3 pts
_____ 1 1/2 pack per day. 4 pts
_____ 2 packs per day or more. 5 pts

(3) At what age did you start smoking regularly? _____ years old.

(4) If you are not now smoking, at what age did you last stop? _____ years old.

A person who has never smoked would have an index value of 0; a current smoker of 1 pack per day and who has smoked for 10 years would have a smoking index value of 60 (2 × 3 × 10).

TABLE 2

Standardized β Coefficients in National Health and Nutrition Examination Survey I (NHANES-I) and Present Study

Dependent variable	NHANES-I White females 25±74 years (n = 1,440)		Current study (equations with RD1) White females 35±80 years (n = 98)	
	SBP	DBP	SBP	DBP
Selected independent variables				
Age	0.40	0.19	0.16	0.17
BMI	0.23	0.36	0.56	0.27
Alcohol[a]	−0.05	0.02	0.08	0.17
Smoking[b]	−0.06	−0.06	−0.01	0.01

[a] Units for alcohol were oz absolute alcohol/day in the NHANES-I study and g pure alcohol/day in the current study.

[b] Smoking was categorized as current smoker vs nonsmoker or former smoker in the NHANES-I study, and the smoking index for the current study is defined in Table 3.

Table 5 summarizes the effects of the religiosity dimensions and the total religiosity score on blood pressure as determined by the 20 path analyses that were performed. The strongest total effects were seen for RD1 (intrinsic religiosity) on diastolic blood pressure (total effect, ¯0.218), RD9 (religious coping) on diastolic blood pressure (total effect, ¯0.193), RTOT (religious total) on diastolic blood pressure (total effect, —0.166), RD8 (religious experiences) on diastolic blood pressure (total effect, ¯0.157), RD2 (extrinsic religiosity) on diastolic blood pressure (total effect, ¯0.150), RD4 (religious well-being) on diastolic blood pressure (total effect, —0.143), and RD3 (belief factor) on diastolic blood pressure (total effect, ¯0.140). In general, the effects of religiosity on diastolic blood pressure were greater than the effects on systolic blood pressure. The direct effect for both systolic and diastolic blood pressure tended to be greater than the total indirect effect through the intermediate health variables. As expected, the total effect of the religiosity dimension was negative in a majority (17 of 20) of the path analyses performed, indicating that higher religiosity scores were associated with lower blood pressure recordings. The total effects that were not negative were relatively close to 0.

Results of one-way ANOVA examining the influence of religiosity on blood pressure for all subjects (including the 14 subjects on blood pressure medication) did not reveal any statistically significant associations ($P > 0.05$). Results of BP X religiosity dimension ANOVA performed separately for three age groups (35 to 49, 50 to 64, 65 to 80 years) also did not reveal any statistically significant associations ($P > 0.05$). However, there was a trend worth noting. There was a stronger association between blood pressure and religious experiences in the older age groups compared with the youngest age group. For the middle age group, 50 to 64 years ($n = 37$), the association between diastolic blood pressure and religious experience approached significance ($P = 0.06$). For

the oldest age group, 65 to 80 years (n = 14), the association between diastolic blood pressure and religious experiences produced a P value of 0.12.

TABLE 4

Religious Affiliation of Subjects

Religious affiliation	All subjects (n = 112) No.	All subjects (n = 112) %	U.S. normal %	Subjects not on BP medication (n = 98) No.	Subjects not on BP medication (n = 98) %
Presbyterian	30	26.8%	2%	28	28.6%
Methodist	22	19.6%	9%	19	19.4%
Baptist	18	16.1%	20%	14	14.3%
Episcopalian	13	11.6%	2%	11	11.2%
Moravian	8	7.1%	[a]	7	7.1%
Lutheran	4	3.6%	5%	4	4.1%
Seventh-Day Adventist	3	2.7%	[a]	3	3.1%
Catholic	6	5.4%	27%	5	5.1%
Other	6	5.4%	16%[b]	5	5.1%
No preference	2	1.8%	9%	2	2.0%

[a] Not reported separately, included in Other category.
[b] Includes Seventh-Day Adventists and Moravians.

TABLE 5

Summary of Indirect, Direct, and Total Effects of Religiosity Dimensions and Total Religiosity on SBP and DBP

Religiosity dimension	Effects on SBP			Effects on DBP		
	Indirect	Direct	Total	Indirect	Direct	Total
RD1 Intrinsic religiosity	−0.010	−0.097	−0.107	−0.026	−0.192	−0.218
RD2 Extrinsic religiosity	−0.007	−0.023	−0.030	−0.024	−0.116	−0.150
RD3 Belief factor	−0.015	−0.009	−0.024	−0.021	−0.119	−0.140
RD4 Religious well-being	−0.011	0.035	0.024	−0.026	−0.117	−0.143
RD5 Organized religious activity	0.001	−0.050	−0.049	−0.016	−0.039	−0.055
RD6 Nonorganized religious activity	0.001	0.016	0.017	0.000	−0.115	−0.115
RD7 Religious knowledge	−0.008	−0.034	−0.042	−0.019	0.006	−0.013
RD8 Religious experience	−0.010	0.026	0.016	−0.018	−0.139	−0.157
RD9 Religious coping	−0.012	−0.007	−0.019	−0.024	−0.169	−0.193
RTOT Total religiosity	−0.011	−0.007	−0.018	−0.026	−0.140	−0.166
Average	−0.008	−0.015	−0.023	−0.020	−0.114	−0.135

DISCUSSION

Data from this study support the hypothesis of a beneficial effect of religiosity on blood pressure among females. Specifically, our findings revealed that in this group of white females, (1) the direct beneficial effect of religiosity on blood pressure appeared to be more important than the indirect effects through health behaviors, (2) intrinsic religiosity and religious coping were dimensions that had the greatest impact on blood pressure, (3) religious experiences exerted a beneficial effect on blood pressure in later years, and (4) religiosity appeared to have a greater effect on diastolic than systolic blood pressure.

While the influence of religiosity on BP was small, our findings are consistent with the magnitude of the effects of established risk factors for BP reported in the National Health and Nutrition Examination Survey I study (see Fig. 2 and Table 2).

There was little evidence of an indirect effect of religiosity on blood pressure acting through the intermediate health variables of alcohol, smoking, diet, and physical activity. This implies that religiosity dimensions and total religiosity may influence blood pressure not by influencing specific health behaviors per se, but rather by a more direct effect. In agreement with our results, Larson et al. [*10*] demonstrated that blood pressure was significantly lower among smokers reporting high religious importance compared with smokers with low religious importance. These authors suggested that the influence of religiosity on blood pressure was mediated not through smoking behavior, but by the ability to cope with stress.

Congruent with our findings, other investigators have reported similar data related to the impact of intrinsic religiosity on blood pressure and the generally stronger relationship observed between religiosity and diastolic blood pressure. In their study of white males, Larson et al. [*10*] found that the association between blood pressure and a combined religiosity index for church attendance and importance of religion (a variable akin to intrinsic religiosity) was statistically significant for diastolic blood pressure only. However, Graham et al. [*9*] and Walsh [*12*] noted that frequent church attenders exhibited lower values for both systolic and diastolic blood pressure compared with infrequent at-tenders. In the current study, path analyses that included organized religious activity (which is closest to the church attendance variable used in the two aforementioned studies) showed a similar total effect for both systolic blood pressure (-0.049)and diastolic blood pressure (-0.055).

Why religiosity demonstrated a greater effect on DBP than SBP among this group of adult females is unclear. DBP provides an indication of the ease with which blood flows from the arterioles to the capillaries [*29*]. As the result of stress attenuation or an increased ability to cope with stress, religiosity may decrease blood pressure by reducing sympathoadrenal activity or lowering levels of angiotensin and aldosterone. In evaluating potential mechanisms underlying the religiosity–BP link, it should be emphasized that this hypothesis is purely speculative in nature.

We also found that religious experiences may have a differential effect at various stages in the life cycle. Our analysis of three separate age groups indicated that the religious experiences–blood pressure relationship was most important among middle-aged females. The association between religious experiences and diastolic blood pressure approached statistical significance for this group and was also important for the oldest age group. These findings may reflect a greater accumulation of religious experiences among older individuals, resulting in an overall positive impact on health.

Limitations

Subjects in this study were self-selected, white female college graduates, 35–80 years of age, of middle to upper socioeconomic status, living in the triad area of North Carolina. Hence, it is difficult to generalize the results of this study beyond this specific population.

The cross-sectional nature of the data in the study makes it impossible to determine with certainty the direction of causality in the observed relationships between the independent variables and blood pressure. Longitudinal studies are needed to confirm cause and effect between religiosity and blood pressure.

Individuals who were on medication that could affect blood pressure were not included in all analyses, specifically the path analysis, because their unmedicated blood pressures were unknown. Exclusion of these individuals may have made it more difficult to detect relationships between religiosity and blood pressure.

CONCLUSION

The results of this study support a direct relationship between religiosity (particularly intrinsic religiosity and religious coping) and blood pressure. These findings are in agreement with the notion that optimal health is a function of all aspects of wellness, including spiritual well-being. Future challenges in this field include refining the measurement of religiosity and elucidating the physiological mechanisms underlying the association between religiosity and blood pressure.

REFERENCES

1. Kaplan NM, editor. Clinical hypertension. Baltimore: Williams & Wilkins, 1990;12–13.
2. Tipton CM. Exercise, training and hypertension. In: Exercise and sports science reviews. Baltimore: Williams & Wilkins, 1991; 19:447–505.
3. Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. The 1988 report of the Joint National Committee on detection, evaluation, and treatment of high blood pressure. Arch Intern Med 1988;148:1023–38.
4. Jenkins CD. Epidemiology of cardiovascular diseases. J Consult Clin Psychol 1988;56(3):324–32.

5. Gruchow HW, Sobocinski KA, Barboriak JJ. Calcium intake and the relationship of dietary sodium and potassium to blood pressure. Am J Clin Nutr 1988;48:1463–70.
6. Levin JS, Schiller PL. Is there a religious factor in health? J Religion Health 1987;25:9–36.
7. Levin J S. Religion and health: is there an association, is it valid, and is it causal? Soc Sci Med 1994;38:1475–82.
8. Matthews DA, Larson DB, Barry CP. The faith factor: an annotated bibliography of clinical research on spiritual subjects. Rockville (MD): Nat. Inst. for Healthcare Res., 1993.
9. Graham TW, Kaplan BH, Comoni-HuntleyJC, James SA, Becker C, Hames CG, et al. Frequency of church attendance and blood pressure elevation. J Behav Med 1978;1:37–43.
10. Larson DB, Koenig HG, Kaplan BH, Greenberg RS, Logue E, Tyroler HA. The impact of religion on men's blood pressure. J Religion Health 1989;28:265–78.
11. Scotch NA. Sociocultural factors in the epidemiology of Zulu hypertension. Am J Public Health 1963;53:1205–12.
12. Walsh A. The prophylactic effect of religion on blood pressure levels among a sample of immigrants. Soc Sci Med 1980; 148:59–63.
13. Koenig HG, Moberg DO, Kvale JN. Religious activities and attitudes of older adults in a geriatric assessment clinic. J Am Geriatr Soc 1988;36:362–74.
14. Armstrong B, Merwyk A, Coates H. Blood pressure in Seventh Day Adventist vegetarians. Am J Epidemiol 1977;105:444–9.
15. Gardner J W, Lyon JL. Cancer in Utah Mormon women by church activity level. Am J Epidemiol 1982;116:258–65.
16. Gardner J W, Lyon JL. Cancer in Utah Mormon men by laypriesthood level. Am J Epidemiol 1982;116:243–57.
17. Koenig HG, Smiley M, Gonzales JP. Religion, health, and aging. New York: Greenwood Press, 1988.
18. U.S. Department of Health and Human Services. Nonpharmacological approaches to the control of high blood pressure. Natl. Inst. of Health, Bethesda (MD): 1993.
19. Lightfoot JT, Tankersley C, Rowe SA, Freed AN, Fortney SM. Automated blood pressure measurements during exercise. Med Sci Sports Exerc 1989;21:698–707.
20. Iyriboz Y, Hearon CM. Blood pressure measurement at rest and during exercise. J Cardiopulmon Rehab 1992;12:277–87.
21. Berenson ML, Levine DM. Basic business statistics. Englewood Cliffs (NJ): Prentice Hall, 1989:465–7.
22. Frohlich E, Grim C, Labarthe D, Maxwell M. Recommendations for human blood pressure determination by sphygmomanometers: report of a special task force appointed by the steering committee, Dallas: American Heart Association, National Center, 1987.
23. Folsom AR, Caspersen CJ, Taylor HL, Jacobs DR, Luepker RV, Gomez-Marin O, Gillum RF, et al. Leisure time physical activity and its relationship to coronary risk factors in a population-based sample: the Minnesota Heart Survey. Am J Epidemiol 1985;121:570–9.
24. Folsom AR, Jacobs DR, Caspersen CJ, Gomezmarin O, Knudsen J. Test–retest reliability of the Minnesota Leisure Time Physical Activity Questionnaire. J Chron Dis 1985;139:505–11.
25. Jacobs DR, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. Med Sci Sports Exerc 1993;25:81–91.
26. Anderson AJ, Barboriak JJ, Rimm AA. Risk factors and angiographically determined coronary occlusion. Am J Epidemiol 1978;107:8–14.
27. Pedhazur EJ. Multiple regression in behavioral research. Chicago: Holt, Rinehart & Winston, 1982:580–8.
28. National Center for Health Statistics. Hyattsville (MD): 1983. [Vital and health statistics, Series II, No. 226].
29. McArdle W, Katch V, Katch F. Exercise physiology: energy, nutrition and human performance, Philadelphia: Lea & Febiger, 1996:269–70.