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AN EPIDEMIOLOGIC INVESTIGATION OF THE RELATIONSHIP BETWEEN RELIGIOSITY, SELECTED HEALTH BEHAVIORS, AND BLOOD PRESSURE

by

Karen Avery Hixson

A Dissertation Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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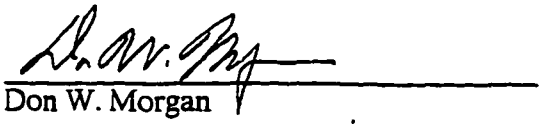
Approved by

Harvey William Gruchow



Don W. Morgan

KAREN AVERY HIXSON, Ph.D. An Epidemiologic Investigation of the Relationship Between Religiosity, Selected Health Behaviors, and Blood Pressure. (1996) Directed by Dr. Harvey William Gruchow and Dr. Don W. Morgan. 146 pp.

The purpose of this investigation was to examine both the direct and indirect relationships between various dimensions of religiosity (the quality of being religious) and blood pressure (BP). One hundred twelve UNC Greensboro and Salem College female alumni, living in Guilford and Forsyth Counties, who were 35 years or older and of Judeo-Christian faith, participated in the study. Following a 10-minute quiet rest period, three BP readings were taken with a validated Colins automated BP monitor at 5-minute intervals and the last two readings were averaged together. Height and weight were measured to determine body mass index. To measure religiosity, a 33-question multidimensional religiosity schedule (Koenig, Smiley & Gonzales, 1988), was utilized. A total religiosity score, as well as scores on nine dimensions (intrinsic religiosity, extrinsic religiosity, belief factor, religious well-being, organized religious activity, non-organized religious activity, religious knowledge, religious experience, and religious coping) were determined. Leisure time physical activity, smoking, an interactive dietary variable (K:Na X Ca), alcohol consumption and control variables (age, socioeconomic status) were abstracted from questionnaires.

Path analyses were conducted to determine the direct and indirect effects of religiosity on systolic blood pressure (SBP) and diastolic blood pressure (DBP). Multiple regression analyses were performed to estimate all path coefficients and provide estimates of the strengths of association along each path of the hypothesized model. The path analyses provided very little evidence of an effect of religiosity on BP through the intermediate health variables of alcohol intake, smoking index, diet, and physical activity. Rather, the direct effect of religiosity on BP was much more substantial, providing support for the hypothesis that religiosity may lower levels of BP by altering the perception of

stress or improving the ability to cope with stress. In considering which dimensions of religiosity exerted the greatest influence on blood pressure, intrinsic religiosity and DBP displayed the strongest relationship, followed by religiosity coping and DBP. Diastolic BP was found to be influenced more by religiosity than SBP. The analyses also indicated religious experiences may have a greater beneficial effect on DBP for the 50 to 64 year age group and 65 to 80 year age group compared to younger participants. In conclusion, this study supports a direct relationship between religiosity (particularly intrinsic religiosity, religiosity coping, and religious experiences) and BP rather than an indirect effect through health behaviors.

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
THE PROBLEM

Introduction

Hypertension, or high blood pressure, is considered a leading cause of death and disability and is a serious health problem affecting 58 million Americans or approximately 25 percent of the adult population (Kaplan, 1982; Tipton, 1991). Uncontrolled hypertension contributes to the onset of heart disease, stroke, and kidney disease (Jenkins, 1988). The most common complication of hypertension is coronary heart disease (CHD). Hypertensive individuals are two to four times as susceptible to CHD as normotensives. CHD may manifest itself as a heart attack or congestive heart failure. In the brain, hypertension may result in the rupture of blood vessels (hemorrhagic strokes). Hypertension is the single strongest risk factor for stroke. Hypertension may also cause kidney failure due to nephrosclerosis, or the narrowing of small vessels.

In addition to medical consequences, another consequence of hypertension is the substantial increase in health care costs for patients and employers. Approximately half of the people in the United States who are hypertensive are in the work force. Workers cost employers billions of dollars in earnings each year due to medical costs and sick leave related to high blood pressure (McLeroy, 1987).

Among risk factors identified, religion, a common and potent force in the lives of the majority of Americans, has been shown to have a positive effect on blood pressure (Graham, Kaplan, Cornoni-Huntley, James, Becker, Hames & Heyden, 1978; Larson, Koenig, Kaplan, Greenberg, Logue, & Tyroler, 1989; Scotch, 1963; Walsh, 1980). These studies, as well as numerous other epidemiologic studies on religion and health

(Koenig, Smiley, & Gonzales, 1988b; Levin & Vanderpool, 1987), suggest that an individual's spirituality or religiosity bears upon his or her physical well-being.

Four studies have examined church attendance as a measure of religion and its relation to blood pressure. Graham and associates (1978) observed a consistent association between frequent church attendance and lowered mean age-standardized systolic and diastolic blood pressure levels in white males. Similarly, Larson and his colleagues (1989) found that a religious importance variable considered separately and together with a frequency of attendance variable had an inverse association with systolic and diastolic blood pressure in a group of rural white males. In a cross-cultural investigation of rural Zulu communities, Scotch (1963) noted that more frequent church attendance was linked to a greater prevalence of normal blood pressure. Lastly, Walsh (1980) examined the impact of immigration on blood pressure and reported that blood pressures were lower for frequent church attenders when compared with infrequent attenders.

There are a number of possible explanations for the protective effects of religion on high blood pressure. Religion may have an indirect effect on blood pressure by influencing health behaviors. In epidemiological surveys among Seventh-Day Adventists (Armstrong, Merwyk & Coates, 1977), Mormons (Gardner & Lyons, 1982a, 1982b), and other Christian religions (Koenig, Moberg, & Kvale, 1988a), lower frequencies of adverse health behaviors, such as smoking and excessive alcohol consumption, and higher frequencies of positive health behaviors, such as engaging in physical activity and demonstrating good eating habits, were observed among religiously-active persons.

It has also been suggested that religion may exert a more direct effect on blood pressure. Religious involvement, for instance, may act as a coping mechanism in response to a perceived stressor (Koenig, Smiley & Gonzales, 1988b). Along these lines, it has been proposed that religion may reduce stress and despair (and hence, blood pressure) by providing socio-emotional support, making crisis intervention resources available, and

offering counseling and belief healing (Graham et al., 1978). Given this scenario, reduction in stress may decrease sympathetic nervous system activity and blood pressure (Benson, Kotch, Crassweller & Greenwood, 1977).

Purpose

The purpose of the proposed research is to identify direct and indirect relationships between religiosity (the quality of being religious) and blood pressure in women aged 35 and older. Religiosity will be measured as a multidimensional variable (Koenig et al., 1988b) rather than as a simple limited aspect of religion. The relationship between nine different dimensions of religiosity (intrinsic religiosity, extrinsic religiosity, belief factor, religious well-being, organized religious activity, non-organized religious activity, religious knowledge, religious experience, and religious coping), total religiosity and blood pressure will be examined. The indirect effects of religiosity on blood pressure will be isolated utilizing a path analysis statistical procedure. Employing this statistical procedure will allow for the examination of any remaining direct effect of religion as a coping mechanism. The indirect effects to be studied are the effects of religiosity on blood pressure through selected intermediate variables [alcohol consumption, smoking index, leisure time physical activity, and diet - specifically the interaction between calcium (Ca) intake and the potassium (K) to sodium (Na) ratio (K/Na X Ca)]. The following diagram illustrates this conceptual scheme:

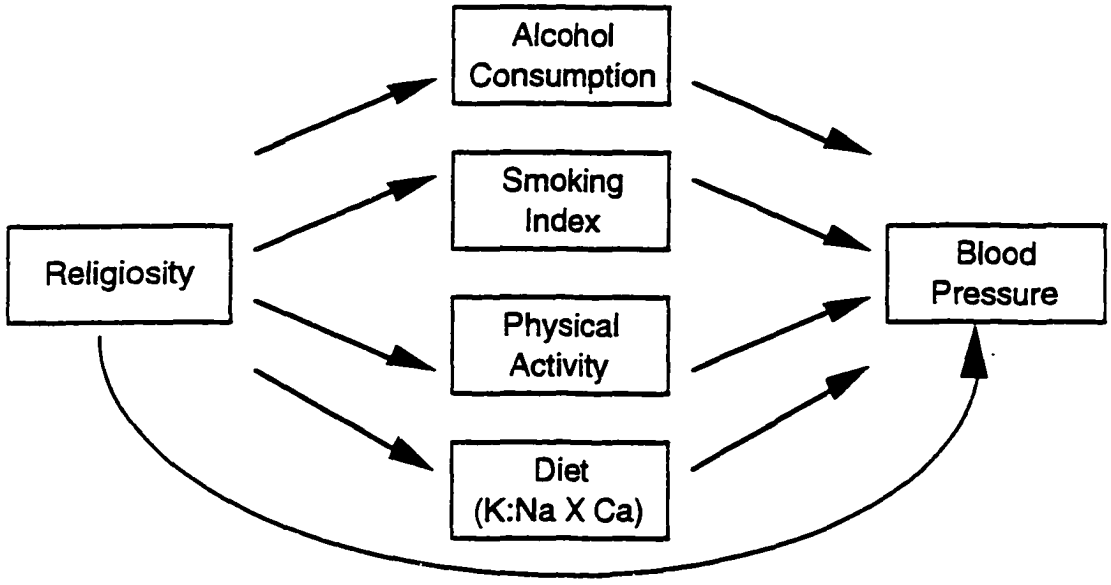


Figure 1. Path diagram of relationships between independent variables and blood pressure.

In this figure, the direct effect of religiosity is represented by the lowest arrow linking religiosity to blood pressure. Conversely, the indirect effects of religiosity are represented by the arrows linking religiosity to the intermediate variables (alcohol consumption, smoking index, physical activity, diet) and the intermediate variables to blood pressure.

Research Questions

Due to the exploratory nature of this research, a series of research questions are asked rather than stating several hypotheses. The following questions concerning the direct and indirect effects of religiosity on systolic and diastolic blood pressure will be answered:

1. Which pathway along the hypothesized model indicates the strongest relationship between religiosity and blood pressure?
2. Which pathway(s) exert a larger effect on blood pressure -- the indirect effects that religiosity may have through influencing health behavior, or the more direct effect of religiosity?

3. Which dimensions of religiosity are most strongly related to blood pressure?

Significance of this Study

The proposed study is significant for several reasons. Religion is a potentially potent force in people's lives and has been shown to be associated with blood pressure. Research on religiosity and health parameters typically focuses on church attendance or other limited aspects of religion. While simple, (and often superficial), indices of religion have been used to represent the total religious experience, this study measures religiosity as a multidimensional variable to better conceptualize the phenomenon. The relationship between different dimensions of religiosity and systolic and diastolic blood pressure will be examined.

Both direct effects of religiosity on blood pressure (through coping and stress reduction) and indirect effects of religiosity on blood pressure (through health behaviors) will be studied utilizing path analyses. No other study has examined the relationship between religiosity and blood pressure distinguishing between the direct and indirect effects.

One problem with previous studies in the area of religion and health is that analyses have been largely uncontrolled for extraneous variance. Conversely, the present study controlled potential confounders of blood pressure such as age, body mass index, and socio-economic status. Alcohol consumption, smoking, physical activity, and diet were measured and accounted for as intermediate variables in the conceptual scheme.

Previous studies on religiosity and blood pressure examined only males or included both males and females. More research is needed which specifically addresses women and coronary heart disease risk factors such as high blood pressure. Given this general underrepresentation in medical studies, the current investigation focused exclusively on women.

Definition of Terms

Belief Factor: the degree of acceptance of the prescribed doctrines of the Judeo-Christian religious tradition (Koenig, Smiley, & Gonzales, 1988b). Items 1 - 4 on the Springfield Religiosity Schedule (SRS) are included in this religiosity dimension.

Blood Pressure: the pressure of the blood on the walls of the arteries, dependent on the strength of the heart contraction, elasticity of the arterial walls, and volume and viscosity of the blood; the maximum or systolic pressure occurs near the end of the stroke output of the left ventricle, and the minimum or diastolic late in ventricular filling (Dorland, 1977).

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 (Koenig, Smiley, & Gonzales, 1988b). Items 24, 31, & 32 on the SRS.

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 (Koenig, Smiley, & Gonzales, 1988b). Religion is an active driving force, not just a tool used to reach self-serving ends (Batson & Ventis, 1982). Items 22, 23, 25 - 28, & 30 on the SRS.

Non-organized Religious Activity: religious activities of non-organizational nature such as private prayer, reading devotional literature, watching and listening to religious programs on television or radio (Koenig, Smiley, & Gonzales, 1988b). Items 8, 9, & 10 on the SRS.

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. (Koenig, Smiley, & Gonzales, 1988b). Items 5 & 6 on the SRS.

Religiosity: the quality of being religious; devoutness (Stein, Hauck & Su, 1979).

Religious Coping: ways in which religion acts as a resource to help deal with stress, problems or difficulties (Koenig, Smiley, & Gonzales, 1988b). Items 15 & 20 on the SRS.

Religious Knowledge: reflects knowledge about beliefs, writings, and rituals that comprise one's religious tradition (Koenig, Smiley, & Gonzales, 1988b). Item 11 on the SRS.

Religious Experiences: occasions defined by those undergoing them as an encounter -- some sense of contact -- between themselves and some supernatural consciousness. Four general types of religious experience have been postulated: (1) the *confirming* type, where one simply senses the existence of God; (2) the *responsive* type, where God responds to one's presence, i.e. answers prayers; (3) the *ecstatic* type, where mutual presence is replaced by an affectionate relationship akin to love or friendship; (4) the *revelational* type, where one perceives himself to be a confidant of or participant in God's plans and actions (Koenig, Smiley, & Gonzales, 1988b). Items 12, 18, 19, & 23 on the SRS.

Religious Well-being: religious satisfaction; a concept that cuts across all other dimensions of religion (Koenig, Smiley, & Gonzales, 1988b). Items 12 - 16, & 21 on the SRS.

Assumptions and Limitations

1. Subjects were asked not to smoke or ingest caffeine within 2 hours prior to blood pressure measurements. The researcher received verbal confirmation of this and can only assume that this instruction was followed. Failure of subject compliance to this instruction may have led to erroneous results.
2. Physical activity and smoking data were abstracted from a questionnaire and dietary intake values were evaluated from food frequency records. Consequently, these independent variables can only be regarded as estimates.

3. Generalization of the results are limited by several factors. Only female subjects age 35 and over, and of Judeo-Christian faith participated in the study. Also, subjects were self selected. Self selection can bias results if the characteristics of these individuals are not representative of all females.
4. Individuals who were on medication that could affect blood pressure were not included in the path analysis, because their unmedicated blood pressures were unknown. Exclusion of these individuals from the study sample may have influenced the results.
5. This investigation is linked to a theory that is based upon previous research. The model only includes variables for which there is current research support. In view of this, it is unlikely that all pertinent variables were included in the statistical analysis. Results of this study, therefore, should be considered only within the context of the proposed model.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

This chapter presents a review of selected literature pertaining to the direct and indirect effects of religion on blood pressure. Information will be presented in four parts: (1) an overview of religion in America, including a section on its measurement; (2) high blood pressure, with a special focus on its prevention and treatment; (3) the relationship between religion and blood pressure; and (4) a chapter summary.

Overview of Religion in America

Religion has been defined as the service and worship of God or the supernatural (Webster, 1977). David Moberg, one of America's foremost sociologists of religion, defines religion as "the personal beliefs, values, and activities pertinent to that which is supernatural, mysterious, and awesome, which transcends, immediate situations and which pertains to questions of final causes and ultimate ends of man and the universe" (Moberg, 1970, p. 175). Most of the knowledge about religion in the United States comes from national surveys by the Gallup Organization and the Princeton Religion Research Center. These surveys indicate that religion is a common and potent force in the lives of Americans, and there has been little change in religious indicators over the past 20 years (Princeton Religion Research Center, 1992). This section of the literature review will present an overview of Religion in America, including (a) importance of religion, (b) denominational preference, (c) membership figures, (d) religious practices , (e) religious beliefs, and (f) measurement of religiosity.

Importance of Religion

Religion is an important ingredient in the lives of many Americans. Recent Gallup Surveys on Religion in the United States (Princeton Religion Research Center, 1992) indicate that the American public believes religion has an increasing influence on American life, with 59% responding that religion is "very important", 34% responding that religion is "fairly important", and only 13% of Americans responding that religion is "not very important". Fifty seven percent of individuals surveyed believe that religion can answer all or most of today's problems, while 23% disagree and 20% are undecided. Those who are most inclined to believe that religion can answer today's problems are women, persons 50 and older, Southerners, Blacks, and evangelicals (Princeton Religion Research Center, 1987).

Denomination Preference

With respect to religious denomination or preference, 59% of Americans report they are Protestants, while 27% are Catholics, 2% are Jews, 4% are "other", and 8% report no preference. The stratification for Protestant Church preferences is as follows (Princeton Religion Research Center, 1987):

Baptist	20%
Methodist	9%
Lutheran	5%
Presbyterian	2%
Episcopal	2%
United Church of Christ (or Congregationalist, Evangelical, Reformed)	2%
Christian Church (Disciples of Christ)	2%
All other Protestants and unspecified Protestants	16%

Membership Figures

While over 90% of Americans report a religious preference, only about 70% of adults profess membership in a particular church or synagogue (Princeton Religion Research Center, 1987). A larger proportion of women (74%) than men (63%) report being members of a church. Church membership also increases progressively with age, with 61% of the youngest age group being members (18-24 years) and 77% of the oldest age group (65 and older) being members. Blacks (78%) are more likely to be church members than Whites and Hispanics (68%). By geographic area, Southerners are most likely and Westerners least likely to allege membership.

Religious Practices/Activities

Attending church and praying are two common religious activities. In 1986, 40% of adults attended church or a synagogue at least once in a typical week (Princeton Religion Research Center, 1987). Church attendance remained remarkably constant in the U.S. from 1969 to 1986. Churchgoing was higher for women (46%) than men (33%) in a typical week. Also, older persons were more likely to attend church. Southerners and Midwesterners were most apt to attend church on a weekly basis, while Hispanics and Blacks were slightly more apt to attend church than Whites.

Nearly 90% of Americans say they pray at least occasionally, and 19% say they pray three times a day or more. Other results from this study reveal that women pray more than men, older individuals pray more than younger individuals, Blacks pray more than Whites or Hispanics and Protestants pray more than Catholics (Princeton Religion Research Center, 1987).

Religious Beliefs

The Gallup findings indicate that 94% of American adults 18 years and older believe in God or a universal spirit (Princeton Religion Research Center, 1987). In addition, findings on the divinity of Jesus Christ indicate that 70% believe that in some

respects, we find the reality of God in Jesus Christ. Seventy percent of Americans also believe in heaven, while only 53% believe in hell.

Measurement of Religiosity

Religiosity refers to the quality of being religious (Stein et al., 1979). Problems with the measurement of religiosity have existed for a long time (Wilson, 1978, Koenig, Smiley, and Gonzales, 1988b). In order to examine the religiosity of an individual, a detailed instrument is needed to measure the diverse aspects of being religious. Unfortunately, a review of literature on the subject reveals that measurement of religiosity has been oversimplified in many studies (Wilson, 1978; Koenig et al., 1988b). Often, simple and superficial signs of religiosity, such as church attendance or church affiliation, have been used to represent the total religious experience. This is problematic, because people are religious in many different ways. For example, an individual may spend a great deal of time in private prayer, yet not attend church regularly. Also, using church attendance as a measure of religiosity can be misleading because the significance of church-going varies among denominations.

Over the past three decades, there has been a gradual recognition of the multidimensional nature of religion. Attempts to list and measure dimensions of religiosity began in the 1960s (Wilson, 1978). Fukuyama (1961) proposed a four-dimensional classification system consisting of organizational activity, doctrinal knowledge, doctrinal adherence, and extent of involvement in extrachurch life. Lenski (1963) also used four dimensions in his work: associationalism (frequency of attendance at worship services), communalism (choice of friends by religion), orthodoxy of belief (acceptance of the prescribed doctrines in the Judeo-Christian faith), and devotionalism (private prayer).

Glock and Stark's (1965) scheme of four dimensions has been given much attention and has been widely used. These four dimensions are 1) belief dimension, 2) experiential dimension, 3) ritual dimension, and 4) knowledge dimension. The belief

dimension, which Glock and Stark conclude is the most important dimension of religion, is similar to that of Lenski's. A second dimension, an experiential dimension, measures those feelings, perceptions and sensations experienced with a divine essence. Glock and Stark (1965) described four different types of experiences: (confirming, responsive, ecstatic, and revelational), all of which are defined in Chapter 1.

The ritual dimension measures more than just church attendance. Additional items include (1) watching religious television, (2) listening to religious services on the radio, (3) participating in Communion or the Lord's Supper, (4) attendance at midweek services or study groups, (5) financial support, (6) saying grace at meals, (7) Bible reading, and (8) private prayer. Glock and Stark's (1965) final dimension, knowledge, measures knowledge about church history or the scriptures. The knowledge dimension is independent of the belief dimension, as it is possible to believe without having extensive knowledge and to know without believing (Wilson, 1978).

In addition to the previously mentioned scales, a wide variety of other religious instruments have been developed which contain other religious dimensions. Spiritual well-being and satisfaction with religion, for example; are concepts developed by Moberg (1974) that cut across other dimensions. [According to Koenig et al. (1988b) the most well-known scale measuring spiritual well-being was developed by Paloutzian and Ellison (1982).]

Gordon Allport, a psychologist of religion, developed the concept of intrinsic and extrinsic religiosity, which encompasses other religious dimensions (Allport, 1950, 1954; Allport & Ross, 1967). In developing this concept, Allport's aim was to characterize the truly religious person. The intrinsic, or truly religious, person was seen as one who takes religion seriously and tries to put it into practice in daily life. This person internalizes religion and follows it fully. This person lives their religion (Allport & Ross, 1967). The extrinsic person, on the other hand, is one possessing a relatively superficial faith who

finds "religion useful in a variety of ways - to provide security, solace, sociability, and distraction, status and self-justification" (Allport & Ross, 1967, p. 434). Allport's 20-item scale to measure extrinsic- and intrinsic-oriented individuals received criticism from Hunt and King (1971) as being too unstable and diffuse to be used for research. Hoge (1972) considered these criticisms and developed a clearer and more easily usable 10-item scale which correlates highly with Allport's scale (Koenig et al., 1988b).

Being frustrated in attempts to find in the literature a suitably detailed multidimensional instrument to examine religious characteristics of older individuals, Koenig and his colleagues at Duke University designed their own instrument, which they called the Springfield Religiosity Schedule (SRS) (Koenig et al., 1988b). The aim of the SRS was to capture as many dimensions of religion as possible. Christianity was chosen as the religious tradition on which to base the contents of the instrument because over 90% of Americans are of Judeo-Christian faith. The resulting instrument was comprised of eight dimensions which were borrowed from a variety of religiosity scales in existence and a ninth dimension, religious coping, which Koenig et al. (1988b) created.

Koenig's instrument, (see Appendix A), is one of the most comprehensive instruments available. The dimensions included are as follows:

Dimension 1 (RD1) Intrinsic religiosity

Dimension 2 (RD2) Extrinsic religiosity

Dimension 3 (RD3) Belief factor

Dimension 4 (RD4) Religious well-being

Dimension 5 (RD5) Organized religious activity or rituals

Dimension 6 (RD6) Non-organized religious activity or rituals

Dimension 7 (RD7) Religious knowledge

Dimension 8 (RD8) Religious experience

Dimension 9 (RD9) Religious coping

Although the SRS was originally designed for use with older populations, Koenig (personal communication, March 3, 1994) believes it is a valid scale for use with both young and old adults. The SRS was administered to 87 pastors of all ages (mean age of 47) in a validation study. Mean scores obtained on three different subsets of questions (organizational religious activities, non-organizational 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 (Koenig et al., 1988b). Reliability was tested by computing Cronbach's alpha for the data collected from surveying a sample with the SRS. Cronbach's alpha ranged from .61 to .87 for different parts of the schedule. Test-retest reliability was determined with 11 subjects and revealed an overall agreement of 91.7% (Koenig et al., 1988b).

Summary

Information provided by the Princeton Religion Research Center reveals that religion remains an important aspect in the lives of Americans. A review of the literature regarding instruments to measure religiosity reveals a hodgepodge of instruments, all purporting to measure various aspects of religiosity. Most of the instruments measure only limited aspects of religion. Koenig et al's (1988b) instrument, however, is comprehensive and considers the multidimensional nature of religion. It allows the researcher to separate out various attributes of religious behavior and derive a total religiosity score.

High Blood Pressure

This portion of the literature review will examine high blood pressure and factors which influence it. Specifically, the following sections will be presented: (1) definition, classification, and basic epidemiology and physiology of hypertension; and (2) prevention and treatment of hypertension. The latter section will focus on non-pharmacologic

approaches to the control of blood pressure, including weight reduction, diet, alcohol consumption, smoking, caffeine, exercise and stress reduction.

Definition, Classification, Basic Epidemiology and Physiology of Hypertension

High blood pressure, or hypertension, refers to the elevation of systolic and/or diastolic blood pressure (Berkow & Fletcher, 1992). Hypertension is a serious health problem. It has been identified as one of the leading causes of death and disability in the United States (Kaplan, 1990). Hypertensives face the prospect of shorter life spans as well as heart failure, renal failure, vascular lesions in the central nervous system, brain, or kidney, and myocardial infarctions (Tipton, 1991).

Hypertension has been classified as either primary (essential or of unknown etiology) or secondary (Tipton, 1984). More than 90% of hypertension cases are of unknown etiology. Less than 10% are secondary, meaning that the disease may be associated with specific medical complications such as renal disease, Cushing's syndrome, primary aldosteronism, narrowing of the aorta, hyperthyroidism, pheochromocytoma, and corticoid hypersecretion.

In 1988, it was estimated that 58 million Americans were hypertensive (approximately 25% of American adults). This number is likely to increase if more effective intervention programs are not implemented (Tipton, 1991). The U.S. Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (1988) has recommended that a diagnosis of hypertension be confirmed when the average of at least two subsequent diastolic measurements is equal to or greater than 90 mmHg. The Committee developed the following guidelines to be used when classifying blood pressure in adults (U.S. Department of Health and Human Services, 1993):

Table 1*

Classification of Blood Pressure in Adults Aged 18 Years and Older

Category	Systolic (mmHg	Diastolic (mmHg)
Normal	<130	<85
High Normal (Borderline)	130 - 139	85 - 89
Hypertension		
Stage 1 (Mild)	140 - 159	90 - 99
Stage 2 (Moderate)	160 - 179	100 - 109
Stage 3 (Severe)	180 - 209	110 - 119
Stage 4 (Very Severe)	≥ 210	≥ 120

*(U.S. Department of Health and Human Services, 1993)

The prevalence of hypertension increases with age and is especially prevalent in lower socioeconomic groups (U.S. Department of Health and Human Services, 1993). Prevalence of high blood pressure is higher in men than women during young adulthood and early middle age; thereafter, the reverse is true (U.S. Department of Health and Human Services, 1993). Individuals who live in the southeastern United States have a greater incidence of hypertension and greater stroke death rates than individuals in other areas of the country (Rocella & Lenfant, 1989). Blacks experience higher prevalence rates (37% of adults) than Whites (18%) (Berkow & Fletcher, 1992).

The basic physiological relationship concerning blood pressure can be stated as follows (Berkow & Fletcher, 1992): Mean Blood Pressure = Cardiac Output X Total Peripheral Resistance. Mean Blood Pressure refers to the result of adding systolic blood pressure to the product of two times the diastolic pressure and dividing the sum by three. Whatever the mechanisms are which underlie hypertension, they must either produce an increase in total peripheral resistance or an increased cardiac output. Factors which alter cardiac output will simultaneously cause a change in mean blood pressure. An increase in either stroke volume (blood volume/beat) or heart rate can increase blood pressure.

Conditions that alter the resistance to blood flow, such as changes in the dimensions of vessels, will also cause blood pressure to change (Tipton, 1988).

Blood pressure is influenced by many conditions, including family history, age, sex, race, and such environmental factors as obesity, sodium, potassium, calcium, fish oil, smoking, caffeine, alcohol, exercise, and stress. Each of these environmental factors which contribute to hypertension will be discussed in the following section on prevention and treatment of high blood pressure.

Prevention and Treatment of Hypertension

It is beyond the scope of this literature review to comment in detail on antihypertensive drug therapy. The main focus of this section will be on non-pharmacological treatments and prevention. However, a brief summary of the steps most commonly used in drug therapy of hypertension will be presented below, and are described in detail elsewhere (Berkow & Fletcher, 1992). The step therapy model recommends that non-drug treatment be tried first, particularly in borderline hypertensive cases. If this treatment fails, then the following steps are used:

1. Treatment is usually started with an oral diuretic, a beta blocker, a calcium antagonist or angiotensin converting enzyme (ACE) inhibitor.
2. If Step 1 does not adequately control the hypertension, the dosage of the first drug is increased, another drug is used, or a second drug is given.
3. A substitute second drug is given or a third drug is added.
4. A third or fourth drug is added.

Various non-drug therapies have been shown to reduce blood pressure in most hypertensive individuals. Those with mild hypertension may be able to abstain from drug use, while those with more severe hypertension may be able to reduce medication dose when adopting a non-drug therapy (Kaplan, 1990). The next section describes various non-drug therapies. The following non-drug modalities will be included in this discussion:

weight reduction, sodium restriction, potassium supplementation, calcium supplementation, fat and fish oil intake, caffeine restriction, smoking cessation, alcohol consumption, exercise, and stress reduction techniques.

Weight Reduction

There is a strong association between being overweight (excess fat in the upper body in particular) and the prevalence of hypertension and between the incidence of hypertension and weight gain (Chiang, Perlman, & Epstein, 1969; Kaplan, 1990). In the Framingham offspring study, (Garrison, Kannel & Stokes, 1985) adiposity was a major controllable contributor to hypertension, with estimates of 78% of hypertension in men and 64% in women attributable to obesity. The mechanism by which obesity leads to hypertension most likely involves an increase in blood volume, stroke volume, and cardiac output (Raison, Archimastos, Asmar, Simon, & Safar, 1986). Other hypothetical mechanisms which may explain the correlation between body weight and blood pressure include (Staessen, Fagand, & Amery, 1985; Kaplan, 1990): a) hyperinsulinemia associated with obesity which may induce hypertension via renal sodium retention, b) catecholamine release, or vascular smooth muscle hypertrophy, which may increase peripheral resistance, and c) increased sympathetic tone which increases peripheral resistance and possibly increases tubular reabsorption of sodium.

There is evidence that weight reduction will lower established hypertension (Clarke, Woolson & Lauer, 1986; Fagerberg, Anderson, Isaksson, & Bjorntorp, 1984; Reisen, Abel, Modan, Silverberg, Eliahou, & Modan, 1978; Staessen, Fagard, Lynen, & Amery, 1989; Tyroler, Heyden, & Hames, 1975; MacMahon, Macdonald, & Bernstein, Andrews & Blacket, 1985). When Staessen et al. (1989) combined the results of the four most adequately controlled studies that he reviewed on weight reduction and blood pressure, the mean effect of a 1 kg fall in body weight was a 1.6 and 1.3 mmHg fall in systolic and diastolic pressures, respectively. In general, a decrease in blood pressure is seen before

normal weight is achieved. In addition, the blood pressure reduction after weight loss remains reduced, as long as there is no marked regain of body weight (Staessen et al., 1985). Possible mechanisms that contribute to the fall in blood pressure that accompanies weight loss include (1) a sodium diuresis (Krieger & Landsberg, 1989); (2) a fall in sympathetic nervous activity (Fagerberg, Anderson, Persson, & Hedner, 1985); and (3) a fall in plasma insulin (Rocchini, Katch, Schork, & Kelch, 1987).

Sodium Restriction

Although it is by no means proven that excess salt (sodium chloride) intake contributes to hypertension, there is general agreement that salt plays a role among some individuals (Kaplan, 1990). Evidence of a function for excess sodium chloride includes studies involving primitive people from different parts of the world who do not eat sodium. Individuals in these primitive cultures have little or no hypertension, nor does their blood pressure rise with age, as seen with civilized cultures. For example, the Yanomamo Indians of northern Brazil have an average blood pressure of 107/67 for men and 98/62 for women aged 40 to 49 (Oliver, Cohen, & Neel, 1975). In another example, New Guinea villages, where salt intake is also low, have a very low incidence of hypertension (Simpson, 1978). Inter-population correlational studies have demonstrated a positive relationship between sodium intake and blood pressure (Kesteloot & Joossens, 1988; Poulter, Shipley, Bulpitt, Markowe, & Marmot, 1988. In studies of animals with a genetic predisposition, exposure to sodium leads to hypertension . The more sodium in the diet, and the earlier it is added to the diet, the higher the blood pressure (Louis, Tabei, & Spector, 1971).

The possible mechanism(s) by which elevated dietary sodium may contribute to higher blood pressure is not clear. It has been suggested that high sodium intake may lead to increased plasma volume, to diminished renal function, to a hyperadrenergic state, or to

a combination of these outcomes, any of which can increase vascular pressures (Kaplan, 1990).

Modest restriction of dietary sodium intake to 70 to 100 mmol/day (about half the usual intake) has been shown to lower systolic and diastolic blood pressure by 4 to 8 mmHg (Staessen et al., 1989). In an attempt to determine the level of sodium restriction needed for an antihypertensive effect, MacGregor, Markandu, Best, Elder, Cam, Sagnella, & Squires, (1989) gave three levels of sodium, 50, 100, or 200 mmol/day each for 4 weeks, to 20 mild hypertensives in a double-blind, randomized, crossover study. With the level of 200 mmol/day as the comparison, blood pressure fell 16/9 mmHg on the 50 mmol/day intake and 8/5 mmHg on the 100 mmol/day intake. It appeared that in order to obtain the best effect, sodium intake should be reduced as much as possible.

Potassium Supplementation

Many of the benefits of reduced sodium intake could be related to an increased potassium intake (Kaplan, 1990). In an attempt to restrict sodium, high sodium-low potassium processed foods are usually replaced with low sodium-high potassium foods. It is interesting to note that the high ratio of sodium to potassium in the modern diet is the reversal of the ratio of the diet consumed by our ancestors which was low in sodium and high in potassium. There is compelling evidence for considering the combined effects of low sodium and high potassium on lowering blood pressure (Meneely & Barrarbee, 1976; Haddy, 1987).

Evidence that potassium itself may protect against high blood pressure include correlational studies between blood pressure and potassium (Reed, McGee, Yano, & Kankin, 1985; Dai, Kuller, & Miller, 1984) and the observation that vegetarians have high potassium intakes and low blood pressure (Ophir, Peer, Gilad, Blum, & Aviram, 1983). Possible mechanisms involved in the lowering effect of potassium on blood pressure

include a natriuretic action and a dampening of vasoconstriction due to an inhibition of the Na^+:K^+ pump (Kaplan, 1990).

Calcium Supplementation

Calcium intake may be lower among hypertensive individuals than normotensives (McCarron, Morris, Henry, & Stanton, 1984; Reed et al., 1984). Although McCarron et al. (1984) presented an analysis of the First National Health and Nutrition Examination Survey, (NHANES I) data, there may have been numerous methodological problems with that presentation (Kaplan, 1990). In a reanalysis of the data by Gruchow and colleagues (1985) as well as an analysis of NHANES I and II by Sempos et al. (1986), the conclusions were different. Specifically, sodium was deemed a more important dietary element for increased blood pressure than calcium and dietary calcium was a significant predictor of blood pressure only in nonwhite men (Gruchow, Sobocinski, & Barboriak, 1988). Calcium supplements may lower blood pressure in some mild to moderate hypertensive patients (McCarron & Morris, 1985). However, in another study (Thomsen, Nilas, & Christiansen, 1987), calcium therapy did not appear to lower blood pressure.

The results concerning calcium and blood pressure are equivocal. This may be due to (1) methodological problems; (2) the possibility that only individuals that have lower plasma ionized Ca^{+2} levels due to increased urinary calcium secretion respond to calcium supplementation (Kaplan, 1990), or (3) the interaction effect between Ca^{+2}, Na^+, and K^+ may be more important than the effect of calcium alone (Gruchow et al., 1988).

Gruchow and colleagues (1988) studied the relationships of dietary sodium, potassium, and alcohol to blood pressure in relation to levels of dietary calcium intake, using the NHANES I data. At low Ca^{+2} intakes (<400 mg/d for men and <800 mg/d for women) the ratio of Na^+ to K^+ (Na:K) was significantly related to blood pressure after controlling for age, body mass index, race and gender. At higher Ca^{+2} intakes, the Na:K was not related to blood pressure. The Na:K was more strongly related to blood pressure

than either Na^+ or K^+ alone. For the Na:K and blood pressure relationship to be evident, low Ca^{+2} intakes were necessary. These results concerning the interaction of Na^+, K^+, and Ca^{+2} in relation to blood pressure were evident across all race and gender groups.

The exact mechanism by which elevated Na:K in the absence of adequate Ca^{+2} may contribute to high blood pressure is unclear. Ca^{+2} levels appear to affect membrane stability and peripheral resistance, and may be related to the active and passive transport of fluids, sodium, and potassium (Morgan & Morgan, 1984; Parrot-Garcia & McCarron, 1984).

Dietary Fat and Fish Oil

Sacks (1989) reviewed the literature on blood pressure and dietary fat intake. He concluded the following:

> Comparisons of blood pressure patterns among populations suggest that low-fat diets or consumption of unsaturated fatty acids decrease blood pressure. However, in most single populations dietary fatty acids and total fat, as determined by diet history, are not significantly correlated with blood pressure. Dietary fatty acids and total fat were not predictive of the development of hypertension over four years in a large cohort of nurses in the United States. Although several dietary trials lacking randomized controls suggested effects of dietary fats on blood pressure, 11 of 12 controlled trials showed no significant effects. All seven double-blind trials, and the two trials of longest duration (one and five years), showed no effect of either varying the content of total fat or of exchanging polyunsaturated for saturated fatty acids. In summary, there is little convincing evidence that the amount or type of dietary fat, varied within customary dietary patterns, affects blood pressure levels in persons with normal or mildly elevated blood pressure. (Sacks, 1989, p. 291)

There is some evidence, however, that the omega-3 polyunsaturated fatty acids found in cold water fish are able to lower blood pressure and decrease platelet aggregation, presumably by altering the production of prostaglandins (Kaplan, 1990). In one interesting study, Knapp and FitsGerald (1989) examined the effects of small (3g) and large (15g) amounts of n-3 fatty acids from fish oils versus a mixture of oils that approximated the fats

present in the American diet and n-6 fatty acids from sunflower oil. The investigators found a drop of 6.5 mmHg and 4.4 mmHg for systolic and diastolic blood pressures respectively, in the fish oil group versus the other groups.

Caffeine

Blood pressure increases 5 to 15 mmHg within 15 minutes after consumption of 250 mg of caffeine (two to three cups of coffee). This elevation in blood pressure may last as long as 2 hours (Robertson, Hollister, Kincaid, Workman, Goldberg, Tung, & Smith, 1984). Some epidemiologic surveys do not show a relation between chronic caffeine ingestion and hypertension (van Dusseldorp, Smits, Thien, & Katan, 1989). Some studies, however, show a hypertensive effect of caffeine (Freestone & Ramsey, 1982; Smits, Thien, & Larr, 1985). A rise in blood pressure due to caffeine is likely mediated by catecholamine release and a rise in cardiac output (U.S. Department of Health and Human Services, 1984).

Smoking Cessation

Smoking, like caffeine, is known to acutely raise blood pressure. Chronic smoking, however, is not associated with higher levels of blood pressure or a higher frequency of hypertension (Ballantyne, Devine, & Fife, 1978). Nevertheless, smokers have higher rates of death from hypertension than non-smokers. In addition, there is a five-fold greater incidence of malignant hypertension among smokers (WRI, 1983). These associations may reflect the adverse effects of toxins in smoke on the vascular system, which in turn affect blood pressure.

Alcohol Consumption

Heavy alcohol consumption of more than one to two ounces of ethanol per day is associated with a higher prevalence of hypertension and has been shown to produce an acute pressor action. The association has been documented in over 32 cross-sectional studies involving various ethnic groups, in at least seven longitudinal studies, and in

numerous intervention trials of either administration or withdrawal of alcohol. (Keil, Swales, & Grobbee, 1993; Potter, Macdonald, & Beevers, 1986; Shapiro & Goldstein, 1982). Researchers have suggested that up to 10% of hypertension could result from alcohol consumption. In one alcohol reduction study (Pudley, Parker, & Vandogen, 1989), reducing alcohol intake from 537 ml to 57 ml was associated with a 6.7 mmHg and 4.0 mmHg fall in systolic and diastolic blood pressure, respectively. The pressor effect of alcohol is likely to be mediated by an increase in cardiac output secondary to elevations in plasma cortisol, epinephrine, and norepinephrine levels (U.S. Department of Health and Human Services, 1984).

It is interesting to note that although there is more hypertension among heavy drinkers, there is evidence there may be less hypertension among moderate drinkers, who drink two or less drinks per day. In addition, moderate consumption of alcohol has been associated with a lower mortality and morbidity rate from coronary disease than either abstinence or higher amounts of alcohol intake (Burr, 1988).

Aerobic Exercise Training

Resting blood pressure is usually lowered following chronic aerobic exercise. Regularly repeated aerobic exercise is likely to be important in the prevention and management of hypertension (Tipton, 1991). Both epidemiologic and longitudinal investigations support the beneficial effects of exercise on blood pressure.

Epidemiologic studies investigating chronic exercise and hypertension typically establish a relationship between an index of physical fitness and the presence of the future development of hypertension. One of the most cited and impressive epidemiologic studies is by Paffenbarger and his colleagues (1983). Their research reported the resting blood pressure findings of approximately 15,000 male alumni from Harvard University who entered college between 1916 and 1950 and were followed from 1962 to 1972. These researchers found that alumni who did not participate in vigorous athletics as students had a

35% greater risk of developing hypertension than those who engaged in vigorous athletic activity. They concluded that vigorous physical activity is associated with a reduced risk of hypertension.

In another important investigation, Blair et al., (1984) studied the association between aerobic fitness levels and the risk of developing hypertension. More than 6000 normotensive males and females between the ages of 20 and 65 years participated in this investigation. During a follow-up period ranging from 1 to 12 years, 240 individuals developed hypertension. Individuals assigned low fitness scores had a relative risk of 1.52 (incidence rate of low-fit individuals/incidence rate of high-fit individuals) for becoming hypertensive compared with those assigned high fitness ratings. In interpreting these findings, it should be noted that these data were adjusted for sex, age, body mass index, and baseline values.

Darga et al. (1989) conducted a survey of 1269 members of American Joggers Association and 683 members of the American Medical Association. The joggers ran an average of 10 miles per week while the medical professionals were non-runners. The two groups were similar with regard to age, sex, and socioeconomic status. The researchers reported normal blood pressure in 93% of the joggers compared to 81% of the non-runners. They also found that approximately five times as many non-runners as runners were on or had been taking blood pressure medication.

In addition to epidemiologic studies, many longitudinal investigations provide support for the concept that chronic exercise is beneficial in lowering resting blood pressures (Tipton, 1991). Both animal and human research has shown that regular moderate exercise programs (40 - 65 percent of maximal oxygen uptake or 60 - 80 percent of maximal heart rate) are effective in decreasing resting blood pressure in hypertensive individuals (Hagberg, 1990; Tipton, 1991). Interestingly, when hypertensive rats were exercised at a high intensity (80 - 95 percent of maximal oxygen uptake), resting blood

pressures were increased (Tipton, Matthes, Marcus, Rowlett, & Leininger, 1983) even though other indices of a training effect were reported. Furthermore, when the training intensity was reduced to 40 to 70 % maximal oxygen consumption, the trained rats exhibited resting blood pressures that were lower than control values. Consequently, one of the reasons why aerobic exercise training is not always associated with lowered resting pressures could be that the exercise intensity being prescribed is too high. Therefore, moderate aerobic exercise is usually recommended for people with hypertension. Examples of this type of activity include walking, jogging, swimming, cycling, or aerobic dance performed for approximately 30 minutes or more three days per week at moderate intensities (Tipton, 1991).

Hagberg (1990) published a meta-analysis of 25 longitudinal studies examining the effects of aerobic training on hypertension. In these investigations, sample size ranged from 4 to 66 subjects, age ranged from 15 to 70 years, and training duration ranged from 4 to 52 weeks. Results from the meta-analysis indicated an average baseline resting blood pressure of 150/92, with training reducing the systolic and diastolic blood pressures by 10.8 mmHg and 8.2 mmHg, respectively. Statistically significant decreases in systolic blood pressure occurred in 67% of the studies, while 70% noted a statistically significant decrease in diastolic blood pressure following training.

In his meta-analysis of 25 endurance training studies, Hagberg (1990) noted subsets of hypertensive subjects that did not exhibit a reduction in their resting blood pressure after participating in an exercise program. In addition to aspects related to program compliance, exercise prescription, and heredity, Hagberg's discussion included several possible explanations of this "non-response" to exercise training (Tipton, 1991). Some individuals, for instance, may have an exaggerated pressor response to acute exercise while others may have an increased resting adrenergic tone, or some may have altered cardiac mechanics.

Recently, Kelly and Tran (1995) published a meta-analysis of 35 human clinical training studies on aerobic exercise and blood pressure in normotensive adults. They concluded that aerobic exercise results in small reductions in resting systolic and diastolic blood pressure in normotensive adults. It should be noted, though, that several potential problems with these studies were discussed. Weaknesses mentioned included weight loss as a confounder, lack of randomization in 60% of the studies, over-reliance on male subjects, and incomplete reporting of blood pressure measurement techniques.

It seems likely that exercise is effective in lowering blood pressure in some individuals. It is presumable that more than one physiological mechanism is involved. Of all the mechanisms mentioned by investigators in Tipton's (1991) review of 60 human and animal longitudinal studies, the sympathetic nervous system was cited most frequently. There is considerable evidence that the activation of the sympathetic nervous system is reduced with endurance training. This reduction, along with an increase in the activation of the parasympathetic nervous system, will lower cardiac output by lowering resting heart rate and/or by reducing vascular resistance. Endurance training may also increase elimination of sodium by the kidneys (Nomura, Kumagai, Midorikhwa, Kitano, Tashiro, & Toshima, 1984; Tipton et al., 1983). This will promote fluid loss from the body which, in turn, promotes a decline in blood pressure.

As mentioned previously, being overweight contributes to hypertension. Exercise may indirectly cause an antihypertensive effect by contributing to a caloric deficit and weight loss. This may reduce the activity of the sympathetic nervous system resulting in lower cardiac output and decreased vascular resistance. In addition, fat loss is associated with lower plasma insulin levels which may contribute to lower blood pressure via reduced sympathetic activity and increased sodium excretion (Edwards, 1987).

Endurance training has also been shown to alter the function of the pressure receptors that help control blood pressure (Tipton, 1991). It has been postulated that

arterial baroreflex control of blood pressure is attenuated by exercise training and this change decreases the sympathetic traffic associated with the baroreflex. Whether this change is possibly due to baroreceptor resetting is unknown (Bedford & Bishop, 1987). It has also been speculated that the attenuated effect of training on the arterial baroreflex is the result of an enhanced inhibitory effect by the cardiac afferents and not by a change per se in the arterial baroreflex (DiCarlo & Bishop, 1970).

Many hypertensive individuals have personalities and behaviors that are very responsive to states of anxiety, stress, frustration, and apprehension (Tipton, 1984). Any intervention that can reduce these emotional and psychological conditions may contribute to a lowered resting blood pressure. There is considerable evidence that exercise may contribute to a reduced response to stress and/or a faster physiological recovery from stress (Crews & Landers, 1987), and therefore help control blood pressure.

Stress Reduction

In order to understand the role of stress reduction techniques in the control of blood pressure, the ensuing section will a) define the concept of stress, b) examine the relationship between stress and hypertension, and c) present evidence that stress reduction techniques can lower resting blood pressure.

Stress.

A pioneer in the area of stress research, Selye (1975) defined stress as the nonspecific response of the body to any demand made upon it. He distinguished the stress-producing factor, or stressor, from the stress response itself. Stress results from any action or situation that unbalances a person's equilibrium, whether negative or positive. Divorce, a death in the family, the loss of a big account at work, getting married, the birth of a baby and starting a new job are all stressful events that can place demands on an individual's ability to adapt to change.

Chronic stress is manifested both psychologically and physiologically, and can lead to a multitude of stress-related problems and psychological manifestations of stress including tension headache, insomnia, and anxiety. Chronic conditions such as asthma and diabetes can be aggravated by stress. Studies on both laboratory animals and humans have established a clear link between stress and major illnesses such as hypertension, heart disease, and cancer (Pratt, Wood, & Alman, 1988).

The presence of stress should not always be considered negative. Studies have shown that the absence of stress, such as during sensory deprivation or isolation, can be as harmful as stress overload. Individuals who lack stimulation may suffer from a stagnation disease such as depression or a digestive disturbance (Pratt, Wood, & Alman, 1988).

In order to understand the relationship between stress and hypertension, it is necessary to first have a basic understanding of the physiology of the stress response. Selye's (1956) theory of non-specificity states that in addition to their specific effects, all stressors provoke the same biochemical reactions in the human body. Thus, the effect of a stressor is not dependent upon its origin, but rather, on its perception and the intensity of the demand made on the body to adapt to the situation and maintain the equilibrium of the internal environment.

The sequence of changes that the body undergoes in response to a stressor is named the general adaptation syndrome, or GAS (Selye, 1956). It consists of the following three stages:

STAGE 1: The alarm reaction. The autonomic nervous system reacts by releasing stress hormones epinephrine and norepinephrine that increase heart rate and blood pressure and increase flow of blood and oxygen to the muscles. This alarm reaction prepares the body for vigorous action and has been called the "fight or flight" response by physiologist, Cannon (1953).

STAGE 2: Resistance. The organism applies various coping mechanisms and typically achieves suitable adaptation. During this stage, there is a relatively constant resistance to the stressor, but there is a decrease in resistance to other stimuli.

STAGE 3. Exhaustion. Prolonged exposure to stress destroys the body's ability to adapt. Symptoms similar to those of the first stage reappear, but this time they are irreversible. Once adaptation energy is exhausted, the organism experiences disease or death.

Following the popularization of Selye's research on stress, Lazarus (1966) and others added a psychological dimension to the stress concept. The notion of psychological appraisal (i.e., that the stress process can be initiated or influenced by psychological events) was not inconsistent with Selye's model, but historically, physiological and psychological research were not combined (Gatchel, Baum, & Krantz, 1989). Lazarus (1975) emphasized the role of perception and cognitive appraisal in the stress response. He believed that unless a situation is perceived as threatening, stress will not be experienced. For example, if one fails an examination, a number of factors will enter into the appraisal of the event. One may consider whether the failure will count toward the grade, whether the failure was personal or the fault of a bad test, how the failure affects your self-esteem, or the extent to which concern about grades or tests is registered. If the failure does not count toward the grade or there is no concern for performance, stress will not be manifested. However, if the failure is perceived as threatening, stress will be present (Gatchel et al., 1989).

Following appraisal of a stressor, if a situation is judged to be threatening, attention is turned to the dangers or benefits of different modes of coping. Coping behavior is an important part of the stress response. Lazarus proposed that stress responses can take manipulations of accommodative forms (Lazarus & Folkman, 1984). Coping includes:

1 Direct Action Response, where the individual tries directly to manipulate of alter his or her relationship to the stressful situation. One may flee or change the physical presence of the stressor.

2 Seek information about the situation to better understand and predict events.

3 Inhibition of Action or doing nothing may be the best course of action in some situations.

4 Intrapsychic or palliative coping, where the individual accommodates the stressful situation by reappraising the situation or by altering one's internal environment. Examples of this type of coping include using alcohol, taking drugs, learning to relax, engaging in meditation or prayer, and creating or using psychological defense mechanisms.

In addition to styles of coping with stress, psychological supports and assets will affect response to stressors and ultimate consequences of exposure to them (Baum, Singer, & Baum, 1981). Social support, the feeling that a person is cared about and valued by other people and that he or she belongs to a social network, is a mediator of stress (Cobb, 1976). People need a sense of belonging, social caring, love, and nurturing (Fromm, 1955). People derive many kinds of social support from each other. Examples of social support include: a) esteem support, which refers to the effects of other people in increasing feelings of self-esteem; b) information support, which refers to acquiring necessary support from social interactions; c) social companionship, which refers to support derived from social activities; and d) instrumental support, which refers to the physical aid one can get from friends (Wills, 1985).

Several mechanisms by which stress is mediated by social support have been offered. Cobb (1976) notes that social support can help people to be flexible and alter roles and identities as stressors demand. Schachter (1959) considered the role of affiliation in

reduction of distress. Social support may affect the degree to which an event is viewed as stressful or may help in choosing a positive way of coping with the stressor.

Finally, control is another important mediator of stress. Control is one of the most basic processes in daily interactions with the environment and other people. The desire for control has been referred to as "effectance motivation" (White, 1959) and is thought of as an innate need. Bandura (1977) also described an inherent gratification accompanying a sense of control. He described self efficacy as the belief that one can do what is necessary to obtain desired outcomes. Research on both humans and animals has shown clearly that being able to control a stressful event, believing that one can control the event, or perceiving that one can control other aspects of the environment can reduce the impact of a stressor (Gatchel et al., 1989).

Stress and hypertension.

There is considerable evidence that stress is another environmental factor that may lead to hypertension. Certain traumatic events have been linked to elevations in blood pressure. Soldiers who spent a year in desert warfare, for instance, exhibited unexpectedly high blood pressures lasting for one to two months after retirement from combat. Constant exposure to job stress has also been associated with elevated blood pressure. A four fold higher incidence of hypertension has been found among air-traffic controllers, a group involved in high stress, compared with second-class airmen, who are subjected to less stress. Other studies have shown that constant exposure to industrial noise on the job can lead to high prevalence of hypertension (Shapiro & Goldstein, 1982). Individuals undergoing job loss experience elevations of blood pressure which increase with the length of time unemployed. Hypertension rates are also higher among residents of areas characterized by the stresses of economic deprivation, family instability, crowded living circumstances, and crime (WRI, 1983).

Whenever people are faced with stressful situations, the involuntary response, or "fight or flight" response is activated. This response is associated with increased sympathetic nervous activity that is manifested as increases in blood pressure, heart rate, respiratory rate, metabolism and skeletal blood flow. The continual stresses of modern living may lead to the excessive and inappropriate arousal of the "fight or flight" response. The behavioral features of this response, which are running or fighting, are often unsuitable. Constant unnecessary arousal of the sympathetic nervous system is likely to have a role in the pathogenesis of several disorders, including hypertension (Benson, Kotch, Crossweller & Greenwood, 1977).

The primary mechanism involved in the effect on blood pressure by environmental stress is neural (U.S. Department of Health and Human Services, 1984). The brain and central nervous system are perceptive organs which mediate the impact of stress. The central nervous system, in turn, operates through peripheral mechanisms, which include renal, hormonal, and cardiovascular pathways. Peripheral activity itself can also cause sensory input and influence the brain.

Stress reduction techniques.

The use of various stress reduction techniques — including biofeedback, prayer, meditation, yoga, and progressive relaxation — have been shown to be of preventive and therapeutic value in hypertension as well as other diseases in which increased sympathetic nervous system activity is implicated (Benson et al., 1977; Jacobson, 1939; Patel, 1984; Shapiro, 1971). It is hypothesized that relaxation techniques reduce stressful environmental stimuli that are factors in the development and maintenance of the hypertensive state.

Biofeedback involves providing individuals with input or feedback concerning blood pressure on an almost continuous basis. By receiving immediate feedback with rewards for success, individuals develop mental techniques to alter blood pressure on a

trial-and-error basis (U.S. Department of Health and Human Services, 1984). There is evidence to support the use of biofeedback in both animal and human studies. In a review of almost 60 studies which involved biofeedback in the treatment of hypertension in humans, average reductions in mean blood pressure of 8 and 6 mmHg were seen in mild and moderate hypertensives, respectively. In one of the better controlled studies (Patel, Marmot, Terry, Carruthers, Hunt, & Patel, 1985), over 200 hypertensives in an English industrial company were identified in a screening program. Half were randomly assigned to a biofeedback-aided relaxation program for 8 weeks while half were assigned to a control group. Blood pressures of the biofeedback group were significantly lower at the end of the program, 6 months later, and 4 years later.

The "relaxation response" described by Herbert Benson (1977) has been shown to reduce sympathetic nervous system responsivity. While undergoing practices such as meditative prayer, transcendental meditation, yoga and hypnosis, there appears to be a common physiologic response, which Benson termed the "relaxation response." The physiologic changes involve an altered state of consciousness with generalized decreased sympathetic nervous system activity. Examples of these changes include decreases in oxygen consumption and carbon dioxide elimination, lowering of heart and respiration rates, and a decrease in blood lactate and blood pressure. These physiologic changes oppose those observed during the "fight or flight " response (Benson et al., 1977).

Several longitudinal studies have shown that the regular elicitation of the relaxation response lowers blood pressure in both pharmacologically treated and untreated individuals (Benson, Beary & Carol, 1974; Patel, 1973; Stone & DeLeo, 1976). In Benson's investigation (1974), transcendental meditation was used to bring forth the relaxation response in hypertensive volunteers. Of the 36 patients included in the study, 22 received no medication during the investigation and 14 remained on unaltered antihypertensive medication during both a control and experimental period. In the 22 non-medicated

subjects, both systolic blood pressure and diastolic blood pressure decreased significantly (7.0 mmHg and 3.8 mmHg respectively) after elicitation of the relaxation response. In the 14 patients who maintained their medication, systolic and diastolic blood pressure also decreased significantly (10.6 mmHg and 4.9 mmHg respectively).

In a study by Daley and co-workers (1969), 47 hypertensive patients experienced the relaxation response through a yoga technique. Significant decreases were noted in both systolic and diastolic blood pressures. Patel (1973) combined yoga with biofeedback techniques in the treatment of 20 hypertensive patients and observed a 20.4 mmHg reduction in diastolic pressure and a 14.2 mmHg reduction in systolic pressure, while no significant changes in blood pressure occurred in a matched control group. Stone and DeLeo (1976) provided further evidence of the usefulness of the relaxation response in the treatment of the hypertension using a Buddhist meditation exercise. Again, significant decreases were seen in both systolic and diastolic blood pressures.

Summary

To summarize, several non-drug modalities have been shown to have therapeutic and perhaps preventive value with regard to hypertension. There is evidence that weight reduction will lower hypertension. There is also evidence that sodium restriction, potassium supplementation, calcium supplementation, or a combination of these dietary changes may have considerable value for some hypertensive patients. In addition, a reduction in alcohol consumption, engaging in moderate aerobic exercise, and relaxation techniques appear to have a beneficial effect on blood pressure. Although smoking and caffeine have been shown to have an acute effect on blood pressure, there is a lack of evidence for a chronic effect or a beneficial effect on blood pressure due to a reduction in smoking or caffeine intake.

Relationship Between Religiosity and Blood Pressure

This section will provide evidence of the relationship between religion and blood pressure. The relationship between religion and health behaviors will be discussed initially to provide support for the indirect effect of religion on blood pressure through health behaviors. The link between various health behaviors (e.g. diet, alcohol consumption, smoking, exercise) and blood pressure has been examined in the previous section.

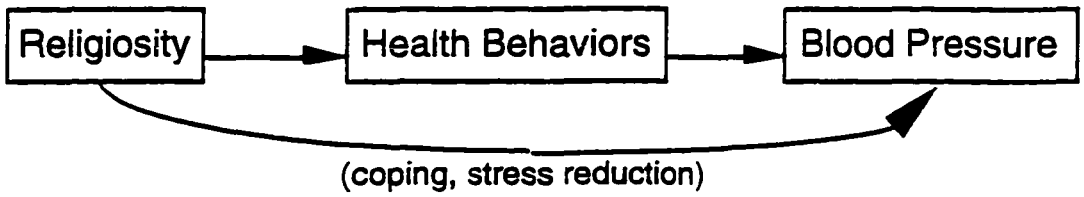


Figure 2. Hypothesized relationships between religiosity and blood pressure.

Secondly, the relationship between religiosity and stress will be discussed to provide support for a more direct effect of religion on blood pressure via coping strategies. Finally, an examination of existing studies on the relationship between religiosity and blood pressure will be presented.

Relationship Between Religiosity and Health Behaviors

In general, Judeo-Christian religious traditions emphasize the importance of caring for the physical body (Favazza, 1982) which, according to I Corinthians 3:17, represents the temple or dwelling place of God. Good health practices such as no smoking, less frequent use of alcohol and drugs, better eating habits, regular exercise, and normal weight maintenance among religiously-oriented subjects has been a common finding in work done by several investigators (Armstrong, Merwyk & Coates, 1977; Berkman, 1979; Cahalan, Casin, Crossley, 1969; Koenig, Moberg, & Kvale, 1988a; Gardner & Lyons, 1982a, 1982b; Parfrey, 1976; Zimberg, 1977).

Epidemiologic surveys among Mormons (Gardner & Lyons, 1982a, 1982b) and Seventh-Day Adventists (Armstrong et al., 1977) show a lower frequency of adverse health behaviors among religiously active individuals. These populations are intensely interested in diet and health. Such negative health behaviors as smoking, alcohol consumption and illicit drug use are discouraged and viewed as contrary to doctrinal teachings (Koenig et al., 1988b). In addition, among Seventh-day Adventists there is frequent adherence to a lacto-ovovegetarian diet. Individuals on lacto-ovovegetarian diets include plant foods, milk, and eggs but abstain from meat, poultry, and fish (Robinson, 1978). This diet is low in cholesterol and saturated fat and high in fiber intake. Studies on California male Seventh-day Adventists show they have heart attacks later than non-Seventh-Day Adventists living in the same area. In addition, the incidence of heart disease in the Seventh-Day Adventists group was only 60 percent as high as the non-Seventh-Day Adventist control group (Register & Sonnenberg, 1973).

Cahalan and co-workers (1969) examined the drinking behavior of adults in a nationwide sample that included several Christian traditions. Only 10% of frequent churchgoers were heavy drinkers compared to 22% of non-churchgoers. In another study which involved several Christian traditions, Koenig and co-workers (1988a) found that older individuals who smoked tobacco or drank alcohol reported lower intrinsic religiosity.

The history of the Methodist church reveals an association between religion and health behaviors that has existed for over 200 years. John Wesley, founder of the Methodist church, held strong beliefs about the impact of religion on health, health habits, and longevity (Koenig et al., 1988b). In 1755, Wesley published a tract of rules for those who desired, through the blessing of God, to retain their health. Wesley believed the following rules were necessary addenda to Christian living (Numbers & Amundsen, 1986):

1. curtail consumption of salty, greasy, pickled, and highly seasoned foods.
2. fast occasionally

3. eat plenty of vegetables, bread, and eggs
4. if weak in digestion, avoid foods like rich pies
5. drink fresh well water, as it is the best to drink
6. drink milk, as it is nourishing
7. drink only limited amounts of wine and ale
8. avoid distilled liquors, as they are a slow poison
9. exercise is important -- at least 2 hours of walking, or, for less vigorous persons, 2 hours of horseback riding per day.
10. smoking tobacco or dipping snuff is an unwholesome and self-indulging habit
11. getting enough sleep and healthy habits in clothing are important.

Relationship Between Religiosity and Stress

While an effect of religious beliefs on physical health may occur indirectly through an avoidance of self-destructive health behaviors (e.g., smoking, alcohol abuse) and an emphasis on positive health behaviors (e.g., healthy dietary habits and exercise), other more direct factors may be equally important. Private as well as social religious activities may alter an individual's perception of a stressful event or facilitate adaptations to stressful life events.

Koenig and colleagues (1988b) hypothesized that religious beliefs, activities, and experiences may serve as external resources enhancing social support and financial security. An increased involvement in church social activities may help distract one from his or her own problems. Socializing can provide comfort, reassurance, and a sharing of effective coping strategies. Regardless of actual financial assets, a person with a strong religious faith may be more likely to perceive their financial situation as secure.

Religion may also act on internal personal resources and influence personality traits relevant to coping (Koenig et al., 1988b). Vaux (1976) suggests that religious beliefs may

affect health by releasing an individual from obsessive self-concern, narcissism and neuroticism, all of which are integrally related to physical and mental illness.

Religious beliefs, activities, and experiences may also alter the perception and meaning of stress. After consulting physicians on this subject, Vaux (1976) reported the general feeling was that religion helps reduce anxiety and stress, and faced with a certain disease, the sense of morbidity is diminished by an intact and integrated spiritual outlook. As discussed previously, the appraisal and interpretation of a stressful event may be more important than any purely objective feature of the stressful situation itself.

Religion may also cushion the impact of social, psychological, and biological stressors, through reading, private prayer, and counseling with clergy (Koenig et al., 1988b). In response to stress, the religious person may seek solutions to problems in religious literature, such as the Bible. The Bible can provide practical, culturally-based solutions for a number of stressful life situations. Prayer may assist one in seeking solutions to problems and it may counteract a sense of loneliness during times of severe emotional distress. Prayer may serve to intervene with a destructive preoccupation with a problem. Prayer has also been shown to evoke a relaxation response (Benson et al., 1977). Finally, counseling with clergy may help one seek solutions to problems and reduce stress (Koenig et al., 1988b).

Koenig and co-workers (1988a) recently examined the spontaneous coping behaviors of a sample of 100 adults ages 55 to 80 to see how often religion was mentioned. The sample consisted of white males and females, most of whom had a college education. Social class was moderate to high. Participants were asked about the three most stressful periods in their life and how they coped with them. A total of 556 coping strategies were mentioned in response to 288 stressful events or periods. Religious coping behaviors were mentioned most frequently. Nearly half of the sample mentioned that a religious coping strategy had helped them to get through at least one of their three difficult experiences.

Personal or private religious behaviors (faith and trust in God, prayer) were present in 91% of cases in which religion was employed. Religious social activities (church attendance, involvement in church activities, church friends) were present only 33% of the time. This suggests that religious attitudes and private activities predominate over the social aspects of religion in coping.

Studies Examining The Relationship Between Religion and Blood Pressure

Scholars from many different disciplines have long speculated about the effects of religion on human health (Levin & Vanderpool, 1987). Several epidemiologists have devoted sporadic attention to religion-health interrelationships, as manifested by their use of religion variables in epidemiologic surveys. Unfortunately, most of these studies compared morbidity and mortality rates across religious groups or categories (e.g. Protestants vs. Catholics; Mormons vs. non-Mormons). However, Levin and Vanderpool (1987) reviewed a subset of the religion and epidemiology literature that used frequency of religious attendance as a measure of religious behavior. In general, these studies (see Table 2) suggest that infrequent religious attendance should be regarded as a consistent risk factor for morbidity and mortality for various types of diseases.

Table 2* Chronological Summary of Findings Linking Religious Attendance to Health

Authors [Ref.]	Operationalization of religious attendance	Dependent variables	Association between religious attendance and health
King and Funkenstein (1957)	Parental attendance (regular, occasional, infrequent)	Cardiovascular pattern (epinephrine-like vs. nor-epinephrine-like)	+
Scotch [23]	Yes vs. no	Hypertension	+
Naguib et al. (1963)	>1/wk, 1/wk, >1/mo, 2-12/yr, <2/yr	Trichomoniasis prevalence	+
Naguib et al. (1966)	>1/wk, 1/wk, >1/mop, 2-12/yr, <2/yr or never	Positive pap smears and cervical cancer incidence	+
Comstock and Lundin (1967)	1+/mo vs. <1/mo	Neonatal mortality rate	+
Kuemmerer and Partridge (1972)	Parental attendance (1+/mo vs. <1/mo)	TB test sensitivity	–
Comstock et al. (1970)	1+/mo, 1/mo, ≤2/yr	Five-year TB total case rate	+
Comstock (1971)	1+/wk vs. < 1/wk	Risk of ASDHD mortality	+
Comstock and Partridge (1972)	1+/wk vs. <1/wk	Risk of mortality due to ASHD, emphysema, cirrhosis, suicide, and colorectal cancer	+
Enstrom (1975)	1/wk vs. <1/wk	Six and a half year mortality rate	+
Comstock and Tonascia (1977)	1+/wk, 1/mo, 2-12/yr, <2/yr, never	Total mortality	+
Croog and Levine (1977)	2+/mo, ≤1/mo, never	Symptomatology and depression	+
Graham et al. (1978)	1+/wk vs. <1/wk	Risk of hypertension	+
Hannay (1980)	Yes vs. no	Number of physical, mental, and social symptoms	+
Steinitz (1980)	(Not reported)	Subjective Health	+
Walsh (1980)	Yes vs. no	Blood Pressure	NS
West et al. (1980)	2+/wk, 1/wk, 1-2/mo, <1/mo, never	Cancer risk factors	+
Yates et al. (1981)	Yes vs. no	Cancer-related pain level	+
House et al. (1982)	1+/wk, 1/wk, 1-2/mo, 6-12/yr, 1-5/yr, not in past year	Total mortality	+
Gardner and Lyon (1982)	Very active, active, possibly active, inactive	Cancer incidence rates	NS
O'Brien (1982)	1+/wk, 1/mo, 1/yr, never	Alienation in dialysis patients	+
Markides et al. (1983)	1+/wk, 2-3/mo, 1/mo, 4/yr, 1-2/yr, never	Subjective health	+
Clearly and Houts (1984)	Yes vs. no	Psychological symptoms	NS
Martin (1984)	>1/wk, 1/wk, ~1/wk, 2-3/mo, ~1/mo, 3-6/yr, 1-2/yr, never	Suicide	+
Zuckerman et al. (1984)	Six categories from 1+/wk to never	Total mortality	+
Levin and Markides (1985)	1+/wk, 2-3/mo, 1/mo, 4-6/yr, 1-2/yr, never	Subjective health	+
Levin and Markides (1986)	1+/wk, 2-3/mo, 1/mo, 4-6/yr, 1-2/yr, never or almost never	Subjective health	NS

*Levin and Vanderpool (1987)

Even after critiquing these studies for methodological and analytical problems, such as an over-reliance upon uncontrolled analyses, the authors concluded that religion bears upon our psychological and physical health and well-being.

The remainder of this chapter will focus on studies which examine the relationship between religion and hypertension. The three papers on religion and hypertension which Levin and Vanderpool (1987) included in their review (Scotch, 1963; Graham, Kaplan, Coroni-Huntley, James, Decker, Hames & Heyden, 1978; Walsh, 1980) will be discussed. In addition, two other studies (Koenig, Moberg, & Kvale, 1988a; Larson, Koenig, Kaplan, Greenberg, Logue, & Tyroler, 1989), published after 1987 will be examined (see Table 3).

Scotch's (1963) study of Zulus of South Africa detected an association between attendance and normotension in rural areas. Among urban-dwelling females, an association was observed between church membership and normotension. Among urban males, it was more common for those who belonged to a church to be hypertensive than those who were not members. In Zulu society, women were expected to attend church, while men who did were considered peculiar. Therefore, Scotch postulated that persons who deviated from the social norms of the community were more likely to be hypertensive. He also hypothesized that church attendance may serve as an adequate outlet for frustration among many women.

Graham et al. (1978) examined blood pressure levels with respect to church attendance patterns in a group of white male heads of households who participated in the Evans County Cardiovascular Epidemiologic Study. A consistent pattern of lower systolic and diastolic blood pressures among frequent church attenders was noted compared to that of infrequent attenders, even after the effects of age, obesity, cigarette smoking, and socioeconomic status were controlled for. The authors suggested the following reasons for their findings: (1) Religious ritual behaviors contribute to a feeling of warmth, release of

Table 3. Summary of Studies Examining Effects of Religion on Blood Pressure

Researcher Date	N	Gender	Design/Methods	Religious Variable	Dependent Variable	Controls	Results
Scotch (1963)	548 rural 505 urban 1053 total	M, F	Case-control study design. Interviews and BP measurements taken by trained Zulu health workers.	Church attendance, church membership	hypertension (DBP > 90) vs. normotension	—	Church attendance negatively related to hypertension in rural areas; not tested in urban areas. Church membership negatively related to hypertension in urban areas for females; not tested in rural areas.
Graham et al. (1978)	355	White M	Cross-sectional design. Sample drawn from subjects examined in 1967-69 Evans County CV Study. Church attendance recorded on sociological questionaire.	frequency of church attendance: (1+/wk vs. <1/wk)	SBP DBP	age smoking Quetelet Index Socec Class	Frequent attender group had lower SBP + DBP compared to that of infrequent attenders. Difference for SBP was significant ($p < 0.05$); difference for DBP was appreciable, but not significant.
Walsh (1980)	75	41 M 34 F Immi-grants	Cross-sectional study design. Interviews and BP measurements (standard sphygmomanometer) were taken in respondents home.	church attendance: (12+ times/yr and <12)	SBP DBP	age CV health	SBP 5.1 mmHg less for attenders. DBP 4.9 mmHg less for attenders. However, difference not significant.
Koenig et al. (1988)	106	M 28% F 72% Mean age 74 yrs.	Case-control design. Sample consisted of patients attending a geriatric outpatient clinic. Religious variables extracted from questionaire. Health variables measured from a subjective self-assessment and a multidimensional objective assessment by a physician.	Organized religious activities, non-organized religious activities and intrinsic religiosity	hypertension (>160/90) vs. normotension	—	No consistent difference for males and females in either relgious activity or intrinsic religiosity between normotensive and hypertensive patients. Hypertensive males did report consistently lower levels of religious community activity, private devotional activity and intrinsic religiosity (significant) than normotensive males.

Table 3. Summary of Studies Examining Effects of Religion on Blood Pressure (continued)

Researcher Date	N	Gender	Design/Methods	Religious Variable	Dependent Variable	Controls	Results
Larson et al. (1989)	401	White M 24+ yrs.	3 BP taken of left arm, subject seated. Religious variables abstracted from socioligical questionaire.	frequency of church attendance: (at least weekly vs. < weekly) & importance of Religion (very important vs. somewhat or not important)	SBP DBP	age sococono-mic status smoking Quetelet index	Importance of religion had an inverse association with SBP + DBP (more notable in persons over age of 55, in those who smoked and for DBP). There was an interaction between the effects of both church attendance and importance of religion - when both variables were high there was a greater association with lower BP than with just one religious variable (statistically significant for DBP only).

fear/anxiety, and stress reduction; (2) Social activities provide an extended family and crisis support; (3) Religious teachings provide models for coping, emergency threat management, self-esteem protection, not giving up, and hope. The authors refer to Psalms 27 as a means of maintaining hope.

Walsh (1980) studied the effect of church attendance on blood pressure levels among a sample of immigrants. The sample consisted of 41 males and 34 females representing 19 countries and now residing in Toledo, Ohio. There were 51 Catholics, 14 Protestants, 7 others and three individuals with no religious affiliation. The data collected supported the hypothesis that a smoother adjustment is made possible for the immigrant who has a religious outlook on life. There was a significant correlation between blood pressure and anomie scores. Anomie is characterized by feelings of uncertainty uprootedness, tension, and distress, and has been linked to illness (Walsh, 1980). There was a significant relationship between anomie and church attendance -- church attenders experienced less anomie feelings than non-attenders. While there was a trend for church attenders to have lower mean blood pressures (5.1 mmHg lower on the systolic scale and 4.9 mmHg on the diastolic scale), the relationship was not statistically significant. The authors concluded that religious association functions to diminish the immigrants anomic feelings, provide a sense of continuity and a feeling of security in situations fraught with uncertainty, and yield a new sense of belonging.

Koenig et al. (1988a) examined the religious beliefs, activities, and motivations of 106 male and female geriatric patients (mean age 74.4 years). A high prevalence of orthodox Christian beliefs, religious community activity, private devotional activity, and intrinsic religious orientation was observed. In general, results indicated levels of religious activity and intrinsic orientation were lower among patients with mental and physical health problems. Intrinsic religiosity was found to be lower among men with hypertension. No

significant relationships were found between blood pressure and any of the religious variables in women.

Larson et al. (1989) examined the effect on blood pressure status of a religious meaning variable, importance of religion, both by itself and together with frequency of church attendance. The relationship between blood pressure, self-perceived importance of religion, and church attendance was examined among a group of 407 rural white males free from hypertension or cardiovascular disease. The results indicated an interaction between the effects of both religious variables on blood pressure. Importance of religion had an even greater association with lower blood pressure than did church attendance. Diastolic blood pressure of persons with high church attendance and high religious importance was significantly lower than those in the low attendance, low importance group. The differences were most notable for persons over the age of 55, and among those who smoked. The authors found the smoking findings particularly interesting because of the presumption that the positive effects of religion on health are mediated through health care behaviors resulting from religious attitudes against cigarette smoking, alcohol consumption and harmful dietary practices (Larson et al., 1989). The authors suggested some other factor, such as improved ability to cope with stress, may moderate the effect of religion on blood pressure.

Summary

There is evidence that religion may vitally affect health attitudes and behaviors which, in turn, may decrease blood pressure. Religion may also decrease blood pressure by reducing stress through psycho-physiologically mediated processes. Studies (Graham et al., 1978; Koenig et al., 1988a; Larson et al., 1989; Scotch, 1963; Walsh, 1980) support the impact of religion on blood pressure. However, more work needs to be done to clarify which aspects of religion exert a pronounced effect on blood pressure, and what is the

relative importance of any direct or indirect effect (through a health behavior) on blood pressure.

Overall Summary

While it is known that an increase in blood pressure is due to an increase in cardiac output and/or total peripheral resistance, about 90% of hypertension cases are essential, or of unknown etiology. Blood pressure may be influenced by religion, a common and potent force in the lives of many Americans. Religion may act as an effective coping strategy to reduce psychological stress, which has been identified as a risk factor for hypertension. Religion may also influence certain health behaviors (smoking, alcohol consumption, diet and exercise) which may subsequently influence blood pressure.

While there have been various attempts to clarify the relationship between religion and blood pressure (Graham et al., 1978; Koenig et al., 1988a; Larson et al., 1989; Scotch, 1963; Walsh, 1980), research in this area has been criticized for its methodological inadequacies. Some of the problems are the simplistic measurement of religion, the inability to distinguish between direct and indirect effects on blood pressure, and the lack of statistical control. Against this backdrop, a multidimensional assessment of religiosity, featuring an analysis distinguishing between direct and indirect effects, and adequate statistical controls would improve existing research methodology.

CHAPTER 3

METHODOLOGY

Subjects

The sample consisted of females who were 35 years of age or older and were of Judeo-Christian faiths. Subjects were drawn from UNC Greensboro and Salem College alumni living in Guilford and Forsyth counties. An advantage of studying females is that there has been a general underrepresentation of female subjects in studies of coronary heart disease and hypertension, diseases which afflict females as well as males. The subjects in this study were selected to be 35 years or older because younger individuals may not have developed their own religious beliefs, or these beliefs may not have had time to influence blood pressure. Also, higher blood pressures are more prevalent as people age (Berkow & Fletcher, 1992). Only individuals of Judeo-Christian faith were included, since this is the population for which the religiosity instrument that was used was designed and nearly 90% of Americans are Jewish or Christian.

Procedures

Six hundred UNC Greensboro and Salem College alumni, age 35 or older living in Guilford and Forsyth Counties were selected randomly and sent a letter describing the proposed study. If alumni were interested in partaking in the study, they were asked to return a postcard to the primary investigator indicating whether they preferred to participate in the fall of 1994 or in the spring of 1995. Phone calls were made to interested alumni to schedule data collection. Follow-up phone calls were made in an effort to recruit additional subjects. Information concerning the study also appeared in alumni publications and in area church newsletters.

Individuals who volunteered to engage in this investigation were mailed a consent form and survey to complete at home. Each participant visited the laboratory once to confirm proper completion of the survey and for measurement of blood pressure, height and weight. The survey consisted of questions regarding demographic information, medical history, religiosity, physical activity, and food intake. The following chart depicts the time sequence during the lab visit:

Time	Procedure
10 min.	Check for completion of the survey: demographic information, medical history, religiosity, physical activity, food intake.
20 min. (10 min. rest and 3 BP measurements with 5 min. between each measurement)	3 resting blood pressure measurements
5 min.	Height and weight measurements

Outcome (Dependent) Variable: Blood Pressure Measurement

Three systolic and diastolic blood pressure readings were taken at 5 minute intervals after the subject had been seated for a 10 minute quiet rest period (Iyriboz & Hearon, 1992). The last two readings were averaged to derive an estimate of resting blood pressure. To determine the systolic and diastolic blood pressure, the first and fifth Korotkoff components were used (U.S. Department of Health and Human Services, 1993). A validated automatic sphygmomanometer monitor, the Colins STBP-780, was used to measure blood pressure (Lightfoot, Tankersley, Rowe, Freed & Fortney, 1989).

In preparation for blood pressure measurement, subjects were instructed to empty their bladder and bowels before measurement because bladder or bowel distention can contribute to false high blood pressure readings (Frohlich, Labarthe, Maxwell, et al., 1987). Subjects refrained from eating, drinking (especially alcohol and caffeine), and

smoking for at least 60 minutes before blood pressure measurement because these activities can alter blood pressure (Frohlich et al., 1987). Participants refrained from exercising for at least four hours prior to testing because recently performed activity can also alter blood pressure (Iyriboz & Hearon, 1992). The subject's clothing was loose, specifically around the right arm, to allow for easy access by the observer and to prevent a tourniquet effect on circulation. Subjects were instructed to relax and avoid voluntary contraction of the arm which could increase blood pressure (Iyriboz & Hearon, 1992). An explanation of the measurement procedure and a warning of the mild discomfort that might be experienced during the cuff inflation was given.

Prior to blood pressure measurement, subjects sat and rested for 10 minutes in the preferred measurement position for adults (Frohlich et al, 1987). This position is described as (1) sitting with back support, (2) the arm bent at approximately 45°, (3) a soft surface supporting the arm, and (4) the legs uncrossed. In order to measure blood pressure, three electrodes were attached to the subject in the CM-5 position. To lower electrode resistance, the subject's skin was rubbed gently at the attachment points with a special electrode file and with gauze containing alcohol (Colins, 1990).

A cuff size appropriate to the diameter of the subject's upper arm was selected to ensure the proper measurement of blood pressure. The cuff was wrapped snugly around the upper arm, with the air hose on the wrist side and the two microphones properly positioned on the brachial artery of the right arm. The end of the cuff was positioned 2 to 3 cm above the elbow. Finally, the velcro strap was attached around the wrist and the air hose fastened to it (Colins, 1990).

After proper positioning and preparing the subject, blood pressure was determined by pressing the start switch on the STBP-780 blood pressure monitor to inflate the cuff to the preset pressure of 180 mmHg and to automatically measure blood pressure during deflation. During the blood pressure measurement, neither the subject nor observer spoke.

Predictive (Independent) Variable: Measurement of Religiosity

To assess religiosity, a 33-question multidimensional religiosity schedule constructed and validated by Koenig and his colleagues (1988b) was utilized. A total religiosity score, as well as scores on nine dimensions (intrinsic religiosity, extrinsic religiosity, belief factor, religious well-being, organized religious activity, non-organized religious activity, religious knowledge, religious experience, and religious coping) were determined. A more detailed discussion of this instrument is presented in Chapter 2.

Potential Intervening and Confounding Variables

Measurement of Health Behaviors

Physical activity was determined from a modified version of the Minnesota Leisure Time Physical Activity Questionnaire (MNLTPA) (Appendix A). Using this questionnaire, an average daily physical activity caloric value for the past three months was estimated. The MNLTPA has been widely used and has high test-retest reliability (Jacobs, Ainsworth, Hartman & Leon, 1993; Folsom, Jacobs, Caspersen, Gomezmarin & Knudsen, 1986). In addition, Dr. Barbara Ainsworth, a recognized authority in developing and evaluating physical activity questionnaires, recommended this questionnaire for use in this particular study, as it identifies activities associated with hypertensive and cardiovascular diseases and includes a household activity section (personal communication, March 28, 1994).

Dietary intake of nutrients related to blood pressure (sodium, potassium, calcium, and alcohol) was determined using a food frequency questionnaire (Appendix A). Subjects reported the number of servings they ate per week for 141 food items. The data was analyzed using the Nutritionist III program (N^2 Computing, Salem, Oregon). The interactive dietary variable of interest [(K:Na) X Ca] was computed. A high ratio reflects a favorable ratio or more adequate K (potassium) intake, Ca (calcium) intake, or both.

A smoking index was determined from the subject's responses to four questions on the survey concerned with smoking history (Appendix A).

Control Variables

Age and socioeconomic status were abstracted from the general information reported on the survey (Appendix A). Body mass index was calculated from height and body mass measurements obtained using an anthropometer and balance beam scale while the subject's shoes were removed.

Statistical Analyses

Data collected from the survey, height, weight, and blood pressure measurements were entered into a computer file for later analysis. Frequency distributions of responses to all variables were tabulated to assess suitability for statistical analysis. Bivariate relationships between each independent variable and blood pressure were assessed using Pearson product-moment correlation analysis. A series of multiple regression analyses were performed to estimate all path coefficients (the standardized partial regression coefficients) based on the model in Figure 1 (Pedhazur, 1982). This method of statistical analysis (sometimes called path analysis) provided estimates of the strengths of association along each path of the hypothesized model and allowed for a comparison of the direct and indirect effects of the independent variable (religiosity) on the dependent variable (blood pressure).

Path analysis was performed for each of the dimensions of religiosity separately, and for a total religiosity score. Systolic and diastolic blood pressure were also analyzed separately. As an example, Figure 3 illustrates the path diagram for the analysis examining the direct and indirect effects of the belief dimension of religiosity on systolic blood pressure.

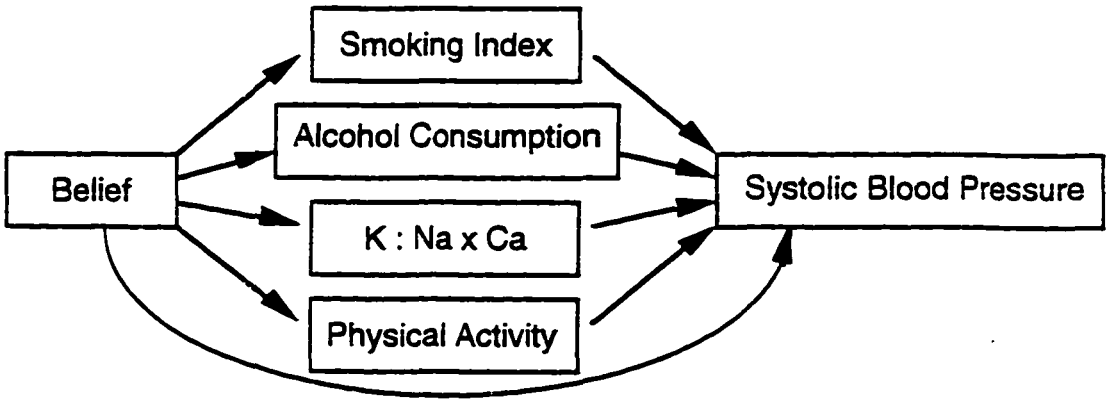


Figure 3. Relationships between belief dimension and systolic blood pressure.

Blood pressure by religiosity dimension one-way Analysis of Variance (ANOVAs) with age, BMI, smoking index, alcohol consumption, diet and physical activity as covariates were conducted for each religiosity variable and for systolic blood pressure (SBP) and diastolic blood pressure (DBP) separately to further examine the effects of religiosity on BP. A total of 20 ANOVAs were performed on all subjects. This additional analysis was conducted in order to include all subjects, even those on BP medication (n=112). The SBP and DBP variables were categorized into normotensive and hypertensive groups. Each religiosity dimension was categorized into high, medium, and low groups. ANOVAs were also performed separately for three age groups (35 to 49 years, 50 to 64 years, and 65 to 80 years) because religion may operate differently at different stages of life. A total of 60 ANOVAs were performed for the specific age groups.

CHAPTER 4
RESULTS

Introduction

The results of this study will be presented in five sections: (1) subject characteristics; (2) frequency distributions of all variables studied; (3) correlational analysis; (4) regression/path analysis and; (5) analysis of variance (ANOVAs). The correlational and path analyses conducted were restricted to the 98 subjects who were not on medication known to affect blood pressure. Unmedicated blood pressures were unknown for 14 subjects who were on blood pressure medication. The ANOVAs which were performed on 112 subjects (including those who were on BP medication), categorized the dependent variables, SBP and DBP, into hypertensive and normotensive groups. For SBP, hypertension was defined as present if either of the following criteria existed: (1) systolic blood pressure ≥ 140 mmHg, or (2) currently taking medication for blood pressure control. For DBP, hypertension was defined as present if either: (1) diastolic blood pressure ≥ 90 mmHg, or (2) currently taking medication for blood pressure control.

Subject Characteristics

A total of 112 white females who are alumni from Salem College and UNC Greensboro participated in this study. Subjects ranged in age from 35 to 80 years. A summary of subject characteristics, selected health variables, resting blood pressures, and religious affiliation are found in Tables 4 and 5. Additional information concerning religiosity scores and selected subject characteristics can be found in Appendix D. Three blood pressure readings were taken at 5 minute intervals after 10 minutes of rest. Measures of the dependent variables, SBP and DBP, represent an average of the second and third blood pressure readings. Blood pressure measurements taken at three time periods were

compared using repeated measures analysis of variance followed by a post-hoc comparison of means (Tukey's test) (Table 6). The first SBP reading was significantly greater ($p < .05$) than the second and third SBP readings. Because the first reading might have been higher due to subject apprehension, the average of the second and third readings was used to calculate resting SBP. There was no significant difference among the three DBP readings. For consistency, however, the reported DBP is the average of the second and third readings.

Table 4.

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

Variable	Mean (± SD) or Percentage
Height (in)	64.761 ± 2.428
Weight (lbs)	140.770 ± 24.196
BMI [(lbs x in^{-2}) x 100]	3.352 ± 0.518
Age (yr)	50.116 ± 10.348
Alcohol (gm/day)	7.573 ± 9.367
Physical Activity Index[a]	813.455 ± 497.951
Diet [(K x Na^{-1}) x Ca] (mg/day)	1108.735 ± 667.649
Smoking Index[a]	26.634 ± 46.336
SBP (mmHg)	120.906 ± 15.023
DBP (mmHg)	73.308 ± 8.856
Married (%)	80.4 %
College Graduate (%)	100.0 %
Graduate Work (%)	53.6 %

[a] defined in text, Ch 3.

Table 5.

Religious Affiliation of Subjects.

Religious Affiliation	All Subjects n=112 #	All Subjects n=112 %	U.S. Normal %	Subjects not on BP medication n=98 #	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%
7th Day Adventist	3	2.7%	a	3	3.1%
Catholic	6	5.4%	27%	5	5.1%
Other	6	5.4%	16%*	5	5.1%
No Preference	2	1.8%	9%	2	2.0%

[a]not reported separately, included in "other" category
*includes Seventh-Day Adventists and Moravians

Table 6.

Repeated Measures Analysis of Variance Results for 3 BP Readings for Subjects not on BP Medication (n = 98).

	Measurement (Mean ± SD)		
Variable	1	2	3
SBP (mmHg)	122.04 ± 16.13*	119.06 ± 14.33	119.57 ± 14.27
DBP (mmHg)	73.19 ± 9.44	73.08 ± 9.47	72.74 ± 8.83

*Significantly greater than SBP at Time 2 and Time 3, $p < .05$

Subjects appeared to be fairly typical of white females in the United States relative to selected characteristics for which epidemiologic data are available (Table 7). Compared to normal U.S. data for similar age groups, in the present study there are slightly fewer obese individuals, slightly more who consume alcohol, slightly less who are current smokers, and approximately the same percentage who are hypertensive. It should be noted that exact comparisons to the white females aged 35 to 80 years in the current study could not be made due to the different age groups for which data are not available.

Table 7.

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% aged 20+ years in 1988 to 1991
% Who Consume Alcohol	69.6%	65% aged 25 to 44 years,
		44% aged 45+ years in 1990
% Hypertensive[c]	20.5%	19.0% aged 20 to 74 years in 1988 - 1991
% Who Currently Smoke	8%	12.5% aged 16+ years in 1993

[a] source = National Center for Health Statistics. Health, United States, 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 $(lbs/in^2) \times 100$ indicates obesity.

[c] A person with hypertension is defined by either having elevated blood pressure (systolic pressure of at least 140 mmHg or diastolic blood pressure of at least 90 mmHg) or taking antihypertensive medication.

Frequency Distributions

Frequency distributions of responses to all variables were tabulated to assess suitability for statistical analyses. Frequency distributions for height, weight, BMI, calcium intake, sodium intake, potassium intake, alcohol consumption, physical activity index, systolic blood pressure and diastolic blood pressure appeared approximately normal. However, most of the religiosity dimension variables, (RD1, RD2, RD3, RD4, RD5, RD7, RD8, RD9) had slightly negative or left-skewed distributions. More specifically, scores tended to aggregate at the high end of the distribution, indicating high religiosity scores. On the other hand, age (54.5% were in the youngest age group, ages 35 - 49 years), smoking index (54.5% never smoked), and alcohol (30.4% were non-drinkers) showed slightly positive or right-skewed distributions.

Frequency distributions for race, education, and income revealed little or no variance and therefore were not controlled for in the statistical analysis. With regard to race, all participants in the study were white. Education and income, the two variables most often used to represent socioeconomic status, also showed little variance. All subjects were college graduates and the majority were in the highest household income bracket ($60,000/year or more).

Correlations Between Study Variables

To assess bivariate relationships between variables in the path analysis model, simple correlational analysis was performed. This analysis was conducted on subjects not on blood pressure medication (n = 98), since these were the subjects that would be used in the path analysis. Not included were 14 subjects on BP medication, since blood pressure readings do not reflect a non-medicated state. Table 8 displays the correlation coefficients (r).

Table 8.

Correlations Between Variables in the Path Analysis Model, n = 98.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. BMI	1.0	.11	.01	-.05	.24*	.13	-.05	-.02	.07	.08	.14	.09	.20	-.09	-.15	-.13	.21*	.27**
2. AGE		1.0	-.02	.05	-.04	-.07	.09	.13	.27**	-.10	-.04	.01	.35**	.17	-.09	-.14	.57**	.20*
3. RD1			1.0	.72**	.65**	.81**	.61**	.63**	.31**	.81**	.75**	.93**	-.13	.04	-.13	.00	-.11	-.22*
4. RD2				1.0	.44**	.64**	.39**	.55**	.32**	.64**	.63**	.76**	-.05	.05	-.13	.12	-.01	.14
5. RD3					1.0	.69**	.38**	.49**	.17	.66**	.66**	.76**	-.03	.04	-.11	-.09	-.01	-.08
6. RD4						1.0	.50**	.58**	.27**	.93**	.91**	.93**	-.08	.06	-.13	.03	.00	-.12
7. RD5							1.0	.52**	.22*	.50**	.40**	.64**	-.11	.11	-.03	.12	.01	-.05
8. RD6								1.0	.31**	.56**	.54**	.73**	.01	.00	.00	.01	.08	-.10
9. RD7									1.0	.27**	.30**	.35**	.22*	.14	-.05	-.03	.12	.05
10. RD8										1.0	.89**	.92**	-.11	.07	-.09	.01	-.03	-.16
11. RD9											1.0	.87**	-.05	.09	-.11	-.02	-.02	-.16
12. RTOT												1.0	-.08	.07	-.13	.02	.00	-.14
13. SMDX													1.0	-.05	.19	-.15	.24*	.18
14. DIET														1.0	-.03	.03	.03	-.09
15. ALC															1.0	.07	.12	.17
16. PA																1.0	-.04	-.03
17. SBP																	1.0	.68**
18. DBP																		1.0

* $p < 0.05$; ** $p < 0.01$

Note. BMI = body mass index; RD1 = intrinsic religiosity; RD2 = extrinsic religiosity; RD3 = belief factor; RD4 = religious well-being; RD5 = organized religious activity; RD6 = non-organized religious activity; RD7 = religious knowledge; RD8 = religious experience; RD9 = religious coping; RTOT = religious total; SMDX = smoking index; DIET = (K:Na X Ca) intake; ALC = alcohol intake; PA = physical activity index; SBP = systolic blood pressure; DBP = diastolic blood pressure.

With respect to age and BMI, which were controlled for in all path analyses, significant positive correlations were observed between age and SBP ($r = +.57$, $p < .01$); age and DBP ($r = +.20$, $p < .05$); BMI and SBP ($r = +.21$, $p < .05$), and BMI and DBP ($r = +.27$, $p < .01$). Significant relationships between age and smoking index ($r = +.35$, $p < .01$) and age and RD7 (religious knowledge) ($r = +.27$, $p < .01$) were also detected.

Considering the associations between each of the religiosity dimensions and the intermediate variables (Figure 4), significant correlations were found between RD7 (religious knowledge) and smoking index ($r = +.22$, $p < .05$). Trends worth noting included the observation that the relationship between all religiosity dimensions and diet was positive, indicating that as the religiosity score increased, the diet score (K:Na X Ca) increased. A high diet score reflects either a high K to Na ratio, a high calcium intake, or both conditions, and may be protective against high blood pressure. Also, the majority of the religiosity dimensions (9 out of 10) and alcohol consumption exhibited a negative relationship, demonstrating that as religiosity scores increased, alcohol consumption decreased.

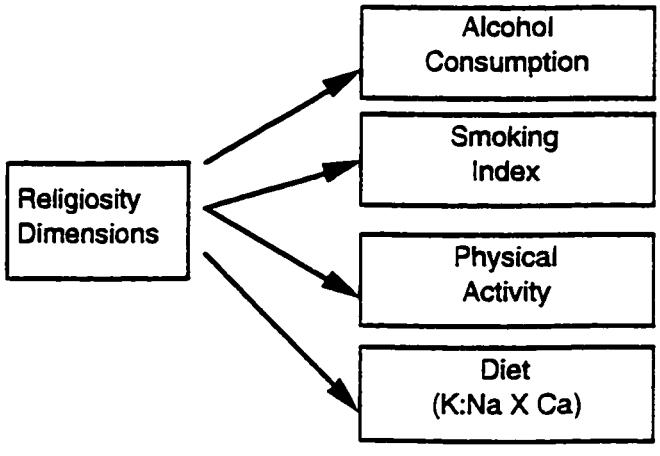


Figure 4. Relationships between religiosity dimensions and intermediate variables

Upon evaluating the relationships between the independent variables and blood pressure (Figure 5), a significant positive correlation was seen between smoking index and SBP ($r = +.24$, $p < .05$), indicating that a higher smoking index was associated with higher SBP. A significant negative correlation was observed between RD1 (intrinsic religiosity) and DBP ($r = -.22$, $p < .05$): demonstrating that a higher intrinsic religiosity score was related to a lower DBP.

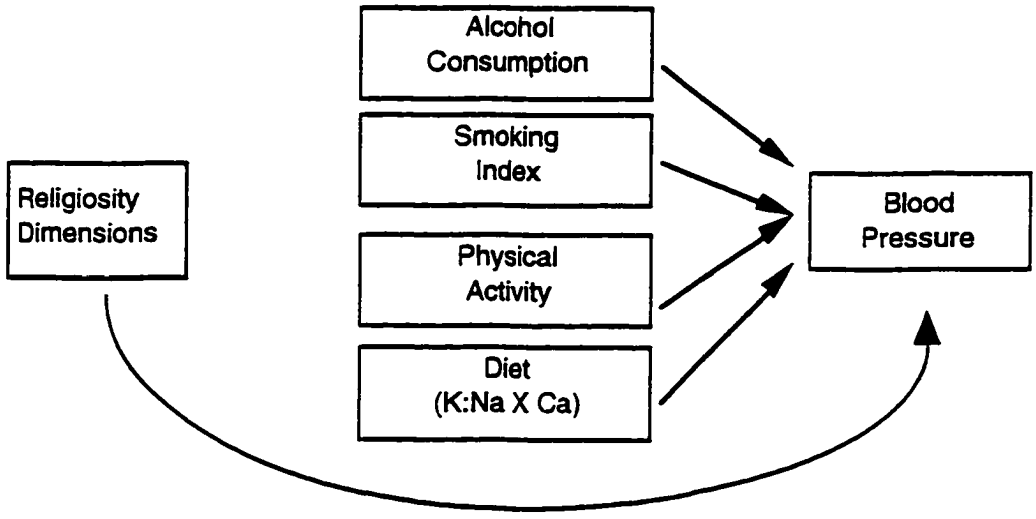


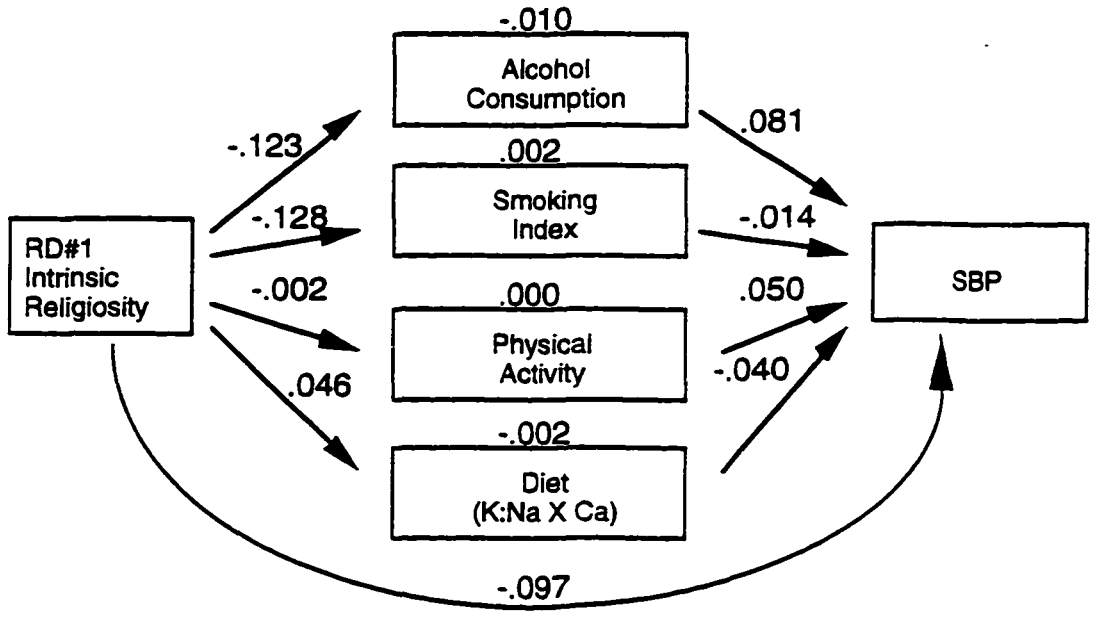
Figure 5. Relationships between independent variables and blood pressure.

No significant relationships were observed between alcohol and blood pressure, physical activity and blood pressure, and diet and blood pressure.

Regression Analysis/Path Analysis

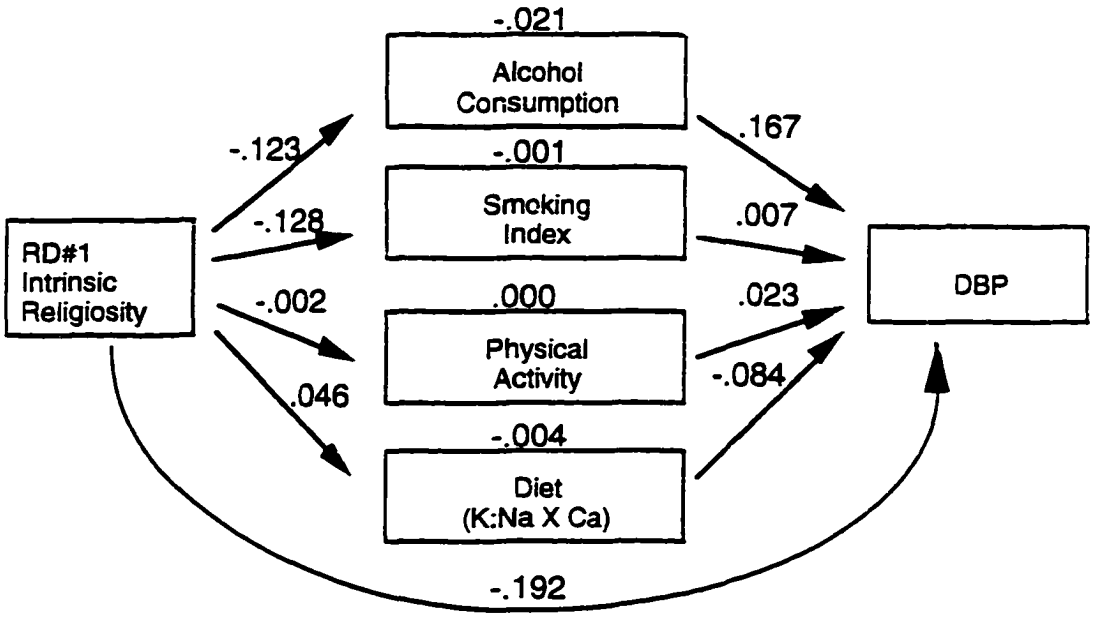
Path analysis is an important analytic tool for testing whether or not relationships in the data are consistent with a theoretical model. Data in this study were subjected to path analysis to provide estimates of the strengths of association (path coefficients) along each path of the hypothesized models and to allow for a comparison of the direct and indirect effects of the independent variable (religiosity) on the dependent variable (blood pressure). A separate path analysis was conducted for each of the nine dimensions of religiosity, and

for the total religiosity score. Systolic and diastolic blood pressure were analyzed in separate path diagrams. Therefore, a total of 20 path diagrams (10 for systolic blood pressure and 10 for diastolic blood pressure) were completed. Results from these analyses are shown in Figures 6 through 25.



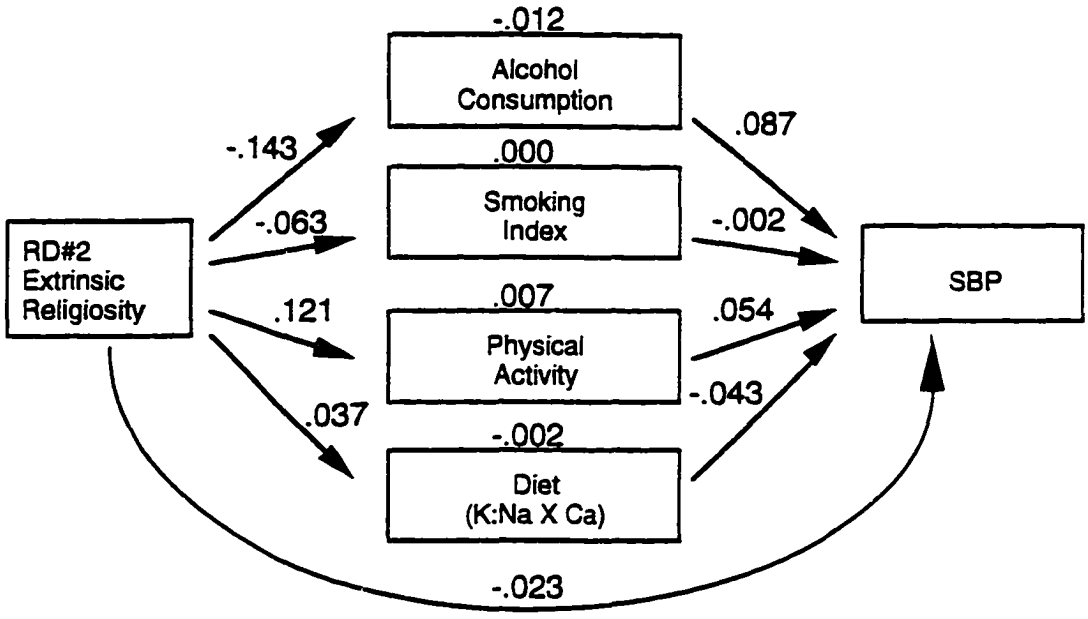
INDIRECT EFFECT, through:	
Alcohol	-.010
Smoking Index	.002
Physical Activity	.000
Diet	-.002
DIRECT EFFECT	-.097
TOTAL EFFECT	**-.107**

Figure 6. Effects of intrinsic religiosity on SBP (controlling for age and BMI).



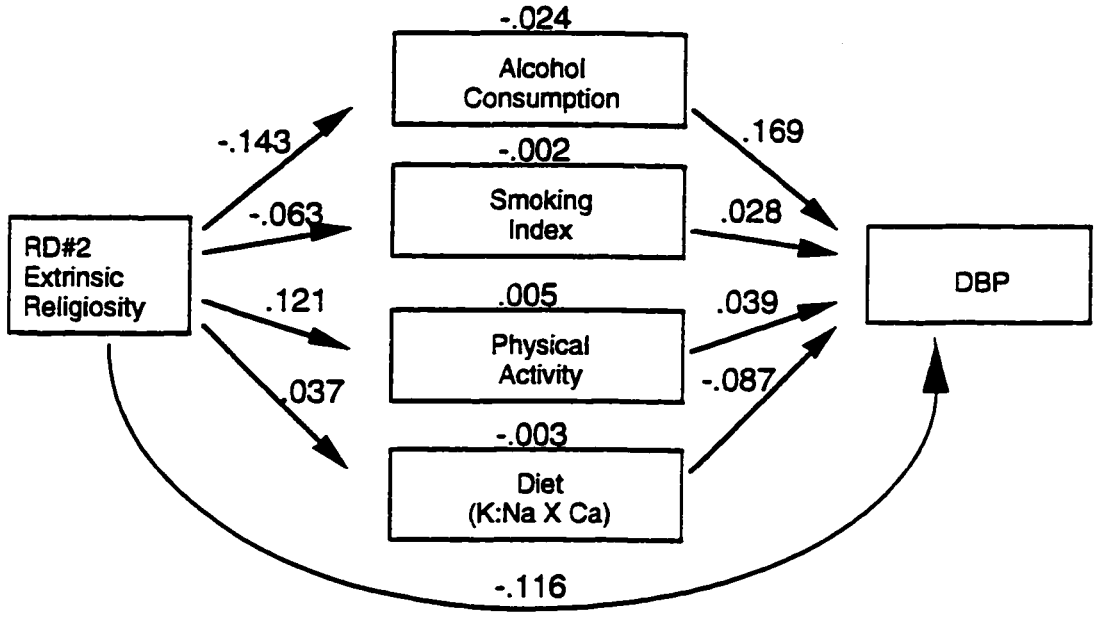
INDIRECT EFFECT, through:	
Alcohol	-.021
Smoking Index	-.001
Physical Activity	.000
Diet	-.004
DIRECT EFFECT	-.192
TOTAL EFFECT	**-.218**

Figure 7. Effects of intrinsic religiosity on DBP (controlling for age and BMI).



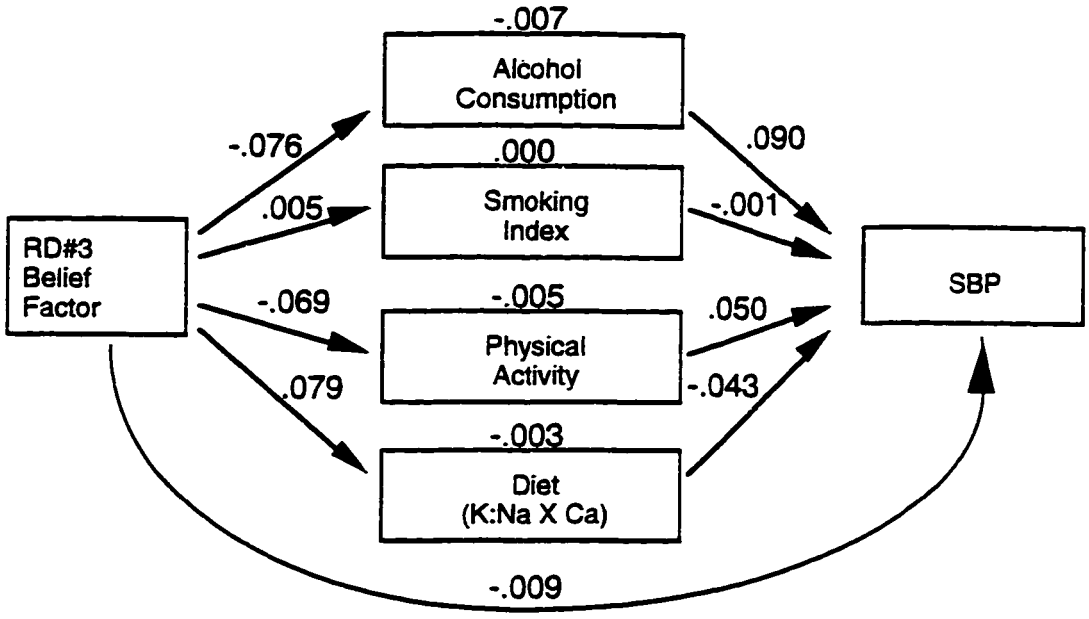
INDIRECT EFFECT, through:	
Alcohol	-.012
Smoking Index	.000
Physical Activity	.007
Diet	-.002
DIRECT EFFECT	-.023
TOTAL EFFECT	**-.030**

Figure 8. Effects of extrinsic religiosity on SBP (controlling for age and BMI).



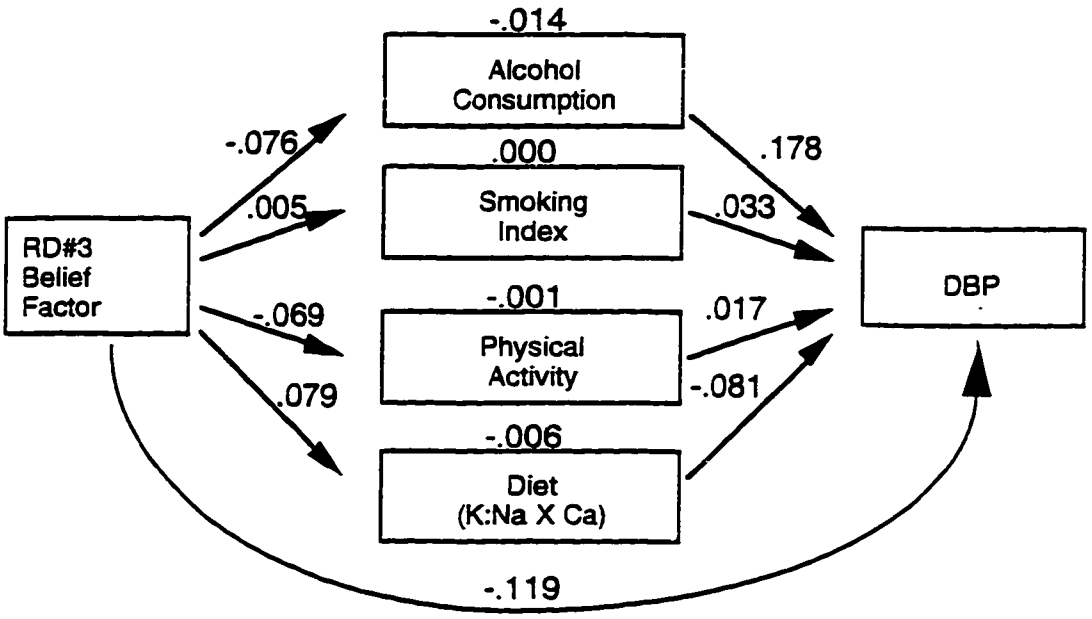
INDIRECT EFFECT, through:	
Alcohol	-.024
Smoking Index	-.002
Physical Activity	.005
Diet	-.003
DIRECT EFFECT	-.116
TOTAL EFFECT	**-.150**

Figure 9. Effects of extrinsic religiosity on DBP (controlling for age and BMI).



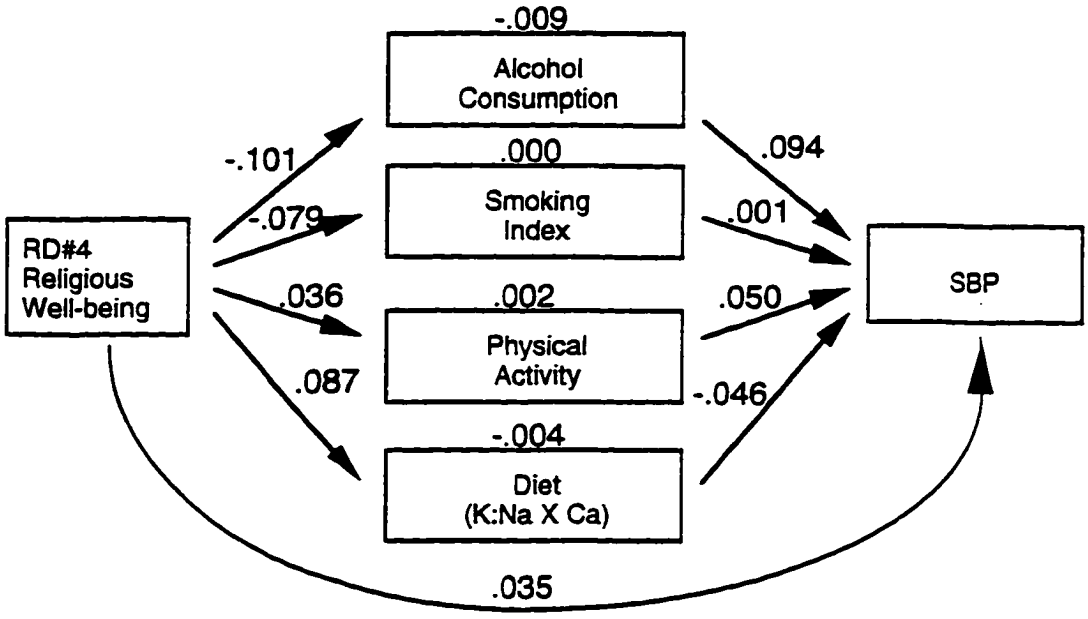
INDIRECT EFFECT, through:	
Alcohol	-.007
Smoking Index	.000
Physical Activity	-.005
Diet	-.003
DIRECT EFFECT	-.009
TOTAL EFFECT	**-.024**

Figure 10. Effects of belief factor on SBP (controlling for age and BMI).



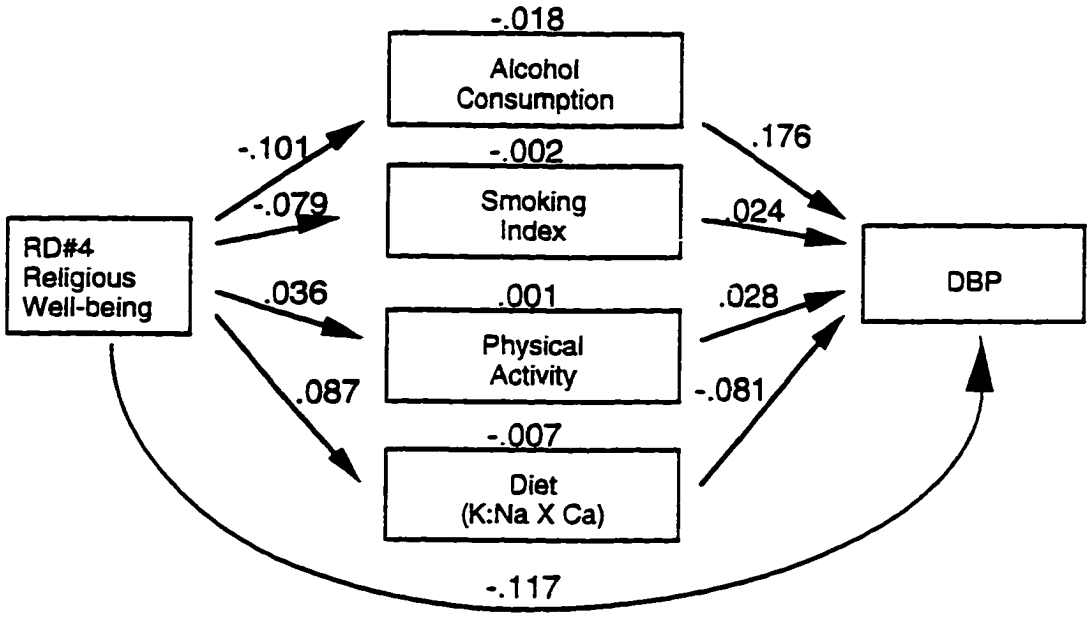
INDIRECT EFFECT, through:	
Alcohol	-.014
Smoking Index	.000
Physical Activity	-.001
Diet	-.006
DIRECT EFFECT	-.119
TOTAL EFFECT	**-.140**

Figure 11. Effects of belief factor on DBP (controlling for age and BMI).



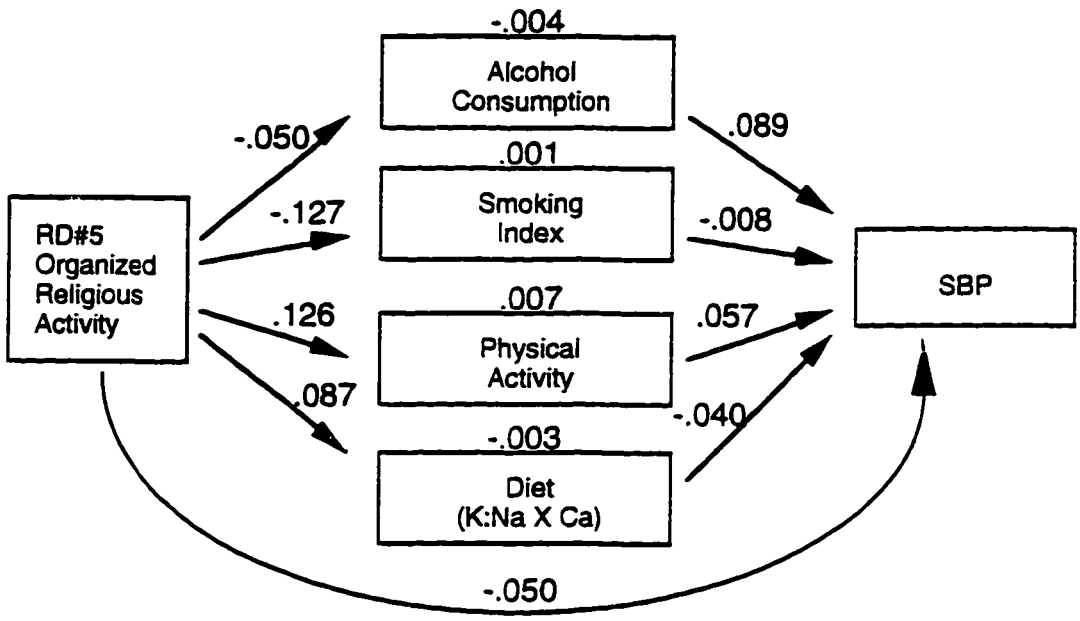
INDIRECT EFFECT, through:	
Alcohol	-.009
Smoking Index	.000
Physical Activity	.002
Diet	-.004
DIRECT EFFECT	.035
TOTAL EFFECT	**.024**

Figure 12. Effects of religious well-being on SBP (controlling for age and BMI).



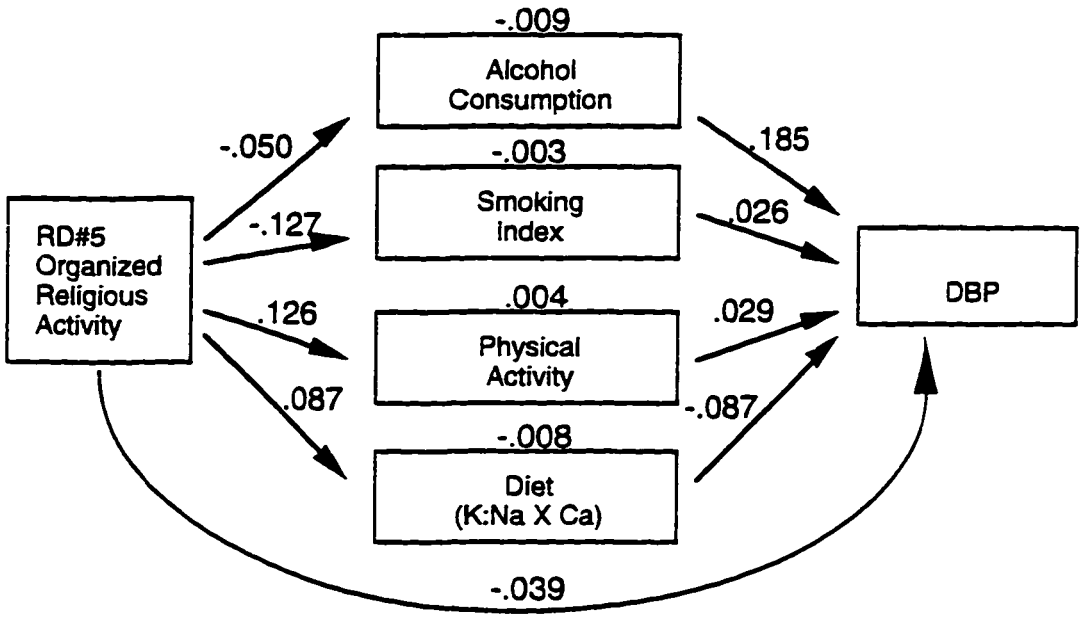
INDIRECT EFFECT, through:	
Alcohol	-.018
Smoking Index	-.002
Physical Activity	.001
Diet	-.007
DIRECT EFFECT	-.117
TOTAL EFFECT	**-.143**

Figure 13. Effects of religious well-being on DBP (controlling for age and BMI).



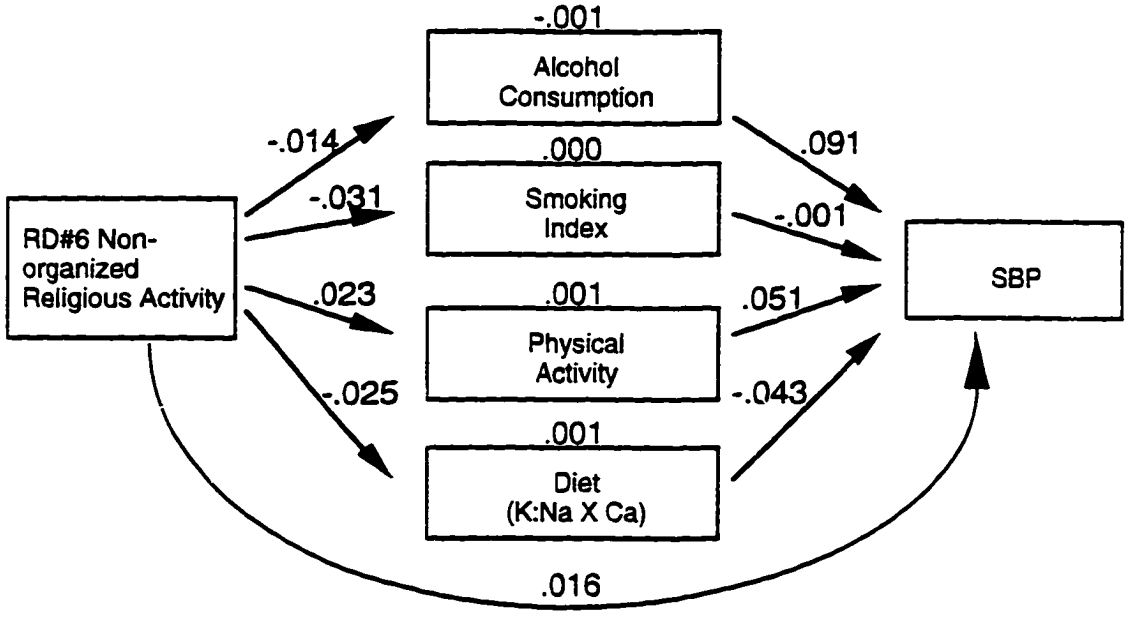
INDIRECT EFFECT, through:	
Alcohol	-.004
Smoking Index	.001
Physical Activity	.007
Diet	-.003
DIRECT EFFECT	-.050
TOTAL EFFECT	**-.049**

Figure 14. Effects of organized religious activity on SBP (controlling for age and BMI).



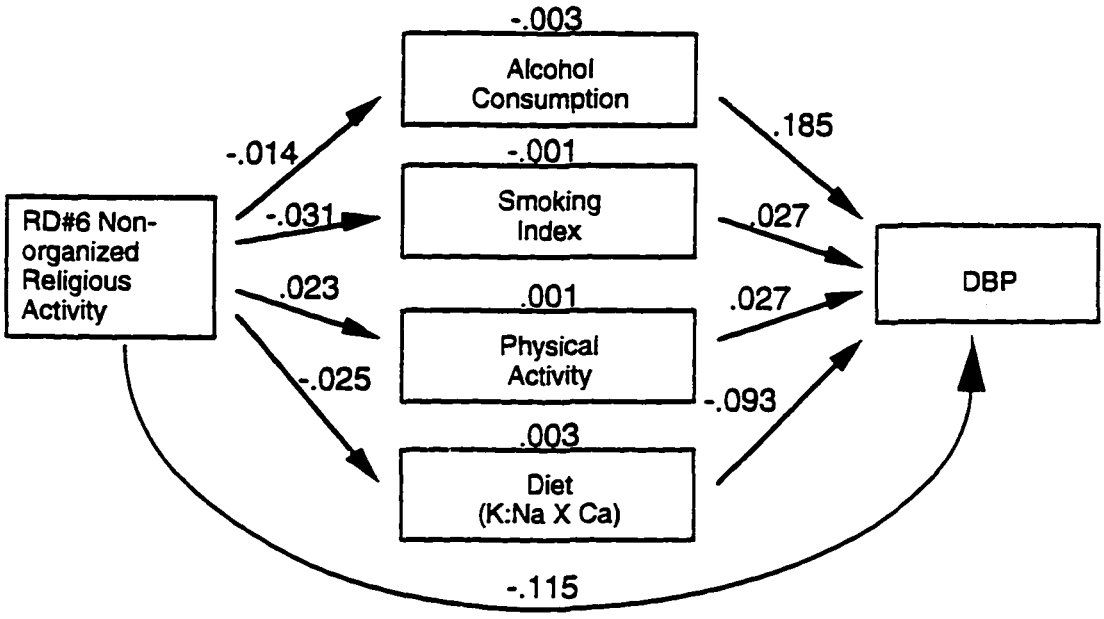
INDIRECT EFFECT, through:	
Alcohol	-.009
Smoking Index	-.003
Physical Activity	.004
Diet	-.008
DIRECT EFFECT	-.039
TOTAL EFFECT	**-.055**

Figure 15. Effects of organized religious activity on DBP (controlling for age and BMI).



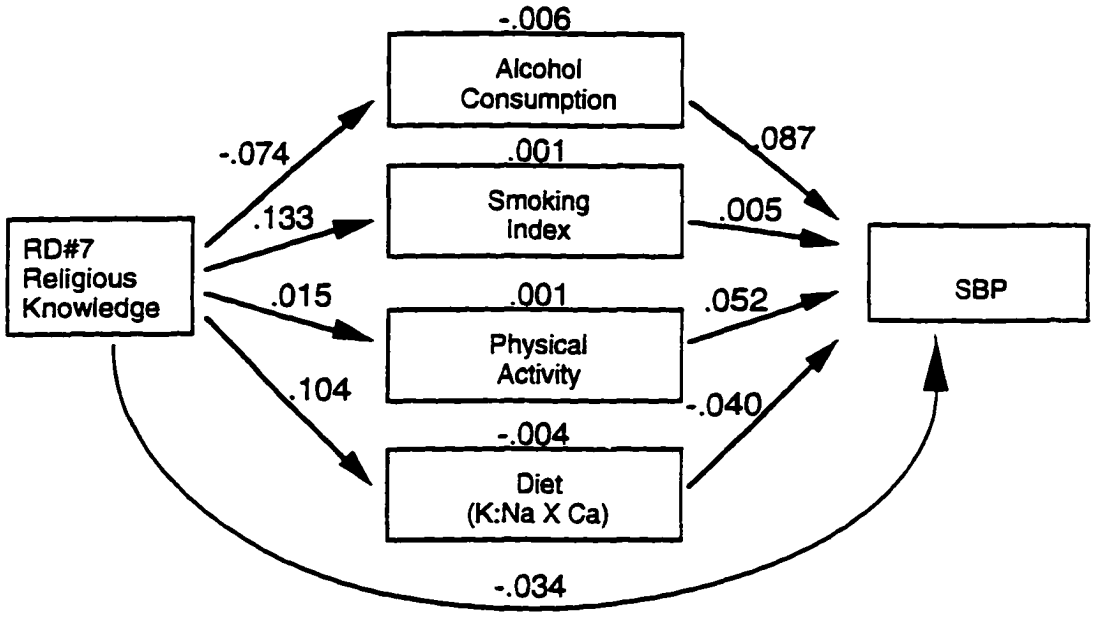
INDIRECT EFFECT, through:	
Alcohol	-.001
Smoking Index	.000
Physical Activity	.001
Diet	.001
DIRECT EFFECT	.016
TOTAL EFFECT	**.017**

Figure 16. Effects of non-organized religious act. on SBP (controlling for age and BMI).



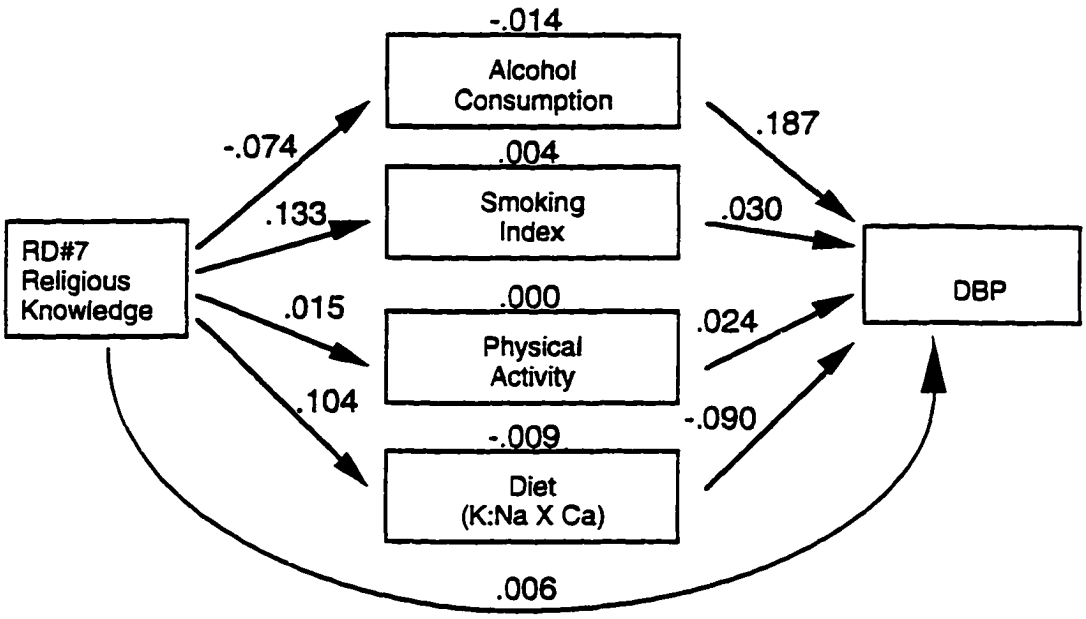
INDIRECT EFFECT, through:	
Alcohol	-.003
Smoking Index	-.001
Physical Activity	.001
Diet	.003
DIRECT EFFECT	-.115
TOTAL EFFECT	**-.115**

Figure 17. Effects of non-organized religious act. on DBP (controlling for age and BMI).



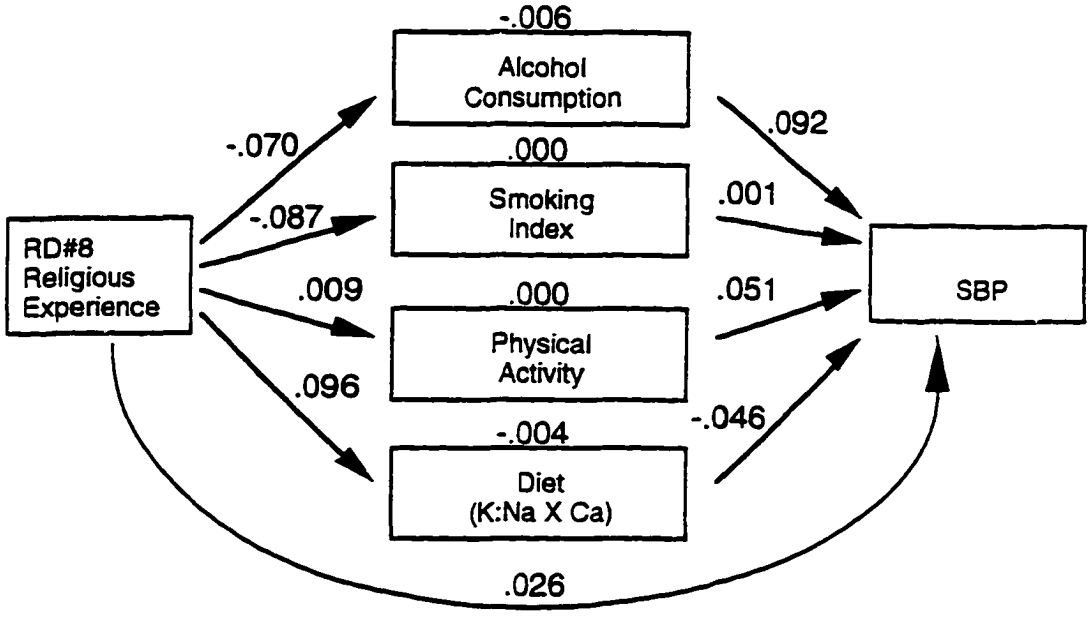
INDIRECT EFFECT, through:	
Alcohol	-.006
Smoking Index	.001
Physical Activity	.001
Diet	-.004
DIRECT EFFECT	-.034
TOTAL EFFECT	**-.042**

Figure 18. Effects of religious knowledge on SBP (controlling for age and BMI).



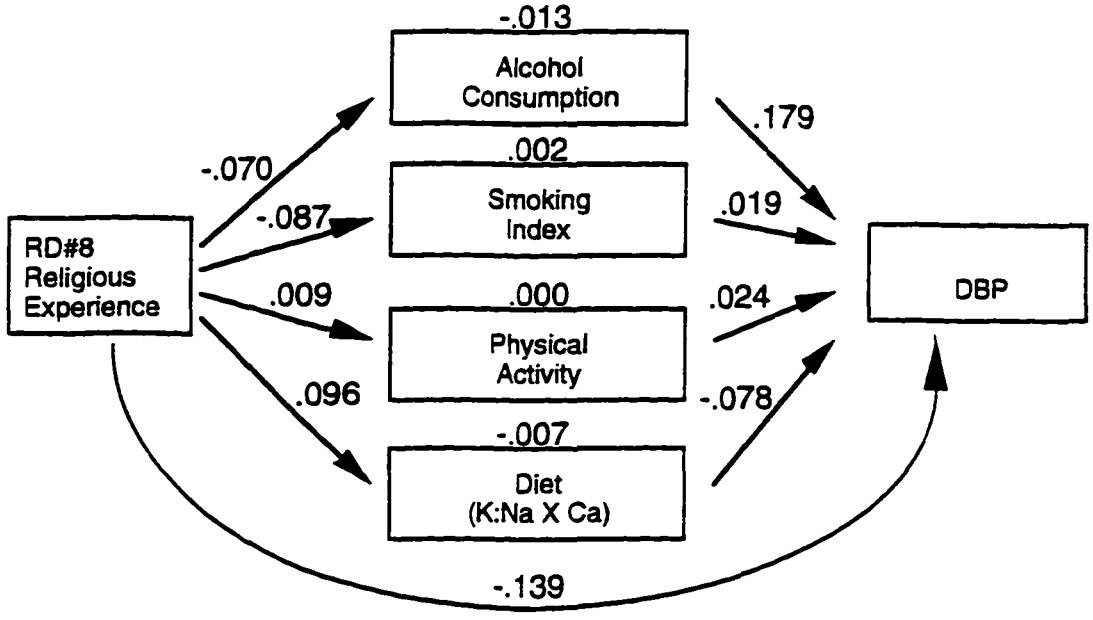
INDIRECT EFFECT, through:	
Alcohol	-.014
Smoking Index	.004
Physical Activity	.000
Diet	-.009
DIRECT EFFECT	.006
TOTAL EFFECT	**-.013**

Figure 19. Effects of religious knowledge on DBP (controlling for age and BMI).



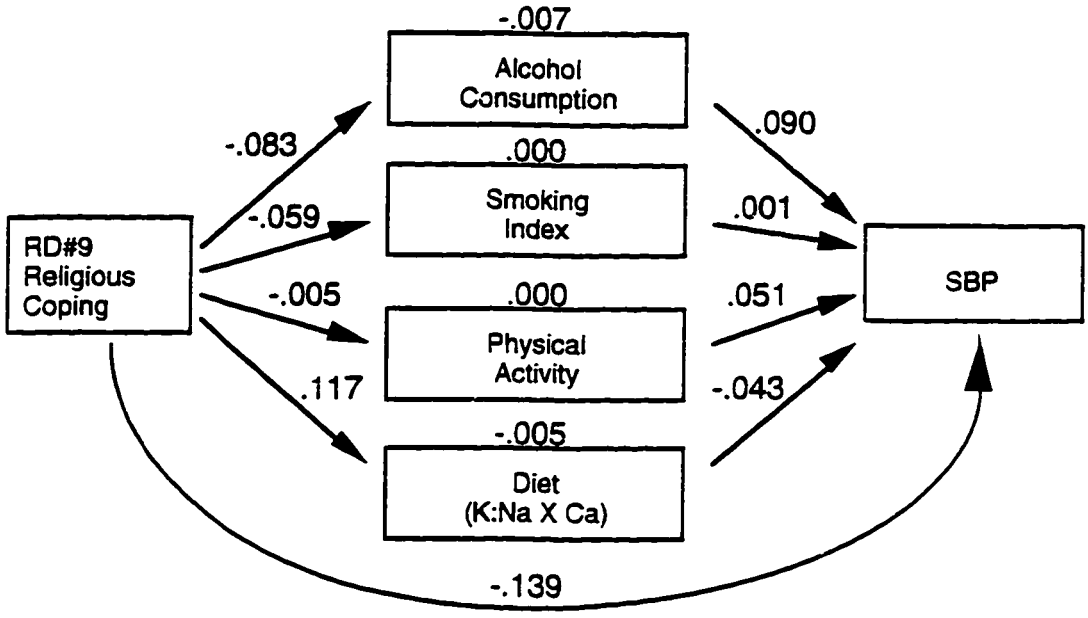
INDIRECT EFFECT, through:	
Alcohol	-.006
Smoking Index	.000
Physical Activity	.000
Diet	-.004
DIRECT EFFECT	.026
TOTAL EFFECT	**.016**

Figure 20. Effects of religious experience on SBP (controlling for age and BMI).



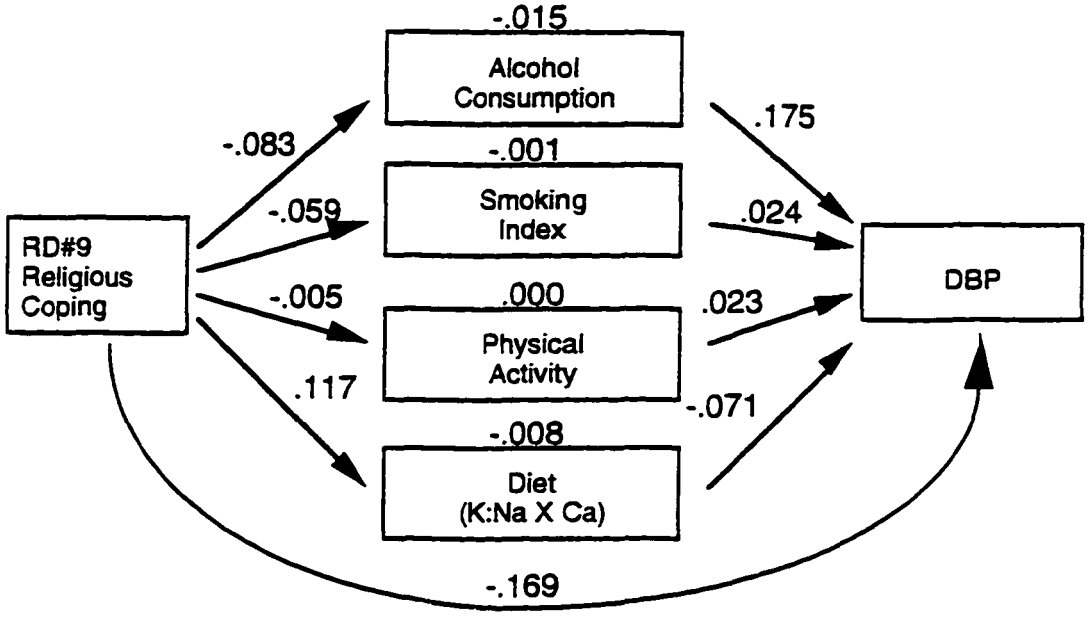
INDIRECT EFFECT, through:	
Alcohol	-.013
Smoking Index	.002
Physical Activity	.000
Diet	-.007
DIRECT EFFECT	-.139
TOTAL EFFECT	**-.157**

Figure 21. Effects of religious experience on DBP (controlling for age and BMI).



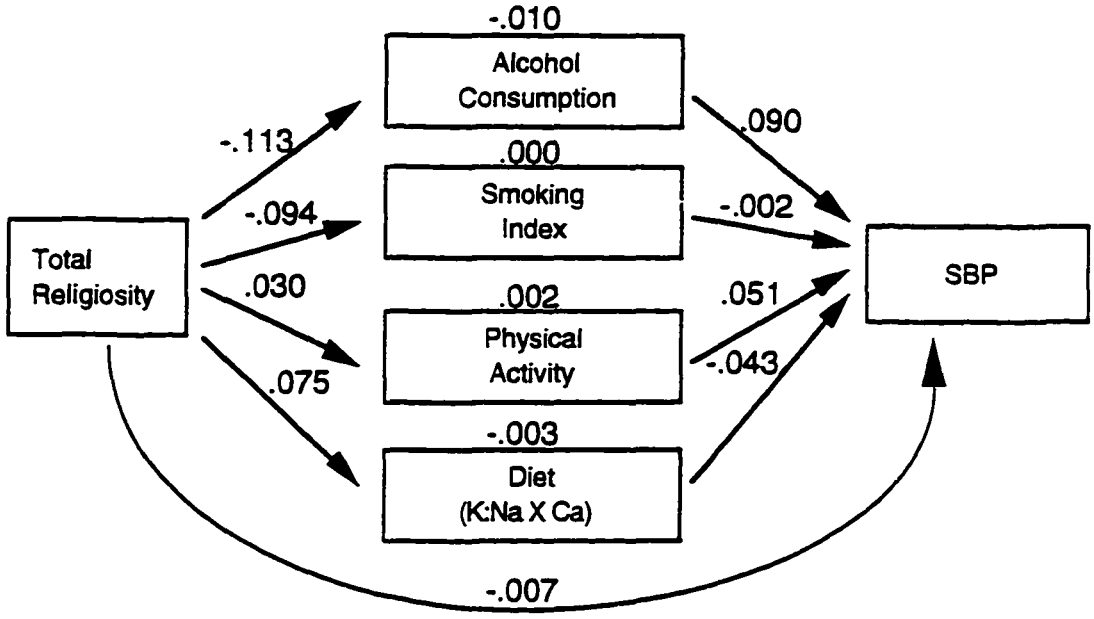
INDIRECT EFFECT, through:	
Alcohol	-.007
Smoking Index	.000
Physical Activity	.000
Diet	-.005
DIRECT EFFECT	-.007
TOTAL EFFECT	**-.019**

Figure 22. Effects of religious coping on SBP (controlling for age and BMI).



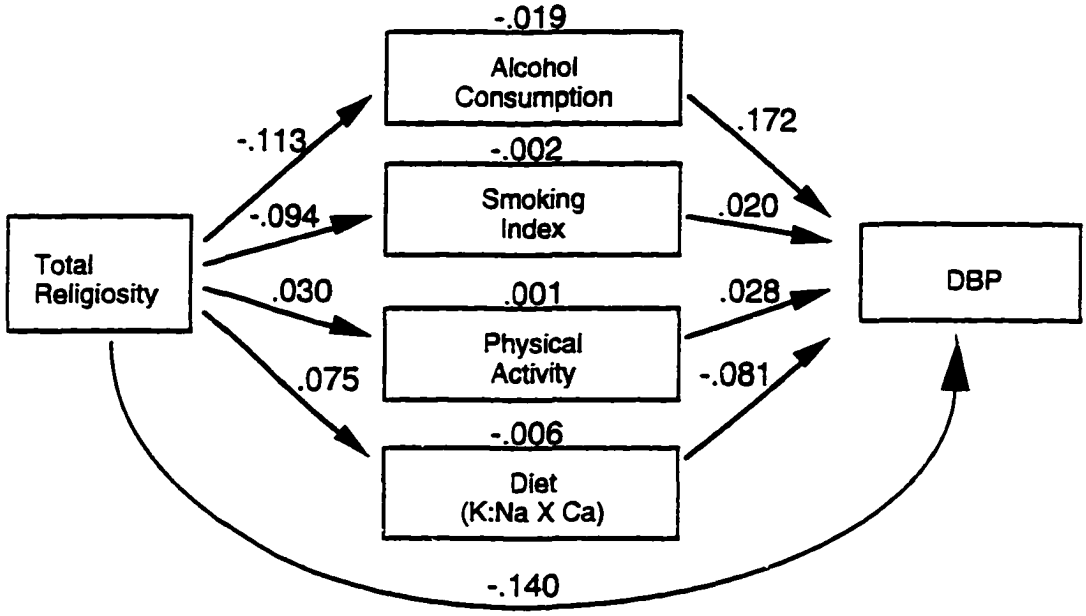
INDIRECT EFFECT, through:	
Alcohol	.015
Smoking Index	.001
Physical Activity	.000
Diet	-.008
DIRECT EFFECT	-.169
TOTAL EFFECT	**-.193**

Figure 23. Effects of religious coping on DBP (controlling for age and BMI).



INDIRECT EFFECT, through:	
Alcohol	-.010
Smoking Index	.000
Physical Activity	.002
Diet	-.003
DIRECT EFFECT	-.007
TOTAL EFFECT	**-.018**

Figure 24. Effects of total religiosity on SBP (controlling for age and BMI).



INDIRECT EFFECT, through:	
Alcohol	-.019
Smoking Index	-.002
Physical Activity	.001
Diet	-.006
DIRECT EFFECT	-.140
TOTAL EFFECT	**-.166**

Figure 25. Effects of total religiosity on DBP (controlling for age and BMI).

A series of multiple regression analyses was performed to estimate all path coefficients for each path diagram. To estimate path coefficients in each path diagram, each endogenous variable was regressed on all variables that had a direct effect on it, including endogenous and exogenous variables. In each regression equation, age and BMI were controlled to eliminate their potential impact on the relationship between the independent variables in the model and BP. This was accomplished by entering age and BMI into each of the regression equations and examining the regression coefficients. The path coefficients in the diagrams are equal to standardized partial regression coefficients in the resultant multiple regression equations. The beta coefficients in the path diagrams do not always correspond with the correlational analysis because age and BMI are controlled for in the multiple regression equations. Only subjects not on BP medication were included in this analysis (n = 98) because unmedicated BPs were unknown for the other 14 subjects who were on BP medication.

Under each path diagram (Figures 6 through 25), a summary of the direct, indirect and total effect of the religiosity dimension on the blood pressure variable is given. The direct effect was equal in magnitude to the path coefficient from the religiosity variable to blood pressure along its direct path. The indirect effect of a religiosity variable on blood pressure through a particular intermediate health behavior variable was calculated as the product of the path coefficients between the religiosity dimension and blood pressure along that path. The overall indirect effect in the model or path diagram was equal to the sum of the indirect effects through all paths leading from the religiosity dimension to the blood pressure variable. The total effect of the religiosity dimension in question on blood pressure was equal to the sum of its direct effect plus its overall indirect effect (Pedhazur, 1982).

Table 9 summarizes the effects of the religiosity dimensions on BP. The strongest total effects were seen for: RD1 (intrinsic religiosity) on DBP (total effect = -.218); RD9

(religious coping) on DBP (total effect = -.193); RTOT (religious total) on DBP (total effect = -.166); RD8 (religious experience) on DBP (total effect = -.157); RD2 (extrinsic religiosity) on DBP (total effect = -.150); RD4 (religious well-being) on DBP (total effect = -.143); RD3 (belief factor) on DBP (total effect = -.140).

Table 9.

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

Religiosity Dimension	Effects on SBP			Effects on DBP		
	Indirect	Direct	Total	Indirect	Direct	Total
RD1 Intrinsic Religiosity	-.010	-.097	-.107	-.026	-.192	-.218
RD2 Extrinsic Religiosity	-.007	-.023	-.030	-.024	-.116	-.150
RD3 Belief Factor	-.015	-.009	-.024	-.021	-.119	-.140
RD4 Religious Well-being	-.011	.035	.024	-.026	-.117	-.143
RD5 Organized Religious Activity	.001	-.050	-.049	-.016	-.039	-.055
RD6 Non-organized Religious Activity	.001	.016	.017	.000	-.115	-.115
RD7 Religious Knowledge	-.008	-.034	-.042	-.019	.006	-.013
RD8 Religious Experience	-.010	.026	.016	-.018	-.139	-.157
RD9 Religious Coping	-.012	-.007	-.019	-.024	-.169	-.193
RTOT Total Religiosity	-.011	-.007	-.018	-.026	-.140	-.166
Average	-.008	-.015	-.023	-.020	-.114	-.135

In general, the effects of religiosity on DBP were greater than the effects on SBP. The direct effect for both SBP and DBP 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 which were not negative were relatively close to zero.

Analysis of Variance - Comparison of Normotensive and Hypertensive Groups

Blood pressure by religiosity dimension one-way ANOVAs 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 to further examine the effects of religiosity on BP. A total of 20 ANOVAs were performed. This additional analysis was conducted in order to include all subjects, even those on BP medication. The SBP and DBP variables were categorized into normotensive and hypertensive groups. The SBP and DBP analyses were conducted separately. For the SBP analyses, 89 subjects had normal SBP and 23 were categorized as hypertensive. For the DBP analyses, 95 subjects had normal DBP and 17 subjects were categorized as hypertensive. Each religiosity dimension was categorized into high, medium, and low groups. The boundaries to establish the religiosity dimension categories were chosen as close as possible to the 33rd and 67th percentiles. The ANOVA analyses did not produce any statistically significant results ($p > .05$).

ANOVAs were performed separately for three age groups (35 to 49 years, 50 to 64 years, 65 to 80 years) because religion may operate differently at different stages or ages of life. Responses to events vary according to the age at which they are experienced. In some instances, events are relevant only at particular stages of adulthood (Elder, 1985). If certain aspects of religiosity are more important at one stage of life than another, then the previous ANOVA results which collapsed the data across ages may have been insensitive to some meaningful associations between religiosity and blood pressure for specific age groups. For the youngest group, ages 35 to 49 ($n = 61$) no significant results were obtained ($p > .05$). For the middle group, ages 50 to 64 ($n = 37$), DBP by RD8 (religious experience) approached significance ($p = .058$). For the oldest group, ages 65 to 80 ($n = 14$), DBP by RD8 (religious experience) produced a p value of .118. These

findings are worth mentioning because statistical significance may have been difficult to detect, given the small n in each group.

CHAPTER 5
DISCUSSION

Introduction

This study examined the association between religiosity and blood pressure among white females aged 35 to 80 years. Over the past 33 years, there have been few investigations documenting the association between religion and blood pressure (Scotch, 1963; Graham et al., 1978; Walsh, 1980; Koenig et al., 1988a; Larson et al., 1989). The majority of studies examining the influence of religion on blood pressure and other health parameters has typically focused on church attendance or other limited aspects of religious practice. These simple and often superficial external signs of religion have been used to reflect the total religious experience. The present study is unique because it has measured religiosity as a multi-dimensional variable, thus better conceptualizing this phenomenon. The relationship between several dimensions of religiosity and both systolic and diastolic blood pressures have been quantified. This study is also noteworthy because for the first time, both the direct effect of religiosity on blood pressure and the indirect effects of religiosity on blood pressure through pertinent health behaviors have been calculated. Moreover, this investigation featured statistical control of potential confounding variables, a weakness of previous studies in this area. In this regard, the use of the Colins automated blood pressure monitor to obtain blood pressure values eliminated human error in this measurement.

Data from this study support the findings of other investigations revealing a beneficial relationship between religiosity and blood pressure (Scotch, 1963; Graham et al., 1978; Walsh, 1980; Koenig et al., 1988a; Larson et al., 1989). Specific findings of this study include the following: 1) the direct effect of religiosity on blood pressure appears to

be more important than the indirect effects through health behaviors, 2) intrinsic religiosity and religious coping are dimensions that have the greatest impact on blood pressure, 3) religious experiences have a beneficial effect on blood pressure in later years (50 to 64 year and 65 to 80 year age groups in this study), and 4) religiosity appears to have a greater effect on DBP than SBP.

Statistical and Interpretive Considerations

Prior to discussing the results of this study, it is important to acknowledge some statistical and interpretive considerations. Some of the correlations which achieved significance were not very large in magnitude. These correlations are meaningful, however, when characteristics of this study such as use of questionnaires and subject bias are considered. Many of the variables, for instance, were obtained from questionnaire information (e.g., religiosity, alcohol consumption, smoking index, physical activity index, dietary information). When utilizing questionnaires, reliability depends to a large extent on the recollection of the subject and the subject's opinion regarding what are acceptable or good habits. In addition, religiosity is not an easily definable or quantifiable variable. Even though a multidimensional approach was used to quantify religiosity and a religiosity instrument was chosen with careful consideration, it is acknowledged that further work needs to be conducted to better understand the construct of religiosity.

Given the methodological shortcomings noted previously, it is likely that the associations found in this study between religiosity and other variables may actually be stronger than the data suggest. Additionally, individuals who were on BP medication were excluded from the correlational and path analyses. These a priori selection criteria reduced the overall variation in blood pressure, an outcome which was undesirable from a statistical standpoint. Therefore, when considering the above acknowledged limitations concerning the variability of questionnaire measurement, subject bias, and selection criteria, many trends in the data may not have achieved statistical significance. Even though some

correlation coefficients were small and standardized beta coefficients were low and statistically insignificant, these results may represent important trends, suggesting the need for further research. Trends in the correlational analyses and path analyses are reported because this type of exploratory research is intended to confirm theory, generate new hypotheses and questions, and provoke additional analyses and studies.

One of the important uses of path analyses is comparing the relative strengths of association along each path of the hypothesized model. Age and BMI often account for the greatest amount of variance in blood pressure (National Center for Health Statistics, 1983). The effects of these variables on blood pressure are generally considered strong and are often statistically significant while the influence of other factors on blood pressure is generally considered weaker. However, the effects of factors other than age and BMI are still meaningful because it is important to identify as many risk factors as possible (where one can intervene to change them) for high blood pressure. In this chapter, the influence of alcohol intake, smoking, diet, physical activity, and religiosity on blood pressure will be characterized as stronger or weaker relative to each other. In the current investigation, BMI consistently accounted for the greatest amount of variance in SBP and DBP. The standardized beta coefficients for age, however, were not as large as the BMI coefficients and often did not attain statistical significance. Interestingly, the coefficients for alcohol consumption and the religiosity dimensions were often similar in magnitude to age for each of the multiple regression equations with SBP or DBP as the dependent variables. BMI and age are not depicted on the path diagrams, as it is conventional for control variables to be excluded for simplicity.

Throughout discussion of the path analysis results, the terms direct, indirect, and total effects of religiosity on blood pressure are used. Use of the term 'effect' is consistent with conventional path analysis terminology. Path diagrams are based on unidirectional theory. However, since the study is cross-sectional in nature, it should be noted that the

data actually exhibit associations between the independent variables and blood pressure, rather than cause and effect. Longitudinal studies are needed to confirm cause and effect between the independent variables and blood pressure.

The standardized beta coefficients in the present experiment were similar in magnitude to those discussed in a widely cited report by the National Center for Health Statistics (1983). Table 10 illustrates the relationship between the National Health and Nutrition Examination-I Survey (NHANES-I) data and findings from the present study for selected variables.

Table 10. Standardized Beta Coefficients in NHANES-I and Present Study

	NHANES-I White females 25 - 74 years n=1440		Current study (equations with RD1) White females 35 - 80 years n=98	
	Dependent Variable		Dependent Variable	
	SBP	DBP	SBP	DBP
Selected Independent Variables	β coefficient	β coefficient	β coefficient	β coefficient
Age	0.40	0.19	0.16	0.17
BMI	0.23	0.36	0.56	0.27
Alcohol	−0.05	0.02	0.08	0.17
Smoking	−0.06	−0.06	−0.01	0.01

Path Analyses

Indirect Effects of Religiosity on Blood Pressure

The previous literature has only speculated on the mechanisms by which religion may exert a beneficial effect on blood pressure. The assertion that faith is associated with healthy behaviors (Hannay, 1980; Vaux, 1976), which in turn may have subsequent effects

on health outcomes, is not strongly supported by the current investigation. The present study provides evidence that there is little effect of religiosity on blood pressure through intermediate health variables (e.g., alcohol, smoking, diet, physical activity) compared to the direct effect of religiosity on blood pressure. Findings related to each of these indirect effects will be discussed separately.

Upon examining the four indirect effect pathways on each path diagram (Figures 6 through 25), the pathway through alcohol consumption was the only one that appeared somewhat important. In all path diagrams, the indirect effect of the religiosity variable on systolic or diastolic blood pressure through alcohol consumption was negative, indicating that as the religiosity score increased, blood pressure decreased. The indirect effects for each religiosity dimension through alcohol were small, ranging from -.001 to -.012 for SBP, and from -.003 to -.024 for DBP.

With regard to the first link of this indirect effect through alcohol consumption, the relationship between each religiosity dimension and alcohol was always negative, meaning that higher religiosity scores were related to a lower alcohol consumption. These results are consistent with findings from other studies (Cahalan et al., 1969; Koenig et al., 1998a). In considering the second link in this indirect pathway through alcohol consumption, the relationship between alcohol consumption and blood pressure was positive for each path diagram, indicating that as alcohol consumption increased, blood pressure increased. This finding is in agreement with over 32 cross-sectional studies which have shown an association between chronic alcohol intake and hypertension (Keil et al., 1993). When the two links of this pathway through alcohol were multiplied together on each path model to determine the indirect effect of each religiosity dimension on SBP or DBP through alcohol consumption, the resultant effect was negative, yet quite small in each case. In general, however, it was larger than the other indirect effects examined and the trends for each path diagram are as expected.

The association between the religiosity dimensions and blood pressure through smoking was close to zero on all 20 path diagrams (indirect effects ranged from -.003 to .004). The specific link between the religious dimensions and smoking was slightly negative for eight of the 10 religiosity variables. This supports the notion that more religious individuals exhibit better health habits. The second part of this indirect effect through smoking, the link between the smoking index and blood pressure, was always close to zero. Therefore, when these two links were multiplied to determine the indirect effect of religiosity through smoking, the resultant value was always near zero. This finding of no association between smoking and blood pressure is consistent with previous research demonstrating that smoking acutely increases blood pressure, but does not exert a chronic effect on blood pressure (Ballantine, Devine, & Fife, 1978). It is interesting to note that the significant correlation between smoking index and SBP ($r = 0.24$, $p < .05$) was not reflected in the beta coefficient along the path between smoking index and SBP on the path analysis diagrams. In the regression equations for the path analysis, age and BMI were controlled. Hence, the significant correlation between smoking index and SBP was due to smoking index being associated with age and/or BMI.

The effects of the religiosity dimensions on systolic and diastolic blood pressure through physical activity were also close to zero, with the range being -.005 to .007 for the 20 diagrams. This would imply that none of the religiosity dimensions or total religiosity had an effect on blood pressure by influencing physical activity for this group of women. Relative to the first link in this indirect relationship (the association between the various religiosity dimensions and physical activity), no trend was discernible and beta coefficients varied quite a bit depending on the dimension. For three religiosity dimensions (intrinsic religiosity, belief factor, and religious coping), the relationship was negative, whereas for the other six dimensions and total religiosity, the relationship was positive. There is no known literature to which these findings can be compared.

Concerning the association between physical activity and blood pressure, the standardized beta coefficient was always slightly positive, with the range being .023 to .057. These results indicate that with an increased physical activity index, there was an increase in SBP and DBP. This is interesting to note insofar as the research literature suggests physical activity may decrease blood pressure slightly in both normotensive and hypertensive individuals (Tipton, 1991). A very weak inverse relationship (statistically insignificant and nearly zero) was seen in our correlational analysis between physical activity and SBP ($r = -.04$) and DBP ($r = -.03$). This is noted only because it is in contrast to the positive standardized beta coefficients for the relationships between physical activity and blood pressure in the path analysis diagrams when age and BMI were controlled. This insinuates that age, BMI, or both are confounders in this relationship. It has been suggested (Kelly & Tran, 1995) that one of the weaknesses of research on aerobic exercise and blood pressure in normotensive adults is that weight loss or BMI may be uncontrolled confounding factors. A reduction in blood pressure associated with physical activity, for example, may be mediated partially through weight loss or a reduction in BMI rather than through some other physiological response to exercise. Another weakness of studies on aerobic exercise and blood pressure in normotensive adults is the over-reliance on males as subjects. In Kelly & Tran's (1995) meta-analysis of 35 studies in this research area, 91% of the subjects were male, while only 9% were female.

The current study did not detect an association between religiosity and physical activity and only a weak association between physical activity and blood pressure. Therefore, no indirect effect of religiosity on blood pressure through the intermediate variable of physical activity was observed. There is no known data in the literature to compare our results regarding the effect of religiosity dimensions on blood pressure through physical activity.

The dietary variable in this study is an interactive variable of three nutrients (K:Na X Ca) that are known to affect blood pressure. Previous research has shown low K and high Na in the presence of low Ca is associated with high blood pressure in females (Gruchow et al., 1988; Gruchow & Hixson, 1994). In view of these findings, an inverse relationship would be expected between this interactive dietary variable and blood pressure, such that a high (K:Na X Ca) would be associated with lower blood pressure or low ratios would be associated with higher blood pressure. In each of the 20 path diagrams, there was an inverse relationship between diet (K:Na X Ca) and both SBP and DBP. The standardized beta coefficients were, in fact, always negative, yet fairly low (range of -.040 to -.093).

With regard to the first part of the link for the indirect effect of religiosity on blood pressure through diet (K:Na X Ca), no relationship was detected between any of the religiosity variables and systolic or diastolic blood pressure. All standardized beta coefficients were very low, ranging from -.009 to .003. Most of the literature which supports an association between religion and diet has focused on groups (e.g., Seventh-Day Adventists and Mormons) which are known to be especially healthy eaters with frequent adherence to lacto-ovo vegetarian diets. (Armstrong et al., 1977; Gardner & Lyon, 1982a, 1982b). In the current study, only three of the 98 participants (3.1 %) who were included in this path analysis were Seventh-Day Adventists and no participants were Mormon. It is not too surprising, therefore, that this study did not provide evidence of a relationship between religiosity and diet. When the two links of the pathway indicating the indirect effect of diet on blood pressure were multiplied together to determine the magnitude of the indirect effect, the result was always near zero. Hence, results from this study do not support any indirect effect of religiosity on BP through diet (K:Na X Ca).

Direct Effect of Religiosity on BP

As shown in Table 8, the direct effect of religiosity on BP was greater in magnitude than the total indirect effect in most (16 out of 20) of the path analysis diagrams. This implies that most religiosity dimensions and total religiosity are influenced not so much by changing specific health behaviors (which then influence blood pressure), but rather by a more direct influence. An individual's perception of stress may be altered or an adaptation to stressful events may be facilitated by the act of being religious. These data are in agreement with Larson et al. (1989) who reported the association between religion and blood pressure to be most significant among those who smoked. Blood pressures were significantly lower among smokers reporting high religious importance compared to smokers with low religious importance. This indicated that the influence of religiosity on BP was not mediated through smoking behavior. These authors suggested that religion may reduce BP by improving the ability to cope with stress rather than affecting health behaviors.

Different Dimensions of Religiosity

Another important finding of the current investigation deals with ascertaining which aspects of religiosity exert the greatest effect on blood pressure. Data from this study on 35 to 80 year-old females indicate that intrinsic religiosity has the greatest effect on blood pressure (specifically, DBP). Figure 7 shows a total effect of -.218, with a direct effect alone of -.192. The standardized beta coefficient for intrinsic religiosity (-.192) is greater than the other beta coefficients calculated for the regression of diastolic blood pressure on alcohol (.167), smoking index (.007), physical activity index (.023), and diet (-.084). Recognizing that the direct effect of intrinsic religiosity is greater that the effect of alcohol consumption (a generally accepted risk factor for high BP) on diastolic blood pressure may aid in explaining the importance of intrinsic religiosity as a possible risk factor for BP. Previous research has shown a significant relationship between low intrinsic religiosity

scores and hypertension in males but no significant relationship between these variables among female subjects (Koenig et al., 1988a). People who score high in intrinsic religiosity regard faith as a supreme value in its own right and find motivation and meaning for life in their religion. Having faith and a sense of meaning for life may contribute to an inner peace which assists an individual in coping with stress and results in a beneficial effect on blood pressure.

Religious coping (RD9) had the second largest effect on blood pressure. The total effect of religious coping on DBP was -.193. These data suggest that religion may influence BP by assisting individuals in coping with stress. The religious coping score was derived from responses to two statements that dealt specifically with religion acting as a resource to help deal with stress, problems, or difficulties. Participants determined how much they agreed or disagreed with these statements:

A. While dealing with difficult times in my life, I don't get much personal strength and support from God.

B. Prayer does not help me cope with difficulties and stress in my life.

Findings from the present study are consistent with Larson et al.'s (1989) suggestion that religion acts by helping individuals cope with stress. Results of the current study are also in agreement with Koenig et al.'s (1988a) finding that religious coping behaviors are used more often in response to stressful events than any other coping strategy.

The relationship between the total religiosity score and diastolic blood pressure was next strongest in magnitude (total effect = -.166) followed by the effect of religious experience on DBP (-.157), extrinsic religiosity on DBP (-.150), religious well-being on DBP (-.143) and belief factor on DBP (-.140). Each of these is greater than the average of the effects of the different religiosity variables on DBP, and each is greater than any of the total effects seen for any religiosity variable on SBP. Why do these religiosity dimensions have greater effects on DBP than organized religious activity, non-organized religious

activity, or religious knowledge? The group of religiosity dimensions listed as having stronger associations with blood pressure all address attitudes regarding how we think about or perceive religion. The religiosity dimensions that displayed a weaker association with BP measured time involved in religious activity or religious knowledge. Viewed in this context, what we internalize about religion may be more important than time we spend in religious activity.

The religious knowledge dimension had the lowest association with blood pressure. It should be noted that this dimension was based on a single question requiring the subject to identify the prophets of the Old Testament. In retrospect, one question is probably not an accurate indication of religious knowledge and having religious knowledge does not necessarily make a person more 'religious'. Therefore, it is not surprising to find little to no relationship between this spiritual dimension and blood pressure.

Organized religious activity, which includes church attendance and participation in Sunday School classes and Bible study groups, is most similar to the simple church attendance variable that has often been used in earlier work. Previous studies examining church attendance has noted a relationship between religion and health. It is interesting to observe that in the current study, RD5 (organized religious activity) was not one of the variables most closely associated with blood pressure. The present study shows that other aspects of religiosity (particularly intrinsic religiosity and religious coping) may be even more strongly related to health outcomes such as blood pressure.

The Effect of Religiosity on SBP Compared to DBP

The relationship between the religiosity variables and blood pressure was generally stronger for diastolic blood pressure than systolic blood pressure. This finding agrees with Larson's (1989) finding in a white male population. The association between blood pressure and a combined religiosity index for church attendance and importance of religion (a variable akin to intrinsic religiosity) was stronger for DBP than for SBP. The

relationship was statistically significant for DBP only. Two of the papers reviewed on religion and blood pressure (Scotch, 1963; Koenig et al., 1988a) analyzed hypertension and normotension as dependent variables. Since SBP and DBP were not reported separately, no conclusion can be made regarding whether SBP or DBP was related more strongly to religiosity. Graham et al. (1978) and Walsh (1980) found that frequent church attenders had both lower SBP and DBP compared to infrequent attenders. In the current study, path analyses which included organized religious activity (which is closest to the church attendance variable used in Graham's and Walsh's studies) showed a similar total effect for both SBP (-.049) and DBP (-.055).

Why religiosity demonstrated a greater effect on DBP than SBP among this group of females is unclear. Systolic blood pressure is the pressure at the end of the ventricular ejection phase and depends greatly on the force of ventricular contraction. Diastolic blood pressure, on the other hand, is the pressure which occurs during the relaxation phase of the cardiac cycle. Diastolic blood pressure provides an indication of peripheral resistance or the ease with which blood flows from the arterioles to the capillaries (McArdle, Katch & Katch, 1991). The association between religiosity and DBP, therefore, may be related to a reduction in peripheral resistance rather than a decrease in the force of ventricular contraction. It is possible, for instance, that religiosity may attenuate stress, thus decreasing sympathoadrenal activity and the release of norepinephrine and epinephrine. This would result in a reduction in vasoconstriction and the maintenance of a lower or reduced DBP.

Another theory which may explain the greater effect of religiosity on DBP than SBP involves the renin-angiotensin-aldosterone system. A reduction in the release of renin by the kidneys would reduce the formation of angiotensin and reduce the production of aldosterone by the adrenal cortices (Guyton, 1991). Similarly, less angiotensin, a powerful vasoconstrictor, would contribute to a decreased peripheral resistance and a lower

DBP. Less aldosterone would contribute to a reduced fluid volume and cardiac output, which could also lead to a reduction in peripheral resistance and DBP.

It should be reiterated that both of the aforementioned hypotheses are purely speculative in nature. Nonetheless, laboratory investigations examining blood and urine levels of norepinephrine, epinephrine, renin, angiotensin, and aldosterone would be useful in confirming or refuting physiological mechanisms underlying the relationship between religiosity and blood pressure. In addition to measuring levels of the above substances, it would be helpful to measure resting heart rate to determine if this is a contributing factor. Recall that BP is affected by cardiac output and total peripheral resistance. Cardiac output is affected by heart rate and stroke volume. A relationship between religiosity and resting heart rate may provide evidence that heart rate and cardiac output are involved in the religiosity - blood pressure relationship.

ANOVAs for Three Age Groups

In the path analysis, religious experience followed total religiosity in strength of association with diastolic blood pressure (total effect = -.157). The ANOVAs for the three separate age groups (35 to 49 years, 50 to 64 years, 65 to 80 years), however, revealed some even more interesting results regarding religious experience. This analysis was performed because religion may operate differently at different stages of an individual's life. Analyzing three age groups separately revealed that the religiosity - blood pressure relationship was found to be most important among the middle age range (50 to 64 years. n = 37). The relationship between religious experiences (confirming, responsive, ecstatic, and revalational types, as described in Ch. 1) and DBP approached statistical significance for this group ($p = .058$). The relationship was also important for the oldest age group (65 to 80 years, $n = 14$, $p = .118$). These findings appear logical since older individuals have probably had more religious experiences, and a greater probability for these experiences to impact health. For this religiosity variable, data from the current investigation suggest that

religious experiences have a differential effect at various stages in the life cycle. There did not appear to be any other dimensions that had meaningful differences in their relationship with blood pressure between age groups.

Summary

In general, the direct effect of religiosity on blood pressure was greater than the indirect effects through intermediate health variables. This study did not support the suggestion that religious individuals may choose healthier behaviors, which would lead to consistently lower levels of blood pressure. This study provided very little evidence of an effect on blood pressure through the intermediate health variables of alcohol intake, smoking index, diet, and physical activity. Rather, the direct effect of religion on blood pressure was much more substantial, providing support for the theory that religion may have a beneficial effect on blood pressure by altering our perception of stress or improving our ability to cope with stress. In considering which dimensions of religiosity had the greatest influence on blood pressure, intrinsic religiosity and DBP showed the strongest relationship, followed by religiosity coping and DBP. Diastolic blood pressure was found to be influenced more by religiosity than SBP. It is possible that religiosity may act to attenuate stress and thereby reduce sympathoadrenal activity and vasoconstriction, thus producing a reduction in DBP. Another potential mechanism revolves around the involvement of the renin-angiotensin-aldosterone system. Religious experiences may have a beneficial effect on blood pressure, particularly in the later stages of life. This relationship was insignificant for the 35 to 49 year age group, but approached statistical significance for the 50 to 64 year age group and 65 to 80 year age group.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions were drawn from the results of this study:

1. Religiosity beneficially influenced blood pressure in white females aged 35 to 80 years, who are alumnae of Salem College or UNC Greensboro, living in Guilford or Forsyth Counties of North Carolina.

2. The direct effect of religiosity on blood pressure was more important than the indirect effects of religiosity on blood pressure through health behaviors (alcohol consumption, smoking, physical activity, and diet) in this group of white females. It is suggested that religion may alter our perception of stress, assist in coping with stress, or both, resulting in a beneficial effect on blood pressure. This theory is supported by the finding that the religious coping dimension was one of two dimensions of religiosity most strongly related to blood pressure (see #3, below).

3. Of the nine religiosity dimensions examined, those most closely associated with blood pressure in this group of white females were intrinsic religiosity and religious coping.

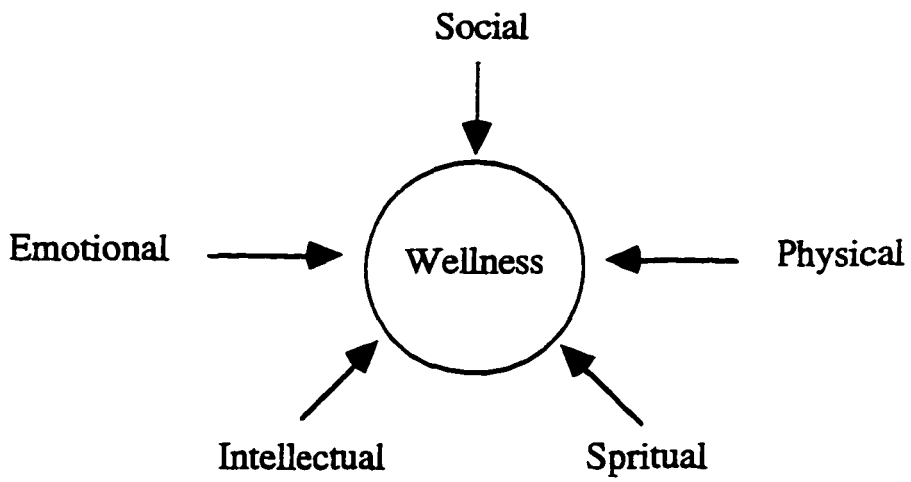
4. The relationship between religiosity and DBP is stronger than the relationship between religiosity and SBP. Religiosity may influence blood pressure by decreasing total peripheral resistance rather than influencing ventricular contraction, the latter of which would have a more pronounced effect on SBP.

5. Religious experiences had a greater effect on DBP for the older age groups: (the 50 to 64 year-old group and 65 to 80 year-old group), compared to the 35 to 49 year-old group.

These findings suggest that it may be important for physicians and other health care professionals to become aware of the relationship between religiosity and blood pressure so they, in turn can, engender positive attitudes and practices in patients toward religiosity. It is important to identify all possible risk factors that can be modified when attempting to prevent and control hypertension.

In order to maximize optimal health, an individual must constantly balance and maintain all the components of the wellness model (Figure 26) (Prentice, 1994). This involves attending to physical, mental, emotional, social, and spiritual aspects of well-being. Individuals benefit from understanding the importance of maintaining balance in all aspects of their lives.

Figure 26. Wellness Model



Religion, which is included in the spiritual component of the wellness model, could be a significant resource for living. For some persons, the findings of this study suggest that in many life situations, relying strictly on one's own resources, rather than turning to religion or some equivalent resource, could increase the probability of elevated blood

pressure. Religion may facilitate the ability to perceive stress differently or cope with stress more effectively.

Recommendations For Future Research

More studies on the relationship between religiosity (especially intrinsic religiosity and religiosity coping) and blood pressure are needed that are longitudinal in design and include other population characteristics. It is difficult to generalize the results of this study beyond the specific population of 35 to 80 year-old, white females who are college graduates of middle to upper socioeconomic status living in Guilford or Forsyth County, NC. Populations that include other races, all socioeconomic classes, and males need to be examined. Larger population studies would also be helpful because they would allow examination of data by denomination as well as by religiosity scores. Specific denominations such as Seventh-Day Adventists and Mormons, who are known to have healthy eating habits, may show evidence of an indirect effect of religiosity on blood pressure through diet.

Studies that include subjects from other geographic locations are also needed. The effect of geographic location on the prevalence rates of various religious activities and on religious attitudes is difficult to determine. It should be kept in mind that data from the current investigation were collected on women who live in the south, specifically in Forsyth and Guilford counties in North Carolina. This area is generally included in the "Bible Belt" region in the United States. One must therefore be careful about generalization of these results to different geographic locations.

The cross-sectional nature of the data in the present 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 just becoming

involved with religion in their lives should be examined over time. Other health outcomes such as cancer and depression could also be examined.

Improving the measurement of religiosity, which is still considered difficult to define and quantify should continue. Future work in this area will better enable researchers to identify existing relationships between religion and health outcomes. It would be advantageous for sociologists, religion professors, and health professionals to collaborate on studies involving religiosity and health outcomes.

It is important to keep in mind that the aspects of religiosity of the Judeo-Christian faith showing evidence of an association with lower blood pressures may also have relevance for other religions. Spiritual activities of non-Judeo-Christian affiliated individuals may also have a beneficial effect on blood pressure. Other faiths and spiritual activities need to be examined.

Finally, in order to gain insight into the mechanisms that may be involved in this relationship between religiosity and blood pressure, studies need to be conducted that measure blood and urine levels of norepinephrine, epinephrine, renin, angiotensin, and aldosterone. Resting heart rates should also be measured to determine if they have a similar relationship to religiosity as blood pressure, indicating a possible contributing factor in the religiosity-blood pressure relationship.

Overall, the results of this study support a direct relationship between religiosity (particularly intrinsic religiosity and religiosity coping) and blood pressure. These findings are in agreement with the notion that optimal health is a function of all aspects of well-being, including spiritual well-being. So now we are left with the challenge of improving the measurement of religiosity, refining methodologies, and expanding the subject base to gain further insight into the mechanisms involved in the association between religiosity and blood pressure.

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Appendix A

UNC Greensboro and Salem College Alumni Health Questionnaire

Thank you for volunteering to participate in the UNC Greensboro and Salem College alumni women's health study. Please complete the attached questionnaire regarding demographic information, medical history, religiosity, physical activity, food intake, and perceived stress. All questionnaire information will be kept strictly confidential. Only statistical summaries of large groups of people will be used in reporting any results (no information on individuals will be used). Please bring this questionnaire when you visit UNC Greensboro on _____ at _____.

Please report to the second floor of the Health and Human Performance Building and follow the signs to the Alumni Study. In order to ensure the most accurate estimate of your resting blood pressure, please adhere to the following guidelines:

- Do not eat, drink (especially alcohol and caffeine) or smoke for at least 60 minutes before your visit to UNC Greensboro.
- Do not exercise for at least 4 hours before your appointment.
- Wear loose clothing, specifically around the right arm, to allow for easy access for blood pressure measurement.

On the reverse side of this page, please find a map of UNC Greensboro's campus. If you will be on campus on a Saturday you can park in the lot at the corner of Aycock Street and Walker Avenue. If you visit the campus on a weekday, please park on a public street, such as Mayflower, Jefferson, or Kenilworth.

Thank you for your cooperation.

Appendix A

SALEM COLLEGE AND UNC GREENSBORO
ALUMNI HEALTH STUDY
QUESTIONNAIRE

Name: _____
First M.I. Last

Address: _____
Number Street

_____
City State Zip

Telephone: _____

INSTRUCTIONS: Please fill in the blank or check the appropriate box for each question. Answer the questions as completely and accurately as you can. If you are unsure of an answer, please respond with your best estimate rather than leaving a question unanswered.

PART I. GENERAL INFORMATION

The following questions have to do with general information that may be related to your health status.

1. Are you: _____ male _____ female
2. When were you born? _____/_____/_____ mo./day/year
3. About how tall are you? _____ Feet _____ Inches
4. About how much do you weigh? _____ Pounds
5. What is your current marital status?
   _____ Married (including common law)
   _____ Separated
   _____ Divorced
   _____ Widowed
   _____ Never Married
6. What was your household's total income from all sources before taxes and deductions for last year?
   _____ $ 0.00 to $19,999
   _____ $20,000 to $39,999
   _____ $40,000 to $59,999
   _____ $60,000 or greater
   _____ Don't Know
7. What is your highest level of education? **(Circle One)**

Elementary School:	1	2	3	4	5	6	7	8
High School:	9	10	11	12				
College:	13	14	15	16	17 +			

8. Are you:
   _____ White
   _____ Black
   _____ Native American
   _____ Hispanic
   _____ Asian
   _____ Other _____ (please specify)

9. In general, compared to other persons your age, would you say your health is:
   _____ Excellent
   _____ Good
   _____ Fair
   _____ Poor

10. Which is your alma mater?
    _____ UNC Greensboro
    _____ Salem College

PART II. MEDICAL HISTORY

Has a physician ever told you hat you had any of the following? (Please check and give "year of onset." if applicable.)

	No	Yes	Year of Onset
1. Coronary Heart Disease	☐	☐	_____
a. Angina Pectoris	☐	☐	_____
b. Heart Attack	☐	☐	_____
c. Coronary Surgery	☐	☐	_____
2. Chronic Bronchitis	☐	☐	_____
3. Emphysema	☐	☐	_____
4. Bronchiectasis	☐	☐	_____
5. High Blood Pressure	☐	☐	_____
6. High Blood Cholesterol	☐	☐	_____
7. Stroke	☐	☐	_____
8. Thrombophlebitis	☐	☐	_____
9. Claudication	☐	☐	_____
10. Obesity	☐	☐	_____
11. Peptic Ulcer:	☐	☐	_____
a. Stomach	☐	☐	_____
b. Duodenum	☐	☐	_____
12. Gall Bladder Disease	☐	☐	_____
13. Appendicitis	☐	☐	_____
14. Ulcerative Colitis	☐	☐	_____
15. Diverticulitis	☐	☐	_____
16. Diabetes	☐	☐	_____
17. Chronic Back Pain	☐	☐	_____
(diagnosis: _____)			
18. Arthritis:	☐	☐	_____
a. Rheumatoid	☐	☐	_____
b. Degenerative (osteo)	☐	☐	_____
c. Gout	☐	☐	_____
d. Other	☐	☐	_____
19. Cirrhosis	☐	☐	_____

20. Prostate Disease	☐	☐	_____
21. Multiple Sclerosis	☐	☐	_____
22. Parkinson's Disease	☐	☐	_____
23. Glaucoma	☐	☐	_____
24. Cataract	☐	☐	_____
25. Poliomyelitis	☐	☐	_____
a.. Recurrent weakness	☐	☐	_____
26. Osteoporosis	☐	☐	_____
a. Related fractures	☐	☐	_____
27. Nervous Breakdown	☐	☐	_____
a. Psychosis	☐	☐	_____
b. Neurosis	☐	☐	_____
c. Depression	☐	☐	_____
28. Alcoholism	☐	☐	_____
29. Cancer	☐	☐	_____
(site: _____)			
30. Other major disease	☐	☐	_____
(specify: _____)			

31. As nearly as you can recall, how old were you when you had your first menstrual period?
_____ years old

32. Have you ever been pregnant? (Mark "yes" even if your pregnancy did not result in a living child.)
_____ Yes
_____ No (GO TO QUESTION 34)

33. At what age did you have your first pregnancy? _____ years old

34. Are you still menstruating?
_____ Yes -> How long ago was your last menstrual period? _____ days
_____ No -> How old were you at the time of your last menstrual period?
_____ years old

35. Have you ever taken oral contraceptives?
_____ Yes -> What was (were) the name(s) of the oral contraceptive(s)?
_____

If you took oral contraceptives at any time, please mark below with an "X" those ages at which you took them.

AGE: < 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

AGE: 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 +

_____ No

These next questions are about smoking cigarettes.

36. Have you ever smoked cigarettes during any period of your life (aside from possibly trying them once or twice)?
_____ Yes, currently smoking -> _____ brand
_____ Yes, smoked in the past but not now.
_____ No never smoked cigarettes -> IF YOU HAVE NEVER SMOKED, SKIP TO PART III. on the next page.)

37. What is the greatest number of cigarettes that you have ever regularly smoked?
_____ 1/4 pack per day
_____ 1/2 pack per day
_____ 1 pack per day
_____ 1 1/2 packs per day
_____ 2 packs per day or more

38. At what age did you start smoking regularly? _____ years old

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

The following questions are concerned with medication.

40. Are you presently taking any medication for blood pressure or heart disease?
_____ Yes, specify _____.
_____ No

41. Are you taking any other medication?
_____ Yes, specify _____.
_____ No

PART III. RELIGIOSITY SCHEDULE

Place a check next to the phrase which best describes your response to each question.

1. Which of the following statements comes closest to expressing what you believe about God?
   _____ I know God really exists and I have no doubts about it
   _____ While I have doubts, I feel that I do believe in God
   _____ I don't believe in a personal God, but I do believe in a higher power of some kind
   _____ I don't know whether there is a God or not and I don't believe there is any way to find out
   _____ I don't believe in God

2. Which of the following statements comes closest to expressing what you believe about Jesus?
   _____ Jesus is the divine Son of God and I have no doubts about it
   _____ While I have some doubts, I feel basically that Jesus is divine
   _____ I feel that Jesus was a great man and very holy, but I don't feel him to be the son of God any more than all of us are children of God
   _____ I think Jesus was only a man, although an extraordinary one
   _____ Frankly, I'm not sure there really was such a person as Jesus

3. The Bible tells of many miracles, some credited to the Christ and some to other prophets and apostles. Generally speaking, which of the following statements comes closest to what you believe about Biblical miracles?
   _____ I believe miracles are stories and never really happened
   _____ I am not sure whether these miracles really happened or not
   _____ I believe the miracles happened, but can be explained by natural causes
   _____ I believe the miracles actually happened just as the Bible says they did

4. The Devil actually exists. Do you believe this is ...
   _____ Completely true
   _____ Probably true
   _____ Probably not true
   _____ Definitely not true

5. How often do you attend services at a church or temple?
   _____ Several times a week
   _____ about once a week
   _____ Several times a month
   _____ Several times a year
   _____ Seldom
   _____ Never

6. How often do you participate in other religious group activities (i. e., adult Sunday school classes, Bible study groups, prayer groups, etc.)
   _____ Several times a week
   _____ about once a week
   _____ Several times a month
   _____ Several times a year
   _____ Seldom
   _____ Never

7. Think of your five closest friends. How many of them are members of your church or temple?
   _____ None
   _____ One
   _____ Two
   _____ Three
   _____ Four
   _____ Five
8. How often do you pray privately?
   _____ Not at all
   _____ Only occasionally
   _____ Several times a week
   _____ Once a day
   _____ Twice a day
   _____ Three or more times a day
9. How often do you read the Bible or other religious literature (magazines, papers, books) at home?
   _____ Several times a day
   _____ Daily
   _____ Several times a week
   _____ Several times a month
   _____ Only occasionally
   _____ Not at all
10. How often do you listen to or watch religious programs on radio or TV?
   _____ Not at all
   _____ Only occasionally
   _____ Several times a month
   _____ Several times a week
   _____ Daily
   _____ Several times a day
11. Which of the following were old testament prophets? (For this question, please check as many as apply.)
   _____ Elijah
   _____ Leviticus
   _____ Deuteronomy
   _____ Ezekiel
   _____ Jeremiah
   _____ Paul
   _____ None of these were prophets

Part III. Religiosity Schedule

The next section of the questionnaire asks how much you agree or disagree with each item. Place a check next to the phrase which best describes your feeling for each item.

12. I experience God's love and care for me in my relationship with him.
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

13. I believe that God is impersonal and not interested in my daily situations.
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

14. I have a personally meaningful relationship with God.
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

15. While dealing with difficult times in my life, I don't get much personal strength and support from God.
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

16. My relationship with God helps me not to feel lonely?
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

17. Private prayer is important in my life?
    _____ Strongly Agree
    _____ Moderately Agree
    _____ Slightly Agree
    _____ Slightly Disagree
    _____ Moderately Disagree
    _____ Strongly Disagree

18. I do not experience God's intervention in my life in any concrete or personal way.
_____ Strongly Agree
_____ Moderately Agree
_____ Slightly Agree
_____ Slightly Disagree
_____ Moderately Disagree
_____ Strongly Disagree

19. God has revealed things to me about my life, other people, himself, or his divine plan.
_____ Strongly Agree
_____ Moderately Agree
_____ Slightly Agree
_____ Slightly Disagree
_____ Moderately Disagree
_____ Strongly Disagree

20. Prayer does not help me to cope with difficulties and stress in my life.
_____ Strongly Agree
_____ Moderately Agree
_____ Slightly Agree
_____ Slightly Disagree
_____ Moderately Disagree
_____ Strongly Disagree

21. I feel most fulfilled when I am in close communion with God.
_____ Strongly Agree
_____ Moderately Agree
_____ Slightly Agree
_____ Slightly Disagree
_____ Moderately Disagree
_____ Strongly Disagree

The next section of the questionnaire asks how true you believe each statement to be. Check the phrase which best describes your feelings about each item.

22. My faith involves all of my life.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

23. In my life I experience the presence of the divine (that is of God).
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

24. Although, I am a religious person, I refuse to let religious considerations influence my everyday affairs.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

25. Nothing is as important to me as serving God as best I know how.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

26. My faith sometimes restricts my actions.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

27. My religious beliefs are what really lie behind my whole approach to life.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

28. I try hard to carry my religion over into all my other dealings in life.
_____ Definitely true of me
_____ Tends to be true
_____ Tends not to be true
_____ Definitely not true of me
_____ Unsure

29. My religious faith is the most important influence in my life.
_____ Completely true
_____ Mostly true
_____ Mostly untrue
_____ Completely untrue

The final part of this section of the questionnaire asks how much you agree or disagree with each item. Place a check next to the phrase which best describes your feeling about each item.

30. One should seek God's guidance when making every important decision.
_____ Definitely agree
_____ Tend to agree
_____ Tend to disagree
_____ Definitely disagree
_____ Unsure

Part III. Religiosity Schedule

31. Although I believe in religion, I feel there are many more important things in my life.
_____ Definitely agree
_____ Tend to agree
_____ Tend to disagree
_____ Definitely disagree
_____ Unsure

32. It doesn't matter so much what I believe as long as I lead a moral life.
_____ Definitely agree
_____ Tend to agree
_____ Tend to disagree
_____ Definitely disagree
_____ Unsure

33. Please check your religious preference.
_____ Protestant (if yes, specify denomination: _____)
_____ Catholic
_____ Jewish
_____ Other (specify: _____)
_____ None

34. How many years have you been religious? _____ years.

PART IV. PHYSICAL ACTIVITY QUESTIONNAIRE

Consider your leisure time physical activities for the past 3 months. Check activities you engage in. Indicate the average number of times you engage in the activity each month, and the average time (in minutes) per occasion.

	Activity	Do you perform this?		Average Number of Times per Month	Time per Occasion
SECTION A: Walking and Miscellaneous		No	Yes		Minutes
010	Walking for Pleasure				
020	Walking to Work				
030	Using Stairs When Elevator				
040	Cross Country Hiking				
050	Back Packing				
060	Mountain Climbing				
115	Biking to Work/Pleasure				
125	Dancing-Ballroom, Square, Disco				
135	Dancing-Aerobic, Ballet				
140	Horseback Riding				
SECTION B: Conditioning Exercise					
150	Home Exercise				
160	Health Club Exercise				
180	Jog/Walk Combination				
200	Running				
210	Weight Lifting				
SECTION C: Water Activities					
220	Water Skiing				
235	Sailing in Competition				
250	Canoeing/Rowing for Pleasure				
260	Canoeing/Row in Competition				
270	Canoeing on a Camping Trip				
280	Swimming (50 ft.) at a Pool				
295	Swimming at the Beach				
310	Scuba Diving				

		No	Yes	Times/Month	Min/Occasion
320	Snorkeling				
SECTION D: Winter Activities					
340	Snow Skiing, Downhill				
350	Snow Skiing, Cross Country				
360	Ice (or roller) Skating				
370	Sledding or Tobogganing				
SECTION E: Sports					
390	Bowling				
400	Volley Ball				
410	Table Tennis				
420	Tennis, Singles				
430	Tennis, Doubles				
440	Softball				
450	Badminton				
460	Paddle Ball				
470	Racquet Ball				
480	Basketball: Non-Game				
490	Basketball: Game Play				
500	Basketball: Officiating				
510	Touch Football				
520	Handball				
530	Squash				
540	Soccer				
	GOLF				
070	Riding a Power Cart				
080	Walking, Pulling Cart				
090	Walking, Carrying Clubs				
SECTION F: Lawn and Garden					
550	Mow Lawn with Riding Mower				
560	Mow Lawn Behind Power Mower				
570	Mow Lawn Pushing Hand Mower				
580	Weeding and Cultivating Garden				
590	Spading, Digging, Filling Garden				

		No	Yes	Times/Month	Min/Occasion
600	Raking Lawn				
610	Snow Shoveling by Hand				

SECTION G: Home Repair Activities

620	Carpentry in Workshop				
630	Paint Inside of House				
640	Carpentry Outside				
650	Paint Outside of House				

SECTION H: Fishing and Hunting

660	Fishing from River Bank				
670	Fishing Stream w/Wading Boots				
680	Hunting Pheasant or Grouse				
690	Hunt Rabbit, Squirrel, Raccoon				
710	Hunt Large Game: Deer, Elk, Bear				

SECTION I: Other Leisure Physical Activity

SECTION J: Household Activities

1A	Climbing Stairs at Home				
2A	Major Cleaning				
3A	Light Cleaning				
4A	Grocery Shopping				
5A	Other Shopping				
6A	Making Beds - # of Beds _____				
7A	Doing Laundry - # of Loads ____				
8A	Prepare Quick Meals				
8B	Elaborate Meals/Baking				
9A	Washing Dishes				
10A	Other Household Activities				
11A	Caring for Child				
12A	Caring for Elderly				

PART V. PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate *how often* you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   _____ Never
   _____ Almost never
   _____ Sometimes
   _____ Fairly often
   _____ Very often
2. In the last month, how often have you felt that you were unable to control the important things in your life?
   _____ Never
   _____ Almost never
   _____ Sometimes
   _____ Fairly often
   _____ Very often
3. In the last month, how often have you felt nervous or stressed?
   _____ Never
   _____ Almost never
   _____ Sometimes
   _____ Fairly often
   _____ Very often
4. In the last month, how often have you dealt successfully with irritating life hassles?
   _____ Never
   _____ Almost never
   _____ Sometimes
   _____ Fairly often
   _____ Very often
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?
   _____ Never
   _____ Almost never
   _____ Sometimes
   _____ Fairly often
   _____ Very often

6. In the last month, how often have you felt confident about your ability to handle your personal problems?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

7. In the last month, how often have you felt that things were going your way?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

8. In the last month, how often have you found that you could not cope with all the things that you had to do?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

9. In the last month, how often have you been able to control irritations in your life?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

10. In the last month, how often have you felt you were on top of things?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

11. In the last month, how often have you been angered because of things that happened that were outside of your control?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

12. In the last month, how often have you found yourself thinking about things that you have to accomplish?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

13. In the last month, how often have you been able to control the way you spend your time?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
_____ Never
_____ Almost never
_____ Sometimes
_____ Fairly often
_____ Very often

PART VI. FOOD INTAKE QUESTIONNAIRE

Instructions for Completing Food Intake Questionnaire

For each item listed, put down how many servings you eat per week. Most importantly be as accurate as possible. Pay special attention to the PORTION SIZE of each food item listed. When your portion is different the one listed in the form, adjust your answer accordingly.

Please put **numbers** in the per week column. **Please do not put check marks.** You must use numbers or your nutrition report cannot be processed. If you don't eat the food at all, leave it blank.

Please round all entries to the nearest whole number.

Please include every food that you eat at least once a week.

Food Intake:

How often do you eat (or drink) the following?

No.	Servings per Week	Serving Size	Food/Name Description
1.		1 slice	Whole wheat bread
2.		1 slice, a each	Sourdough or French bread/roll
3.		1 slice, 1/2 bun	White bread, hamburger or hot-dog bun
4.		4 to 6 each	Whole grain crackers (Triscuits, Wheat Thins, Ry Krisp)
5.		4 to 6 each, 40 each	Refined crackers (Saltines, cheese, Ritz), or Oyster crackers
6.		2 each, 7 each	Graham crackers, or Animal crackers

7.		1 each	Tortilla, corn, 6" diameter
8.		1 each	Tortilla, flour, medium
9.		1 each	Muffins (corn, bran, blueberry)
10.		½ each	English muffin, bagel, pita bread
11.		3 each, or 1 each	Pancakes, or Waffles, 7" diameter
12.		½ cup	Whole grain hot cereal (rolled oats, rolled wheat, Roman Meal)
13.		½ cup	Refined hot cereal (cream of wheat, cream of rice)
14.		½ cup or 1 package	Instant hot cereal
15.		3/4 cup, or ¼ cup	Cold cereals, no sugar (shredded wheat, Nutrigrain), or Grapenuts
16.		3/4 cup	Bran type cold cereals (raisin bran, bran flakes, All Bran)
17.		3/4 cup	Sweetened cold cereals (Frosted Flakes, Sugar Smacks)
18.		½ cup	Granola
19.		½ cup	Brown rice, cooked
20.		½ cup	White rice, cooked
21.		½ cup	Pastas, cooked (macaroni, spaghetti, noodles)

Servings per: **Fruits**

No.	Week	Serving Size	Food Name / Description
22.		1 each	Apple, fresh, medium
23.		1 each	Banana, medium
24.		1 each, or ½ each	Citrus fruit Grapefruit
25.		1 each, or 1 each 3 each 2 each 10 each	Peaches Nectarines Apricots Plums Cherries
26.		3/4 cup	Berries
27.		¼ each	Cantaloupe, medium
28.		1 cup	Melons (watermelon, honeydew, casaba)
29.		1 each	Pears, fresh, medium
30.		½ cup	Pineapple, fresh
31.		1 cup	Grapes, fresh

32.		2 tbsp 2 each 2 each 4 each	Dried fruits: Raisins Dates Prunes Apricots
33.		½ cup	Canned or frozen unsweetened fruit
34.		½ cup	Canned or frozen sweetened fruit

Servings per: **Juices**

No.	Week	Serving Size	Food Name / Description
35.		½ cup	Orange or grapefruit, unsweetened
36.		½ cup	Tomato or V-8
37.		½ cup	Other, unsweetened (apple, grape, pineapple)
38.		½ cup	Sweetened juices or nectars

Servings per: **Fats and Oils**

No.	Week	Serving Size	Food Name / Description
39.		1 tbsp	Vegetable oils (corn, safflower, soy)
40.		1 tbsp	Olive oil
41.		1 tbsp	Shortening, vegetable
42.		1 tbsp	Lard
43.		1 tsp	Margarine
44.		1 tsp	Butter
45.		5 each	Olives
46.		1/8 each	Avocado
47.		1 tbsp	Mayonnaise
48.		1 tbsp	Regular salad dressings
49.		1 tbsp	Low-calorie dressings
50.		1 tbsp	Sour cream
51.		1 tbsp	Cream cheese
52.		1 tbsp	Half & Half
53.		1 tbsp	Whipping cream
54.		1 tbsp	Coffee whitener, imitation cream
55.		2 slices	Bacon

Servings per: **Milk and Yogurt**

No.	Week	Serving Size	Food Name / Description
56.		1 cup	Nonfat milk

57.		1 cup	Lowfat (2%) milk
58.		1 cup	Whole milk
59.		1 cup	Chocolate lowfat milk
60.		1 cup	Buttermilk
61.		1 cup	Yogurt, lowfat plain
62.		1 cup	Yogurt, lowfat with fruit
63.		1 cup	Yogurt, nonfat plain

Servings per: **Vegetables**

No.	Week	Serving Size	Food Name / Description
64.		1 to 1½ cups	Salads (lettuce, celery, green peppers, onions)
65.		½ cup	Dark green leafy vegetables
66.		1 each, or ½ cup	Carrots, raw or cooked
67.		1 each	Tomatoes, fresh, medium
68.		½ cup	Starchy vegetables (corn, peas, mixed vegetables, succotash)
69.		½ cup	Other cooked vegetables (green beans, cauliflower, beets, asparagus, summer squash)
70.		1 each	White potato, baked, boiled or mashed
71.		½ cup	Sweet potatoes or yams
72.		½ cup	Winter squash (acorn, butternut, hubbard)

Servings per: **Beverages**

No.	Week	Serving Size	Food Name / Description
73.		1 cup	Lemonade, punch, Koolaid
74.		12 fl. oz.	Cola drinks with sugar (Coke, Pepsi, RC, etc.)
75.		12 fl. oz.	Diet cola drinks
76.		12 fl. oz.	Non-cola drinks with sugar (7-Up, Sprite, Slice, etc.)
77.		12 fl. oz.	Diet non-cola drinks
78.		1 cup	Regular coffee and tea
79.		1 cup	Decaffeinated or non-caffeinated hot drinks (Sanka, herbal tea)
80.		1 cup	Hot chocolate or cocoa
81.		12 fl. oz.	Beer
82.		12 fl. oz.	Light beer
83.		4 fl. oz.	Wine, sweet or dessert (sherry, port, muscatel)
84.		4 fl. oz.	Wine, dry or table

85.		1½ fl oz.	Liquor (vodka, whiskey, gin, rum, etc.)

Servings per: **Protein Foods**

No.	Week	Serving Size	Food Name : Description
86.		1 cup	Legumes (lentils, pinto beans, navy beans), cooked
87.		¼ cup	Nuts, seeds (peanuts, almonds, cashews, sunflower seeds, etc.)
88.		1 tbsp	Peanut butter, nut butters
89.		4 ounces	Tofu
90.		3 ounces	Vegetarian meat substitutes, lowfat (Skallops, Choplets, etc.)
91.		3 ounces	Vegetarian meat substitutes, medium fat (meatless chicken, etc.)
92.		3 ounces	Vegetarian meat substitutes, high fat (Wham, Prosage, etc.)
93.		3 ounces	Beef (rib roast, steak, pot roast, veal, etc.)
94.		3 ounces	Beef, ground, cooked
95.		3 ounces	Pork (chops, roast, ham)
96.		3 ounces	Lamb (chops, roast)
97.		3 ounces	Poultry (chicken, turkey, duck)
98.		3 ounces	Fish, canned with oil (tuna, sardines)
99.		3 ounces	Tuna, water pack
100.		3 ounces	Fish, fresh or frozen, no breading (trout, halibut, sole, etc.)
101.		3 ounces	Shellfish (shrimp, scallops, lobster, clams)
102.		1 each	Eggs, whole, large
103.		2 each	Eggs, whites only, large
104.		¼ cup	Egg substitutes
105.		1 ounce	Cheeses (cheddar, colby, american, monterey jack
106.		1 ounce	Cheeses, lower fat (swiss, mozzarella, ricotta, string)
107.		½ cup	Cottage cheese, regular
108.		½ cup	Cottage cheese, lowfat
109.		1 ounce	Lunch meats (bologna, salami, etc.)
110.		1 each, or 2 each	Frankfurters, or Sausage links

Servings per: **Desserts & Sweets**

No.	Week	Serving Size	Food Name / Description
111.		2 each	Cookies (chocolate chip, oatmeal, peanut butter)
112.		1 each	Brownies, 1½ inch by 1 inch
113.		1 each	Doughnut or sweetroll

114.		1 each	Cake without icing, 3 inches by 2 inches
115.		1 each	Cake with icing, 3 inches by 2 inches
116.		1 each	Granola bars
117.		1 slice	Pie, 1/8 of whole pie
118.		½ cup	Jello, regular, sugar-sweetened
119.		½ cup	Jello, diet, no sugar
120.		½ cup	Pudding or custard
121.		½ cup	Ice cream
122.		½ cup	Ice milk
123.		½ cup	Sherbet
124.		1 each	Popsicles
125.		1½ ounce	Candy bar, chocolate, M&Ms
126.		1½ ounce	Hard candy, gum drops, Lifesavers
127.		12 fl. oz.	Milkshake

Servings per: **Miscellaneous**

No.	Week	Serving Size	Food Name / Description
128.		1 slice	Pizza
129.		2 cups	Popcorn, popped without oil
130.		2 cups	Popcorn, popped with oil
131.		1 ounce, or 10 to 15 each	Potato chips, corn chips, tortilla chips
132.		1 tbsp	Catsup or chili sauce
133.		½ cup	Tomato sauce
134.		5 slices, or 1 tbsp	Pickles, or Pickle relish
135.		1 stick	Chewing gum
136.		1 tbsp	Sauces (soy sauce, steak sauce, barbecue sauce)
137.		¼ cup	Gravy (brown, giblet, white sauce)
138.		1 cup	Soups (vegetable or noodle type)
139.		1 cup	Soups (cream type)
140.		1 each	Fast foods (hamburgers, burritos, tacos)
141.		1 tbsp	Sugar, honey, jam, jelly, syrups

Appendix B

CONTACT LETTER

Dear UNC Greensboro and Salem College Alumnae,

The Department of Exercise and Sport Science and the Department of Public Health Education at UNC Greensboro and the Department of Physical Education at Salem College are conducting a women's health study among UNC Greensboro and Salem College Alumnae. This study will provide insight as to how social factors, physical activity, dietary variables, and smoking may interact to influence blood pressure.

Participants will be asked to complete a survey which consists of questions regarding demographic information, medical history, religiosity, physical activity, and food intake. Participants will also visit UNC Greensboro for measurement of resting blood pressure, height, and weight. Total involvement in this research project will be approximately 90 minutes. Participants will complete a survey at home (approximately 45 minutes), and visit the lab for approximately 30-45 minutes.

All data collected will be kept strictly confidential. Only statistical summaries of large groups of people will be used in reporting any results (no information on individuals will be reported).

This study is specifically looking at graduates who are female, living in Guilford and Forsyth Counties, 35 years or older, and of Jewish or Christian faith. You are eligible to participate in the study if you meet these criteria. Your participation in this study will help ensure the success of this project. Please complete the enclosed postcard as soon as possible and indicate when you prefer to visit UNC Greensboro. Please include your phone number on the postcard. If your phone number is unlisted, please give me a call at 917-5402. It is very important that you return the postcard whether you wish to participate or not. This will help to complete the study. If you wish to participate, you will receive a survey in the mail and a call to schedule your visit to the lab.

Thanks in advance for your help.

Karen A. Hixson
Project Director

Appendix C

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Consent to Act as a Human Subject

PROJECT TITLE: **AN EPIDEMIOLOGIC INVESTIGATION OF THE RELATIONSHIP BETWEEN RELIGIOSITY, SELECTED HEALTH BEHAVIORS, AND BLOOD PRESSURE**

I, _____, agree to engage in a research study under the auspices of the University of North Carolina at Greensboro. I have been informed that the purpose of this research study is to examine the relationship between religiosity, selected health behaviors, and blood pressure in females aged thirty-five and older.

My participation in this project has been described to me as follows: Initially, I will complete a written questionnaire addressing demographic status, medical history, religiosity, dietary habits, smoking habits, and physical activity status. In addition, the following measures will be obtained on me: height and weight, resting blood pressure.

I understand that the following experimental procedures will be used in this research: height and weight will be measured using a medical scale and an anthropometer. Resting blood pressure will be measured using a Colins automated blood pressure device.

I understand a potential benefit of this investigation is to provide insight as to how religiosity, physical activity, dietary variables, and smoking may interact to influence blood pressure.

I understand the above procedures involve no medical risks for healthy females.

I have been informed that my total expected involvement in this research project will be approximately 90 minutes.

I understand that there are no feasible alternative procedures for this study.

I understand that my personal rights and privacy will be maintained. I will not be identified by name when the data are reported. To maintain confidentiality of my records, Karen Hixson will code results by number rather than by name, and all data will be kept in a locked room. Only Karen Hixson, her research colleagues, or research assistants will have access to this information. Following the completion of the study, I will be able to see the data collected on me. I have been informed that I can contact Karen Hixson (917-5402), director of this research project, if I have any questions.

SIGN WHERE INDICATED. BRING THIS FORM, ALONG WITH YOUR QUESTIONNAIRE, WHEN YOU REPORT TO THE LAB FOR YOUR HEIGHT, WEIGHT, AND BLOOD PRESSURE MEASUREMENTS.

I have read this Informed Consent Form. The nature, demands, and benefits of the project have been explained to me. I knowingly assume the risks involved and understand that I may withdraw my consent and discontinue participation at any time without penalty.

Signature: _____ Date: _____

Witness: _____ Date: _____

These elements of the Informed Consent Form conform to the assurance given by The University of North Carolina at Greensboro to the Department of Health and Human Services to protect the rights of human subjects.

Appendix D

Median, Mean, and Range of Selected Subject Characteristics

Variable	Median	Mean (± SD)	Range (Max. possible)
Age (yr)	47.00	50.12 ± 10.35	35 - 80
Height (in)	64.88	64.76 ± 2.43	60.25 - 70.50
Weight (lbs)	135.38	140.77 ± 24.20	101.00 - 213.50
BMI [(lbs x in^{-2}) x 100]	3.22	3.35 ± 0.52	2.55 - 5.30
RD1 Intrinsic Religiosity	29.00	27.50 ± 6.73	8 - 35 (35)
RD2 Extrinsic Religiosity	12.00	11.55 ± 2.94	4 - 15 (15)
RD3 Belief Factor	18.00	16.63 ± 3.56	8 - 20 (20)
RD4 Religious Well-being	33.00	30.26 ± 7.47	6 - 36 (36)
RD5 Organized Religious Activity	9.00	8.05 ± 2.74	2 - 12 (12)
RD6 Non-organized Religious Activity	8.00	8.34 ± 3.28	3 - 17 (18)
RD7 Religious Knowledge	2.00	1.52 ± 0.67	0 - 2 (2)
RD8 Religious Experience	21.00	18.69 ± 5.02	4 - 23 (23)
RD9 Religious Coping	12.00	10.34 ± 2.50	2 - 12 (12)
RTOT Total Religiosity	136.50	128.17 ± 28.73	54 - 169 (171)
Alcohol (gm/day)	4.70	7.57 ± 9.37	0.00 - 49.70
Smoking Index (yrs X # cigarettes smoked)	0.00	26.63 ± 46.34	0 - 190
Physical Activity (Kcal)	709.00	813.46 ± 497.951	182 - 2713
Diet [(K x Na^{-1}) x Ca] (mg/day)	969.77	1108.74 ± 667.65	139.79 - 6138.69
SBP (mmHg)	118.75	120.91 ± 15.02	96.00 - 166.00
DBP (mmHg)	72.50	73.31 ± 8.86	42.50 - 96.00