Social Networks and Support in Disease Management: An Examination of Hypertension among Older Adults*

Erin York Cornwell
Cornell University

&

Linda J. Waite
University of Chicago

* This work and the National Social Life, Health, and Aging Project (NSHAP) are supported by the National Institutes of Health, including the National Institute on Aging, the Office of Women's Health Research, the Office of AIDS Research, and the Office of Behavioral and Social Sciences Research [grant number 5R01AG021487]. We thank Benjamin Cornwell for comments provided on an earlier draft. Direct correspondence to Erin York Cornwell, Department of Sociology, Cornell University, 336 Uris Hall, Ithaca, NY 14853. Email: eyc46@cornell.edu.

Social Networks and Support in Disease Management: An Examination of Hypertension among Older Adults

ABSTRACT

About two-thirds of older adults suffer from hypertension, but only about half of them are able to effectively manage the condition. In this paper, we examine the role of social networks and support in hypertension awareness and management, and whether differential access to these social resources explains persistent racial disparities in hypertension. We use data from a population-based study of older adults to identify those with managed, unmanaged, or undiagnosed hypertension. We find that marriage/partnership is positively associated with hypertension awareness and management. Older adults with more practical support are less likely to have undiagnosed hypertension. Those who have larger social networks are less likely to have unmanaged hypertension – if they discuss health issues with their network members. These factors account for nearly ten percent of blacks' greater risk of unmanaged hypertension. We conclude with suggestions for further research on how social relationships shape chronic disease diagnosis and management.

Social Networks and Support in Disease Management:
An Examination of Hypertension among Older Adults

Most older adults do – or will – suffer from hypertension. About two-thirds of older Americans currently have hypertension, and the prevalence is increasing (Ostchega et al. 2007). It is estimated that individuals who have normal blood pressure at mid-life have a 90 percent risk of developing hypertension during their lifetime (Vasan, Beiser, Seshadri, and al. 2002). Hypertension is a major risk factor for cardiovascular disease, which is the leading cause of death among American adults, and it increases the risk of heart attack, heart failure, stroke, and kidney disease (NHLBI 2003). For those who are aware of the condition, medical treatment and lifestyle changes can often lower blood pressure to normal levels, thus reducing the risks associated with high blood pressure (Staessen et al. 2000). But only about half of hypertensive older adults have effectively controlled blood pressure (Hertz, Unger, Cornell, and Saunders 2005). Understanding this gap between diagnosis and disease management is a critical task for research in medical sociology.

The risk of uncontrolled hypertension is sharply socially structured. Racial disparities in hypertension awareness and management are well-documented in previous research (Bell, Adair, and Popkin 2004; Bosworth et al. 2006; Hajjar, Kotchen, and Kotchen 2006). We know, for example, that African-American older adults are more likely to have hypertension than whites, and, once diagnosed, they are less likely to have controlled blood pressure (Bell et al. 2004; Bosworth et al. 2006; Hertz et al. 2005; Ostchega et al. 2007). As a result, about half of the

mortality disparity between blacks and whites has been attributed to hypertension (Wong, Shapiro, Boscardin, and Ettner 2002).

Less is known about the role of social connectedness in hypertension diagnosis and management. Research has linked social connectedness and support to lower blood pressure (Hawkley, Thisted, Masi, and Cacioppo 2010; Uchino 1996), as well as lower mortality following diagnosis with coronary artery disease (Brummett et al. 2001) and acute myocardial infarction (Mookadam and Arthur 2004). One pathway through which social resources may be associated with these outcomes is through the process of disease diagnosis and management. Social relationships may, for example, provide practical and emotional support, bolster self-efficacy, exert social control, and connect individuals to information (Antonucci and Jackson 1987; Berkman, Glass, Rissette, and Seeman 2000; Gorman and Sivaganesan 2007; House, Landis, and Umberson 1988; Umberson 1987) – all of which may increase the likelihood of seeking medical care, becoming aware of a health problem, and adhering to medical treatment.

Previous work has not fully examined the role played by multiple social factors like social network size, instrumental and emotional support, and relationship quality in the process of hypertension diagnosis and management. Most research on social relationships and chronic illness has focused on diabetes management, and this work typically relies on just one or two indicators of social connectedness, such as marital status (DiMatteo 2004; Gallant 2003). Qualitative studies have provided some detailed accounts of day-to-day processes of disease management (e.g., Gallant, Spitze, and Prohaska 2007), but they are limited in generalizability across race and gender. Our goal, then, is two-fold. We aim to assess the unique contributions of social networks and support to hypertension diagnosis and management. And, we examine the

extent to which differential access to social resources helps to account for sociodemographic disparities in hypertension awareness and management (Gorman and Sivaganesan 2007).

In this paper, we draw on data from the National Social Life, Health, and Aging Project (NSHAP), a nationally-representative, population-based survey of 3,005 older adults. NSHAP includes both self-reported hypertension and measures of blood pressure, which allow us to classify older adults into one of four categories: normal (non-hypertensive), managed hypertensive, unaware hypertensive, and unmanaged hypertensive. Echoing findings in recent medical research (Hertz et al. 2005; Ostchega et al. 2007), we find that blacks are more likely to have unmanaged hypertension. We also identify a variety of social factors that are associated with hypertension awareness and management, including marriage, practical social support, social network size, and network communication. These factors partially account for racial disparities in hypertension management. We conclude by suggesting further research to explicate how social relationships shape the diagnosis and management of chronic diseases.

DISEASE DIAGNOSIS AND MANAGEMENT AS A SOCIAL PROCESS

The Centers for Disease Control and Prevention (2009) refers to chronic diseases as the "public health challenge of the 21st century." Americans are living longer, but spending more years with chronic conditions, such as diabetes, heart disease, and cancer (Crimmins and Beltran-Sanchez 2010). While some older adults are able to successfully manage these chronic conditions, many lack access to health care, remain unaware of their disease status, or do not follow treatment regimens. These situations may lead to a cascade of health problems that significantly increase hospitalization risk, care costs (Sokol, McGuigan, Verbrugge, and Epstein 2005), and mortality (Rasmussen, Chong, and Alter 2007). In fact, a report by the World Health Organization (2003)

concluded that an increase in adherence to treatments may have a far greater impact on population health than any improvement in specific medical therapies. Thus, a key task for sociological and medical researchers is to identify factors that shape processes of diagnosis, treatment, and management of chronic conditions.

Much of the work on this topic has documented serious racial disparities that deserve more attention. Black older adults with hypertension are less likely to be aware of their hypertension, less likely to receive treatment for hypertension, less likely to use cardiovascular medications, and less likely to have controlled blood pressure (Balkrishnan 1998; Bosworth et al. 2008; Hertz et al. 2005; Ostchega et al. 2007; Qato et al. 2010). Evidence suggests that racial disparities are increasing for both hypertension prevalence (Hajjar et al. 2006) and control (Hertz et al. 2005; but see Ong et al. 2006).

These racial disparities are partly, but not entirely, explained by socioeconomic disparities such as income (Bell et al. 2004) and education (Hertz et al. 2005). Lack of insurance or access to health care also affects processes of disease awareness and management (Hertz et al. 2005), but disparities in hypertension diagnosis, treatment, and management remain even after controlling for factors such as health care access and medication benefits (Bosworth et al. 2008).

Beyond access to health care and medications, several features of health care delivery shape diagnosed and management of health conditions. Previous research suggests that characteristics of health care providers, types of practice settings, and physician bias shape processes of clinical decision-making, diagnosis, and recommended treatments (Fincher et al. 2004; Lutfey and Freese 2005). There is some evidence that factors such as physician bias may contribute to racial disparities in diagnosis and treatment (Fincher et al. 2004). For example, physicians are often less certain of their diagnosis of black patients, which may result in fewer

follow-up tests, fewer prescriptions, and less advice about lifestyle changes (Lutfey et al. 2009). As an initial point of contact, the patient-physician interaction can determine patients' motivation toward, and views of, treatment regimens (Osterberg and Blaschke 2005).

Effective treatment of chronic conditions such as hypertension or diabetes requires individuals' determination and ability to follow a medication schedule and modify everyday behaviors such as diet and exercise. This day-to-day management is a critical factor for long-term health outcomes (DiMatteo, Giordani, Lepper, and Croghan 2002; McDermott, Schmitt, and Wallner 1997). But only about 40 percent of hypertensive individuals have good adherence with medications and healthy lifestyles including routine exercise and a healthy diet (Weir et al. 2000). Some individuals choose not to follow recommended treatments because they perceive the medications or lifestyle changes as unnecessary or ineffective (Elliott et al. 2007). But several factors have been found to contribute to the likelihood of adherence.

The daily management of medications may prove particularly challenging in light of changes in health and function that are common at older ages. Advancing age is often associated with the development of multiple chronic diseases or conditions. The cost and complexities of managing multiple medications for multiple health conditions may also reduce overall adherence (Balkrishnan 1998; Elliott et al. 2007). In addition, particular health problems common among older adults, such as depression and cognitive impairment, are associated with a lower likelihood of medical adherence and lifestyle changes (DiMatteo, Lepper, and Croghan 2000; Insel, Morrow, Brewer, and Figueredo 2006; Trivedi, Ayotte, Edelman, and Bosworth 2008). Finally, functional impairments such as poor vision and limited manual dexterity pose practical challenges in terms of reading medication labels and opening containers (Murray et al. 2004).

African American patients tend to report lower levels of medication adherence compared to whites (Charles et al. 2003). These differences contribute to lower levels of blood pressure control observed among black patients (Bosworth et al. 2006; Bosworth et al. 2008). Even in intervention research providing drugs at no cost and frequent physician follow-up, less than 70 percent of hypertensive individuals achieved blood pressure control (Cushman et al. 2002).

The limitations of formal health care for increasing adherence to medications suggests that other factors likely shape patients' willingness and ability to follow recommendations and treatments that they receive from physicians. A recent meta-analysis suggests a generally positive association between social support and medication adherence, but calls for more detailed consideration of specific types and sources of support (DiMatteo 2004). Below, we build from previous studies of the relationship between social resources and health to consider the potential role of social networks and support in the process of disease diagnosis and management.

Social Connectedness and Chronic Conditions

Previous research indicates that social connectedness and support are generally salubrious, while socially isolated older adults face elevated risk for a variety of health problems (House 2001; House et al. 1988). There are a number of mechanisms examined in previous research that help to explain why older adults who are able to maintain social connectedness and remain socially active tend to have better health outcomes. Social relationships may buffer stress (Thoits 1995) or diminish its deleterious effects on health through the provision of instrumental support (Waite and Hughes 1999) and the enhancement of self-efficacy and sense of control (Cornman et al. 2003; Ernst and Cacioppo 1999). Social connectedness can provide access to material resources such as information, transportation, financial loans, or emotional support (Ellison and George

1994; Haines and Hurlbert 1992; Lin 2001), as well as informal care (Langa et al. 2002). And, social integration may promote healthy behaviors, although stressful relationships have been linked to worse health outcomes (Umberson et al. 2006; Wickrama et al. 2001) and health-risk behaviors such as smoking and poor diet can be diffused through social networks (Christakis and Fowler 2007; Latkin, Forman, Knowlton, and Sherman 2003). A less-explored possibility is that social relationships may enhance individuals' commitment or ability to manage their disease through regular check-ups and adhere to medical treatments or physician-recommended lifestyle changes following diagnosis with chronic conditions or other health problems (Gallant 2003; Nicklett and Liang 2010).

Previous studies have found that socially connected individuals who are diagnosed with health problems have lower rates of subsequent hospitalization (Mookadam and Arthur 2004) and mortality (Brummett et al. 2001), but this work has not specifically addressed the role of social relationships and support in disease management. In a review, DiMatteo (2004) found considerable evidence of a relationship between social support and adherence to medications. However, the fact that many studies are limited to the assessment of single-item indicators of social connectedness limits our ability to draw conclusions about the relationship between social connectedness and compliance with medical treatments (DiMatteo 2004; Levy 1983). For example, marriage is generally found to be positively associated with better management (i.e., medication adherence or disease control) (DiMatteo 2004; He et al. 2002; Trivedi et al. 2008), but most work on this topic does not examine other indicators of social connectedness or support. However, a lack of attention to these factors leaves unanswered questions about how specific features and qualities of relationships may be associated with disease diagnosis and management.

In fact, various aspects of social relationships may be relevant for processes of hypertension diagnosis and treatment. First, with respect to diagnosis, it is important to note that hypertension is typically asymptomatic (NHLBI 2003). Most individuals do not know that they have high blood pressure, so they are unlikely to feel compelled to see a physician because of symptoms or discomfort. In this regard, close network members may play a critical role in diagnosis by encouraging proactive health behaviors, such as getting regular health check-ups and monitoring one's blood pressure. These individuals may also provide instrumental support through assistance with transportation to health care appointments.

Social relationships are also likely to be important following diagnosis. For the majority of older adults, lowering blood pressure to non-hypertensive levels requires multiple anti-hypertensive medications (Black, Elliott, and Neaton 2001; Law, Wald, Morris, and Jordan 2003). Management of the schedule and dosage for these new medications may be easier when someone provides reminders or assistance. In focus groups with older adults suffering from chronic illnesses, Gallant, Spitze, and Prohaska (2007) found that family members can play a particularly important role in medication management. Family and friends may also exert direct and indirect social control by encouraging compliance with physician recommendations. And, discussing issues related to hypertension, medication side effects, and other health-related topics with network members increases self-efficacy and motivation to adhere to one's treatment regimen (DiMatteo 2004).

In addition to medications, successful treatment of hypertension often requires changes in health-related behaviors. Physicians may recommend weight reduction, diet modification, regular physical activity, reduced alcohol consumption, and smoking cessation to lower blood pressure (NHLBI 2003). Social integration, support, and control may be crucial in helping people

make these changes. Partners and family members may assist with the preparation of healthier foods or discourage cigarette use and alcohol consumption (Lewis and Rook 1999; Umberson 1987). Finally, talking with network members about health-related issues may increase motivation and provide access to information about lifestyle changes like diet modification (DiMatteo 2004). On the other hand, individuals who lack social connections or have unsatisfying social relationships are more likely to engage in unhealthy behaviors. For example, people who feel lonely are more likely to smoke cigarettes (Lauder, Mummery, Jones, and Caperchione 2006) and less likely to exercise (Hawkley, Thisted, and Cacioppo 2009).

There are clearly reasons to believe that social connections are important for maintaining a healthy lifestyle, accessing health care, and maximizing the benefits of medical treatment. Unfortunately, this idea has been underexplored in research on diagnosis, treatment, and control of chronic conditions, and the unique contributions of particular types and features of relationships have not been examined (DiMatteo 2004; Gallant 2003). In this paper, we use data from a population-based sample of older adults to explore two central research questions. First, are social networks and instrumental and emotional social support associated with hypertension diagnosis and management? And, if so, do differences in social resources help to account for persistent racial disparities in hypertension?

DATA AND METHODS

We use data from the National Social Life, Health, and Aging Project (NSHAP), a nationally representative population-based study of community-residing older adults. The NSHAP sample was selected from a multi-stage area probability design screened by the Institute for Social Research (ISR) for the Health and Retirement Study (HRS). The HRS design oversampled by

race/ethnicity; NSHAP retained this design and also oversampled by age and gender. From summer 2005 to spring 2006, NSHAP interviewed 3,005 individuals, ages 57-85, achieving a final weighted response rate of 75.5 percent (O'Muircheartaigh, Eckman, and Smith 2009).

Most of the data for the NSHAP study were collected during a two-hour in-home interview. Respondents were also given a paper-and-pencil questionnaire (LBQ) to complete at their leisure and return by mail. The return rate for the LBQ was 84 percent. The NSHAP study was modularized, so that some questionnaire items were always included in the in-person questionnaire, while other items were included in either the in-person interview or the LBQ for a randomly-selected subset of respondents (for more details, see Smith et al. 2009)

Dependent Variable: Hypertension Awareness and Management

We use both self-reported and biological measures of hypertension collected during the NSHAP interview to assess hypertension diagnosis and control. First, respondents indicated whether a medical doctor had ever told them that they have high blood pressure or hypertension. We use this as a self-reported indicator of hypertension diagnosis. Second, each respondent completed two seated blood pressure measures on the left arm. If the first two readings differed by more than 20 mmHg systolic or 14 mmHg diastolic, a third blood pressure reading was taken. NSHAP interviewers took these readings using a Lifesource digital blood pressure monitor (Model UA-767PVL). Respondents' blood pressure is calculated as the mean systolic and mean diastolic pressure from all of the readings taken (Williams, Pham-Kanter, and Leitsch 2009).

Following guidelines established by the National Heart, Lung, and Blood Institute (NHLBI), we define hypertension as blood pressure exceeding either 140 mmHg systolic or 90 mmHg diastolic. We use lower cutoffs, consistent with the guidelines, of 130 mmHg systolic or

90 mmHg diastolic for respondents who reported that they have been diagnosed with diabetes or suffered kidney problems. For those who have hypertension, lowering blood pressure below these systolic and diastolic levels is considered a target for effective treatment (NHLBI 2003).

Using self-reported hypertension and the blood pressure readings, we place each respondent into one of four categories. Respondents who have not been told that they have hypertension and had non-hypertensive blood pressure readings are classified as *normal*. Those who had hypertensive systolic or diastolic blood pressure readings but had not been diagnosed with hypertension were considered to be *unaware*. Those who reported that they had been diagnosed with hypertension are *controlled* if they had non-hypertensive blood pressure and *uncontrolled* if they had hypertensive systolic or diastolic blood pressure.

Figure 1. Distribution of Hypertension Awareness and Management

		Normal blood pressure (≤ 140/90 mmHg)	High blood pressure (> 140/90 mmHg)[a]
Self-report: Ever been diagnosed with hypertension?	No	*Non-hypertensive* n = 649 (26.50%)	*Unaware Hypertensive* n = 418 (17.07%)
	Yes	*Managed Hypertensive* n = 563 (22.99%)	*Unmanaged Hypertensive* n = 819 (33.44%)

[a] Individuals who had been diagnosed with diabetes or suffered kidney problems were considered to have high blood pressure if their pressure exceeded 130/80.

Figure 1 indicates the proportion of NSHAP respondents included in each of the four hypertension categories. About a third of the respondents are unmanaged hypertensive – they have been diagnosed with hypertension, but their high blood pressure is not controlled. About 17 percent are unaware of their hypertension. Taken together, fully half of the older adults in our

sample have undiagnosed or unmanaged hypertension. These individuals face elevated risk for cardiovascular disease, heart attack, heart failure, stroke, and kidney disease (NHLBI 2003).

All of our models control for whether the respondent takes anti-hypertensive medications. The NSHAP medication log recorded respondents' prescription, non-prescription, over-the-counter, and alternative medications. These medications have been classified according to the Multum Drug Hierarchy (Qato et al. 2009). We control for the use of medications that Multum categorizes as cardiovascular agents, including anti-hypertensive drugs such as ACE inhibitors, beta-blockers, diuretics, calcium channel blockers, and peripheral vasodilators, as well as other medications that may have anti-hypertensive side effects.

Measures of Social Connectedness and Support

We assess three aspects of social connectedness: partnership status, social network characteristics, and social support. First, we use a dummy variable indicating whether the respondent has a spouse or current partner. Second, we consider the relationship between social network characteristics and hypertension awareness and management. NSHAP collected a social network roster, in which respondents were asked to list people with whom they most often discussed things that were important to them over the last 12 months. Each respondent was permitted to name up to five network members and then indicate (if applicable) whether there are more people with whom he or she discusses important matters. Social network size therefore ranges from 0 to 5 and 6 or more.

An important aspect of the relationship between social connectedness and health is the degree to which individuals communicate with their close family and friends about health problems. To assess this, NSHAP respondents were asked each of the network members named:

"Suppose you had a health problem that you were concerned about, or needed to make an important decision about your own medical treatment. How likely is it that you would talk with [name] about this?" Response categories included "very likely," "somewhat likely," and "not likely." To get a general sense of an individual's prospects for discussing health-related concerns, we calculate the average likelihood of discussing health across all of his/her network members. This variable ranges from 1 ("not likely" to discuss health with all network members) to 3 ("very likely" to discuss health with all network members).

Finally, we examine the role of social support. NSHAP assessed respondents' practical social support by asking: "How often can you rely on members of your family for help if you have a problem?" and "How often can you rely on friends for help if you have a problem?" Responses ranged from "hardly ever (or never)" to "some of the time" and "often." We combine the two practical support items to create a variable indicating the respondent's sources of instrumental support and we combine the two emotional support items to create a measure of emotional support. For both of these constructed variables, 0 indicates that the respondent can often rely on *neither* family nor friends, 1 indicates the respondent can often rely on *either* family or friends, and 2 indicates that the respondent can often rely on *both* family and friends. Similar questions were asked to assess emotional support from family and friends: "How often can you open up to members of your family if you need to talk about your worries?" "How often can you open up to your friends if you need to talk about your worries?" Responses again ranged from "hardly ever (or never)" to "some of the time" and "often." We combine these two items to create a measure of emotional support where 0 indicates that the respondent can often open up to *neither* family nor friends, 1 indicates that the respondent can often open up to *either* family or friends, and 2 indicates that the respondent can often open up to *both* family and friends.

Social Status and Health-Related Covariates

In all of our models, we control for aspects of respondent health and function that may impact individuals' likelihood of having hypertension, their likelihood of being diagnosed, and their ability to manage the condition. First, we include a count of the number of conditions or health problems with which a respondent has been diagnosed. This is based on a series of questions asking respondents whether a doctor has ever told them that they have any of a number of conditions, including diabetes, lung disease, Alzheimer's disease, and cancer. Second, we control for cognitive function using scores on the 10-item Short Portable Mental Status Questionnaire (SPMSQ). This includes items that assess knowledge of general and personal information, such as the date, the day of the week, the respondent's age and date of birth, and the respondent's mother's maiden name (Pfeiffer 1975). Results are combined into a single variable indicating the number of items that were answered incorrectly.

Because they are cardiovascular risk factors, we include dichotomous indicators of cigarette use (=1) and alcohol use (=1). We also include an interviewer-reported assessment of the respondent's body shape, ranging from 1 (thin) to 7 (obese) as a general measure of obesity, which is also associated with elevated cardiovascular risk. Access to health care may also be an important factor for hypertension awareness and management. We control for the number of times a respondent visited a physician or health care provider within the past 12 months, ranging from 0 = none to 7 = three times a month or more. And, we include a variable indicating whether the respondent has any health insurance (=1), including Medicare, Medicaid, private insurance, Veterans' Administration insurance, or some other program.

Finally, we consider the relationship between hypertension awareness and management and a number of socio-demographic characteristics. We assess the contributions of the

respondent's age (in tens of years) and gender (female = 1). We use three categories of race/ethnicity: black (or African-American), Hispanic, non-black, and white or other. We examine educational attainment using four categories: less than high school, high school diploma or equivalent, college attendance (including a vocational certificate or associate's degree), and bachelor's degree or higher. Finally, we incorporate an indicator of whether the respondent is currently employed (=1). Table 1 presents summary statistics, across race/ethnicity, for each of the variables included in our models.

<Table 1 about here>

Analytic Strategy

The goals of this paper are to investigate whether social connectedness and social support are associated with individuals' likelihood of having undiagnosed or unmanaged hypertension and the extent to which racial differentials in access to these resources account for gaps in awareness and management of hypertension. Because NSHAP data are cross-sectional, causal inferences from the results of this analysis should be made with caution. We therefore use multinomial logistic regression analysis to examine whether social connectedness and social support are associated with the risk of having undiagnosed or unmanaged hypertension.

Multinomial logistic models simultaneously estimate binary comparisons among the categories of the dependent variable: normal (non-hypertensive), controlled hypertensive, undiagnosed hypertensive, and unmanaged hypertensive. We present relative risk ratios (i.e., exponentiated coefficients) in the tables. The relative risk ratios are estimates of the change in the relative risk of being in a particular hypertensive category rather than the base category (non-hypertensive) associated with a unit change in the predictor variable, net of other variables in the

model. The tables include significance of the coefficients based on the *z*-test statistics in order to aid in interpretation of the results. However, it is important to remember that the significance of a variable to the model is not calculated for a single comparison on the dependent variable (e.g., being unmanaged hypertensive compared to being normal), but for the complete multinomial model and all of the possible comparisons on the dependent variable. We indicate statistical significance of individual coefficients only when they satisfy this requirement.

All models are adjusted for design effects resulting from NSHAP's multi-stage sampling procedure. Stratification and clustering in the sample design can lead to underestimation of standard errors, so variance estimates are adjusted for strata and Primary Sampling Units. In addition, all models include person-level weights that adjust for differential probabilities of selection into the NSHAP study (with post-stratification adjustments for non-response) and potential selection issues related to the exclusion of cases from our analyses. One source of missing cases is related to the modular design of the NSHAP study. NSHAP respondents were randomly assigned to one of six paths through the data collection. There were 964 respondents who were assigned to paths in which they were asked about social support on the leave-behind questionnaire rather than during the in-home interview. Of these, 162 respondents did not return the leave-behind questionnaire. Because these individuals have missing data on social support, they are excluded from all models.

Potential selection issues arise if any factor disproportionately affects individuals' likelihood of not completing the leave-behind questionnaire. To adjust for this, we employ a complete-case weighting form of missing data adjustment (Morgan and Todd 2008). We begin by calculating a logit model predicting each respondent's probability of inclusion in our analyses, based on sociodemographic characteristics, employment status, health measures,

marital/partnership status, network size, and interview path. From this first-stage logit model, we derive the inverse of the predicted probability, or propensity score. We multiply this by the person-level weight provided with the NSHAP data, which adjusts for selection into the study and non-response, and use the product as the person-weight in all models. This procedure affords disproportionate weight to cases that were least likely to be included in the models, thereby attenuating potential selection effects caused by exclusion of respondents who did not return the leave-behind questionnaire.

RESULTS

Table 2 presents results from multinomial logistic regressions predicting the relative likelihood of being controlled, undiagnosed, or unmanaged hypertensive (compared to the base category of non-hypertensive). We focus on the relative risk of being undiagnosed or unmanaged hypertensive, since individuals in these categories face elevated risk for cardiovascular disease, heart attack, heart failure, stroke, and kidney disease (NHLBI 2003). The first model includes sociodemographic characteristics and well-established cardiovascular risk factors. We find that increasing age is associated with greater likelihood of being in any of the hypertensive categories. Individuals in their 70s, for example, face about 56 percent greater relative risk of undiagnosed hypertension (compared to non-hypertensive) and 24 percent great risk of unmanaged hypertension (compared to non-hypertensive) than those in their 60s.

<Table 2 about here>

We find no differences in the likelihood of hypertension awareness or management according to gender, but we do observe racial disparities. Blacks face more than twice the risk of whites of being managed hypertensive (vs. non-hypertensive) and of being unmanaged

hypertensive (vs. non-hypertensive). This result is remarkably similar to findings from the 1999-2004 National Health and Nutrition Examination Survey (NHANES), which indicate that older blacks are 1.97 times more likely to have untreated hypertension than older whites (Bell et al. 2004). Hispanic older adults are no more likely than whites to have managed, undiagnosed, or unmanaged hypertension. However, we find (in supplementary analyses) that Hispanic older adults are significantly less likely than blacks to be undiagnosed hypertensive (relative risk ratio = .422, $p < .05$) and unmanaged hypertensive (relative risk ratio = .399, $p < .05$).

Another way to examine differences in hypertension diagnosis and management across racial groups is to compare predicted probabilities, which we have calculated from the first model and plotted in Figure 2. From this, we can see that blacks have an 84 percent chance of having hypertension in some form – managed, unaware, or unmanaged. This is also consistent with the 1999-2004 NHANES, which found that 84 percent of older African-Americans have hypertension (Ostchega et al. 2007). We find that whites and Hispanics have a 67 and 71 percent chance of having hypertension, respectively.

Note that the probabilities of having undiagnosed hypertension are lower than those for other categories of hypertension and do not significantly differ across race. This may reflect the commonality of blood pressure readings as part of a typical health care visit. Most people who have hypertension know that they have it – so the more important question seems to hinge on whether they can do anything about it. In fact, it is particularly notable that blacks are more likely to be unmanaged hypertensive (probability = .42) than to be in any other category.

<Figure 2 about here>

Returning to Model 1, we find that educational attainment is associated with hypertension awareness and management (Bell et al. 2004; Ong et al. 2006). Older adults who did not finish

high school have about twice the relative risk of unmanaged hypertension (compared to being non-hypertensive) than those who have a college degree. In addition, the higher relative risk of unmanaged hypertension for those who completed high school compared to those who have a college degree achieves marginal significance (relative risk ratio = 1.486; p = .057).

Although employment is not a focus of our paper, it is worth noting that individuals who are employed are more likely to have managed hypertension and undiagnosed hypertension – and they are marginally more likely to have unmanaged hypertension (p = .053). This may reflect a number of mechanisms. First, work-related stress may contribute to the overall risk of developing hypertension, leading them to be more likely to fall into any of the hypertensive categories. Time constraints at work may impede individuals' ability to have regular health check-ups, thereby increasing the likelihood of having undiagnosed hypertension. On the other hand, relationships with co-workers may increase the likelihood of hypertension management by providing social support and control that promote adherence with medical treatments and lifestyle changes like healthier eating.

As expected, we also observe relationships between health conditions and health-related behaviors and the hypertension categories – all of which are generally consistent with previous research (NHLBI 2003). However, access to health care plays only a minor role here. Having health insurance is not associated with any of the hypertension categories. Visiting one's health care provider more frequently is associated with a lower relative risk of undiagnosed hypertension, but it is not related to the risk of unmanaged hypertension. This reinforces the limitations of health care access and delivery for promoting treatment adherence and lifestyle changes, which has also been demonstrated in previous studies (McDonald, Hertz, Unger, and Lustik 2009).

Social Connectedness, Social Support, and Hypertension

We now turn to our first research question. Are social relationships and support associated with the likelihood of hypertension awareness and management? Model 2 introduces indicators of marriage/partnership and social support. First, having a spouse or partner is important for both hypertension diagnosis and management. Partnered older adults are generally less likely to be hypertensive (managed, undiagnosed, or unmanaged). In particular, those who are partnered have about 45 percent lower risk of being undiagnosed hypertensive and 40 percent lower risk of being unmanaged (compared to non-hypertensive).

We find mixed results for social support. Instrumental social support is modestly associated with hypertension diagnosis. Calculation of predicted probabilities indicates that older adults who can rely on both family and friends have a 16 percent chance of having undiagnosed hypertension, while those who cannot rely on family or friends have a 21 percent chance of being unaware of their high blood pressure. Surprisingly, instrumental support is not associated with the likelihood of having unmanaged hypertension – and we find no association between emotional support and hypertension awareness or management.

While instrumental social support is positively associated with the likelihood of diagnosis, but not associated with management, we find that the opposite is true for social networks. As shown in Model 3, social network size and network communication about health are not significantly associated with the risk of undiagnosed hypertension. However, network size is related to the likelihood of having unmanaged hypertension. In fact, we find that the relationship between network size and unmanaged hypertension varies according to the likelihood of discussing health problems with network members. In Model 3, an interaction term

crossing network size with network communication about health is significantly associated with the likelihood of having unmanaged hypertension.

The relationship between social network size, network communication, and hypertension management is depicted in Figure 3. The probability of having unmanaged hypertension is lower for those who have larger networks – provided that they are very likely to talk with their network members about health problems. For those who are unlikely to talk about health problems with their family and friends, the risk of unmanaged hypertension *increases* as network size increases. In other words, relationships that involve open communication about health seem to be beneficial for hypertension management, but when the lines of communication are closed, relationships may present more costs than benefits.

<Figure 3 about here>

Social Resources and Racial Disparities in Hypertension

A second goal of this paper is to assess the extent to which variations in social networks and support may help to account for racial disparities in hypertension awareness and management. Recall that Hispanic older adults are no more likely to have undiagnosed or unmanaged hypertension than whites, and we found no differences between African American older adults and whites in terms of hypertension awareness. But blacks are more than twice as likely as whites to have unmanaged hypertension, putting them at disproportionate risk of cardiovascular disease, heart failure, heart attack, stroke, and kidney disease (NHLBI 2003).

With the inclusion of social support and marriage in Model 2, blacks' relative risk of unmanaged hypertension is reduced by about 5 percent, from 2.395 (in Model 1) to 2.263. The reduction is nearly significant ($F_{(df=1, 50)} = 3.49$; $p = .07$), and it is primarily due to the inclusion

of marriage/partnership in the model. (In supplemental analyses, we removed the two measures of social support from Model 2 and found that blacks' relative risk of unmanaged hypertension was reduced to 2.275 by marriage/partnership alone.) As shown in Table 1, blacks in our sample are less likely to be married or partnered than whites, and the difference is statistically significant ($F_{(df=1, 2448)} = 64.77$; $p < .001$). Sources of practical and emotional support do not significantly differ across blacks and whites. The reduction in blacks' relative risk of unmanaged hypertension therefore suggests that blood pressure control may be lower among African American older adults because they are less likely to have a spouse or partner helping them to manage their medications and encouraging healthy behaviors.

Adding social network size and network communication about health in Model 3 reduces blacks' relative risk of unmanaged hypertension to 2.191. The reduction in the magnitude of their relative risk, compared to that in Model 2, is not significant ($F_{(df=1, 50)} = .95$; $p = .33$). However, when we compare Model 1 (with no indicators of social connectedness) to Model 3, we find that controlling for all of the indicators of social connectedness reduces blacks' relative risk of unmanaged hypertension by nearly 10 percent ($F_{(df=1, 50)} = 4.33$; $p < .05$). As shown in Table 1, African American older adults in our sample have significantly smaller social networks than whites ($F_{(df=1, 2448)} = 15.49$; $p < .001$), but they are more likely than whites to discuss health issues with their social network members ($F_{(df=1, 2448)} = 4.71$; $p < .05$). Black older adults, therefore, do not seem to be at greater risk for unmanaged hypertension because of lower quality social relationships. On the contrary, African Americans who suffer from hypertension or other health problems are more likely to communicate about these issues with their network members. However, our results indicate that blacks face higher risk of unmanaged hypertension in part because they have *fewer* close relationships with partners, family members, and friends.

DISCUSSION

In this paper, we first set out to assess whether social connectedness and support are associated with hypertension awareness and management among older adults. The prevalence of hypertension among older adults is increasing (Ostchega et al. 2007). Hypertensive individuals who are aware of their condition and able to lower their blood pressure to normal levels have significantly lower risks cardiovascular disease and other conditions that are linked to elevated blood pressure (NHLBI 2003). However, we find that less than one-third of the hypertensive older adults in our sample have effectively managed blood pressure.

Even after accounting for socio-demographic characteristics and health behaviors, we find support for our argument that the process of hypertension diagnosis and management is shaped by social relationships and social resources. Older adults who have a spouse or partner and those who have greater practical support are more likely to be aware that they have high blood pressure. However, social network size, emotional support, and health-related discussions with network members are not associated with the likelihood of hypertension diagnosis. These findings suggest two broader points about the relationship between social connectedness and awareness of hypertension. First, instrumental forms of support such as assistance with scheduling or transportation to health care visits may play a particularly important role in promoting older adults' awareness of their health condition. Second, the spouse or partner may also be integral in encouraging proactive health behaviors through informal social control (Lewis and Rook 1999; Umberson 1987). This may include regular health care visits, which ultimately increases the likelihood that a hypertensive individual will be diagnosed. Through these close relationships, individuals may also gain a greater sense of self-efficacy and motivation to monitor their health (DiMatteo 2004), even when they do not perceive any health problems.

But awareness of hypertension is only the first step. Of the older adults in our sample who said that they had been diagnosed with hypertension, nearly 60 percent had high blood pressure on the day of their interview. Having a spouse or partner is associated with lower risk of unmanaged hypertension, but we find that social support from family and friends is not associated with hypertension management. This suggests that the close relationship and daily contact that are common among spouses/partners may be uniquely important for hypertension management. Recall that hypertension management often requires multiple medications and routine health care visits (NHLBI 2003). One's spouse or partner, particularly if he or she co-resides with the patient, can assist with the practicalities of arranging these health care visits, managing medications, and adjusting one's diet in an effort to lower blood pressure (DiMatteo 2004; Gallant et al. 2007; Trivedi et al. 2008). Spouses or partners may also exert social control promoting lifestyle changes that often accompany hypertension treatment (Lewis and Rook 1999; Umberson 1987).

Finally, our results indicate that older adults who have larger social networks – and are likely to talk with their network members about health problems – have a lower likelihood of hypertension. But for those who are unlikely to communicate about health, the risk of unmanaged hypertension *increases* with network size. This reflects both the potential benefits and the potential costs of social connectedness for disease management. Those who are socially connected and talk with their network members about health can benefit from others' advice, experiences, and expertise. Open lines of communication about health may lead to greater monitoring, a sense of self-efficacy, and motivation. All of these may increase the likelihood of adherence to medical treatments (DiMatteo 2004; Osterberg and Blaschke 2005) and success with lifestyle changes such as diet modification (Trivedi et al. 2008). However, having more

relationships that do not involve such communication may disproportionately increase burdens and stress. This is an important finding, since having more social relationships is generally assumed to be beneficial for health (House et al. 1988; Umberson et al. 2006).

Accounting for social networks and marriage/partnership explains a modest portion of the well-established association between race and unmanaged hypertension in older adults. Blacks are more likely to have unmanaged hypertension, at least in part, because they have smaller social networks and are less likely to be married/partnered. Therefore, further exploration of the role of social relationships in disease management may be a fruitful direction for addressing persistent racial disparities in health. Social relationships need to be examined alongside other mechanisms of racial disparities in hypertension management, such as patient-physician interactions (Fincher et al. 2004; Lutfey et al. 2009), health literacy (Bosworth et al. 2006), and stress (Bosworth et al. 2008). From a policy perspective, this is a critical line of inquiry since racial disparities in hypertension seem to be increasing (Hajjar et al. 2006; Hertz et al. 2005).

We intend this paper as an initial step toward the identification of social factors that impact disease management among older adults. The cross-sectional nature of our data, and the breadth rather than depth in our measures of social integration, leave a number of questions unanswered. We know that characteristics of social networks tend to change as adults age, with especially large differences at the oldest ages (Cornwell, Laumann, and Schumm 2008). Changes in health are certainly responsible, at least in part, because functional limitations and declining sensory function may make socializing more difficult (Cornwell 2009; Cornwell et al. 2008). Thus, differences in social resources that we observe may stem from health, muddying causal direction. Hypertension has no symptoms that could lead to declines in social

relationships, but individuals who have been diagnosed with hypertension may be more likely to speak to network members about their health, since the diagnosis raises a new health concern.

We have been limited in our ability to explore the mechanisms through which social relationships are associated with the process of disease diagnosis and management. While we theorized that social relationships may be particularly important in increasing an individual's abilities to adhere to recommended medical treatments and make recommended lifestyle changes, we have not been able to test this directly. An alternate possibility is that older adults with greater social resources have less severe forms of hypertension, perhaps due to stress buffering. In fact, there is some evidence that blacks have higher rates of more severe, stage 3 hypertension (exceeding 180/110 mmHg) than whites (Flack, Ferdinand, and Nasser 2003). In this way, it may be easier for some individuals, such as whites and those who are married and more socially connected, to reduce their blood pressure to normal levels. Detailed data that link disease etiology, the process of disease management, and social relationships are needed to disentangle the possible mechanisms linking social connectedness to blood pressure control.

Life expectancy has risen steadily in virtually all developed countries, as have survival rates for those with chronic diseases, so that many individuals are living longer with serious disease. Cardiovascular diseases, diabetes, and cancer are among the main contributors to this trend (Crimmins and Beltran-Sanchez 2010). Thus, a crucial challenge for the future arises in limiting the health consequences of chronic diseases, which means maximizing the extent to which people are aware of and appropriately treated for these conditions. Our findings suggest that social relationships and the resources they bring offer an important set of tools for improving these outcomes.

REFERENCES

Antonucci, Toni C. and James S. Jackson. 1987. "Social Support, Interpersonal Efficacy, and Health: A Life Course Perspective." Pp. 291-311 in *Handbook of Clinical Gerontology*, edited by L. L. Carstensen and B. A. Edelstein. Elmsford, NY: Pergammon Press.

Balkrishnan, Rajesh. 1998. "Predictors of Medication Adherence in the Elderly." *Clinical Therapeutics* 20:764-771.

Bell, A. Colin, Linda S. Adair, and Barry M. Popkin. 2004. "Understanding the Role of Mediating Risk Factors and Proxy Effects in the Association Between Socio-Economic Status and Untreated Hypertension." *Social Science and Medicine* 59:275-283.

Berkman, Lisa F., Thomas Glass, Ian Rissette, and Teresa E. Seeman. 2000. "From Social Integration to Health: Durkheim in the New Millennium." *Social Science and Medicine* 51:843-857.

Black, H. R., W. J. Elliott, and J. D. Neaton. 2001. "Baseline Characteristics and Elderly Blood Pressure Control in the CONVINCE Trial." *Hypertension* 37:12-18.

Bosworth, Hayden B., Tara Dudley, Maren K. Olsen, Corrine I. Voils, Benjamin Powers, Mary K. Goldstein, and Eugene Z. Oddone. 2006. "Racial Differences in Blood Pressure Control: Potential Explanatory Factors." *American Journal of Medicine* 119:e9-e15.

Bosworth, Hayden B., Benjamin Powers, Janet M. Grubber, Carolyn T. Thorpe, Maren K. Olsen, Melinda Orr, and Eugene Z. Oddone. 2008. "Racial Differences in Blood Pressure Control: Potential Explanatory Factors." *Journal of General Internal Medicine* 23:692-698.

Brummett, Beverly H., John C. Barefoot, Ilene C. Siegler, Nancy E. Clapp-Channing, Barbara L. Lytle, Hayden B. Bosworth, Redford Williams, and Daniel B. Mark. 2001. "Characteristics of Socially Isolated Patients with Coronary Artery Disease who are at Elevated Risk for Mortality." *Psychosomatic Medicine* 63:267-272.

Centers for Disease Control and Prevention. 2009. "The Power of Prevention: Chronic Disease... the Public Health Challenge of the 21st Century." US Department of Health and Human Services, Atlanta, GA:.

Charles, Hyasmine, Chester B. Good, Barbara H. Hanusa, Chung-Chou H. Chang, and Jeff Whittle. 2003. "Racial Differences in Adherence to Cardiac Medications." *Journal of the National Medical Association* 95:17-27.

Christakis, Nicholas A. and James H. Fowler. 2007. "The Spread of Obesity in a Large Social Network over 32 Years." *New England Journal of Medicine* 357:370-379.

Cornman, Jennifer C., Noreen Goldman, Dana A. Glei, Maxine Weinstein, and Ming-Cheng Chang. 2003. "Social Ties and Perceived Support: Two Dimensions of Social Relationships and Health Among the Elderly in Taiwan." *Journal of Aging and Health* 15:616-644.

Cornwell, Benjamin. 2009. "Good Health and the Bridging of Structural Holes." *Social Networks* 31:92-103.

Cornwell, Benjamin, Edward O. Laumann, and L. Philip Schumm. 2008. "The Social Connectedness of Older Adults: A National Profile." *American Sociological Review* 73:185-203.

Crimmins, Eileen M. and Hiram Beltran-Sanchez. 2010. "Mortality and Morbidity Trends: Is There a Comptression of Morbidity?" *Journal of Gerontology: Social Sciences* 66B:75-86.

Cushman, William C., Charles E. Ford, Jeffrey A. Cutler, Karen L. Margolis, Barry R. Davis, and et al. 2002. "Success and Predictors of Blood Pressure Control in Diverse North American Settings: The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT)." *Journal of Clinical Hypertension* 4.

DiMatteo, M. Robin. 2004. "Social Support and Patient Adherence to Medical Treatment: A Meta-Analysis." *Health Psychology* 23:207-218.

DiMatteo, M. Robin, Patrick J. Giordani, Heidi S. Lepper, and Thomas W. Croghan. 2002. "Patient Adherence and Medical Treatment Outcomes." *Medical Care* 40:794-811.

DiMatteo, M. Robin, Heidi S. Lepper, and Thomas W. Croghan. 2000. "Depression is a Risk Factor for Noncompliance with Medical Treatment." *Archives of Internal Medicine* 160:2101-2107.

Elliott, Rachel A., Dennis Ross-Degnan, Alyce S. Adams, Dana Gelb Safran, and Stephen B. Soumerai. 2007. "Strategies for Coping in a Complex World: Adherence Behavior Among Older Adults with Chronic Illness." *Journal of General Internal Medicine* 22:805-810.

Ellison, Chrostopher G. and Linda K. George. 1994. "Religious Involvement, Social Ties, and Social Support in a Southeastern Community." *Journal for the Scientific Study of Religion* 33:46-61.

Ernst, John M. and John T. Cacioppo. 1999. "Lonely Hearts: Psychological Perspectives on Loneliness." *Applied & Preventative Psychology* 8:1-22.

Fincher, Contessa, Joyce E. Williams, Vicky MacLean, Jeroan J. Allison, Catarina I. Kiefe, and John Canto. 2004. "Racial Disparities in Coronary Heart Disease: A Sociological View of the Medical Literature on Physician Bias." *Ethnicity and Disease* 14:360-371.

Flack, John M., Keith C. Ferdinand, and Samar A. Nasser. 2003. "Epidemiology of Hypertension and Cardiovascular Disease in African Americans." *Journal of Clinical Hypertension* 5:5-11.

Gallant, Mary P. 2003. "The Influence of Social Support on Chronic Illness Self-Management: A Review and Directions for Research." *Health Education and Behavior* 30:170-195.

Gallant, Mary P., Glenna D. Spitze, and Thomas R. Prohaska. 2007. "Help or Hindrance?: How Family and Friends Influence Chronic Illness Self-Management among Older Adults." *Research on Aging* 29:375-409.

Gorman, Bridget K. and Ahilan Sivaganesan. 2007. "The Role of Social Support and Integration for Understanding Socioeconomic Disparities in Self-Rated Health and Hypertension." *Social Science and Medicine* 65:958-975.

Haines, Valerie A. and Jeanne S. Hurlbert. 1992. "Network Range and Health." *Journal of Health and Social Behavior* 33:254-266.

Hajjar, Ihab, Jane Morley Kotchen, and Theodore A. Kotchen. 2006. "Hypertension: Trends in Prevalence, Incidence, and Control." *Annual Review of Public Health* 27:465-490.

Hawkley, Louise C., Ronald A. Thisted, and John T. Cacioppo. 2009. "Loneliness Predicts Reduced Physical Activity: Cross-Sectional and Longitudinal Analyses." *Health Psychology* 28:354-363.

Hawkley, Louise C., Ronald A. Thisted, Christopher M. Masi, and John T. Cacioppo. 2010. "Loneliness Predicts Increased Blood Pressure: Five-Year Cross-Lagged Analyses in Middle-Aged and Older Adults." *Psychology and Aging* 25:132-141.

He, Jiang, Paul Muntner, Jing Chen, Edward J. Roccella, Richard H. Streiffer, and Paul K. Whelton. 2002. "Factors Associated with Hypertension Control in the General Population of the United States." *Archives of Internal Medicine* 162:1051-1058.

Hertz, Robin P., Alan N. Unger, Jeffrey A. Cornell, and Elijah Saunders. 2005. "Racial Disparities in Hypertension Prevalence, Awareness, and Management." *Archives of Internal Medicine* 165:2098-2014.

House, James S. 2001. "Social Isolation Kills, But How and Why?" *Psychosomatic Medicine* 63:273-274.

House, James S., Karl R. Landis, and Debra Umberson. 1988. "Social Relationships and Health." *Science* 241:540-545.

Insel, Kathleen, Daniel Morrow, Barbara Brewer, and Aurelio Figueredo. 2006. "Executive Function, Working Memory, and Medication Adherence Among Older Adults." *Journals of Gerontology, Series B: Psychological and Social Sciences* 61:P102-P107.

Langa, Kenneth M., Sandeep Vijan, Rodney A. Hayward, Michael E. Chernew, Caroline S. Blaum, Mohammed U. Kabeto, David R. Weir, Steven J. Katz, Robert J. Willis, and A. Mark Fendrick. 2002. "Informal Caregiving for Diabetes and Diabetic Complications among Elderly Americans." *Journals of Gerontology, Series B: Psychological and Social Sciences* 57:S177-S186.

Latkin, Carl A., Valerie Forman, Amy Knowlton, and Susan Sherman. 2003. "Norms, Social Networks, and HIV-related Risk Behaviors Among Urban Disadvantaged Drug Users." *Social Science and Medicine* 56:465-476.

Lauder, W., K. Mummery, M. Jones, and C. Caperchione. 2006. "A Comparison of Health Behaviours in Lonely and Non-Lonely Populations." *Psychology, Health, and Medicine* 11:233-245.

Law, M. R., N. J. Wald, J. K. Morris, and R. E. Jordan. 2003. "Value of Low Dose Combination Treatment with Blood Pressure Lowering Drugs: Analysis of 354 Randomised Trials." *British Medical Journal* 326:1427-1434.

Levy, Rona L. 1983. "Social Support and Compliance: A Selective Review and Critique of Treatment Integrity and Outcome Measurement." *Social Science and Medicine* 18:1329-1338.

Lewis, Megan A. and Karen S. Rook. 1999. "Social Control in Personal Relationships: Impact on Health Behaviors and Psychological Distress." *Health Psychology* 18:63-71.

Lin, Nan. 2001. *Social Capital: A Theory of Social Structure and Action*. Cambridge, UK: Cambridge University Press.

Lutfey, Karen E. and Jeremy Freese. 2005. "Toward Some Fundamentals of Fundamental Causality: Socioeconomic Status and Health in the Routine Clinic Visit for Diabetes." *American Journal of Sociology* 110:1326-1372.

Lutfey, Karen E., Carol L. Link, Richard W. Grant, Lisa D. Marceau, and John B. McKinlay. 2009. "Is Certainty More Important than Diagnosis for Understanding Race and Gender Disparities?: An Experiment Using Coronary Heart Disease and Depression Case Vignettes." *Health Policy* 89:279-287.

McDermott, Mary McGrae, Brian Schmitt, and Elizabeth Wallner. 1997. "Impact of Medication Nonadherence on Coronary Heart Disease Outcomes: A Critical Review." *Archives of Internal Medicine* 157:1921-1929.

McDonald, Margaret, Robin P. Hertz, Alan N. Unger, and Michael B. Lustik. 2009. "Prevalence, Awareness, and Management of Hypertension, Dyslipidemia, and Diabetes Among United States Adults, Aged 65 and Over." *Journal of Gerontology: Medical Sciences* 64A:256-263.

Mookadam, Farouk and Heather M. Arthur. 2004. "Social Support and Its Relationship to Morbidity and Mortality After Acute Myocardial Infarction." *Archives of Internal Medicine* 164:1514-1518.

Morgan, Stephen L. and Jennifer J. Todd. 2008. "A Diagnostic Routine for the Detection of Consequential Heterogeneity of Causal Effects." *Sociological Methodology* 38:231-281.

Murray, Michael D., Daniel G. Morrow, Michael Weiner, Daniel O. Clark, Wanzhu Tu, Melissa M. Deer, D. Craig Brater, and Morris Weinberger. 2004. "A Conceptual Framework to Study Medication Adherence in Older Adults." *American Journal of Geriatric Pharmacotherapy* 2:36-43.

NHLBI. 2003. "The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure." U.S. Department of Health and Human Services.

Nicklett, Emily J. and Jersey Liang. 2010. "Diabetes-Related Support, Regimen Adherence, and Health Decline Among Older Adults." *Journals of Gerontology, Series B: Psychological and Social Sciences* 65:390-399.

O'Muircheartaigh, Colm, Stephanie Eckman, and Stephen Smith. 2009. "Statistical Design and Estimation for the National Social Life, Health, and Aging Project." *Journals of Gerontology, Series B: Psychological and Social Sciences* 64B:i12-i19.

Ong, Kwok Leung, Bernard M. Y. Cheung, Yu Bun Man, Chu Pak Lau, and Karen S. L. Lam. 2006. "Prevalence, Awareness, Treatment, and Control of Hypertension Among United States Adults 1999-2004." *Hypertension* 49:69-75.

Ostchega, Yechiam, Charles F. Dillon, Jeffery P. Hughes, Margaret Carroll, and Sarah Yoon. 2007. "Trends in Hypertension Prevalence, Awareness, Treatment, and Control in Older U.S. Adults: Data from the National Health and Nutrition Examination Survey 1988 to 2004." *Journal of the American Geriatrics Society* 55:1056-1065.

Osterberg, Lars and Terrence Blaschke. 2005. "Adherence to Medication." *New england Journal of Medicine* 353:487-497.

Pfeiffer, E. 1975. "A Short Portable Mental Status Questionnaire for the Assessment of Organic Brain Deficit in Elderly Patients." *Journal of the American Geriatrics Society* 23:433-441.

Qato, Dima M., Stacy Tessler Lindau, Rena M. Conti, L. Philip Schumm, and G. Caleb Alexander. 2010. "Racial and Ethnic Disparities in Cardiovascular Medication Use among Older Adults in the United States." *Pharmacoepidemiology and Drug Safety* 19:834-842.

Qato, Dima M., L Schumm, Philip, Michael Johnson, Andreea Mihai, and Stacy Tessler Lindau. 2009. "Medication Data Collection and Coding in a Home-Based Survey of Older Adults." *Journal of Gerontology: Social Sciences* 64(B):i86-i93.

Rasmussen, Jeppe N., Alice Chong, and David Alter. 2007. "Relationship Between Adherence to Evidence-Based Pharmacotherapy and Long-Term Mortality After Acute Myocardial Infarction." *Journal of the American Medical Association* 297:177-186.

Smith, Stephen, Angie Jaszczak, Jessice Graber, Katie Lundeen, Sara Leitsch, Erin Wargo, and Colm O'Muircheartaigh. 2009. "Instrument Development, Study Design Implementation, and Survey Conduct for the National Social Life, Health, and Aging Project." *Journals of Gerontology, Series B: Psychological and Social Sciences* 64B:i20-i29.

Sokol, Michael C., Kimberly A. McGuigan, Robert R. Verbrugge, and Robert S. Epstein. 2005. "Impact of Medication Adherence on Hospitalization and Healthcare Cost." *Medical Care* 43:521-530.

Staessen, J. A., J. Gasowski, J. G. Wang, L. Thijs, E. Den Hond, J. P. Boissel, J. Coope, T. Ekbom, F. Gueyffier, L. Lio, K. Kerlikowske, S. Pocock, and R. H. Fagard. 2000. "Risks of Untreated and Treated Isolated Systolic Hypertension in the Elderly: Meta-Analysis of Outcome Trials." *Lancet* 355:865-872.

Thoits, Peggy. 1995. "Stress, Coping, and Social Support Processes: Where Are We? What Next?" *Journal of Health and Social Behavior* 35:53-79.

Trivedi, Ranak B., Brian Ayotte, David Edelman, and Hayden B. Bosworth. 2008. "The Association of Emotional Well-Being and Marital Status with Treatment Adherence among Patients with Hypertension." *Journal of Behavioral Medicine* 31:489-497.

Uchino, Bert N. 1996. "The Relationship between Social Support and Physiological Processes: A Review with Emphasis on Underlying Mechanisms and Implications for Health." *Psychological Bulletin* 119:488-531.

Umberson, Debra. 1987. "Family Status and Health Behaviors: Social Control as a Dimension of Social Integration." *Journal of Health and Social Behavior* 28:306-319.

Umberson, Debra, Kristi Williams, Daniel A. Powers, Hui Liu, and Belinda Needham. 2006. "You Make Me Sick: Marital Quality and Health Over the Life Course." *Journal of Health and Social Behavior* 47:1-16.

Vasan, R. S., A. Beiser, S. Seshadri, and et al. 2002. "Residual Lifetime Risk for Developing Hypertension in Middle-Aged Women and Men: The Framingham Heart Study." *Journal of the American Medical Association* 287:1003-1010.

Waite, Linda J. and Mary Elizabeth Hughes. 1999. "At Risk on the Cusp of Old Age: Living Arrangements and Functional Status Among Black, White, and Hispanic Adults." *Journal of Gerontology* 54B:S136-S144.

Weir, Matthew R., Edward W. Maibach, George L. Bakris, Henry R. Black, Purnima Chawla, Franz H. Messerli, Joel M. Neutel, and Michael A. Weber. 2000. "Implications of a Health Lifestyle and Medication Analysis for Improving Hypertension Control." *Archives of Internal Medicine* 160:481-490.

Wickrama, K.A.S., Frederick O. Lorenz, Lora Ebert Wallace, Laknath Peiris, Rand D. Conger, and Glen H. Elder, Jr. 2001. "Family Influences on Physical Health During the Middle Years: The Case of Onset of Hypertension." *Journal of Marriage and the Family* 63:527-539.

Williams, Sharon R., Genevieve Pham-Kanter, and Sara A. Leitsch. 2009. "Measures of Chronic Conditions and Diseases Associated with Aging in the National Social Life, Health, and Aging Project." *Journal of Gerontology: Social Sciences* 64B:i67-i75.

Wong, M.D., M.F. Shapiro, W.J. Boscardin, and S.L. Ettner. 2002. "Contribution of Major Diseases to Disparities in Mortality." *New England Journal of Medicine* 347:398-404.

World Health Organization. 2003. "Adherence to Long-Term Therapies: Evidence for Action." Geneva, Switzerland.

Table 1. Summary Statistics for Hypertension Categories, Social Connectedness and Support, and Covariates According to Respondent Race/Ethnicity

	Mean (and Standard Deviation) or Proportion[a]		
	Black (n = 366)	**Hispanic (n = 243)**	**White or Other[b] (n = 1,840)**
Hypertension Categories			
Normal (non-hypertensive)	.161	.280	.284
Managed hypertensive	.276	.243	.219
Unaware hypertensive	.120	.156	.183
Unmanaged hypertensive	.443	.321	.315
Social Connectedness and Support			
Co-resident spouse or partner {1 = yes, 0 = no}	.437	.663	.664
Sources of instrumental support {can often rely on: 0 = *neither* family nor friends; 1 = *either* family or friends; 2 = *both* family and friends}	1.022 (.790)	.817 (.746)	1.140 (.775)
Sources of emotional support {can often open up to: 0 = *neither* family nor friends; 1 = *either* family or friends; 2 = *both* family and friends}	.766 (.761)	.614 (.684)	.718 (.751)
Social network size {range: 0 to 5, and 6 or more}	3.227 (1.555)	2.780 (1.494)	3.689 (1.505)
Likelihood of discussing health with network members {range: 1 "not likely" to 3 "very likely" with all network members}	2.655 (.440)	2.714 (.431)	2.595 (.453)
Cardiovascular Risk Factors			
Alcohol use {1 = yes; 0 = no}	.440	.465	.617
Cigarette use {1= yes; 0 = no}	.210	.103	.137
Obesity {assessed by interviewer; range = 1,5}	2.917 (1.094)	2.994 (1.009)	2.858 (1.009)
Health-Related Covariates			
Anti-hypertensive medication use {1 = yes; 0 = no}	.730	.556	.605
Co-morbidities (number of conditions reported; range = 0,8)	1.581 (1.305)	1.282 (1.224)	1.660 (1.363)
Cognitive impairment {number of errors on the SPMSQ; range = 0,10}	.912 (1.093)	.919 (1.228)	.460 (.783)
Visits to health care provider {from 0 = "none" to 7 = "three month or more"}	2.714 (1.403)	2.502 (1.503)	2.583 (1.372)
Health insurance {1 = yes; 0 = no}	.801	.806	.930
Additional blood pressure reading taken {0 = no; 1 = yes}	.104	.078	.084
Respondent Characteristics			
Age (in decades)	6.715 (.727)	6.669 (.745)	6.821 (.790)
Female {1 = yes; 0 = no}	.577	.498	.513
Education			
Less than high school	..377	.568	.128
High school degree	.240	.144	.291
Some college	.262	.198	.316
College degree or higher	.120	.091	.265
Currently employed {1 = yes; 0 = no}	.254	.325	.324

[a] Means are survey-adjusted and weighted to account for the probability of selection, with post-stratification adjustments for non-response. Proportions are unadjusted and unweighted.

[b] This category comprises 1,781 white respondents and 59 respondents who identified their race/ethnicity as "other."

Table 2. Relative Risk Ratios from Multinomial Logistic Models Predicting Hypertension Awareness and Management (n = 2,449)[a]

	Model 1						Model 2					
	Managed		Undiagnosed		Unmanaged		Managed		Undiagnosed		Unmanaged	
	RRR	(SE)	RRR	(SE)	RRR	(SE)	RRR	(SE)	RRR	(SE)	RRR	(SE)
Age (in decades)	1.284*	(.132)	1.561***	(.176)	1.244*	(.117)	1.230	(.134)	1.400**	(.161)	1.689	(.113)
Female	1.101	(.177)	.960	(.127)	1.047	(.124)	1.075	(.182)	.911	(.140)	.951	(.120)
Black	2.172***	(.414)	1.451	(.440)	2.395**	(.601)	2.098***	(.396)	1.312	(.395)	2.263**	(.553)
Hispanic, non-black	1.186	(.387)	.612	(.210)	.954	(.295)	1.206	(.404)	.576	(.356)	.959	(.297)
Education												
Less than high school	1.640	(.499)	1.538	(.377)	2.069*	(.588)	1.620	(.404)	1.424	(.356)	2.042*	(.572)
High school diploma	1.414	(.376)	1.340	(.299)	1.486	(.303)	1.408	(.372)	1.298	(.301)	1.483	(.302)
Some college	1.276	(.343)	1.151	(.266)	1.214	(.298)	1.281	(.337)	1.137	(.261)	1.221	(.294)
Bachelor's degree or higher	---		---		---		---		---		---	
Currently employed	1.649*	(.343)	1.592*	(.276)	1.579	(.364)	1.641*	(.332)	1.520*	(.263)	1.559	(.351)
Anti-hypertensive medications	36.334***	(7.121)	.550**	(.117)	16.149***	(2.516)	36.635***	(7.261)	.541**	(.116)	16.229***	(2.520)
Co-morbidities	1.048	(.066)	1.061	(.077)	1.091	(.066)	1.046	(.065)	1.053	(.074)	1.086	(.065)
Cognitive impairment	1.166	(.136)	.979	(.118)	1.059	(.095)	1.164	(.134)	.955	(.120)	1.049	(.093)
Visits to health care provider	1.098	(.072)	.881*	(.056)	.962	(.058)	1.101	(.072)	.878	(.057)	.964	(.059)
Health insurance	1.113	(.326)	1.415	(.368)	.891	(.222)	1.124	(.319)	1.530	(.421)	.922	(.228)
Alcohol use	1.268	(.253)	1.072	(.190)	1.349*	(.200)	1.275	(.258)	1.069	(.194)	1.395*	(.204)
Cigarette use	1.116	(.309)	1.526*	(.303)	.903	(.180)	1.081	(.298)	1.393	(.294)	.851	(.171)
Obesity	1.547***	(.137)	1.610***	(.121)	1.704***	(.135)	1.534***	(.139)	1.609***	(.126)	1.692***	(.135)
Co-resident partner							.724*	(.107)	.537***	(.076)	.594**	(.107)
Sources of instrumental support							1.049	(.104)	.781*	(.086)	1.012	(.096)
Sources of emotional support							.917	(.111)	.991	(.155)	.997	(.121)
Social network size												
Likelihood of discussing health												
Network size * Discussing health												

Note: Normal (or non-hypertensive) is the base category for all models. The number of blood pressure readings and insurance status are included but not shown.

*p < .05; **p < .01; ***p < .001 (two-tailed tests)

[a] Estimates presented are survey-adjusted and weighted for the probability of selection with post-stratification adjustments for non-response.

Table 2, continued. Relative Risk Ratios from Multinomial Logistic Models Predicting Hypertension Awareness and Management (n = 2,449)[a]

	Model 3					
	Managed		Undiagnosed		Unmanaged	
	RRR	(SE)	RRR	(SE)	RRR	(SE)
Age (in decades)	1.234	(.136)	1.425**	(.171)	1.179	(.114)
Female	1.099	(.197)	.894	(.140)	1.000	(.137)
Black	1.998***	(.362)	1.273	(.384)	2.191**	(.505)
Hispanic, non-black	1.099	(.369)	.558	(.174)	.871	(.263)
Education						
Less than high school	1.519	(.461)	1.415	(.353)	1.956*	(.565)
High school diploma	1.328	(.362)	1.278	(.301)	1.390	(.298)
Some college	1.260	(.335)	1.144	(.263)	1.208	(.298)
Bachelor's degree or higher	---		---		---	
Currently employed	1.621*	(.330)	1.529*	(.262)	1.555	(.354)
Anti-hypertensive medications	37.266***	(7.358)	.543**	(.114)	16.943***	(2.651)
Co-morbidities	1.050	(.065)	1.053	(.075)	1.090	(.065)
Cognitive impairment	1.156	(.127)	.956	(.116)	1.041	(.091)
Visits to health care provider	1.102	(.072)	.873*	(.055)	.972	(.062)
Health insurance	1.134	(.320)	1.504	(.404)	.937	(.226)
Alcohol use	1.289	(.256)	1.056	(.190)	1.410*	(.202)
Cigarette use	1.074	(.301)	1.404	(.286)	.860	(.180)
Obesity	1.534***	(.139)	1.606***	(.125)	1.697***	(.134)
Co-resident partner	.711*	(.104)	.513***	(.073)	.598**	(.106)
Sources of instrumental support	1.072	(.109)	.780*	(.086)	1.052	(.100)
Sources of emotional support	.915	(.112)	.942	(.151)	1.041	(.126)
Social network size	1.100	(.289)	1.142	(.305)	1.757*	(.489)
Likelihood of discussing health	1.658	(.676)	1.635	(.718)	2.711*	(1.065)
Network size * Discussing health	.934	(.091)	.957	(.094)	.772*	(.079)

Note: Normal (or non-hypertensive) is the base category for all models. The number of blood pressure readings is included but not shown.

*p < .05; **p < .01; ***p < .001 (two-tailed tests)

[a] Estimates presented are survey-adjusted and weighted for the probability of selection with post-stratification adjustments for non-response.

Figure 2. Predicted Probability of Hypertension Awareness and Management, by Race/Ethnicity

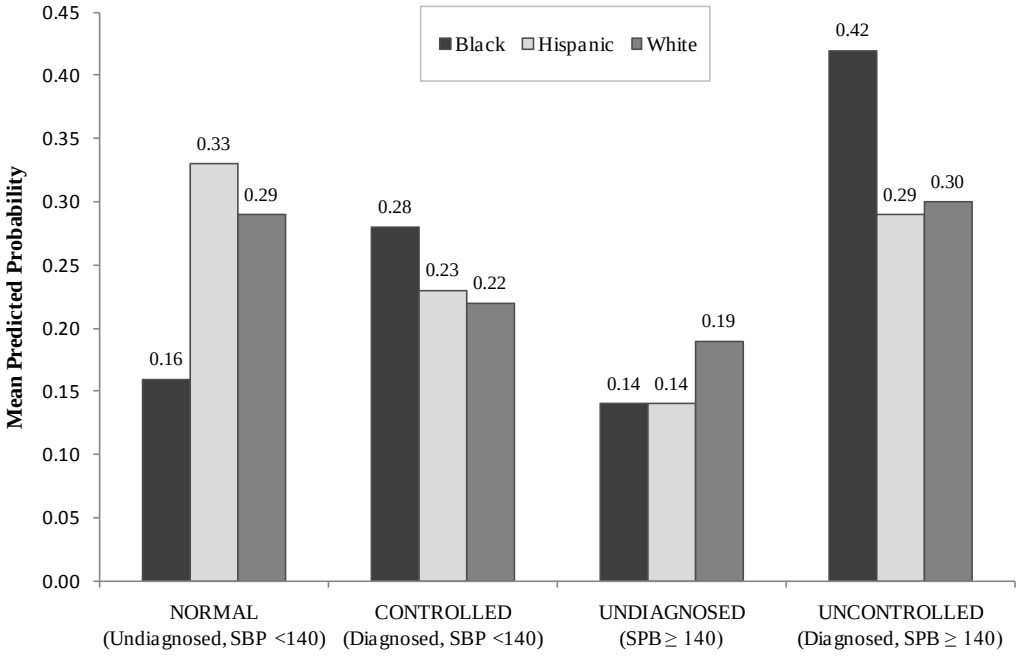

Figure 3. Predicted Probability of Unmanaged Hypertension, by Network Size and Likelihood of Talking about Health Problems