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Social Relationships and Health in Later Life: Investigating the Associations among Health and Network Structure and Function

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Abstract

Objectives: Social networks and social support can influence older adult health, but health can also influence network maintenance. This study investigates this dynamic, examining whether networks impact future health, and whether health matters for future network characteristics. **Methods:** Data are from the National Social Life, Health, and Aging Project (NSHAP), a longitudinal study on health and social factors of older adults. **Results:** Using lagged dependent variable models, I find no associations between network characteristics and future health outcomes, but find that health influences later network structure. While depression reduces contact with one's personal network, poor physical health increases contact, possibly because the need for support from one's network becomes greater. In addition, network characteristics are associated with later social support, and social support is associated with later health. **Discussion:** Network structure is meaningful in that it provides the source from which support is derived to influence health.

Introduction

Social relationships are influential to the achievement and maintenance of good health (House, Umberson, & Landis, 1988). The study of how social networks influence health is not new. The link between social relationships and indicators of health and well-being has been widely documented in the literature, such as links between social relationships and mortality (Berkman & Syme, 1979), mental illness and psychological well-being (Kawachi & Berkman, 2001; Umberson & Montez, 2010), and disability and morbidity (House, Landis, & Umberson, 1988; Mendes de Leon, Glass, & Berkman, 2003). Given these benefits, the maintenance of social relationships is an important component of older adult health.

Past research has firmly established the importance of social relationships to health. The current research trend is to better understand how the structure of the network itself (e.g., network size, social contact) impacts health and the benefits that can be derived from an individual's network, such as social support. For instance, having large networks may be beneficial in and of themselves, or perhaps levels of support derived from a personal network matter more, regardless of the size of an individual's personal network.

An important limitation of studies that examine the relationship between social relationships and health is the focus on how social relationships impact health, taking the existence of the network itself as given and static rather than something that can be impacted by health. Few studies have explicitly examined how health can impact the structure of one's personal network. In addition, many studies are cross-sectional. In this study, I seek to unpack the differences in the impact that network structure and network functions have on health, focusing on older adult health. I also assess the impact that prior health status can have on network structure. My research contributes to the current literature by examining the

bidirectional relationship of network structure, network function, and physical/mental health using two waves of data from a nationally representative longitudinal survey of older adults. In doing so, I contribute to better understanding networks and health while treating networks as an inherently dynamic phenomena.

In this study, I differentiate between the structure versus the function of personal social networks, both as predictors of later physical and mental health, as well as outcomes affected by physical and mental health. I use social network structure to refer to the characteristics of the ties or set of ties between individuals and other members in their personal network. I use the concept of social network function to refer to the benefit that network ties can offer the individual as well as the demands that can be placed on an individual by other ties in their personal network (e.g., social support and social strain).

By making a distinction between the functions of social relationships in a network and the structural characteristics of the network, I can investigate how structural characteristics of the network may be related to the functions of social ties, such as social support, and how the functions of a network may serve as a mediator between structural network characteristics and health and well-being. It is important to study network structure and network function as distinct concepts because there could be independent effects on health outcomes.

Social Support and Social Strain

In this study, the functions of a network are conceptualized as social support and social strain. One of the most important functions of social networks is the provision of social support (Thoits, 2011). The relationship between social support and better health is well established in the literature. Less studied is social strain, but a few studies do document the negative impact that social strain has on health, particularly on mental health (Chen & Feeley, 2014).

Social support theory, or the support buffer theory, asserts that social support is critical in buffering individuals from the stresses of their social environment and thereby diminishing the adverse impacts on their health from those stresses (Cohen & Wills, 1985). Social support is commonly defined as the perception, if not the actuality, that one can rely on others in their network for support when needed. Support can be emotional, instrumental, informational, or provide companionship and a sense of belonging; sources of support can come from family, friends, neighbors, coworkers, etc. In this study I will focus on emotional and instrumental support from family and friends.

Social strain can also be conceptualized as a function of a network, albeit one that has adverse consequences. Network members may provide support to an individual, but also can be sources of strain. If other alters in an individual's network are demanding or critical rather than supportive, then the health impacts to the individual may very well be more negative than positive. In this case, having more social contacts is not necessarily beneficial to the individual.

Social ties in and of themselves may have an influence on health outcomes, regardless of whether an individual actually receives any social support from others in their personal network (Rook, 1990; Unger, McAvay, Bruce, Berkman, & Seeman, 1999). Being socially connected can have health benefits independent of any support received. Studies have shown the benefits of social ties, independent of social support (e.g., Rook, 1987), suggesting the importance of considering structural and functional characteristics of a social network as independent and distinct constructs, as social support is oftentimes conflated to mean social connectedness (Smith & Christakis, 2008).

Associations Among Structural Network Characteristics, Social Support, and Health

Studies have shown that certain structural network characteristics are associated with

social support. For instance, social support is higher among older adults with larger networks and denser networks, as well as among older adults who interact with other members of their network more frequently (Seeman & Berkman, 1988).

Much of the recent research seeks to explain how social ties affect well-being. The question remains whether there are direct effects, or are the effects through some other mechanism, like social support. The literature establishing the link between social support and health is very extensive. However, the relationship does depend on the outcome of study. For some outcomes, like onset of activities of daily living (ADL) disability, protective effects are not found when looking at social network characteristics and measures of social support (Seeman, Bruce, & McAvay, 1996). Other studies find that the association between social ties and health hold for mental health, but are less conclusive for physical health (Seeman, 1996), even though depression increases the future risk of disability (Penninx, Leveille, Ferrucci, Van Eijk, & Guralnik, 1999).

Social support can reduce health-related uncertainty and therefore have health benefits. However, the extent to which support improves quality of life and well-being over time remains relatively unknown. Much of the literature on the positive impacts of social support on health are cross-sectional in nature, due to the availability of such kinds of data. These studies do clearly establish that social support, even if perceived, have beneficial effects on health, even if much of this research is correlational in nature (Cohen & Janicki-Deverts, 2009; Mor-Barak & Miller, 1991).

Research Questions

This study examines the association among social network characteristics of community-dwelling older adults with perceived social support and social strain and older adults' self-

reported physical and mental health status as well as disability status and depression. I seek to unpack the associations between older adults' social ties, levels of social support, and physical and mental health. My main research questions are as follows:

1. Do social network characteristics affect elderly physical or mental health?
2. Does elderly physical or mental health affect social network characteristics?
3. Does social support or social strain act to mediate any relationship between personal network characteristics and older adult health and well-being?

Accounting for baseline health and baseline network characteristics, I examine whether changes in networks and support impact future health, and whether changes in health impact future network characteristics. The aim of the study is to identify which specific network characteristics or whether social support affects older adult health. I assess three sets of hypotheses that correspond with the three research questions.

Data

To answer my research questions, I use the National Social Life, Health, and Aging Project (NSHAP) (Waite, Laumann, Levinson, Lindau, & O'Muircheartaigh, 2007; Waite et al., 2014). This survey uses a national area probability sample of community residing adults born between 1920 and 1947, ages 57 to 85 at the time of the Wave 1 interview. NSHAP has two waves, with five years between each wave, which will allow me to assess how social network characteristics affect health from time 1 to time 2, but also see how poor health affects the ability to maintain ties or loss of ties from one time to the next. In Wave 1, 3,005 interviews were conducted between July 2005 and March 2006. For Wave 2, NSHAP re-interviewed the Wave 1 respondents and also non-interviewed respondents from Wave 1 who were eligible to participate in NSHAP but were not selected for interview out of the sample of households identified by

HRS. For Wave 2, 3,377 interviews were conducted between August 2010 and May 2011. This study restricts analyses to only complete cases.

Measures

For this study, I included measures for egocentric network structure, social network functions, health outcomes, and typical demographic and control variables.

Social Network Characteristics

Multiple measures for social network structure were used in this study to allow for the examination of which aspects of social network connectedness are impactful for health. The measures used were the following: egocentric network size, number of alters living in the same household as ego, percent female, closeness, density, and frequency of contact with alters.

The NSHAP social network data is egocentric. The social network module for NSHAP permits respondents to identify network members important to the respondent, and then subsequently obtains information about those alters. A set of persons around each respondent are identified, as well as the relationships that link the respondents to other network members, and other network members to each other, providing a "local" sample from the larger social network around ego. All of the network structure measures were calculated from the roster data, then aggregated and merged to the main dataset for analyses.

The most basic measure is egocentric network size. To calculate network size, I utilized the roster data. In Wave 1, the number of alters was calculated and included in the core dataset. However, this variable only included alters listed as core confidantes to the respondent, not the total number of alters reported by the respondent. Instead, I constructed another variable to indicate the number of alters in each respondent's network. The number of alters was calculated by taking the sum of alters in the network dataset for each respondent.

Each respondent responded to four different rosters: A, B, C, and D. For Roster A, up to five names can be entered for core confidantes whom the respondent discusses important matters to. Those who entered five were then asked if there were any others. For Roster B, respondents can name one spouse or current partner not named in roster A. For Roster C, anyone else important or close not mentioned in A can be named, but only one person can be named. For Roster D, all household members not captured in A, B, or C can be named, and there is no limit.

To construct a measure for the number of alters living with the respondent, I counted the number of alters reported by ego whom ego indicated as residing in the same household. Gender composition was calculated as the proportion of reported alters who are women.

To calculate closeness with alters, I used the responses for the question asking the respondent how close they feel to the person cited, which varied from not very close to extremely close. The responses were (1) not very close, (2) somewhat close, (3) very close, and (4) extremely close. To calculate a variable for a count of how many close alters a respondent has, first the variable measuring closeness was dummy coded to be an indicator for very close and extremely close alters.

The density measure captures the extent to which the members are connected to each other, or the frequency of contact between alters, expressed as a ratio of the number of actual ties to the number of theoretically possible ties. The density measure captured the number of existing ties between the alters of a respondent divided by the number of all possible pairs. This measure was constructed by first binary coding the variable asking about how frequently the respondent thinks the alters talk to each other. The variable responses ranged from (0) never to (8) every day. Any contact was re-coded as 1. Each respondent could have up to 7 alters for these sets of questions, because the respondent was only asked about the frequency of talking for alters in

rosters A to C. After binary coding the set of 7 questions asking about the frequency of communication between alters 1 to 7 for each respondent, I summed all the ties reported between alters. The number of ties was divided by the number of pairs to capture the density for each personal network.

Frequency of contact with named alters was constructed by recoding the set of variables asking about the frequency of talking to alters. The responses for this variable ranged from (1) less than once a year to (8) every day and were asked only of those alters listed in rosters A to C, and so the maximum number of alters for this variable is seven. To use the variable as a continuous variable, the responses were recoded to reflect contact-days a year. Then the number of days was summed across all alters to capture the total days a year of contact that ego has with all reported alters in ego's network. This sum can be quite large, so the sum was then re-scaled by dividing the value by 100 to reflect hundred-days a year so that the coefficients produced would be easier to interpret.

Social Network Functions

The functions of a network were operationalized as social support and social strain experienced from friends and family. Scales were constructed to capture the social support and social strain. The NSHAP survey included the reported level of support or strain from family and friends. There were eight variables in total—four each for family and friends. The survey questions used were the following:

- "How often can you open up to members of your family (friends) if you need to talk about your worries? Would you say hardly ever, some of the time, or often?"
- "… rely on them for help if you have a problem? …"
- "How often do members of your family (friends) make too many demands on you?

…"

- "How often do they criticize you? …"

The response categories for each question were (1) hardly ever (or never), (2) some of the time, and (3) often.

In Wave 2, the response categories for hardly ever and never were in two separate categories. The question that offered the response options was phrased as follows: "Would you say never, hardly ever or rarely, some of time or often?" The categories "never" and "hardly ever or rarely" were collapsed to be consistent with the responses for these questions in Wave 1. For the question asking how often the respondent can open up to the family, those who volunteered no family (only 18) were collapsed into the hardly ever or never category. Similar recoding was done for the question asking about frequency of opening up to friends.

The social support scale was created by summing the response for the four questions asking if the respondent could rely on or open up to family and friends. The response categories were re-coded so that 0 was hardly ever or never, 1 was some of the time, and 2 was often. The range of the scale was a minimum of 0 and a maximum of 8, since there were four questions and 2 was the maximum value for each response. Alpha reliability for this scale was 0.64.

The social strain scale was created by summing the responses for the four questions asking the extent to which the respondent's family and friends criticized or made demands on them. The response categories for this scale was recoded similarly to how the recoding was done for the social support questions, and the range for this measure was 0 to 8. Alpha reliability for this scale was 0.53.

General Health Status

ADL disability status and depressive symptoms were used to measure physical health and

mental health, respectively. To measure disability status, a binary variable was constructed. The indicator variable employed self-reported level of difficulty with daily activities, or activities of daily living (ADLs). There were seven variables that measured the respondent's difficulty with activities of daily living (ADLs). Difficulty with the following activities were measured: walking one block, walking across the room, dressing, bathing or showering, eating, getting in or out of bed, using the toilet. The responses for these variables are as follows: (0) no difficulty, (1) some difficulty, (2) much difficulty, and (3) unable to do. The variables measuring difficulty walking a block, bathing/showering, and using the toilet, had a fourth response option "have never done." I collapsed these values with (3) unable to do. Most respondents responded that they did not have any difficult with any of the ADLs. Those who had some difficulty to complete inability to do any of the ADLs were coded as "1."

A measure for depression was constructed by building a scale using the Center for Epidemiologic Studies-Depression (CES-D) variables, which includes questions that ask how much respondents experienced the following: did not feel like eating; felt depressed; felt everything was an effort; sleep was restless; was happy; felt lonely; felt people were unfriendly; enjoyed life; felt sad; felt people disliked them; and could not get going. Responses varied from (1) rarely or none of the time to (4) most of the time. NSHAP used an existing 11-item short from of the CES-D.

To construct the NSHAP Depressive Symptoms Measure (NDSM), the variables measuring degree of happiness and enjoyment of life had to be reverse coded so that higher responses reflected higher levels of depression for all variables. The response categories of *occasionally* and *most of the time* were combined into one category denoting *much or most of the time;* this was necessary to achieve full comparability of the NDSM to the CES-D scale. *Rarely*

or none of the time and *some of the time* were left as is. *Rarely or none of the time* was recoded from "1" to "0", *some of the time* was recoded from "2" to "1", and the combined category *much or most of the time* was assigned the value of "2." The scale was then created by summing all the items, producing a total score ranging from 0 to 22, with a higher score reflecting more depressive symptoms. Cronbach's alpha for this scale was 0.788.

An alternative measure for depression status was also constructed using the NDSM. A score of 9+ is the established cutpoint that formally identifies those with Frequent Depressive Symptoms (FDS), which warrants further clinical testing; scores of 8 or less were assigned a score of "0" for the binary variable. (Refer to Payne et al. 2014 for more details on the mental health measures of NDSM and FDS.)

Demographic and Other Covariates

NSHAP includes a number of other demographic and social engagement measures that potentially influence social networks and health, so they are also included in the analysis. Age was left as continuous. Gender was a dichotomous variable (male/female). I recoded this variable to construct an indicator for female. Race/ethnicity included four categories: White, Black, Hispanic non-Black, and other. I used White as the reference category.

A measure for cohabitation status was re-coded from a question asking about the respondent's marital status. The response categories for the survey question were married, living with a partner, separated, divorced, widowed, and never married. I collapsed the responses for married and living with a partner to cohabiting, and collapsed the other four categories to not cohabiting.

The variable for education consists of four categories: less than high school, high school/equivalent, vocational certification/some college/associate's degree, and bachelors or

more. This variable was dummy coded to indicate college completion. Employment status included responses for whether the respondents worked for pay or not last week.

The variable for employment status also serves as a variable for social engagement, along with religious participation which was an ordinal measure that captured the estimated frequency of attending religious services. Responses ranged from never to several times a week. Other variables of social engagement (frequency of volunteer work, attendance at meetings of organized groups in the past year, and frequency of socializing with friends or relatives in the past year) were not used because of high levels of missing data.

Analytical Strategy

Data come from two waves of data collection. Models are estimated using ordinary least squares (OLS) and logistic lagged dependent variable regression models. These models account for prior values of the dependent variable before assessing the influences of other independent variables at time 1 on the dependent variable at time 2. All time-varying variables are lagged by one wave, thus independent variables at time 1 are used to predict changes in the outcome variable at time 2. Lagged independent variables help reduce (although not eliminate) the risk of endogeneity due to reverse causation, as it is not possible for outcome variables at time 2 to effect independent variables from a prior wave. By controlling for prior values of the dependent variable when predicting current values of the dependent variable, the coefficients of the independent variables may be thought of as predicting change in the outcome variable between waves.

Using the conditional change method allows us to take into account the baseline differences between respondents. For purposes of comparison, I include results of models without the lagged dependent variable or controls so we can see how much variation is

accounted for by the lag, and what, if any, associations on the dependent variable at time 2 are left after accounting for the lag and other demographic control variables.

All analyses were done using Stata/SE 12.0. Results were weighted using *svyset* commands to incorporate the adjustment for nonresponse and correct for the sampling design. (For more details on estimation and weighting, refer to O'Muircheartaigh, Eckman, & Smith, 2009.)

Sample Characteristics

Table 1 presents the descriptive statistics for the sample.

[Insert Table 1 about here]

In Wave 1, 26.9% of the sample was disabled. This percent increased to 32.6% in Wave 2. In Wave 1, 17.3% were depressed; this percentage remained the same in Wave 2. The measures for network structure and social support also experienced very little change between waves. Perceived strain decreased from Wave 1 to Wave 2, but was low to begin with. The majority of the sample was female (53.7%), White (82.2%), college educated (56.5%), cohabiting (68.5%), and had an average age of 66.8 years.

Results

[Insert Table 2 about here]

The goal of this study was to examine the associations between network structure and function and health outcomes, while also observing whether baseline health was associated with network structure and/or function. Three sets of results are presented in the following sections. Table 2 presents the odds ratios from the residual change score models for disability and depression status regressed on network structure and social support/strain measures. These models assess the associations between network structure and function and later physical and

mental health.

[Insert Table 3 about here]

The next set of models assess social support/strain regressed on network structure and disability/depression. The last set of models assess network structure regressed on disability/depression.

[Insert Table 4 about here]

Health Outcome

The results present disability and depression status as outcome variables to examine how network structure and social support/strain are related to the onset of disability or depression five years from baseline. Table 2 presents three models for each outcome variable. Model 1 presents the odds ratios for network structure and network function without controls or the lagged dependent variables. Model 2 presents the odds ratios with controls, and Model 3 adds the lagged dependent variable.

From Model 3 for disability status in Table 2, we can see that none of the network structure variables or social support/strain variables at time 1 (T1) predict disability status at time 2 (T2) once we control for disability at baseline or T1. The odds of disability status do increase with age (*OR*=1.046, $p<.001$), and Hispanics experience lower odds of disability compared to Whites (*OR*=0.537, $p<.05$). However, it is disability at T1 that is most important in predicting disability at T2 (*OR*=8.184, $p<.001$).

For depression, higher perceived social support from friends and family reduces the odds of depression onset at T2 (*OR*=.823, $p<.001$), controlling for baseline depression status at T1. Having an educational level of college (*OR*=.565, $p<.01$) and higher and being currently employed (*OR*=.548, $p<.001$) also reduces the odds of depression. Perceived social strain

increases the odds of depression onset (*OR*=1.151, *p*<.05). However, none of the measures of network structure mattered for depression onset. This is inconsistent with the literature that finds that social ties matter for mental health.

Social Support and Strain

Table 3 presents the OLS regression models predicting perceived social support and perceived social strain in Wave 2 from Wave 1 health and network structure variables. The previous results from Table 2 showed that social support and social strain matters more for the onset of depression than any of the measures for personal network structure. Table 3 models social support and social strain as outcome variables to observe whether network structure impacts support. Network measures may not matter for predicting the onset of disability or depression, but they may impact support or strain, which we know matters for health.

The results in Table 3 indeed show that both the number of close ties (*b*=.106, *p*<.05) and the frequency of contact with other network members (*b*=.034, *p*<.001) increases perceived social support, although none of the network structure measures were significantly predictive of Wave 2 social strain. These results show that network structure may play a more indirect role in impacting health by impacting network functions instead, particularly social support.

Baseline depression is also associated with both perceived support and perceived strain. Being depressed in Wave 1 is negatively associated with perceived social support in Wave 2 (*b*=-0.274, *p*<.05) and positively associated with perceived social strain in Wave 2 (*b*=.182, *p*<.05). Other results show that being female and having higher levels of religious service attendance are both associated with higher perceived social support. Being non-White is associated with lower perceived social support in Wave 2, but higher perceived social strain.

Network Structure

The last set of models examine whether baseline health matters for network structure. The prior sets of models show that baseline network structure is not associated with health outcomes. The network function measures do predict later health outcomes. Some of the network structure variables are associated with social support though. This shows network structure's indirect relationship with health via social support.

Table 4 presents the results of the panel regression models for predictors of network structure in Wave 2. The results in Table 4 show that prior disability status is positively associated with network size (b=.264, p<.001) and the number of alters living with ego (b=.118, p<.01) at Wave 2 five years later. The positive associations observed could be explained by the mobilization hypothesis (Dunbar, Ford, & Hunt, 1998), which asserts that individuals with disability or illnesses requiring care or support may have larger networks because of the need to mobilize one's network to obtain support. Depression is negatively associated with the frequency of contact with alters (OR=-0.594, p<.05), which is consistent with the expected direction of poor health negatively impacting personal network structure.

Discussion and Conclusions

There is a growing body of research that documents the associations between network structure, social support, and health outcomes. One important finding in the literature has been the continued finding of the significance of social support to health outcomes. The results concerning the relationship between local network structure and well-being have been less consistent, although many studies do find that having more contacts with alters are beneficial. This study contributes to the literature by employing panel data to demonstrate causal relations between these relationships while differentiating between network structure and social support.

The three primary research questions for this study were as follows:

1. Do social network characteristics affect elderly physical or mental health?
2. Does elderly physical or mental health affect social network characteristics?
3. Does social support or social strain act to mediate any relationship between personal network characteristics and older adult health and well-being?

The results show that none of the social network structure measures are associated with disability status or depression status during the five-year follow-up. These findings suggest that network structure is not directly related to changes in health, at least over a five-year period. Either the effects that network structure has on health are more short-term and fades over time, which is why no significant effects were detected, or the impacts on health from changes in network structure take longer to effect changes.

However, we do see that health does have an association with certain social network characteristics. Depression is associated with reduced contact with networks. Disability status is associated with increases in social network size and number of household members. This could be explained by the mobilization hypothesis, where the need for support generates larger networks to fill that need.

The results show mixed findings for the third research question on whether the social network functions of social support or strain act as mediators to the relationship between networks and health. The models do not show any mediation because there were no main effects observed between networks and health, and so there were no model effects to mediate per se. However, we do observe that networks, namely the number of close ties and the frequency of contact with alters, are related to social support in the models with social support/strain as outcome variables. We also see that social support/strain is associated with depression onset. In this way, network structure can have an indirect association with health outcomes through

impacting the functions of a network, but the lagged dependent variable modeling strategy does not show statistical mediation.

Because no moderation or mediation effects were found, the effects of network structure and network function on health are largely independent. Both network structure and function may affect different aspects of health. The findings emphasize that personal network structure and network function are distinct concepts. Controlling for network structure, social support still matters, suggesting that the structural network characteristics may be less important for health than the functional characteristics of a network. Social support has direct relationships with mental health, indicating that the perceived quality of social ties are more important for mental health than the quantity or the structure of those ties. Adverse impact from baseline poor health can be mitigated by one's personal network, because local networks impact the perception of support, and social support was found to be protective.

A number of limitations should be considered. First, the lagged modeling approach can be used only to consider the possibility of causality, but more conclusive causal arguments cannot be drawn from this approach. Second, NSHAP only collects egocentric network data, so I cannot consider broader family structures beyond personal networks. Third, because I only use two waves for analysis, there are limitations when making arguments about any possible "feedback loops."

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Table 1. Weighted Descriptive Statistics: NSHAP, 2005-2006 and 2010-2011 (N=1,658).

	Wave 1			Wave 2			Sig. difference
Variables	% or Mean	SD	Range	% or Mean	SD	Range	
Health Outcome							
Disabled	26.9			32.6			**
Depressed[1]	17.3			17.3			
Network structure							
Network size	4.802	(.051)	2 to 14	4.907	(.051)	2 to 14	**
Number living with ego	1.017	(.030)	0 to 11	0.964	(.030)	0 to 9	
Proportion female	0.603	(.007)	0 to 1	0.600	(.007)	0 to 1	
Number of close ties	3.688	(.044)	0 to 7	3.638	(.044)	0 to 7	
Density	0.831	(.008)	0 to 1	0.824	(.008)	0 to 1	
Frequency of contact with alters (hundred contact-days per year)	8.611	(.119)	0 to 22	8.596	(.119)	0 to 26	
Social Support and Strain							
Perceived support	5.449	(.050)	0 to 8	5.474	(.050)	0 to 8	
Perceived strain	0.929	(.034)	0 to 8	0.659	(.034)	0 to 8	***
Demographic and Control Variables (only W1)							
Age	66.826	(.229)	57 to 85				
Female	53.7						
Ethnicity							
White	82.2						
Black	9.8						
Hispanic	5.3						
Other	2.7						
College or higher	56.5						
Cohabiting	68.5						
Worked for pay last week	38.6						
Frequency of religious service attendance[2]	3.552	(.052)	0 to 6				

Note: Unweighted N = 1,658. All statistics are survey design adjusted and weighted to account for the probability of selection, with poststratification adjustments for nonresponse. Two-tailed t-tests were conducted to examine the mean differences between 2006 (wave 1) and 2010 (wave 2) measures.

[1] Depressed = CES-D score of 9+.

[2] Responses were 0=never, 1=less than once a year, 2=about once or twice a year, 3=several times a year, 4=about once a month, 5=every week, and 6=several times a week.

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

Table 2. Weighted Odds Ratios of Wave 1 Variables Predicting Wave 2 Disability and Depression from Residual Change Score Models: NSHAP, 2005-2006 and 2010-2011 (N=1,658).

	Disabled (W2)			Depressed (W2)		
Independent Variables from Wave 1	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Disabled (W1)			8.184 ***			
Depressed (W1)			(1.244)			5.584 ***
Network structure						(1.294)
Network size	1.028	0.989	1.034	1.087	1.041	1.006
	(.056)	(.060)	(.074)	(.093)	(.086)	(.075)
Number living with ego	0.868 *	1.004	0.958	0.887	1.008	1.040
	(.058)	(.078)	(.077)	(.078)	(.087)	(.090)
Proportion female	1.166	0.831	1.108	1.779	0.952	0.903
	(.345)	(.229)	(.351)	(.591)	(.311)	(.330)
Number of close ties	1.034	1.039	1.041	0.959	0.984	1.038
	(.049)	(.057)	(.069)	(.067)	(.065)	(.068)
Density	1.002	0.891	0.732	1.075	0.883	0.841
	(.290)	(.236)	(.222)	(.395)	(.319)	(.346)
Frequency of contact with alters (hundred contact-days per year)	1.022	1.024	1.007	0.988	0.988	0.990
	(.018)	(.021)	(.024)	(.024)	(.025)	(.026)
Social Support and Strain						
Perceived support	0.933 *	0.946	0.963	0.824 ***	0.797 ***	0.823 ***
	(.030)	(.033)	(.040)	(.031)	(.031)	(.037)
Perceived strain	1.138 *	1.196 **	1.137	1.234 ***	1.220 ***	1.151 *
	(.066)	(.076)	(.084)	(.062)	(.060)	(.066)
Demographic and Control Variables						
Age		1.046 ***	1.046 ***		0.993	0.995
		(.010)	(.011)		(.015)	(.013)
Female		1.179	1.041		1.481 *	1.429
		(.134)	(.148)		(.289)	(.318)
Ethnicity (ref. = white)						
Black		1.308	1.292		1.031	0.890

		(.231)		(.253)			(.228)		(.214)			
Hispanic		0.692		0.537	*		1.086		1.002			
		(.186)		(.134)			(.301)		(.325)			
Other		0.391	*	0.368			1.055		1.305			
		(.182)		(.208)			(.505)		(.517)			
College or higher		0.699	**	0.904			0.522	***	0.565	**		
		(.077)		(.114)			(.086)		(.098)			
Cohabiting		0.874		0.989			0.664		0.680			
		(.152)		(.186)			(.141)		(.169)			
Worked for pay last week		0.571	***	0.682			0.510	***	0.548	***		
		(.095)		(.131)			(.080)		(.088)			
Frequency of religious service attendance		0.964		0.984			0.955		0.981			
		(.025)		(.029)			(.045)		(.048)			
Intercept	0.416	0.042	***	0.015	***	0.301	*	2.053		0.876		
	(.194)	(.036)		(.014)		(.162)		(2.170)		(.880)		
Likelihood Ratio	2.12	6.94		14.45		5.24		6.61		11.42		

Note: Unweighted N = 1,658. The model estimates survey design adjusted and weighted to account for the probability of selection, with poststratification adjustments for nonresponse. Standard errors are for log odds.

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

Table 3. Weighted Regression Coefficients of Wave 1 Variables Predicting Wave 2 Perceived Social Support and Strain from Residual Change Score Models: NSHAP, 2005-2006 and 2010-2011 (N=1,658).

	Perceived Social Support (W2)			Perceived Social Strain (W2)		
Independent Variables from Wave 1	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Perceived support (W1)			0.328 ***			
			(.031)			
Perceived strain (W1)						0.307 ***
						(.028)
Health Outcome - Disability and Depression						
Disabled	-0.149	-0.158	-0.125	0.108	0.092	0.023
	(.122)	(.118)	(.123)	(.082)	(.086)	(.075)
Depressed	-0.496 ***	-0.461 ***	-0.274 *	0.300 **	0.270 **	0.182 *
	(.129)	(.123)	(.126)	(.090)	(.094)	(.072)
Network structure						
Network size	0.073	0.011	0.0002	0.047	0.032	0.029
	(.046)	(.046)	(.041)	(.028)	(.028)	(.025)
Number living with ego	-0.158 **	-0.045	-0.041	-0.019	0.003	-0.009
	(.056)	(.063)	(.057)	(.033)	(.033)	(.030)
Proportion female	0.391	-0.158	-0.133	0.302 *	0.068	0.042
	(.208)	(.225)	(.200)	(.117)	(.119)	(.121)
Number of close ties	0.242 ***	0.217 ***	0.106 *	-0.074 **	-0.059 *	-0.033
	(.057)	(.054)	(.045)	(.024)	(.024)	(.022)
Density	-0.178	-0.116	-0.108	-0.059	-0.040	-0.020
	(.230)	(.239)	(.230)	(.126)	(.121)	(.116)
Frequency of contact with alters (hundred contact-days per year)	0.042 **	0.039 **	0.034 ***	0.008	0.006	-0.005
	(.014)	(.012)	(.010)	(.009)	(.009)	(.009)
Demographic and Control Variables						
Age		-0.025 ***	-0.010		-0.007	-0.001
		(.006)	(.006)		(.005)	(.005)
Female		0.689 ***	0.497 ***		0.123	0.093
		(.098)	(.103)		(.067)	(.062)

Ethnicity (ref. = white)												
Black			-0.705	***	-0.607	***			0.345	**	0.277	**
			(.178)		(.168)				(.126)		(.110)	
Hispanic			-0.955	***	-0.755	***			0.291	*	0.267	*
			(.230)		(.217)				(.132)		(.123)	
Other			-0.939	***	-0.718	**			0.446		0.251	
			(.278)		(.258)				(.340)		(.277)	
College or higher			-0.106		-0.056				0.020		0.007	
			(.089)		(.078)				(.077)		(.080)	
Cohabiting			-0.232	*	-0.112				-0.204	*	-0.103	
			(.105)		(.095)				(.085)		(.078)	
Worked for pay last week			0.058		-0.119				0.030		0.002	
			(.108)		(.106)				(.074)		(.069)	
Frequency of religious service attendance			0.066	**	0.045	*			0.002		-0.005	
			(.022)		(.022)				(.012)		(.013)	
Intercept	4.064	***	6.054	***	3.723	***	0.447	*	1.036	*	0.425	
	(.291)		(.481)		(.443)		(.201)		(.423)		(.444)	
R^2	0.1039		0.1679		0.2536		0.0273		0.0573		0.1691	

Note: Unweighted N = 1,658. The model estimates survey design adjusted and weighted to account for the probability of selection, with poststratification adjustments for nonresponse.

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

Table 4. Weighted Regression Coefficients of Wave 1 Variables Predicting Wave 2 Network Structure from Residual Change Score Models: NSHAP, 2005-2006 and 2010-2011 (N=1,658).

Independent Variables from Wave 1	Network size (W2)	Number living with ego (W2)	Proportion female (W2)	Number of close ties (W2)	Density (W2)	Frequency of contact with alters (W2)
Network structure (W1)						
Network size	0.275 ***					
	(.034)					
Number living with ego		0.451 ***				
		(.047)				
Proportion female			0.469 ***			
			(.024)			
Number of close ties				0.334 ***		
				(.032)		
Density					0.272 ***	
					(.037)	
Frequency of contact with alters (hundred contact-days per year)						0.450 ***
						(.025)
Health Outcome - Disability and Depression						
Disabled	0.264 ***	0.118 **	-0.010	0.041	-0.016	0.116
	(.076)	(.042)	(.013)	(.072)	(.013)	(.183)
Depressed	-0.134	0.025	0.012	-0.235	0.001	-0.594 *
	(.120)	(.049)	(.015)	(.125)	(.017)	(.265)
Social Support and Strain						
Perceived support	0.066 *	-0.017	0.004	0.102 ***	0.002	0.028
	(.025)	(.009)	(.003)	(.025)	(.003)	(.054)
Perceived strain	0.030	0.010	0.005	-0.024	-0.004	0.209 *
	(.037)	(.019)	(.004)	(.033)	(.004)	(.086)
Demographic and Control Variables						
Age	-0.006	-0.011 ***	0.00003	-0.006	-0.002	0.0008

	(.005)		(.003)		(.001)		(.005)		(.001)		(.016)	
Female	0.114		-0.129	**	0.086	***	0.308	***	-0.038	**	0.276	
	(.065)		(.041)		(.012)		(.082)		(.012)		(.196)	
Ethnicity (ref. = white)												
Black	-0.125		0.147		0.019		-0.111		0.062	**	0.371	
	(.128)		(.080)		(.013)		(.161)		(.020)		(.336)	
Hispanic	0.397		0.373	**	-0.024		0.267	*	0.033		1.309	**
	(.209)		(.114)		(.020)		(.128)		(.022)		(.490)	
Other	0.081		0.294		-0.035		-0.154		0.050		0.918	
	(.229)		(.158)		(.043)		(.275)		(.030)		(.705)	
College or higher	0.111		-0.077		0.020		0.076		-0.045	**	-0.487	**
	(.084)		(.047)		(.011)		(.066)		(.014)		(.181)	
Cohabiting	0.019		0.186	**	-0.043	***	0.153		0.058	***	0.248	
	(.085)		(.065)		(.012)		(.090)		(.014)		(.188)	
Worked for pay last week	0.184		0.035		-0.010		-0.069		-0.026	*	0.026	
	(.104)		(.042)		(.012)		(.089)		(.011)		(.225)	
Frequency of religious service attendance	0.006		-0.003		0.0001		0.030		0.003		0.085	
	(.023)		(.012)		(.003)		(.023)		(.003)		(.048)	
Intercept	3.299	***	1.257	***	0.265	***	1.927	***	0.715	***	3.911	**
	(.464)		(.230)		(.064)		(.441)		(.085)		(1.170)	
R^2	0.1107		0.3083		0.3540		0.2103		0.1504		0.2561	

Note: Unweighted N = 1,658. The model estimates survey design adjusted and weighted to account for the probability of selection, with poststratification adjustments for nonresponse.
*p<.05, **p<.01, ***p<.001 (two-tailed tests).