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*J Women Aging*. ; : 1–29. doi:10.1080/08952841.2019.1608138.**A Descriptive Pilot Study of Structural and Functional Health-related Social Network Ties among Women in the Women's Health Initiative (WHI) Study****Crystal W. Cené, MD, MPH<sup>1</sup>, Leah Frerichs, PhD<sup>2</sup>, Joshua K Evans, BA<sup>3</sup>, Candyce H. Kroenke, ScD, MPH<sup>4</sup>, Peggye Dilworth-Anderson, PhD<sup>2</sup>, Giselle Corbie-Smith, MD, MS<sup>1,5</sup>, Beverly Snively, PhD<sup>6</sup>, Michelle J. Naughton, PhD<sup>7</sup>, Sally Shumaker, PhD<sup>8</sup>**<sup>1</sup>UNC School of Medicine, Department of Medicine<sup>2</sup>Gillings School of Global Public Health, Department of Health Policy and Management<sup>3</sup>Wake Forest University School of Medicine<sup>4</sup>Kaiser Permanente Division of Research<sup>5</sup>UNC School of Medicine, Department of Social Medicine<sup>6</sup>Wake Forest University School of Medicine, Department of Biostatistical Sciences<sup>7</sup>Ohio State University College of Medicine, Department of Internal Medicine<sup>8</sup>Wake Forest University School of Medicine, Social Sciences and Health Policy**Abstract**

Few studies examine network structure and function of older women's health discussion networks. We sought to assess the feasibility and acceptability of collecting social network data via telephone from 72 women from the Women's Health Initiative study, and to describe structural and functional characteristics. Women were socially connected and had dense networks. Women were emotionally close to network members but their networks were not used to facilitate communication with health care providers. One-third of network members were not influential on health-related decision-making. Collecting social network data via telephone is feasible and an acceptable, though un-preferred, mode of data collection.

**Keywords**

Social networks; older women; health communication

**INTRODUCTION**

Women make up over half of the Medicare population, and they are more likely than men to suffer from multiple chronic conditions (Foundation, May 16, 2013). [Over the past two decades, there has been a rise in mortality rates among women (Arias, 2016) which is

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largely due to disparities in social determinants of health.] Social relationships positively and negatively affect women's health and well-being (Kim & McKenry, 1998; Krause, 2006; Seeman, 1996). Social networks, defined as the existence of relationship ties between individuals, are especially important for older adults' health and well-being (Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004; L. F. Berkman, 1995; Blazer, 1982; Cassel, 1976; J. S. House, Robbins, & Metzner, 1982; Seeman, Kaplan, Knudsen, Cohen, & Guralnik, 1987). The structure of one's social network (e.g., size, diversity) has implications for the types of resources (e.g., social support) that are available through social network ties, which in turn influences older women's health and well-being (E. Y. Cornwell & Waite, 2009; H. Litwin & Shiovitz-Ezra, 2011; Howard Litwin, Stoeckel, & Schwartz, 2015). Therefore, it is important to characterize fully the structure of older women's social networks.

The contribution of social network characteristics to health behaviors and outcomes among older adults is important, yet understudied (B. Cornwell, 2009; Rook, 2015), in part because few studies collect both structural network data and health outcome data (L. F. Berkman & Syme, 1979; B. Cornwell, Schumm, Laumann, & Graber, 2009). This gap is critical as the population ages, becomes more racially diverse, and networks change due to age-related life-course changes (e.g., retirement, illness, bereavement). Previous epidemiological studies on social networks and health have important limitations. Many use single indicators (e.g., marital status or living arrangement) or summary measures to assess social ties (Johnston, Jones, & Hernandez, 2016; Kawachi et al., 1996; Orth-Gomer & Johnson, 1987; Schoenbach, Kaplan, Fredman, & Kleinbaum, 1986). These are relatively crude, indicate only one or two types of social connections, and do not capture a broader range of social connections or connections that exist *among* individuals within one's network. Moreover, many studies conflate *structural* and *functional* aspects of social network ties e.g., social support, a resource available through social network ties) (Cohen, Underwood, & Gottlieb, 2000). Much of the research on social relationships and health of older adults has focused on the *quality* of older adults kin relationships, emphasizing the protective effects of positive family relationships and the adverse effects of negative or ambivalent family relationships (Kiecolt-Glaser, Gouin, & Hantsoo, 2010; Liu & Waite, 2014; Rook, 2015; Uchino et al., 2015), with less attention given to how the *structure* of older adults' networks shape their health. [Yet, network structure may vary by race/ethnicity, gender, and other contextual factors.]

In particular, examining health discussion networks, a specific type of social network, is important for understanding the role social relationships play in older adults' ability to prevent, cope with, and recover from illness (Perry & Pescosolido, 2015; Pescosolido, 1992). Health discussion networks provide advice, information, emotional support, positive affirmation, and can influence how individuals interpret and respond to health challenges (Abbott, Bettger, Hanlon, & Hirschman, 2012). Structural (e.g. size, educational level) and cultural aspects of one's network provide a context for which network ties are purposefully activated. [Who individuals choose to discuss health-related needs with is also influenced by socio-cultural norms. Some studies have documented racial differences in health discussion networks. (Ramanadhan, Nagler, McCloud, Kohler, & Viswanath, 2017) (Abbott et al., 2012), while others have not (Perry & Pescosolido, 2015).]The functional specificity

hypothesis (Cantor, 1979; Penning, 1990) suggests that an individual will discuss health issues with select individuals from within their broader social network who they believe will be most sympathetic, helpful, or knowledgeable about the particular health issue they are facing at that time. As individuals age, accumulate more health problems, and their social networks change, understanding who they chose to discuss health-related matters with and how activation of those ties influences health behaviors and health related decision-making is important.

To understand how the structure and function of social relationships [(i.e., the ties between individual study participants and those named as people they discuss health related matters with)] influence health of older women [(ages 65-90)], a critical “first step” involves collecting such data in this population. Egocentric network analysis provides one approach to collecting such data. In this approach, information is collected from an “ego” (the person being interviewed) on a subset of the individuals within one’s personal network (i.e., “alters”). To generate the sample, researchers ask broad *name generator* questions, such as “name 5 people with whom you discuss health-related matters,” often followed by a series of *name interpreter* questions. The name interpreter questions provide descriptive information on sociodemographic (e.g., gender, education) or evaluative (e.g., how much do you trust health information from this person) characteristics.

Collecting egocentric network data is potentially burdensome and time-consuming for the interviewer and respondent (Eddens, Fagan, & Collins, 2017). Most network data is collected via an interviewer-administered network survey completed face-to-face (B. Cornwell et al., 2009), via a mailed survey, or using computer-assisted interviewing. These methods have the advantage of allowing respondents to view the questions as they are answering them and take their time in responding; thereby, decreasing the information processing burden. On the contrary, collecting egocentric network via telephone is likely more time and cost efficient, but may be more challenging, particularly for older adults. The cognitive load of answering questions about *each* alter and relationships between alters is high without viewing a written document to facilitate memory and attention. Each named alter results in a linear increase in the number of additional questions asked. Thus there is a pressing need to assess feasibility and acceptability of conducting egocentric network studies and to describe the social networks of older adult populations. The Women’s Health Initiative (WHI) study provides a rich resource to collect social network data and link it to the wealth of behavioral and health outcome data available from this prospective cohort. However, given that social network data is not routinely collected within the WHI, there was a need to assess the feasibility of collecting such data. The aims of this pilot study were to: 1) assess the feasibility of recruiting older WHI women to the study via a mailed recruitment strategy; 2) document the feasibility and acceptability of collecting social network data via telephone from a subsample of participants in WHI; and 3) describe structural and health-related functional characteristics of the women’s social networks to provide estimates of variability to inform future studies. [The observational study was not designed to address disparities; however, we do present our results stratified by race/ethnicity.]

## RESEARCH DESIGN

### Study Design:

This pilot ancillary study to the Women's Health Initiative (WHI) was conducted using a randomly selected cross-sectional sample of WHI participants. Details of the WHI study design, recruitment strategies, data collection methods and baseline data have been described previously (Anderson et al., 2003; Langer et al., 2003; Ritenbaugh et al., 2003; Stefanick et al., 2003). Briefly, the WHI enrolled 161,809 postmenopausal women aged 50-79 years from 1993 to 1998 at 40 clinical centers across the US. Participants were enrolled into the WHI Observational Study (OS) or one or more of the WHI randomized clinical trials (RCTs) (i.e., the Hormone Therapy Trials, the Dietary Modification Trial, and the Calcium and Vitamin D Trial). This resulted in a diverse population of postmenopausal women with 18% from underrepresented racial and ethnic groups. Participants were followed at least annually for information on vital status and medical outcomes through study closeout (October 2004-March 2005). After closeout, all participants were invited to enroll in two Extension Studies to continue to track their health status. Participants that provided consent are followed annually.

### Sample:

Our analytic sample included women from the WHI Southeast Regional Center (SE-RC) who were originally enrolled in one of the WHI RCTs or in the OS cohort and provided informed consent to participate in the 2<sup>nd</sup> WHI Extension Study (2010-2015) (Espeland et al., 2013).

### Data collection procedures:

This study was conducted from July 2013- April 2014. A study biostatistician drew a random sample of 151 non-Hispanic White, 151 African American (AA), and 151 Hispanic/Latino participants from the SE-RC. We mailed an introductory letter informing women about the study, a postcard for them to return to the SE-RC, and a written informed consent form. We asked them to return the postcard as well a signed informed consent form if they were interested in participating. Written consent was a requirement of the Institutional Review Board. If a woman returned the postcard indicating interest in participating, but did not return the signed consent document, the study team called her to remind her to return the signed consent form and sent her an additional form, if necessary.

One WHI staff member from the SE-RC interviewed consented participants via telephone. During the interview, we asked questions to assess social network characteristics, psychosocial, behavioral, and other health status characteristics. We collected data on paper forms and entered it into a dataset using WHI common identifiers. The Wake Forest University School of Medicine Institutional Review Board approved all study procedures. As is customary with routine follow-up data collection within the WHI, the women did not receive a monetary incentive for study participation.

**Identification of social networks.**—We used an egocentric social network approach to data collection. To collect network data, we asked respondents (egos) to list a set of relevant

individuals (alters) and the connections between them (Laumann, Marsden, & Prensky, 1983; Marsden, 1990) with whom they discussed “important health-related matters” over the last 12 months. The “important matters” item is a well-established name generator for network studies in sociology (Marin, 2004). It elicits names of important, frequently accessed, confidantes. When necessary, the interviewer prompted respondents using the statement, “this could be a person you talk to about your medical problems.” Respondents could name up to seven alters, based on guidance from previous literature (Burt, 1984). Following enumeration of alters, we collected information from the ego about each alter, as outlined below.

## Measures

**Feasibility and acceptability:** We evaluated several indicators of study conduct, including: feasibility of recruitment via mail and the resultant recruitment yields; acceptability (from the respondents’ and the interviewer’s perspectives) of survey completion via telephone; and respondents’ interest in the subject matter (see Table 1).

**Ego and alter socio-demographic characteristics.**—We collected the following information from egos about themselves: highest education level; race/ethnicity; marital status; living arrangement; employment status; and general self-rated health (using single item question) (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Kaplan, Barell, & Lusky, 1988). We asked each ego to report the following about each named alter: relationship to the ego (e.g., relative, friend), gender, age, race/ethnicity, and education level.

In the sub-sections below, we define the structural social network indicators (network size, network density, bridging potential) and indicators of the ego-alter relationship (i.e., longevity, frequency of contact, emotional closeness).

### Structural network indicators

**Social network size.**—Defined as the number of individuals with whom the ego reports discussing “important health related matters.” Network size is a fundamental structural network indicator. All else being equal, individuals with larger social networks have greater access to social resources (B. Cornwell et al., 2009).

**Network density.**—Defined as the proportion of all possible pairs among alters in which the two individuals at least know each other (i.e., are not strangers) and the proportion that know each other and are “very close,” based on the categorization used in the General Social Survey (GSS). (Burt, 1984) High-density networks constitute close-knit social contexts in which alters share and compare information, coordinate caregiving duties, and pool resources. Therefore, high network density is associated with more reliable and more frequent activation of informal support (Haines, Hurlbert, & Beggs, 1996; Hurlbert, Haines, & Beggs, 2000).

**Bridging potential.**—Bridging is a measure of social network structure that refers to a lack of connectivity among network members. In general, an ego occupies a bridging position when two alters have direct ties to ego, but are not directly connected to each other

(B. Cornwell et al., 2009). For this study, bridging potential is defined as a dichotomous indicator based on whether an ego had at least one alter who had “never spoken” to any other alters (B. Cornwell et al., 2009). Bridging is rarely considered in the context of health research (B. Cornwell, 2009; Goldman, 2016; Li & Zhang, 2015). Serving as a bridge can be useful to individuals for a variety of reasons. It increases access to separate pools of information and resources (Granovetter, 1973) which is valuable when seeking advice from numerous sources. In addition, individuals who occupy bridging positions can gain power from mediating the exchange and transfer of resources and information between unconnected parties (Burt, 1992). Alternatively, it can also be associated with poorer health for the person serving as a bridge by decreasing their access to social support or increasing their level of social strain (Goldman, 2016).

### Ego-alter relationship indicators

**Longevity of the relationship.**—Defined based on how long the ego and alter have known one another (< 3 years, 3-6 years, or > 6 years), using the same categories as in the GSS (Laumann et al., 1983).

**Living distance from one another.**—Response options included ‘we live together’, ‘within walking distance’, ‘short drive or bus trip’, ‘or longer journey (> 1 hr)’.

**Frequency of contact.**—Response options included daily, weekly, monthly, or less often, based on the categorization used in the GSS (Burt, 1984). Volume of contact with alters is important because it reflects the potential for alters to influence health and health-related decision-making.

**Emotional closeness.**—Response options included ‘not very close’, ‘close’, or ‘very close’. Subjective, emotional quality of relationships has been linked to well-being (Antonucci & Akiyama, 1987).

**Health-related network support.**—We queried egos to assess their perception of the health-related support received from each alter. We assessed the likelihood that the ego would talk to her alters about important health-related decisions (‘very likely’, ‘somewhat likely’, ‘not likely’); how much each alter facilitates the ego’s understanding of medical information (‘not at all’, ‘a little’, ‘somewhat’, ‘quite a bit’, ‘a lot’); how influential each alter is on health-related decision-making (‘very influential’, ‘somewhat influential’, ‘not at all influential’); and how much each alter helps communicate questions or concerns to the ego’s health care providers (‘not at all’, ‘a little’, ‘somewhat’, ‘quite a bit’, ‘a lot’).

### Data Analysis

We analyzed the survey data using SAS 9.4 (SAS Institute, Cary, NC). Descriptive statistics were calculated for the derived social network and social support variables in Tables 1-4. Given the pilot nature of this study we did not compute multivariate statistics or conduct hypothesis testing.

## RESULTS

### Feasibility of Recruitment by Mail

We mailed introductory letters about the study to 423 women and asked them to participate in a one-time telephone survey about their social networks. After two mailings to potential participants, only 21.9% (94) of those who received a letter consented to be in the study; 5% (20) were not interested; and we did not receive a response from 73% (315) of the women. Of those who returned the informed consent letter indicating their interest in study participation, 76.6% (72) completed the telephone interview (37 White, 20 Hispanic, 15 Black). There was a statistically significant difference between women who consented to the study and those who did not by race/ethnicity (African Americans and Hispanics were less likely to respond to the mailed requests for study participation;  $p=0.02$ ). Differences in educational level at WHI enrollment (college graduates more likely;  $p=0.06$ ) and employment (employed more likely;  $p=0.06$ ) were marginally significant.

### Acceptability

The average (SD) amount of time it took to complete the interview was 48.5 (SD=14.8) minutes, with the range being from 32-118 minutes. The majority of women reported no difficulty understanding the structure and format of the network questions and were comfortable answering questions about their social relationships. Ninety-seven percent of the women said they would participate in a similar study if asked again. The majority (69%) said that they would prefer data collection face-to-face, if possible, while nearly 20% said they would prefer online data collection. There were no differences in acceptability of the survey and its items by race/ethnicity. The interviewers' perspectives on acceptability are reported in the discussion section.

### Characteristics of Egos and Alters

Table 2 describes the sociodemographic and self-rated health characteristics of the 72 egos and 402 alters identified by study participants. The mean age of egos was 76 years. Fifty one percent of the egos were white and 54% were currently married. About one third of egos lived alone and self-rated health of 93% of egos was at least "good." Alters were, on average, noted to be younger (mean age 64 years), female (71%), with greater diversity in their level of educational attainment and employment status.

### Social Networks

A description of and results for all study measures for the overall sample and stratified by race and educational level is outlined in Table 3.

**Network Size:** The mean network size of our study participants was 5.6. None of the participants were socially isolated [defined as reporting fewer than two alters (McPherson, Smith-Lovin, & Brashears, 2006)]; 87.5% reported at least five alters. Alters were fairly similar to egos in both gender (an average of 71% of ego's alters were female) and race/ethnicity (an average of 82% of alters were identified as being of the same group as the ego). In terms of network composition, on average, 46% of identified alters were noted as family

members (i.e., family-centered network) and 43% of alters were identified as friends across all respondents.

**Social connectedness:** On average, 96% of the network connections between egos and alters have existed for >6 years and egos reported at least “weekly” contact with 84% of alters. About 70% of egos reported that they lived within a short distance of their alters. The average density of alters who were not strangers to one another was 0.69, reflecting a moderately dense network in which the majority of possible ties are present. Network density of “very close” ties was lower, 0.47. [Network density by both measures is higher among African Americans versus White and Hispanic women.] Bridging potential was low; only 11% of egos had at least one alter who was not connected to any other alters in their network.

**Health-related network support:** Egos indicated that they were very likely to talk with over half (58.9%) of alters when they needed to make health-related decisions. About one-fifth (19.1%) of alters were reported to facilitate egos’ understanding of medical information ‘a lot’ and about 10% were reported to be at least “somewhat” helpful in communicating with medical providers about questions or concerns. [For each of these indicators, except for how much the alter helps communicate questions for concerns to the ego’s health care providers, our results suggest that African American women rely on a larger proportion of their networks for these types of health-related supports than White or Hispanic women.]

Table 4 describes the perceived influence of alters in egos’ health-related decision-making, broken down by alter characteristics. Overall, egos reported under half (37%) of all identified network members as being “very influential” in decisions about health or medical care. Not surprisingly, spouses and other family members and alters with whom the ego co-resided were deemed as being “very influential,” on decision-making, as were alters with whom the ego had more frequent ( weekly) contact. Interestingly, almost one-quarter (24%) of alters that the egos rated as being “very close” were not considered influential in the ego’s decision making.

## DISCUSSION

The purpose of this pilot study was to evaluate a mailed recruitment strategy, the acceptability and feasibility of completing a social network survey by telephone, and to describe structural and health-related functional characteristics of women’s health discussion networks to provide estimates of variability to inform future large-scale studies.

In this subsample of WHI participants, using a mailed recruitment strategy is ineffective at recruiting high numbers of women to participate in the study. Even with repeat mailings and follow-up phone calls, participants were unlikely to respond to the study invitation. This is likely multifactorial- with the aging nature of the sample, as well as “research fatigue” as contributing factors. There have and continue to be an abundance of research opportunities offered to women enrolled in the WHI. At the time of recruitment to this pilot study, the participants had been in WHI for 20+ years, and many were likely being simultaneously recruited for other ancillary studies. Fatigue in being asked to participate in another study



may have been a factor in the poor recruitment yield. However, part of the poor response rate was likely due to the multi-step recruitment process. IRB restrictions required women to return both a postcard indicating willingness to participate and a signed informed consent document. This may have confused the women. Some women returned the postcard, but not the informed consent form, which necessitated a call to the women to remind them to sign and return the consent document. There were approximately 15 women who returned the postcard expressing interest in participating, and would have completed the interview during the reminder phone call to return their written informed consent document, but we were not permitted to interview them until after the written consent document was received. Unfortunately, these women never returned their signed consent forms and therefore were not included in the study. Verbal informed consent was not permissible by the IRB at the time this study was conducted. In addition, the study interviewer did call participants who did not respond to initial mailings to invite them to participate in the study. Approximately 10 of these women were willing to participate in the study at the time of the phone call, but refused after being notified of the need to wait for another study packet to arrive in the mail and for the study team to receive their signed consent document. The requirements of our IRB process highlights a concern raised by others; namely, that ethical governance requirements often stifle low-risk population-based, epidemiological, social service, public health, and health services research (Riden et al., 2012; van Teijlingen, Douglas, & Torrance, 2008). Our study was non-invasive and low risk. Having an option to obtain verbal telephone consent, which could be recorded, likely would enhance recruitment, require fewer contacts with the participants, and make it easier to complete interviews.

Regarding the feasibility and acceptability of completing the survey, our study findings demonstrated that collecting social network data via telephone interview is feasible. Despite the time required to complete the interview (48 minutes, on average), a high percentage of women found the structure and content of the questions easily understandable. The interviewer noted that the women had very little to no difficulty following the line of questioning or the instructions (even without having a copy of the survey in front of them), and the vast majority of participants communicated understandably and appropriately. The few women who did express discomfort with the questions had concerns mostly related to providing names of individuals in their network. Once told that providing a first name or nickname was sufficient, they were comfortable enough to continue the interview. Importantly, the majority of women reported that they would participate in a similar study in the future.

Many participants expressed that they would have preferred to complete the interview face-to-face if given a choice. This is noteworthy given that face-to-face contact with an interviewer may be particularly important in this age group for building trust, thus aiding survey comprehension. However, we can only speculate as to whether our study response rate would have been better by offering face-to-face interviewing. Our study sample was recruited from the WHI Southeast Regional Center, with women participating in this study from Texas to North Carolina. It was not feasible to complete face-to-face interviews in this pilot study. Indeed, that was the instigation for this pilot study to determine whether older women would be willing to be interviewed by telephone on this topic.

While other studies with large sample sizes, including the GSS (B. Cornwell et al., 2009; Erosheva, Kim, Emlet, & Fredriksen-Goldsen, 2016; Harris KM, 2009; T. W. Smith, Marsden, Michael Hout, and Jibum Kim.) have collected social network data, collection of this type of data is generally limited in part due to the absence of standardized approaches and perceived burden of collecting such data. Network studies derived from the Framingham data set used archived data from administrative tracking sheets to ascertain the network, as opposed to asking respondents directly to identify their network members and specify how those network members influence their behaviors (Christakis & Fowler, 2007, 2008). Our findings demonstrate that collection of these types of detailed network data via telephone is acceptable to some older women.

### Network size

This pilot study, albeit small, provides information that can be compared with other studies of social networks of older adults, in particular the National Social Life, Health and Aging Project (NSAHP). NSAHP is a nationally representative sample of about 3000 community dwelling adults between the ages of 57 and 85 that included a social network assessment, collected via in-home interviews (L. F. Berkman & Syme, 1979). Findings from studies that oversampled adults over 60 years of age suggests that the networks of older adults- particularly women- tend to be smaller, denser, more kin-centered networks, with less frequent contact with network members (Ajrouch, Blandon, & Antonucci, 2005; B. Cornwell et al., 2009). The average network size of women in our sample (5.6) was higher than the average weighted network size in NSAHP (3.48)(B. Cornwell et al., 2009) and other nationally representative surveys, where the average network size is around 2.0 (Brashears, 2011; K. N. Hampton, Sessions, & Her, 2011; McPherson et al., 2006). One possible explanation for this is because NSAHP (B. Cornwell et al., 2009) and other nationally representative studies (Brashears, 2011; K. N. Hampton et al., 2011; McPherson et al., 2006) allowed respondents to name up to 5 or 6 individuals but it is unclear whether they prompted them if they named fewer, whereas we allowed respondents to name up to 7 individuals and we prompted them if they named fewer. Another possibility is that women in our sample (particularly given their mean educational level) may be utilizing technologies, such as internet, cell phones, and social media, more than women in population-based samples. Some studies have shown that information technology is *positively* associated with network size and interaction (K. Hampton, Sessions, Her, & Rainie, 2009; K. N. Hampton et al., 2011; Wang & Wellman, 2010). WHI is currently collecting information on participants use of technology; therefore, this hypothesis could be evaluated in future social network studies in WHI.

### Network composition

The networks of women in our sample were less family-focused (46%) than women in NSHAP (66%). Other studies have demonstrated that older adults' networks tend to be more family-focused (Li & Zhang, 2015). There are at least two possible reasons for this difference. The NSHAP assessed several types of network members, including individuals in the respondents "core discussion network"; individuals' spouse or partner (if not included in the core discussion network); other close network members; and any household members not previously listed; therefore, they were more likely to identify family members in the

network. In addition, NSHAP did not focus specifically on “health discussion” network members, which may be more specific and yield different named alters than focusing on individuals in one’s “core discussion” network. Moreover, sample differences may account for this difference. Our overall sample size is small and with a relatively small proportion of Hispanics. Previous work has shown that the network composition of Hispanics tends to be much more family focused than that of Non-Hispanic Whites and Blacks (B. Cornwell et al., 2009). Therefore, selection bias is possible. Interestingly, longitudinal studies have shown that family-focused, as opposed to more diverse networks, are associated with worse later health outcomes (e.g., lower cognitive function, psychological well-being, self-rated health, and overall health scores) (Li & Zhang, 2015) and friend-focused networks may have more beneficial health effects than family-focused networks (Fiori, Antonucci, & Cortina, 2006; Li & Zhang, 2015; H. Litwin, 2001).

Our participants reported frequent (at least “weekly”) contact with the majority of their alters, who also lived within a short distance of respondents. These findings are encouraging since other research has shown that having a large and diffuse network may be more helpful in problem solving than a small and family-based network (Burt, 2001). Other studies have found that individuals with larger networks tend to have better health (L. F. Berkman & Syme, 1979). Moreover, social isolation, or the relative lack of social network ties, is common in older adults, and is associated with increased risk for all-cause mortality (Eng, Rimm, Fitzmaurice, & Kawachi, 2002; Steptoe, Shankar, Demakakos, & Wardle, 2013), cancer mortality (Kroenke et al., 2013; Kroenke et al., 2016; Morris et al., 2006; Pinquart & Duberstein, 2010), incident cardiovascular disease (Barth, Schneider, & von Kanel, 2010), dementia (Fratiglioni, Paillard-Borg, & Winblad, 2004), increased re-admission risk (Mistry, Rosansky, McGuire, McDermott, & Jarvik, 2001), and increased fall risk (Faulkner, Cauley, Zmuda, Griffin, & Nevitt, 2003).

### **Network density**

The social networks of women in our sample was less dense than the NSHAP sample (B. Cornwell et al., 2009). This is not surprising given that the networks of our respondents were less family-focused. High network density is important because it reflects availability of social support (tangible and other forms of support) and contributes to well-being (Kadushin, 1982). Previous work has shown that individuals with high density networks garner more informal support from their networks than do individuals in less dense networks (Hurlbert et al., 2000). This social resource is particularly important as individuals age, their health declines, and their need for support increases. High network density and close emotional ties between egos and alters in our sample suggests that network-based health promotion interventions may offer promise for older women.

### **Network bridging potential**

About 11% of our participants in our sample occupied a bridging position. This percentage is somewhat lower than in NSHAP which reported that 16.2% of their participants had alters in their networks who were unconnected to one another. Our findings regarding bridging are interesting. On the one hand, it is understandable why so few respondents served as bridges. First, most of our respondents were retired. Retirement reduces bridging potential because it

results in a loss of the major social domain (i.e., co-workers in the workplace) besides one's family and friends (B. Cornwell, 2009). Because most coworkers are "weak ties" and unlikely to be connected to one's friends, family members, and other close contacts, the ego has greater potential to serve as a bridge. Related to this, when individuals stop working, they often invest more in their network of strong ties (e.g., family and friends) who likely will know one another, thereby reducing their bridging potential. In addition, our respondents reported frequent contact with the majority of their network members, which also reduces bridging potential by increasing the likelihood that separate alters will have inadvertent contact with each other (B. Cornwell, 2009). On the other hand, we might have expected a higher bridging potential since our sample was relatively healthy. Cornwell and colleagues found that good health and bridging potential are positively associated (B. Cornwell, 2009). They postulated several possible reasons for this. Healthier individuals are better *able* to function as bridges given that bridging positions are known to be stressful as the bridge must transmit high volumes of information between separate groups that may make conflicting or excessive demands. Bridging may result in greater burden and sense of obligation for the person functioning as the bridge (Goldman, 2016). There remains much to be learned about bridging, especially among older women (B. Cornwell, 2009). A longitudinal study such as WHI offers potential opportunities to understand these processes as they unfold over time.

### **Involvement of network members in health discussions**

We noted some interesting findings related to involvement of network members in health discussions. Similar to NSHAP, women in our sample were very likely to discuss health with the majority of alters, but especially when the alter was a spouse or other family member, who co-resided with the ego, and when the relationship with the alter was rated as "very close" (B. Cornwell et al., 2009). Engaging network members in health discussions affords women the opportunity to articulate their needs and to share and receive information and other health-promoting resources. Our findings acknowledge that such sharing, however, is not done "blindly," but occurs within the context of close ties.

Our findings raise interesting questions about the role of alters in furthering health literacy and health-related communication. Only about 20% of alters were reported to help a lot with understanding medical information (an indicator of health literacy) and only 10% were reported to help facilitate communication with medical providers. This may reflect that our sample was relatively well-educated and healthy and therefore may not *need* this type of support. Received support is often confounded by need (Cohen et al., 2000). Other research has shown that more vulnerable patients (e.g., less well educated, sicker) rely more on their social networks for help with medical-related tasks and decisions (Clayman, Roter, Wissow, & Bandeen-Roche, 2005; Wolff & Roter, 2008, 2011). Alternatively, it is possible that involvement of network members in health discussions and decision-making varies based on the topic under discussion. Our survey asked about the likelihood of having discussions with one's alters when the ego needs to make an important decision about her health or medical care *in general*. However, discussion with networks members may occur more when the discussion relates to specific needs, such as the alter serving as a proxy decision-maker, as in

the case of discussions related to advance care planning (Carr & Khodyakov, 2007; B. Cornwell et al., 2009; Hopp, 2000).

Our study has several limitations. First, our sample was small. However, there is no “gold standard” for an appropriate sample size for pilot studies (Hertzog, 2008) and it is not uncommon to have small samples when assessing feasibility. Moreover, the design and rationale for our pilot study is consistent with “best practices” for pilot studies (Bowen et al., 2009; Moore, Carter, Nietert, & Stewart, 2011). Our findings are not generalizable to the larger sample of women in the WHI or women in the US population in general, given our small and convenience sample of women from the southeast region of the country participating in a research study. Moreover, our low response rate raises concerns about non-response or selection bias. There were differences between women who consented and those who did not participate in the study. However, the fact that many of our findings are similar to those of the NSHAP and other larger social network studies is encouraging. Moreover, some nationally representative samples assessing social networks have also yielded even lower response rates of 21 and 7%, respectively (Brashears, 2011; K. N. Hampton et al., 2011). Second, the sample size precluded us from conducting multivariable analyses. Thus, our analyses are descriptive and do not account for potential confounders. Third, our study was cross-sectional. Eliciting social network data over time makes it possible to distinguish social selection from social causation mechanisms and to assess mediation (K. P. Smith & Christakis, 2008). Finally, data on alter characteristics and relationships between alters were reported by the ego and are therefore subject to recall and measurement bias.

Despite these limitations, our study has strengths. First, we used a well-known and valid method (“important matters” name generator) to assess network ties (Marsden, 1990). This approach is “person-centered” in that we allowed respondents to identify the type of relational ties (family members versus friends) that are most important to them, as opposed to us a priori asking about “family” or friendship ties specifically. Our approach to assessing social networks offers an advantage over questionnaire measures of social integration, which assess the presence or absence of specified ties, such as those used in sentinel studies by Berkman and Syme and Seeman (L. F. Berkman & Syme, 1979; Seeman et al., 1987). Our approach allowed us to calculate structural dimensions of network ties (e.g., bridging potential) which may have important implications for health. Second, while much of the extant literature focuses on social support and other “functional” aspects of network ties, our study assessed both network structure (e.g., size, density, heterogeneity, bridging potential) and function. This approach is more useful for understanding sources of variability in network relationships and network effects. Moreover, knowing the types of network ties that are most influential for affecting specific outcomes is critical to designing network-based interventions. Third, the fact that our sample was not selected based on having a particular health or clinical condition, but instead reflects a sample of relatively healthy women should be considered a strength. To the extent that network ties are activated broadly and network members provide support *in general*, as opposed to support for a specific health condition, our findings may be more applicable to the natural ways in which network ties function. Finally, our study yields important insight into the acceptability of collecting social network data via telephone. In general, participants indicated their willingness to participate in a similar study in the future, suggesting that age is not a barrier to collecting detailed social

network information. Investigators may want to consider collecting social network data in-person versus via phone, if possible, given the preference of our study participants. Of course, face-to-face data collection would require that ample resources (e.g., staff, time, money) to ensure geographic diversity of the sample.

## CONCLUSION

Just as people are interconnected, so too is their health (K. P. Smith & Christakis, 2008). Yet, few studies examine the contribution of network ties to health, largely due to the lack of integration of structural social network and health data. Both structural and functional aspects of networks are important contributors to health and well-being in older adults and therefore should be assessed in clinical settings (L.F. Berkman, 1985; J. S. House, Landis, & Umberson, 1988; James S House, Umberson, & Landis, 1988; Pearlin, 1989; S.L., 1985). [Having data on the structure of individuals', particularly, racial/ethnic minorities or other vulnerable socio-economically vulnerable groups, could shed important light on contributors to and strategies for ameliorating health disparities. For example, health outcomes could be improved and disparities reduced if clinicians and researchers better leveraged the dense, close-knit family-focused networks that have been described in Hispanics by more effectively engaging family members in the care of Hispanic patients or conducting family-focused, as opposed to individual-level interventions. Women in our small sample choose to discuss their health with their close network ties and these individuals help them understand health-related information and to a lesser extent, facilitate communication with health care providers. However, among racial and ethnic minorities or other vulnerable groups, network members may play an even greater and more influential role in health-related decision-making and communication. Yet, currently, health care providers are not incentivized or penalized for delivering (or not) care in a patient-centered way that engages the patient's family. Provider reimbursement could be tied to meeting patient-centered goals around support for members of their social networks.]

Our pilot study provides insight into the feasibility and acceptability of collecting social network data from a small sample of older women and it offers an important glimpse into the social context of some older women's lives. Our study findings should be replicated in a larger more representative sample of older adults. Future larger studies can and should further examine how network structure and function is reciprocally shaped by health over time. Such investigations will yield important contributions to our understanding of the sociology of health and medicine.

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**Table 1.**

## Acceptability

Construct	Survey Question	Percent (n)	
<i>Respondent</i>			
Acceptability – Complexity	How much difficulty did you have understanding the structure and format of the questions?		
	None	76.4 (n=55)	
	A little difficult	23.6 (n=17)	
Acceptability – Discomfort	Did you find it uncomfortable to answer questions about your social relationships?	A lot	0
		Yes	6.9 (n=5)
		No	93.1 (n=67)
Interest	If you were asked to answer questions similar to this again in the future, would you do it?	Yes	97.2 (n=70)
		No	2.8 (n=2)
Implementation Preferred Format	If you were asked to do this interview again, would you prefer to do it via telephone, face-to-face or online (e.g. via the internet)?	Face-to-face	69.0 (n=49)
		Telephone	12.7 (n=9)
		Online	18.3 (n=13)
<i>Interviewer</i>			
Acceptability - Complexity	How often during the interview did the participant have trouble following the line of question or instructions:	Most of the time	2.8 (n=2)
		Some of the time	20.8 (n=15)
		Very little of the time	19.4 (14)
		None of the time	56.9 (41)
Acceptability - Complexity	How much of the time did the participant communicate understandably and appropriately?	Most of the time	86.1 (n=62)
		Some of the time	13.9 (n=10)
		Very little of the time	
		None of the time	

**Table 2.**

Demographics and self-rated health of respondents (egos) and their network contacts (alters)

	<b>Ego n=72</b>	<b>Alters n=402</b>
<b>Mean Age, yrs (range)</b>	76 (65 – 90)	64 (17-97)
<b>Gender % (n)</b>		
Male	0	28.7 (n=115)
Female	100 (n=72)	71.3 (n=286)
<b>Education Level, %</b>		
Grade 12 or GED (High school Grad)	13.9 (n=10)	24.6 (n=99)
College 1-3 years (some or technical or Associates)	25.0 (n=18)	7.2 (n=29)
College 4 years or more (college grad or Bachelors)	25.0 (n=18)	34.3 (n=138)
Graduate (Masters, doctorate) or professional (JD, MD) degree	34.8 (n=25)	28.4 (n=114)
<b>Race/Ethnicity % (n)</b>		
African American	20.8 (n=15)	24.6 (n=99)
Hispanic	27.8 (n=20)	15.2 (n=61)
White	51.4 (n=37)	59.7 (n=240)
<b>Marital Status % (n)</b>		
Never Married	1.4 (n=1)	N/A
Divorced or separated	13.9 (n=10)	
Widowed	30.6 (n=22)	
Presently Married	54.2 (n=39)	
<b>Living Arrangement % (n)</b>		N/A
Lives alone	33.3 (n=24)	
Husband or Partner	52.8 (n=38)	
Children	15.3 (n=11)	
<b>Employment Status % (n)</b>		
Not working	0	1.2 (n=5)
Retired	72.2 (n=52)	45.8 (n=184)
Homemaker	5.6 (n=4)	6.7 (n=27)
Employed full or part-time	22.2 (n=16)	44.5 (n=179)
Disabled	0	1.7 (n=7)
<b>Self-Rated Health % (n)</b>	<i>Ego Self-Rated Health</i>	<i>Ego Perceived Health of Alter</i>
Excellent	18.2 (n=13)	17.9 (n=72)
Very Good	43.1 (n=31)	31.8 (n=128)
Good	31.9 (n=23)	30.4 (n=122)
Fair	4.2 (n=3)	12.9 (n=52)
Poor	2.8 (n=2)	7.0 (n=28)

**Table 3.**

Descriptions and summary statistics for social network variables for overall sample and stratified by race (white vs. non-white) and by educational level (college degree or higher vs. less than college degree)

Variable	Description	Total (n=72)	White (n=37)	Non-White (n=35)	College Degree (n=43)	Less than College Degree (n=29)
<b>Network Socio-demographics</b>						
Social Network size Mean (SD)	Number of alters named in social network	5.6 (1.0)	5.5 (1.2)	5.6 (0.9)	5.7 (1.0)	5.3 (1.0)
Female proportion, Mean (SD)	Proportion of alters each ego identified as female	71.0% (21.5)	67.0% (20.9)	75.1% (21.7)	71.7% (19.7)	69.9% (24.3)
Racial Similarity, Mean (SD)	Proportion of alters that are identified as the same race/ethnicity as the ego	82.4% (31.7)	95.9% (17.3)	68.0% (37.0)	82.9% (31.3)	81.5% (32.9)
Family-focus of network, Mean (SD)	Egos were asked the relationship with each alter and allowed to select all that apply for each alter. Response options included family (spouse, sibling, child, etc.) or non-family (friend, co-worker, etc.). We calculated the proportion of alters that were indicated as a family relation and averaged the proportion across all egos.	46.0% (27.3)	47.3% (24.6)	44.6% (30.2)	42.5% (24.5)	51.1% (30.8)
Friends-focus of network, Mean (SD)	We calculated the proportion of each ego's alters that were indicated as a friend and averaged the proportion across all egos.	43.1% (30.4)	43.2% (29.1)	42.9% (32.1)	45.0% (30.7)	40.2% (30.2)
Healthcare-focus of network, Mean (SD)	We calculated the proportion of each ego's alters that were indicated as a healthcare provider and averaged the proportion across all egos.	1.9% (5.4)	2.1% (5.5)	4.6% (5.4)	2.0% (5.5)	1.8% (5.3)
Other-focus of network, Mean (SD)	We calculated the proportion of each ego's alters that were indicated in 'other' categories (i.e., neighbor, co-worker, or minister) and averaged the proportion across all egos.	10.3% (20.6)	13.7% (25.7)	6.8% (12.8)	12.1% (20.9)	7.7% (20.2)
<b>Social connectedness</b>						
Geographic distance of Network Connections, Mean Proportion (SD)	Egos were asked the distance between where she and her alters lived. We calculated the proportion of alters that were reported to live within a short drive ( 1 hour) or closer and averaged the proportion across all egos.	70.4% (24.5)	72.1% (24.1)	68.6% (25.1)	71.8% (23.5)	68.3% (26.1)
Longevity of Network Connections, Mean Proportion (SD)	Egos were asked how long they knew each network member, with response options of "less than 3 years", "3-6 years", or "more than 6 years." We calculated the proportion of each ego's alters that they have known for more than 6 years and averaged the proportion across all egos.	95.7% (10.1)	94.4% (12.1)	97.2% (7.3)	95.1% (10.8)	96.7% (9.2)
Network interaction, Mean Proportion (SD)	Egos were asked how often they see or talk with each network member, with response options of "daily", "weekly", "monthly", or "less often." We calculated the proportion of each alter for whom there is at least weekly contact and averaged the proportion across all egos.	83.9% (16.7)	80.8% (17.9)	87.1% (14.9)	83.7% (17.1)	84.1 (16.4)
Network Density, Mean (SD)	Egos were asked the closeness of all ties (between herself and each alter and between each pair of alters). We defined density by the intensity of each tie, which was coded as zero if total strangers, 1 if very close, and 0.5 otherwise. The density measure varies from zero, in networks in which alters are mutually unaware of one another, to one, when all pairs are especially close.	0.69 (0.21)	0.67 (0.19)	0.71 (0.22)	0.63 (0.20)	0.78 (0.19)
Network Density of Very Close ties, Mean (SD)	Egos were asked the closeness of the relationship between each pair of listed alters, with response options of "total strangers", "know each other, but not close", and "very close." We	0.47 (0.26)	0.45 (0.23)	0.51 (0.28)	0.40 (0.24)	0.59 (0.25)

Variable	Description	Total (n=72)	White (n=37)	Non- White (n=35)	College Degree (n=43)	Less than College Degree (n=29)
Bridging potential, Mean (SD)	calculated the density of connections that were "very close" (the ratio of ties that are very close to the number of possible ties) and averaged across all egos An ego acts as a bridge whenever two alters are unconnected to each other and not indirectly connected by any other alters. We calculated the mean proportion of egos who served as a bridge for at least one alter.	0.11 (0.32)	0.08 (0.28)	.14 (0.36)	0.16 (0.37)	0.03 (0.19)
<b>Health-related network support</b>						
Communication about health, Mean proportion (SD)	Egos were asked, "If you need to make an important decision about your health or medical care, how likely is it that you would talk with (ALTER NAME) about it?" with response options of "very likely", "somewhat likely", and "not likely." We calculated the proportion of each ego's alters indicated as "very likely", and averaged the proportion across all egos.	58.9% (30.2)	54.3% (25.0)	63.7% (35.0)	56.7% (29.8)	62.1% (31.5)
Understanding medical information, Mean proportion (SD)	Egos were asked, "How much does (ALTER NAME) help you understand medical information?" with response options of "not at all", "a little", "somewhat", "quite a bit" or "a lot." We calculated the proportion of ego's alters who were indicated as "a lot likely" to help understand medical information and averaged the proportion across all egos.	19.1% (23.9)	21.4% (26.3)	16.7% (21.3)	18.8% (24.4)	19.5% (23.7)
Influence in health and medical care, Mean proportion (SD)	Egos were asked, "How influential is (ALTER NAME) on the decisions you make about your health or medical care?" with response options of "very influential", "somewhat influential", "not influential at all." We calculated the proportion of each ego's alters who were indicated as "very influential" and averaged the proportion across all egos.	36.5% (31.0)	34.7% (28.6)	38.5% (33.5)	35.3% (30.8)	38.4% (31.6)
Help to communicate with healthcare providers, Mean proportion (SD)	Egos were asked, "How much does (NAME) help you communicate your questions or concerns to your health care providers?" with response options of "not at all", "a little", "somewhat", "quite a bit" or "a lot." We calculated the proportion of ego's alters indicated as being at least "somewhat helpful" and averaged the proportion across all egos	10.7% (23.2)	11.2% (26.2)	10.2 (20.0)	9.3% (21.7)	12.9 (25.5)

**Table 4.**

Ego's perception of alters' influence on making important health/medical care decisions by alter characteristics (n=402 alters)

Alter characteristics	How influential is alter in making health-related decisions		
	Not at all influential	Somewhat influential	Very influential
<i>Relationship</i>			
Spouse	11.1 (n=4)	16.7 (n=6)	72.2 (n=26)
Family (non-spouse)	18.2 (n=26)	28.0 (n=40)	53.9 (n=77)
Friend	52.8 (n=94)	29.2 (n=52)	18.0 (n=32)
Other	33.3 (n=9)	33.3 (n=9)	33.3 (n=9)
<i>Emotional Closeness to alter</i>			
Very close	24.0 (n=66)	28.0 (n=77)	48.0 (n=132)
Close	60.4 (n=61)	31.7 (n=32)	7.9 (n=8)
Not very close	46.2 (n=12)	19.2 (n=5)	34.6 (n=9)
<i>Frequency of contact</i>			
>= weekly	32.7 (n=110)	26.8 (n=90)	40.5 (n=136)
< weekly	43.9 (n=29)	36.4 (n=24)	19.7 (n=13)
<i>Alter's sex</i>			
Female	40.9 (n=117)	27.6 (n=79)	31.5 (n=90)
Male	19.1 (n=22)	30.4 (n=35)	50.4 (n=58)
<i>Alter's co-resident status</i>			
Co-resident	15.6 (n=7)	15.6 (n=7)	68.9 (n=31)
Not co-resident	37.0 (n=132)	30.0 (n=107)	33.1 (n=118)
<i>All network members</i>	34.6 (n=139)	28.4 (n=114)	37.1 (n=149)