HHS Public Access

Author manuscript

J Aging Health. Author manuscript; available in PMC 2024 December 01.

Published in final edited form as:

J Aging Health. 2024 December ; 36(10): 619–630. doi:10.1177/08982643231209351.

Network Types and Functional Health in Old Age: It is Not Just the Size of the Network That Matters

Talha Ali, PhD[1], **Michael R. Elliott, PhD**[2,3], **Toni C. Antonucci, PhD**[4], **Belinda L. Needham, PhD**[5,6], **Jon Zelner, PhD**[5,6], **Carlos F. Mendes de Leon, PhD**[7]

[1]Department of Community Health, Tufts University, Medford, MA, USA

[2]Department of Biostatistics, University of Michigan School of Public Health, Ann Arbor, MI, USA

[3]Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI, USA

[4]Department of Psychology, University of Michigan, Ann Arbor, MI, USA

[5]Department of Epidemiology, University of Michigan School of Public Health, Ann Arbor, MI, USA

[6]Center for Social Epidemiology and Population Health, University of Michigan School of Public Health, Ann Arbor, MI, USA

[7]Department of Oncology, Georgetown University School of Medicine, Washington, DC, USA

Abstract

Objectives: Findings on the effect of network size and support on functional health are mixed. We examine whether network types, that simultaneously incorporate multiple network characteristics, are associated with functional health in late life.

Methods: Data are from the National Social Life, Health, and Aging Project ($N = 3005$). We estimated the longitudinal effect of membership in five multidimensional network types on disability in six activities of daily living using negative binomial regression, and on mobility (assessed using a timed walk test) using a generalized linear mixed model.

Results: Compared to those in the *large without strain* network, older adults in the *small, restricted, high contact* network had fewer disabilities but worse mobility, while those in the *large network with strain* also had worse mobility.

Discussion: Care plans focusing on function and mobility should consider multiple aspects of older adults' social networks including network size, diversity, and relationship strain.

Keywords

network types; social support; disability; mobility; late life

Corresponding Author: Talha Ali, PhD, Department of Community Health, Tufts University, 574 Boston Ave, Medford, MA 02155, USA. talha.ali@tufts.edu.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Functional ability is vital for older adults to maintain their independence and quality of life. Although some older adults remain stable in their physical functional ability, many experience a general decline in functional ability, and some also recover from a state of disability over time (Avlund et al., 2004; Tak et al., 2013). During the period 2014 to 2019, 36% of people aged 65 and older in the US reported living with at least one disability each year (Mateyka & He, 2022). Mobility difficulty and difficulty in performing daily activities are reported as the most common sources of disability among older adults (United States Census Bureau, 2014). Those who experience disability in mobility and independent living are at a higher risk of additional loss of function, including loss of muscle mass and strength; falls; long hospital stays; and nursing home placement (Wald et al., 2019). In addition to increased health risks, the high social and economic burden of disability warrant further investigation into factors that promote, prevent, and postpone disability and mobility issues in later life.

Social support networks are among the modifiable factors known to have a beneficial effect on the health and well-being of older adults. However, the evidence regarding the association between social support networks and disability and mobility is mixed (Berkman et al., 2000). Several studies note the favorable effects of structural characteristics of the social network: having a large network, greater diversity in relationships, more frequent contact with ties, and more frequent social participation are associated with higher physical function, improved mobility, and fewer disabilities in activities of daily living (ADLs) (Ali et al., 2018; Avlund et al., 2004; Escobar-Bravo et al., 2012; Gao et al., 2018; Giles et al., 2004; Leon & Rajan, 2014; McLaughlin et al., 2012; Mendes de Leon et al., 2001). Other studies have examined functional network characteristics, such as social support, in relation to onset and changes in disability although the findings from this literature have been contradictory. Some studies found no effect of social support as a risk factor of functional decline, others observed a harmful effect of instrumental support on functional decline, and yet others noted that under certain circumstances, a lack of social support in late life may actually promote mobility improvement (Avlund et al., 2004; Litwin & Stoeckel, 2013; Mendes de Leon et al., 1999, 2001; Seeman et al., 1996). One reason for these varied and contradictory findings is the reliance on relatively crude social network measures. Studies examining individual network characteristics in isolation, such as size, implicitly assume that larger networks are also more likely to be diverse and supportive. However, a large network could be restricted (i.e., have low diversity) and unsupportive, in which case the functional health effects may be null or negative.

This study utilizes the Social Convoy Model and Weiss' theory of functional specificity of relationships as guiding frameworks to examine the association between social network types and functional health. The Social Convoy Model proposes that older adults have networks of supportive social ties—social convoys—that move with them throughout life (Antonucci et al., 2014). According to the model, the patterns of these social networks potentially differ by context and circumstances and these network patterns are fundamental to understanding individuals' physical and mental health (Antonucci et al., 2014; Fiori et al., 2008). For our purposes, this suggests that network patterns that contribute to positive health outcomes need to be understood in terms of the specific context and circumstances of later life, when individuals either experience or anticipate declines in physical health and

when they may simultaneously experience increasingly more frequent losses in their existing social networks.

Weiss' theory of the functional specificity of relationships posits that different relationships perform unique functions for individuals (Weiss, 1974). For instance, spouses and very close family fulfill emotional needs, co-workers provide guidance and informational support, friends provide opportunities for socialization and physical activity, etc. There is indeed empirical evidence to suggest that having a more diverse network of ties (i.e., one consisting of a partner, family, and friends) is better for various health outcomes including functional health than a restricted network (e.g., one consisting primarily of family) (Ali et al., 2018). To the extent that the social and emotional needs of individuals change across the life-course, so would one expect the constellation of specific network features to change over time as adults reach the later stages of life. This further underscores the need to investigate the specific constellations of network features that are most closely related to good functional health.

Together, these two theoretical frameworks suggest that more than a single aspect of one's network, it is the network pattern or specific constellation of network features that matter for health. There is an increasing acknowledgment in empirical research that social networks are a complex phenomenon, representing a collection of distinct social network types, each of which may have a different association with health outcomes (Wenger, 1990). The construct of network type, particularly one that combines multiple aspects of the network including its structure, function, and quality, may provide a more comprehensive and nuanced understanding of the relationship between social networks and health than has been shown in studies examining individual social network characteristics.

Social network types have been examined in relation to a few health outcomes among older adults. Multiple studies consistently show that among older adults from the United States and different countries in Europe and Asia, those with diverse networks tend to have higher subjective well-being, fewer depressive symptoms, higher life satisfaction, and better mental health outcomes compared to those in restricted network types (Cheng et al., 2009; Djundeva et al., 2018; Fiori et al., 2006; Kim et al., 2017; Litwin, 2011; Litwin et al., 2020; Park et al., 2018, 2019). Similarly, across multiple countries, older adults in network types that are smaller in size, that consist primarily of unsupportive ties, and are restricted have higher mortality and shorter survival times compared to those in network types that are larger in size, that consist primarily of supportive ties, and are more diverse (Ellwardt et al., 2016; Litwin & Shiovitz-Ezra, 2006; Santini et al., 2015). Because mortality and mental health and well-being are important correlates of functional health, we expect that individuals in larger, more supportive, and more diverse network types would exhibit better functional health compared to older adults in smaller, unsupportive, and restricted network types.

Preliminary evidence suggests that social network types may have a differential effect on disability in old age. In a population of community-dwelling Jewish Israelis, Litwin (1998) observed that older adults in *diversified, friend*, and *neighbor* network types had a lower rate of disability in basic ADLs than average, whereas older adults in the *religious*

family and *attenuated* networks had higher than average rates of disability (Litwin, 1998). Corroborating these findings, in a subsequent study Litwin (2003) found that older adults in *family* and *restricted* networks had a significantly higher degree of disability compared to other network types (Litwin, 2003). However, in contrast to the previous study, Litwin (2003) observed that individuals in the *neighbor* network, in fact, had a higher degree of disability compared to other network types (Litwin, 2003). Data from an older Mexican population suggests that older adults belonging to *widowed* and *restricted* networks have a higher proportion of functional dependency in basic and instrumental ADLs relative to older adults belonging to more diverse network types (Doubova et al., 2010). In sum, the literature on network typology suggests that individuals in more diverse network types, particularly those that include ties outside of the family network, tend to have better functional health whereas those in less diverse network types and those that primarily rely on family ties have worse functional health.

The exact nature of the relationship between network type and disability in old age remains unclear due to several reasons. First, few studies have examined the association between network typology and functional health, with more studies focusing on mortality, mental health, and behavioral health outcomes. Among studies of functional health, to our knowledge, have examined if, in addition to ADL disability, social network types are also associated with changes in mobility over time in old age. Although the capacity of an individual to accomplish specific functional tasks (e.g., ADLs) is important, an individual's performance on other physical function assessments that measure mobility such as the gait speed test and the chair sit-stand test can provide further insight. Unlike ADL disability, which is traditionally self- or proxy-reported, these measures provide more objective results taken in standardized conditions. They are more sensitive to changes in functional capacity and they capture aspects of the underlying neuromuscular mechanisms that drive the ability to perform functional tasks (Patrizio et al., 2021). Second, previous studies have been mostly cross-sectional in nature, making it difficult to determine whether it is social network types that affect older adults' health or whether it is the functional health of older adults that leads them to cluster into different social network types (Doubova et al., 2010; Litwin, 1998, 2003). Even longitudinal analyses only demonstrate an association between network type and progression of disability, and do not permit a true causal inference. A more nuanced understanding of the likely bi-directional relationship between network type and disability will depend on future studies with much more frequent assessments of both constructs. Third, existing research on network typologies has primarily used either structural or functional network characteristics, but not both, and rarely have these studies included a measure of social strain in the construction of network types. For instance, Litwin's network types were based primarily on structural features of the social network and social participation (Litwin, 1998, 2003). Doubova's network types did include a measure of support representing functional features of the network; however, respondents were specifically asked about instrumental types of support while emotional support was not measured (Doubova et al., 2010). Finally, although researchers have constructed network typologies and examined their association with mortality in the United States, studies examining functional health in relation to network types have primarily been conducted

in populations outside the United States, including Israel (Litwin, 1998, 2003) and Mexico (Doubova et al., 2010).

In a previous study, Ali et al. (2022) identified a new, more comprehensive network structure based on social network and support data from the National Social Life, Health, and Aging Project (NSHAP), which is a study of a nationally representative sample of older adults in the United States (Ali et al., 2022). Using a latent variable approach, a 5-class multidimensional network typology representing the structure and function of relationships was identified: (i) large with strain; (ii) *large without strain*; (iii) *small, diverse, low contact*; (iv) *small, restricted, high contact*; and (v) *medium size and support* networks. The present study aims to examine the longitudinal association of these five social network types with disability and mobility in older adults in the US.

Informed by the extant literature, we've conceptualized our outcome in terms of the disablement process; that is, as a chronic and progressive process of functional health that generally gets worse over time. In our view, the process of progression is best captured by considering increases in disability along the entire spectrum of disability, from no disability to the most severe levels of disability, rather than merely new onset of disability (Hardy et al., 2005; Rajan et al., 2012). We acknowledge that progression of disability is not always consistent—changes occur that are reversible, leading to recovery from temporary episodes of disability (Hardy & Gill, 2004; Rajan et al., 2012). The literature also shows that the process of recovery from disability is often not permanent and later reverts to the more chronic underlying disablement process. Proper modeling of recovery therefore tends to require more frequent measurement of disability outcomes than are available in NSHAP. For these two reasons, we decided to use count of ADL disabilities as our outcome variable among those who are disability free at baseline.

Our objective is to determine whether a more nuanced characterization of older adults' social networks as captured by the multidimensional network typology can enhance our understanding of the association between social networks and functional health. The use of longitudinal data in this study allows us to ensure, to some extent, that the social network types into which older adults cluster precede any changes in health status. Using network types to simultaneously capture the effect of multiple individual aspects of social networks, we hypothesized that older adults in smaller, restricted, and less supportive network types would experience greater ADL disability and decline in mobility compared to older adults in larger, diverse, and more supportive network types.

Methods

Sample and Data Collection

Data for the study came from the National Social Life, Health, and Aging Project (NSHAP). NSHAP is a longitudinal, population-based study of health and social factors, designed to understand the well-being of community-dwelling older Americans. Participants aged 57–85 years at baseline were recruited using a complex, multi-stage area probability sample with oversampling of African Americans, Latinos, men, and the oldest old (75–84 years at the time of screening) (O'Muircheartaigh et al., 2009). A total of 3005 participants completed

interviews at baseline (round 1, 2005–2006). In round 2 (2010–2011), 3377 respondents were interviewed of whom 2261 respondents were from round 1 and the remaining were non-interviewed respondents who had declined to participate in round 1 but agreed to participate in round 2, and the spouses or cohabiting romantic partners of the respondents. In round 3 (2015–2016), all surviving respondents from the previous rounds (N = 2409) were interviewed again and a new cohort of respondents born between 1948 and 1965 was added along with their spouses or partners, totaling 4777 participants (O'Muircheartaigh et al., 2014). Data collection was comprised of a face-to-face interview including a brief self-administered questionnaire, in-home collection of biomeasures, and a leave-behind questionnaire. For this study, we restricted our sample to the 3005 participants who were interviewed at baseline and therefore had complete social network data. The analysis for each outcome was limited to participants for whom outcome data were available at baseline and at least one follow-up round.

Social Network Type

The exposure variable was the social network type assigned to individuals at baseline in a previous study (Ali et al., 2022). Five network types were derived by means of a latent class analysis: (i) *large with strain* (14%); (ii) *large without strain* (23%); (iii) *small, diverse, low contact* (26%); (iv) *small, restricted, high contact* (20%); and (v) *medium size and support* (17%). Nine observed variables were used for the delineation of network types; these included variables representing network structure (number of confidants, number of family, number of friends, network diversity, and frequency of contact) and network function (support from family, support from friends, strain from family, and strain from friends).

Two network types (*large with strain and large without strain*) were characterized by a large number of confidants, friends, and family members. Most individuals in both network types reported high diversity (i.e., at least four different types of relationship ties) and high perceived support from family ties. However, almost all individuals in the *large with strain* network type reported experiencing some strain in their family ties and 37% reported strain in friend ties; whereas only 3% of those in the *large without strain* network reported experiencing strain in their family ties and only 8% reported strain in friend ties.

Two network types (*small, diverse, low contact* and *small, restricted, high contact*) were characterized by a small number of confidants, friends, and family members. However, they were distinct from one another in network diversity and frequency of contact. Those in the *small, diverse, low contact* type had a relatively diverse network with the majority of individuals reporting at least 3 different types of relationships, and low level of contact with confidants, whereas more than three-fourths of the older adults in the *small, restricted, high contact* type had a restricted network (i.e., no more than 2 different types of relationship ties), and a high level of contact with confidants with two-thirds of the respondents reporting daily contact. Individuals in both types reported similar levels of support and strain.

The last network type (*medium size and support*) was characterized by a medium-sized network of confidant, friend, and family ties and medium levels of network diversity (i.e., 3 different relationship types). Individuals in this type reported high support from family

but not friends. And most reported experiencing no strain in their relationships with family members or friends.

Disability

Disability was operationalized as impairment in activities of daily living (ADL) and was assessed at all three rounds. Participants were asked to report on how much difficulty they experience in performing six ADLs: (i) walking across a room; (ii) dressing oneself, including putting on shoes and socks; (iii) bathing or showering; (iv) eating, such as cutting up one's food; (v) getting in or out of bed; and (vi) using the toilet, including getting up and down. Ability to perform these six activities is commonly used to determine ADL disability (Litwin, 1998) and they appear on the 7-item modified Katz ADL scale and the Physical Self-Maintenance Scale (Mlinac & Feng, 2016; Spiers et al., 1996). Each item was measured on a 3-point scale: 0 (no difficulty), 1 (some difficulty), and 2 (much difficulty). Respondents were asked to exclude any difficulties that they expected to last less than three months. Any difficulty in performing a task (i.e., a score of 1 or (2) was scored as a disability. The outcome of disability was modeled as a count of the number of ADLs in which an individual experienced any difficulty (range: 0–6).

Mobility

Mobility-related function in older adults was assessed using a timed walk test. In round 1, approximately half of the respondents (N = 1506) were randomly assigned to complete the "get-up-and-go" task (Podsiadlo & Richardson, 1991) where they stand up from a chair without using any support, walk 3 m, turn around, walk back 3 m toward the chair, and sit down. Participants were allowed to use their walking aid if they normally used one for the 6-m walk. The time that it took for the respondent to perform each task: (a) stand, (b) walk 3 m, (c) turn around, (d) return 3 m, and (e) turn and sit was recorded in seconds. In rounds 2 and 3, mobility was assessed using a separate timed walk and repeated chair stands. For the timed walk, derived from the Short Physical Performance Battery (Guralnik et al., 1994), the time that it took for the respondent to (a) walk 3 m and (b) return 3 m was recorded in seconds. In the present study, for round 1, we calculated the overall time of the walk by adding up the times of stages (b), (c), and (d). For rounds 2 and 3, we used the total time it took the respondents to complete the timed walk.

Covariates

In order to control for potential confounding, baseline data for age (in years, centered), sex (male, female), marital status (married or with partner vs. not), race/ethnicity (non-Hispanic White; non-Hispanic Black; Other), educational attainment (less than high school; high school diploma or equivalent; vocational, some college, or associate's degree; bachelor's degree or higher), and number of chronic conditions (arthritis, emphysema/chronic obstructive pulmonary disease/asthma, stroke, hypertension, diabetes, Alzheimer's or other dementia, and cancer) were included.

Statistical Analyses

Social Network Types and Activities of Daily Living Disability.—To estimate the longitudinal association between network types and disability in activities of daily living, we used a generalized estimating equations (GEE) model with negative binomial distribution. This allowed us to account for overdispersion due to high zero counts because most people in the sample did not have a disability. We limited the analysis to those individuals who were disability free at baseline. To model the effect of change in disability over time, we additionally included interaction terms for each of the network types with round of data collection. The five social network types were entered in the model as four dummy variables, with *large without strain* serving as the reference category, as it was the most well-endowed network type in terms of both network structure and function; it also had a high prevalence in our sample at 23%. Confounders were entered into the models in stages: the initial regression model included time interactions with network types to model the effect of change in disability over time; the next model adjusted for demographic covariates of age, sex, marital status, and race/ethnicity; the following model adjusted for educational attainment; and the final model additionally adjusted for number of chronic conditions.

Social Network Types and Mobility.—To estimate the longitudinal association between network types and mobility (time, in seconds, to complete a 6-m walk), we used generalized linear mixed models. Time to walk, which was originally right-skewed, was log-transformed in order to better fit the normal distribution. The independent variable, social network types, was modeled as dummy variables with the *large without strain* type as reference category. To model the effect of change in mobility over time, we included interaction terms in the model for each of the network types with round of data collection. Confounders were entered into the models in stages, as described above.

All statistical analyses accounted for stratification and clustering of the NSHAP sample design, unequal probabilities of selection, and non-response to calculate weighted, nationally representative population estimates and standard errors. Analyses were conducted in SAS 9.4.

Results

Baseline Characteristics

Table 1 presents the weighted (i.e., adjusted for non-response and non-random attrition) background characteristics and health outcomes at baseline. The average age of the sample at baseline was 68 years (SD = 8) and approximately half of the sample was female (52%). Participants took an average of approximately 10 seconds (SD = 6) to complete the 6-m walk and at baseline had less than 1 ADL disability (mean = .6; SD = 1.3).

Activities of Daily Living Disability by Social Network Type

Table 2 presents results of the fully adjusted GEE model with ADL disability counts as the outcome variable and the network types as the predictor variable. The relative risk (RR) associated with the *small, restricted, high contact* network type was .55 (95% CI: .31, .98); that is, individuals in this network type are predicted to have a 45% lower number of ADL

disabilities at round 2 compared to individuals in the *large without strain* network type. None of the other network types were significantly associated with ADL disability. Among background variables, education and comorbidities were associated with percent change in expected disability counts. Those with less than high school education had 73% (RR = 1.73; 95% CI: 1.13, 2.66) higher expected counts of disability compared to those with a bachelor's degree or higher. And those with one additional chronic condition had 34% (RR = 1.34; 95% CI: 1.20, 1.51) higher expected counts of disability.

Mobility by Social Network Type

Table 3 presents results of the fully adjusted generalized linear mixed model that estimated the association between network types and time to complete a 6-m walk (in seconds). Individuals in the *large with strain* network type had 9.42% longer walking times at round 2 (β = .09, p = .016) compared to the reference network type, *large without strain*. In other words, individuals in the *large with strain* network type had worse mobility at round 2 accounting for their mobility at baseline. The interaction term between *large with strain* network type and round was significant (β = −.14, p = .003), which indicates that despite having worse mobility at round 2, individuals in this network type experienced a 13% decrease in walking times (i.e., an improvement in mobility) between rounds 2 and 3, compared to the change in walking times between the two rounds for the reference type.

In round 2, individuals in the *small, restricted, high contact* network type also had significantly longer walking times compared to the reference network type (β = .07, p = .048). However, this decline did not continue into round 3 as the interaction term (*small, restricted, high contact* x Round 3) was not statistically significant (β = −.07, p = .138). Overall, in round 3 individuals took significantly longer to complete the 6-m walk compared to round 2 (β = .11, p < .001). Older individuals (β = .01, p < .001), Black compared to White individuals (β = .15, p < .001), those with a high school education (β = .08, p = .008) or less (β = .14, p < .001) compared to those with a bachelor's degree or more, and those with more chronic conditions (β = .06, p < .001) had significantly longer walking times. The time to complete the 6-m walk at baseline also had a strong positive association with walking times at follow-up.

Discussion

We investigated the prospective association between multidimensional social network types and functional health, determined by ADL disability and mobility, in a large, nationally representative cohort of older adults. Our findings indicate that the association between network types and functional health is somewhat equivocal. In contrast to our hypothesis that smaller, restricted, and less supportive network types would experience significantly greater ADL disability, we observed that those in a *small, restricted, high contact* network experienced disability in fewer ADLs compared to those in a large without strain network type. Consistent with our hypothesis, we observed that the *small, restricted, high contact* network type and the *large with strain* network type had significantly worse mobility compared to the *large without strain* network type. Over time, members of the NSHAP cohort experienced declines in mobility, as indicated by more time taken to complete the

6-m walk. Older age, lower educational attainment, and more chronic conditions were associated with worse physical function in our sample.

There are multiple mechanisms through which social networks affect functional health. One possible explanation for why those in the *small, restricted, high contact* networks had significantly lower ADL disability compared to those in the *large without strain* networks is that networks that are too large can be difficult to manage in terms of coordinating care across network members (Andersson & Monin, 2018). Poor care coordination makes it difficult for the older adult to call on network members in times of need, increasing their risk of disability. Those in the *small, restricted, high contact* network type had frequent contact with their confidants with 63% of the respondents reporting daily contact (Ali et al., 2022). In contrast, only 18% of those in the *large without strain* network type had daily contact with their confidants (Ali et al., 2022). More frequent contact with network members can facilitate timely provision of support to older adults by enabling the network ties to stay informed about the needs of the older adults on a regular basis. This, in turn, can potentially prevent situations from deteriorating to a point where older adults are left to manage their needs independently, which can increase the likelihood of developing ADL disability. It is also possible that high contact confidants constantly provide encouragement to remain physically active which helps older adults maintain ADL independence. Conversely, even with supportive network ties, infrequent contact may impede timely delivery of help, thereby compromising the efficacy of support provision. In the extant literature, less frequent social interaction has been shown to be associated with increased functional disability (James et al., 2011; Kanamori et al., 2014; Travis et al., 2004).

Part of the reason we don't find a strong association between network types and functional health is because social networks and functional health are influenced by cultural context which our study does not consider. In certain cultural contexts, having a large social network leads to increased assistance with ADLs, which is accepted and expected (Abramson, 2015). However, in other cultural contexts increased network support is less acceptable and may lead to "learned helplessness" because daily assistance can also limit an individual's ability to perform daily living tasks independently (Mendes de Leon et al., 2001). Qualitative research may be better suited to examine the impact of cultural context on the role of network types in older adults' functional health trajectories.

The *large with strain* network type in our study had worse mobility compared to the *large without strain* network type at round 2. This finding suggests that a large network is only beneficial if it is not a source of strain. This is consistent with previous literature which shows that the health effects of negative social exchanges—that provoke conflict, convey insensitivity, or interfere with an individual's ability to pursue their goals—often outweigh the effects of positive social exchanges (Brooks & Dunkel Schetter, 2011; Rook, 2015). Negative social interaction is associated with higher allostatic load, hypertension, greater levels of functional limitations, and chronic conditions (Brooks & Dunkel Schetter, 2011; Newsom et al., 2008; Rook, 2015). The negative health effects of social strain might be particularly salient for older adults because the quality of social ties assumes a larger importance for health and well-being in late life as physiological vulnerability increases and a greater awareness of the brevity of life shifts attention towards maintaining close

and meaningful social relationships (Brooks & Dunkel Schetter, 2011; Carstensen, 1993). However, despite having worse mobility at round 2 compared to the reference type, those in the *large with strain* network type over the course of follow-up experienced an improvement in mobility compared to the reference type. This seems to suggest that strain in relationships in the long run may serve to be a motivator, especially if the strain is caused by a network member in the form of constant reminders to exercise or engage in physical therapy, resulting in an improvement in mobility over time.

Although individuals in the *small, restricted, high contact* network type had significantly lower ADL disability, they had worse mobility compared to the *large without strain* network type in our study. This finding is consistent with the previous literature on network types in which *restricted* network types have been associated with worse functional health, whereas *diverse* network types have been associated with better functional health (Litwin, 1998; Santini et al., 2015). In addition, these findings are consistent with the literature that has examined individual network characteristics in relation to physical health. For example, being able to increase the number of social ties is associated with lower risk of functional impairment (Cornwell & Laumann, 2015; Giles et al., 2004; Mendes de Leon et al., 1999) and the ability to call on a diverse set of social network ties is associated with overall higher physical function (Ali et al., 2018). This is because different types of social ties provide specific health benefits or are used in response to specific health needs during the aging process (Ali et al., 2018). Although not maintaining frequent contact as an individual network characteristic is associated with functional decline (Travis et al., 2004) and maintaining frequent contact is associated with improved mobility (Litwin & Stoeckel, 2013), in this case, higher contact frequency does not appear to offset the harmful effects of a small and restricted network. It is noteworthy that despite a positive correlation between ADL disability and mobility, the strength of the correlation was relatively low (r = .24 at round 2 - .35 at round 3); this suggests that the two constructs are measuring different aspects of physical function. Therefore, while a *small, restricted, high contact* network may promote ADL independence, such a network may not foster improved mobility outcomes.

Our study strengthens existing research by using longitudinal data. A major concern in existing studies of social networks and functional health is the lack of a clear unidirectional association due to use of cross-sectional data (Auslander & Litwin, 1991; Mor-Barak & Miller, 1991). Although social support is known to lower the risk of functional decline, disability and mobility limitations have also been shown to influence network formation (Fingerman et al., 2021). For example, while individuals in a *restricted* network may have worse health due to lack of support, it may also be the case that the poor health of individuals in the *restricted* network prevents them from maintaining extensive social ties. We overcame this challenge by establishing network types at baseline and assessing their impact on functional outcomes at follow-up rounds. To minimize the potential for reverse causality, we limited the disability analysis to those who were disability free at baseline and controlled for baseline time to complete the 6-m walk in the models.

The use of NSHAP data is an important strength of this study, as NSHAP provides rich subjective and objective social network data for a large, nationally representative sample of community-dwelling older adults. Detailed assessment of social networks in NSHAP

allowed the construction of a multidimensional typology of social networks that provides a more nuanced and complete picture of the social networks of older adults and enabled us to examine the impact of these network types on functional health. While previous studies have focused on individual network aspects and demonstrated that a smaller or restricted network could be risk factors for functional health (Ali et al., 2018), our study presents a different perspective. We find that a small or restricted network might not increase the risk of ADL disability if there is high contact with network ties. Similarly, while earlier research suggested that a large network is beneficial for health (Cornwell & Laumann, 2015), our findings reveal that a large network, when the network ties become a significant source of strain, can indeed be detrimental to functional health.

Moreover, our study indicates that the same network features could act as risk factors for one health outcome but as protective factors for a different health outcome. For instance, a *small, restricted, high contact* network was a risk factor for mobility decline but not for ADL disability. This nuanced understanding of the association between social networks and functional health became possible due to the development of a multidimensional social network typology.

Despite these strengths, the current study was not without limitations. First, it is possible that attrition due to mortality or other forms of dropout during follow-up may produce biased estimates of the association between network type and functional health outcomes. In sensitivity analyses, we examined the association between network type and loss to follow-up and found that network types were not predictive of attrition. However, it should be noted that participants who dropped out of the NSHAP study after the first wave were less educated and more functionally impaired at baseline compared to the individuals who were included in follow-up waves (Huisingh-Scheetz et al., 2014).

Another limitation that stems from the dataset is that although NSHAP offers detailed social network data, this advantage was offset by the imperfect measurement of physical functioning in the study. Given the reciprocal nature of the association between social relationships and health, few rounds of measurement (only 2 follow-up rounds in NSHAP at the time of the analysis) conducted every 5 years may be insufficient to detect the complex relationship between social networks and functional health. To reduce the influence of functional health on participants' network type classification, we analyzed data from those without disability at baseline. However, it cannot be entirely ruled out that selection into a specific network type in our study is influenced by participants' prior functional health as extant research demonstrates that older adults with poorer functional health tend to have networks characterized by stronger ties (Cornwell, 2009). Ideally, frequent repeated measurements over many years would allow us to appropriately detect subtle changes in physical function as well as explore the bidirectional relationship between network type and functional health. In addition, the measurement of mobility was inconsistent across rounds of data collection. We tried to minimize this inconsistency by focusing only on the timed walk portion of the assessments at each round.

Next, we did not examine changes in network types over time, only changes in physical health overtime. It is possible that individuals transition from one network type to the other

over the course of follow-up which could have implications for physical function. Future research using latent transition analysis could be used to determine the probabilities of individuals transitioning from one network type to another and the impact of these social network transitions on functional health.

Lastly, by treating the latent network type classes as known predictors in our models, we ignored measurement error in these class assignments (Elliott et al., 2020). This will typically have the effect of biasing their predicted effects toward the null and underestimating their uncertainty. We believe this effect to be relatively modest however, as the latent classes were well-defined, with the mean posterior probability of modal membership ranging from .67 to .86 across the five classes.

Despite these limitations, the current study adds to the literature on social networks and functional health and has translational significance. The construct of social network type—which is a composite collection of network characteristics—provides a fuller and more complex picture of one's social resources compared with isolated social network measures which reflect different individual aspects of one's social ties (Shiovitz-Ezra & Litwin, 2015). The notion of social network type can aid health professionals by expanding their awareness to recognize that older adults are embedded in varied interpersonal environments and that these environments have an impact on their physical health (Shiovitz-Ezra & Litwin, 2015). The construct of social network types can also provide a basis for risk-assessment (Shiovitz-Ezra & Litwin, 2015). For example, if an individual transitions over time from a *large without strain* network type to a *small, restricted, high contact* network type, it would signal that the individual is at an increased risk of future mobility decline; healthcare providers can use this information to revise their patients' care plans to prevent unnecessary physical decline.

Acknowledgments

This article benefited from the statistical consulting provided by Dr. Owais Gilani.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This was supported in part by a National Institute on Aging training grant [T32AG019134] to Talha Ali.

References

Abramson CM (2015). The end game: How inequality shapes our final years. Harvard University Press.

Ali T, Elliott MR, Antonucci TC, Needham BL, Zelner J, & Mendes de Leon CF (2022). Multidimensional social network types and their correlates in older Americans. Innovation in Aging, 6(1), igab053. 10.1093/geroni/igab053 [PubMed: 35036584]

Ali T, Nilsson CJ, Weuve J, Rajan KB, & Mendes de Leon CF (2018). Effects of social network diversity on mortality, cognition and physical function in the elderly: A longitudinal analysis of the Chicago health and aging project (CHAP). Journal of Epidemiology & Community Health, 72(11), 990–996. 10.1136/jech-2017-210236 [PubMed: 29970598]

Andersson MA, & Monin JK (2018). Informal care networks in the context of multimorbidity: Size, composition, and associations with recipient psychological well-being. Journal of Aging and Health, 30(4), 641–664. 10.1177/0898264316687623 [PubMed: 28553797]

Antonucci TC, Ajrouch KJ, & Birditt KS (2014). The convoy model: Explaining social relations from a multidisciplinary perspective. The Gerontologist, 54(1), 82–92. 10.1093/geront/gnt118 [PubMed: 24142914]

Auslander GK, & Litwin H (1991). Social networks, social support, and self-ratings of health among the elderly. Journal of Aging and Health, 3(4), 493–510. 10.1177/089826439100300404

Avlund K, Lund R, Holstein BE, & Due P (2004). Social relations as determinant of onset of disability in aging. Archives of Gerontology and Geriatrics, 38(1), 85–99. 10.1016/j.archger.2003.08.003 [PubMed: 14599708]

Berkman LF, Glass T, Brissette I, & Seeman TE (2000). From social integration to health: Durkheim in the new millennium☆. Social Science & Medicine, 51(6), 843–857. 10.1016/S0277-9536(00)00065-4 [PubMed: 10972429]

Brooks KP, & Dunkel Schetter C (2011). Social negativity and health: Conceptual and measurement issues. Social and Personality Psychology Compass, 5(11), 904–918. 10.1111/j.1751-9004.2011.00395.x

Carstensen LL (1993). Motivation for social contact across the life span: A theory of socioemotional selectivity. In Developmental Perspectives on Motivation (vol. 40). University of Nebraska Press.

Cheng S-T, Lee CKL, Chan ACM, Leung EMF, & Lee J-J (2009). Social network types and subjective well-being in Chinese older adults. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 64(6), 713–722. 10.1093/geronb/gbp075 [PubMed: 19820232]

Cornwell B (2009). Good health and the bridging of structural holes. Social Networks, 31(1), 92–103. 10.1016/j.socnet.2008.10.005 [PubMed: 20046998]

Cornwell B, & Laumann EO (2015). The health benefits of network growth: New evidence from a national survey of older adults. Social Science & Medicine, 125, 94–106. 10.1016/j.socscimed.2013.09.011. [PubMed: 24128674]

Djundeva M, Dykstra PA, & Fokkema T (2018). Is living alone “aging alone”? Solitary living, network types, and well-being. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 74(8), 1406–1415. 10.1093/geronb/gby119

Doubova SV, Pérez-Cuevas R, Espinosa-Alarcón P, & Flores-Hernandez S (2010). Social network types and functionaĺ dependency in older adults in Mexico. BMC Public Health, 10, 104. 10.1186/1471-2458-10-104. [PubMed: 20187973]

Elliott MR, Zhao Z, Mukherjee B, Kanaya A, & Needham BL (2020). Methods to account for uncertainty in latent class assignments when using latent classes as predictors in regression models, with application to acculturation strategy measures. Epidemiology, 31(2), 194–204. 10.1097/EDE.0000000000001139 [PubMed: 31809338]

Ellwardt L, Aartsen M, & van Tilburg T (2016). Types of non-kin networks and their association with survival in late adulthood: A latent class approach. The journals of gerontology: Series B, Psychological Sciences and Social Sciences, 72(4), 694–705. 10.1093/geronb/gbw142

Escobar-Bravo M-Á, Puga-González D, & Martín-Baranera M (2012). Protective effects of social networks on disability among older adults in Spain. Archives of Gerontology and Geriatrics, 54(1), 109–116. 10.1016/j.archger.2011.01.008 [PubMed: 21353317]

Fingerman KL, Ng YT, Huo M, Birditt KS, Charles ST, & Zarit S (2021). Functional limitations, social integration, and daily activities in late life. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 76(10), 1937–1947. 10.1093/geronb/gbab014 [PubMed: 33460446]

Fiori KL, Antonucci TC, & Akiyama H (2008). Profiles of social relations among older adults: A cross-cultural approach. Ageing and Society, 28(2), 203–231. 10.1017/S0144686X07006472

Fiori KL, Antonucci TC, & Cortina KS (2006). Social network typologies and mental health among older adults. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 61(1), P25–P32. 10.1093/geronb/61.1.P25 [PubMed: 16399938]

Gao M, Sa Z, Li Y, Zhang W, Tian D, Zhang S, & Gu L (2018). Does social participation reduce the risk of functional disability among older adults in China? A survival analysis using the 2005–2011 waves of the CLHLS data. BMC Geriatrics, 18(1), 224. 10.1186/s12877-018-0903-3 [PubMed: 30241507]

Giles LC, Metcalf PA, Glonek GFV, Luszcz MA, & Andrews GR (2004). The effects of social networks on disability in older Australians. Journal of Aging and Health, 16(4), 517–538. 10.1177/0898264304265778 [PubMed: 15271268]

Guralnik JM, Seeman TE, Tinetti ME, Nevitt MC, & Berkman LF (1994). Validation and use of performance measures of functioning in a non-disabled older population: MacArthur studies of successful aging. Aging (Milan, Italy), 6(6), 410–419. 10.1007/BF03324272 [PubMed: 7748914]

Hardy SE, Dubin JA, Holford TR, & Gill TM (2005). Transitions between states of disability and independence among older persons. American Journal of Epidemiology, 161(6), 575–584. 10.1093/aje/kwi083 [PubMed: 15746474]

Hardy SE, & Gill TM (2004). Recovery from disability among community-dwelling older persons. JAMA, 291(13), 1596–1602. 10.1001/jama.291.13.1596 [PubMed: 15069047]

Huisingh-Scheetz M, Kocherginsky M, Schumm PL, Engelman M, McClintock MK, Dale W, Magett E, Rush P, & Waite L (2014). Geriatric syndromes and functional status in NSHAP: Rationale, measurement, and preliminary findings. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S177–S190. 10.1093/geronb/gbu091 [PubMed: 25360019]

James BD, Boyle PA, Buchman AS, & Bennett DA (2011). Relation of late-life social activity with incident disability among community-dwelling older adults. The journals of gerontology. Series A, Biological sciences and medical sciences, 66(4), 467–473. 10.1093/gerona/glq231 [PubMed: 21300745]

Kanamori S, Kai Y, Aida J, Kondo K, Kawachi I, Hirai H, Shirai K, Ishikawa Y, & Suzuki KJAGES Group. (2014). Social participation and the prevention of functional disability in older Japanese: The JAGES cohort study. PLoS One, 9(6), Article e99638. 10.1371/journal.pone.0099638 [PubMed: 24923270]

Kim H-J, Fredriksen-Goldsen KI, Bryan AEB, & Muraco A (2017). Social network types and mental health among LGBT older adults. The Gerontologist, 57(suppl 1), S84–S94. 10.1093/geront/gnw169 [PubMed: 28087798]

Leon C. F. M. d., & Rajan KB (2014). Psychosocial influences in onset and progression of late life disability. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(2), 287–302. 10.1093/geronb/gbt130 [PubMed: 24389123]

Litwin H (1998). Social network type and health status in a national sample of elderly Israelis. Social Science & Medicine, 46(4–5), 599–609. 10.1016/s0277-9536(97)00207-4 [PubMed: 9460839]

Litwin H (2003). Social predictors of physical activity in later life: The contribution of social-network type. Journal of Aging and Physical Activity, 11(3), 389–406. 10.1123/japa.11.3.389

Litwin H (2011). The association between social network relationships and depressive symptoms among older Americans: What matters most? International Psychogeriatrics, 23(6), 930–940. 10.1017/S1041610211000251 [PubMed: 21356159]

Litwin H, Levinsky M, & Schwartz E (2020). Network type, transition patterns and well-being among older Europeans. European Journal of Ageing, 17(2), 241–250. 10.1007/s10433-019-00545-7 [PubMed: 32549875]

Litwin H, & Shiovitz-Ezra S (2006). Network type and mortality risk in later life. The Gerontologist, 46(6), 735–743. 10.1093/geront/46.6.735 [PubMed: 17169929]

Litwin H, & Stoeckel KJ (2013). Social network and mobility improvement among older Europeans: The ambiguous role of family ties. European Journal of Ageing, 10(3), 159–169. 10.1007/s10433-013-0269-5 [PubMed: 28804291]

Mateyka P, & He W (2022). People ages 65 and older with disabilities change residences more often but move shorter distances. https://www.census.gov/library/stories/2022/10/do-disabilities-impact-older-peoples-moves-to-other-locations.html#:~:text=The_ACS_considers_someone_to,reported_at_least_one_disability

McLaughlin D, Leung J, Pachana N, Flicker L, Hankey G, & Dobson A (2012). Social support and subsequent disability: It is not the size of your network that counts. Age and Ageing, 41(5), 674–677. 10.1093/ageing/afs036 [PubMed: 22454132]

Mendes de Leon CF, Glass TA, Beckett LA, Seeman TE, Evans DA, & Berkman LF (1999). Social networks and disability transitions across eight intervals of yearly data in the new haven EPESE.

Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 54(3), S162–S172. 10.1093/geronb/54B.3.S162 [PubMed: 10363047]

Mendes de Leon CF, Gold DT, Glass TA, Kaplan L, & George LK (2001). Disability as a function of social networks and support in elderly african Americans and whites the duke EPESE 1986–1992. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 56(3), S179–S190. 10.1093/geronb/56.3.S179 [PubMed: 11316843]

Mlinac ME, & Feng MC (2016). Assessment of activities of daily living, self-care, and independence. Archives of Clinical Neuropsychology: The Official Journal of the National Academy of Neuropsychologists, 31(6), 506–516. 10.1093/arclin/acw049

Mor-Barak ME, & Miller LS (1991). A longitudinal study of the causal relationship between social networks and health of the poor frail elderly. Journal of Applied Gerontology: The Official Journal of the Southern Gerontological Society, 10(3), 293–310. 10.1177/073346489101000305 [PubMed: 10113726]

Newsom JT, Mahan TL, Rook KS, & Krause N (2008). Stable negative social exchanges and health. Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association, 27(1), 78–86. 10.1037/0278-6133.27.1.78 [PubMed: 18230017]

O'Muircheartaigh C, Eckman S, & Smith S (2009). Statistical design and estimation for the national social life, health, and aging project. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 64(Suppl 1), i12–i19. 10.1093/geronb/gbp045 [PubMed: 19567827]

O'Muircheartaigh C, English N, Pedlow S, & Kwok PK (2014). Sample design, sample augmentation, and estimation for wave 2 of the NSHAP. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S15–S26. 10.1093/geronb/gbu053 [PubMed: 25360016]

Park NS, Jang Y, Chiriboga DA, & Chung S (2019). Social network types, health, and well-being of older Asian Americans. Aging & Mental Health, 23(11), 1569–1577. 10.1080/13607863.2018.1506751 [PubMed: 30345812]

Park NS, Jang Y, Lee BS, Chiriboga DA, Chang S, & Kim SY (2018). Associations of a social network typology with physical and mental health risks among older adults in South Korea. Aging & Mental Health, 22(5), 631–638. 10.1080/13607863.2017.1286456 [PubMed: 28290722]

Patrizio E, Calvani R, Marzetti E, & Cesari M (2021). Physical functional assessment in older adults. The Journal of frailty & aging, 10(2), 141–149. 10.14283/jfa.2020.61 [PubMed: 33575703]

Podsiadlo D, & Richardson S (1991). The timed "up & go": A test of basic functional mobility for frail elderly persons. Journal of the American Geriatrics Society, 39(2), 142–148. 10.1111/j.1532-5415.1991.tb01616.x [PubMed: 1991946]

Rajan KB, Hebert LE, Scherr P, Dong X, Wilson RS, Evans DA, & Mendes de Leon CF (2012). Cognitive and physical functions as determinants of delayed age at onset and progression of disability. The journals of gerontology. Series A, Biological sciences and medical sciences, 67(12), 1419–1426. 10.1093/gerona/gls098 [PubMed: 22539654]

Rook KS (2015). Social networks in later life: Weighing positive and negative effects on health and well-being. Current Directions in Psychological Science, 24(1), 45–51. 10.1177/0963721414551364 [PubMed: 26366047]

Santini ZI, Koyanagi A, Tyrovolas S, Haro JM, Fiori KL, Uwakwa R, Thiyagarajan JA, Webber M, Prince M, & Prina AM (2015). Social network typologies and mortality risk among older people in China, India, and Latin America: A 10/66 dementia research group population-based cohort study. Social Science & Medicine, 147, 134–143. 10.1016/j.socscimed.2015.10.061. [PubMed: 26575604]

Seeman TE, Bruce ML, & McAvay GJ (1996). Social network characteristics and onset of ADL disability: MacArthur studies of successful aging. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 51(4), S191–S200. 10.1093/geronb/51B.4.S191 [PubMed: 8673648]

Shiovitz-Ezra S, & Litwin H (2015). Social network type and health among older Americans. In Nyqvist F & Forsman AK (Eds.), Social capital as a health resource in later life: The relevance of context (pp. 23–27). Springer.

Spiers N, Jagger C, & Clarke M (1996). Physical function and perceived health: Cohort differences and interrelationships in older people. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 51(5), S226–S233. 10.1093/geronb/51B.5.S226 [PubMed: 8809007]

Tak E, Kuiper R, Chorus A, & Hopman-Rock M (2013). Prevention of onset and progression of basic ADL disability by physical activity in community dwelling older adults: A meta-analysis. Ageing Research Reviews, 12(1), 329–338. 10.1016/j.arr.2012.10.001 [PubMed: 23063488]

Travis LA, Lyness JM, Shields CG, King DA, & Cox C (2004). Social support, depression, and functional disability in older adult primary-care patients. American Journal of Geriatric Psychiatry, 12(3), 265–271. 10.1097/00019442-200405000-00005

United States Census Bureau. (2014). Mobility is most common disability among older Americans, Census Bureau reports. Retrieved May 11 from. https://www.census.gov/newsroom/archives/2014-pr/cb14-218.html

Wald HL, Ramaswamy R, Perskin MH, Roberts L, Bogaisky M, Suen W, & Mikhailovich AQuality, & performance measurement committee of the American geriatrics S (2019). The case for mobility assessment in hospitalized older adults: American geriatrics society white paper executive summary. Journal of the American Geriatrics Society, 67(1), 11–16. 10.1111/jgs.15595 [PubMed: 30276809]

Weiss R (1974). The provisions of social re la tio nsh ip s. In Rubin Z (Ed.). Doing unto others. NO. P rentice-H a ll, Inc.

Wenger GC (1990). Change and adaptation in informal support networks of elderly people in Wales 1979–1987. Journal of Aging Studies, 4(4), 375–389. 10.1016/0890-4065(90)90006-T

Table I.

Sociodemographic Characteristics of the Sample at Baseline (Weighted).

Characteristic	Mean (SD)/N (%)
Age (years)	68.02 (7.69)
Female	1548 (51.53)
Married or living with a partner	2059 (68.52)
Race/ethnicity	
Non-Hispanic White	2416 (80.40)
Non-Hispanic Black	300 (9.98)
Other	279 (9.28)
Educational level	
Less than high school	557 (18.54)
High school or equivalent	810 (27.0)
Vocational/some college/associate's degree	902 (30.02)
Bachelor's degree or higher	736 (24.49)
Number of chronic conditions	1.63 (1.15)
Time to complete 6-m walk (in seconds)	10.16 (6.09)
ADL disabilities	.60 (1.28)

Table 2.

Association of Network Type With Number of ADL Disabilities (N = 2184).

	RR	95% CI	*p*-value
Network types *(ref: Large without strain)*			
Large with strain (14%)	.70	(.42, 1.17)	.172
Small, diverse, low contact (26%)	.94	(.56, 1.58)	.824
Small, restricted, high contact (20%)	.55	(.31, .98)	.044
Medium size and support (17%)	.61	(.34, 1.09)	.098
Network types*Round 3 (change in outcome)			
Large with strain*Round 3	1.14	(.61, 2.13)	.675
Small, diverse, low contact*Round 3	.95	(.48, 1.85)	.870
Small, restricted, high contact*Round 3	1.55	(.87, 2.76)	.137
Medium size and support*Round 3	1.37	(.79, 2.39)	.263
Covariates			
Round 3	1.53	(1.00, 2.34)	.049
Age	1.03	(1.01, 1.05)	.056
Age*Round 3	1.04	(1.01, 1.07)	.004
Female	.99	(.72, 1.37)	.973
Race *(ref: White)*			
Black	1.34	(.89, 2.01)	.161
Other	.85	(.52, 1.40)	.528
Education (ref *Bachelor's or higher)*			
Less than high school	1.73	(1.13, 2.66)	.013
High school or equivalent	.77	(.54, 1.11)	.158
Vocational, some college, or associate's degree	1.28	(.88, 1.87)	.200
Married or living with a partner	.95	(.68, 1.33)	.776
Number of chronic conditions (0–7)	1.34	(1.20, 1.51)	<.0001

Table 3.

Association of Network Type With Walking Time (N = 1677).

	B	SE	*p*-value
Network types (ref *Large without strain)*			
Large with strain (14%)	.09	.04	.016
Small, diverse, low contact (26%)	.02	.04	.568
Small, restricted, high contact (20%)	.07	.04	.048
Medium size and support (17%)	.02	.03	.628
Network types*Round 3 (change in outcome)			
Large with strain*Round 3	−.14	.05	.003
Small, diverse, low contact*Round 3	.04	.05	.335
Small, restricted, high contact*Round 3	−.07	.05	.138
Medium size and support*Round 3	−.06	.04	.199
Covariates			
Round 3	.11	.03	.000
Age	.01	.00	<.0001
Female	.02	.02	.371
Race *(ref: White)*			
Black	.15	.03	<.0001
Other	.05	.03	.113
Education (ref *Bachelor's or higher)*			
Less than high school	.14	.03	<.0001
High school or equivalent	.08	.03	.008
Vocational, some college, or associate's degree	.03	.03	.278
Married or living with a partner	−.04	.02	.085
Number of chronic conditions (0–7)	.06	.01	<.0001
Baseline time to walk (in seconds)	.18	.03	<.0001