Self-rated Health and Global Network Position: Results From the Older Adult Population of a Korean Rural Village

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Background: Since the mid-20th century, the ways in which social networks and older adults’ health are related have been widely studied. However, few studies investigate the relationship between self-rated health and position in a complete social network of one entire Korean rural village. This study highlights use of a complete network in health studies. Methods: Using the Korean Social Life and Health Project, the population-based data of adults aged 60 or older and their spouses in one myeon in Ganghwa island (Ganghwa-gun, Incheon, Korea), Incheon, Korea (with a 95% response rate), this study built a 1,012×1,012 complete social network matrix of the village. The data were collected from 2011 to 2012, and 731 older adults were analyzed. The ordered logistic models to predict self-rated health allowed us to examine social factors from socio-demographic to individual community activities, ego-centered network characteristics, and positions in a complete network. Results: From the network data, 5 network components were identified. Even after controlling for all other factors, if a respondent belonged to a segregated component, the probability that he or she reported good health dropped substantially. Additionally, high in-degree centrality was connected to greater self-rated health. Conclusion: This finding highlights the importance of social position not only from the respondents’ point of view but also from the entire village’s perspective. Even if a respondent maintained a large social network, when all of those social ties belonged to a segregated group in the village, the respondent’s health suffered from this segregation.

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INTRODUCTION

Self-rated health is known as a single valid and efficient predictor of morbidity and mortality independent from other health statuses. One study examined self-rated health as a predictor of mortality in 27 longitudinal studies, which utilized typical community samples\(^5\). They found that self-rated health was an independent predictor of mortality in nearly all examined studies despite the inclusion of numerous health status indicators and other relevant factors known to predict mortality. Although self-ratings of health must to some extent be modified by gender or culture, they still are believed to be a valid measure of health status\(^2\). The association between self-rated health and a variety of biomarkers, such as albumin, hemoglobin, and white blood cell counts, was also studied, and self-rated health was found to have a graded association with all of the biomarkers tested and thus has physiological foundations\(^2\). For example, Christian\(^5\) reported that poorer self-rated health was associated with elevated inflammatory biomarkers such as higher interleukin-6 and C-reactive protein levels. One possible interpretation here is that, as a human being, a living person transmits information from the organism to individual consciousness through sensations that may reflect physiological dysregulations such as inflammatory processes and thus incorporates that information into self-ratings of health\(^2\). In any event, in this study, we treat self-rated health as one of the most universal and inclusive predictors of critical health statuses, including death.

Meanwhile, the tradition of social network research into older adults’ health statuses could go back to the very early stages of social theory development in gerontology. One of the earliest explicit hypotheses and theories was developed by Cumming\(^6\) between 1957 and 1960. Under the title of “a tentative theory of aging,” Cumming et al.\(^7\) proposed an explicit alternative to what was, at that time, an implied theory. They argued that the rate and variety of interaction would lessen with age and pictured the individual as cooperating...
in this disengagement process rather than being deserted and stranded. They focused on the fact that the aged group chose more relational rewards than did the middle-aged group and even enjoyed freedom from all sorts of middle-aged obligations with regard to jobs, spouses, and children. This tentative theory was later coined as disengagement theory. The implied theory to which disengagement theory was proposed as an alternative was later called "activity theory." It assumed that successful aging means the maintenance of the activities and attitudes of middle age as far and as long as possible.

Although the 2 theories are not directly comparable given that the opposite of disengagement is not activity but engagement, they led early work in social gerontology as 2 promising and competing theories and thus influenced a plethora of subsequent studies. Numerous publications, however, showed mixed results for both theories. Different types of disengagement in various social relationships were confirmed while many other studies discredited disengagement theory.

Since the first explicit statement of its core ideas, activity theory also led to various confirming studies. However, many subsequent examinations failed to find sufficient evidence to support the theory and evaluated it as lacking the richness and complexity of activities among older adults. It is interesting that, after failing to sustain consistent and sufficient empirical support, both theories withdrew from the central stage of social gerontology and disappeared into the psychological realm by examining individual personalities or temperaments. After evaluating activity theory as being insufficient to explain optimal or successful aging, Havighurst concluded that personality seemed to be pivotal when describing the relationships between various structural measures of social networks and related concepts such as social support, social integration, social cohesion, social capital, and social efficacy are analyzed without elaborated distinctions as social determinants of health status of older adults.

Since around 2000, in addition to the structure of respondents’ social networks, the position of the ego of each respondent with regard to his or her social ties became a topic of interest in the realm of social gerontology. The National Social Life, Health, and Aging Project (NSHAP), which collected information about the relationships not only between each respondent and his or her ties but also between social ties (alters), was an appropriate dataset with which to start this type of research as it enabled measurement of respondents’ roles between alters. For example, with the NSHAP, Cornwell delved into a bridging (or brokerage) position to examine older adults’ health in which the bridging of respondents was measured by the number of pairs of alters not directly connected to each other. He proposed that maintaining bridging positions requires cognitive skills to deal with alters with different backgrounds and attitudes and, thus, the social friction between them. He showed that both cognitive and functional forms of health were significantly and positively associated with the bridging position of the respondent, which was assumed to survive cognitive challenges. This type of social network research, which systematically examines the structural positions of older adults, allowed gerontology to become gradually more independent from the early tradition, which emphasized the psychological dimensions of social support.

Although the NSHAP included a series of questions about the relationships between the respondents’ alters, it was still based on a sample of the population and thus relied on ego-centered networks (or local networks). If we collect information about the social ties of an entire target population and identify each alter in the population, we will end up with a complete network (or global network) that contains all of the egos and their ties in the population. The use of a complete network in health studies on older adults is extremely rare, with only 2 exceptions. Haas et al. utilized Add Health and revealed that adolescents who reported poor health maintained smaller local networks and occupied less central positions (in terms of both the Influence domain and the Bonacich Index) in a complete network. Additionally, Schafer analyzed a complete network of 123 independent living residents in an
American continuing care retirement community (CCRC). His analysis of a complete network revealed that residents with the best health had a positional advantage in that they were more likely to be autonomous from alters. They also tended to have higher integration scores, which are supposed to measure how close the ego is positioned to all other residents in the CCRC, on average.

This study attempts to continue this recent trend by examining a complete social network in an entire rural village in Korea, and research strategy views gerontology in terms of the more structural and formal characteristics of the social milieu, which is quite different from social support as reported and perceived by the respondents themselves in this area of research. Complete social network data have a definite advantage compared to ego-centered network data. Although an ego-centered network can measure structural factors beyond those associated with an older adult’s individual attributes, it still only conveys the network structure with direct ties (or first-order ties) to the respondent (ego). It does not deliver a complete picture of how indirect ties higher than the first order are associated with the ego’s various health statuses. For example, although 2 people, A and B, may share the same number of social ties (alters) with identical relationships between their direct alters, the network positions of the 2 can differ if all of the ties of person A are confined to a small and segregated group of people while all of the ties of person B belong to a large and expansive cluster.

This study reveals that the self-rated health statuses of persons A and B can be dissimilar. Network components—groups that connected within and separated between—were built using complete social network data. We tested whether self-rated health is different if respondents are positioned in different network components, controlling for other confounding factors including individual-level or perceived social network.

MATERIALS AND METHODS

1. Data

The Korean Social Life, Health and Aging Project (KSHAP) is a population-based dataset pertaining to one entire rural village, referred to here as Township K, in Korea. Township K is a typical rural village in which most residents live by farming. It is located on Ganghwa island (Ganghwa-gun, Incheon, Korea). Approximately 67% of our respondents were working, and 88% of those were farming. Ganghwa island is not a small island by any means at about 300 km². Although it is an island, it is rarely separated from the mainland due to its 2 large bridges. In fact, it is easy to miss that one is on an island when driving through the wide and large bridges connecting it to the mainland. The total population of all ages in Township K was 1,864 with 871 families as of January of 2013. The survey questionnaires were designed to be directly comparable to the NSHAP, a nationally representative data collection funded by the National Institute of Health and gathered by the National Opinion Research Center from 2005 to 2006. The Institutional Review Board of Yonsei University approved this study (approval number: YUIRB-2011-012-01).

The KSHAP has 2 distinctive features. First, it was designed to examine the entire population (not a sample) of people aged 60 years or older and their spouses in Township K. After the aid of township officers and after a pilot study, a total of 860 people were identified for the KSHAP population. We finished face-to-face surveys with 814 of these 860 people from December of 2011 to March of 2012 for a response rate of 94.65% (814/860). The interviews were conducted in respondents’ homes or at community centers. They lasted 48 minutes on average. Without missing value of any variable, 731 out of 814 were included in the analyses.

Second, due to the population dataset, the complete network of an entire village could be constructed from the survey on social networks. We adopted the same name generator as used by the NSHAP: people with whom the respondent discussed personal problems or concerns most (up to 5 people). The social network of the respondents consists of these discussion network partners and a spouse, if any, for a total as high as 6 members. This unique feature enables us to measure one additional valuable network characteristic. We can identify the indirect ties in addition to the direct ties of any person in a population: i.e., we can pinpoint friends of friends of friends of any one person. Fig. 1 shows the complete social network of the entire village, Using Pajek — a network analysis program developed by Mrvar A. and Batagelj V. — a list was made of all respondents, their alters, and all social ties between them, and a network graph was drawn. With this rare complete network, we examine the relationships between network positions and self-rated health statuses.

2. Measurement

1) Self-rated Health

Self-rated health was measured on a 5-point Likert scale. During the survey, each respondent was asked, “In general, would you say your health is excellent, very good, good, fair, or poor?” In analysis, the variable was considered ordinal and scored from 1 to 5: a higher score means better health status.

2) Community Engagement

Following Lemon et al.41, we decided to examine as many types of community activities as possible. The respondents were asked if they had a formal role or position in the village, such as the head of a senior association or alumni association or the head of the “ri”. A “ri” is the smallest administrative
district within a village. Township K consists of one "myeon," which is comprised of 5 "ri's. In addition, visiting a senior center is an important part of the routine of many Korean older adults in rural areas so that they can meet other senior citizens and maintain various social relationships. There is a government-funded program for older adults to help them find part-time jobs, and we identified those who had experience using it. Other types of social engagement in the village for many older adults are religious activities. The respondents were asked about other possible types of community engagement, including their participation in senior citizen associations, organized (by a mutual aid association or an alumni association) or nonorganized (for example, a one-time event to help neighbors) or similar voluntary activities. Lastly, we also included memberships in formal community organizations such as a senior citizens' association or married women's association. All of these variables were measured as binary except for the frequency of attending religious activities, which was measured according to the number of days per year. This was originally a 7-point scale item (from "never" to "3-4 times" per week) and later calculated as days per year. We also included current working status as a community activity considering most working respondents in the village were engaged in farming, which tended to be a community-embedded group task.

3) Egocentric Network Variables

Engagement at the egocentric-level network was measured as follows: (1) network size, which is the number of discussion partners, ranging from 0 to 5; (2) network density, which was measured as the proportion of all possible pairs among alters in which 2 individuals know each other – alters were assumed to know each other unless a respondent answered that "they have never talked to each other before"; (3) the proportion of alters whose gender is female; (4) the proportion of alters who are related to the respondent; (5) the degree of emotional closeness to alters on average, as measured by asking, "How close do you feel your relationship is with the alter?" with 4 response categories ranging from "not close" (coded as 1) to "very close" (coded as 4); and (6) the volume of contact with alters on average, which was scored according to days of talking per year by asking, "How often do you talk to the alter?" with response categories ranging from "every day" to "I have never met the alter before." Network density is calculated only when network size is the same as or greater than 2, by definition. Sixty-two respondents with 0 or 1 egocentric network sizes were excluded from the study.

4) Complete Network Level: Degree Centrality

To construct one complete network of all of Township K based on 814 egocentric networks from the 814 respondents, we needed to identify the same alters (duplicates) who appeared in multiple egocentric networks of different respondents. Based on the respondents' reports, the KSHAP collected detailed information for identifying alters, such as their names, genders, ages, and addresses, in the smallest administrative unit, the "ri." We assumed 2 alters were the same person if the alters satisfied all of the following 4 criteria: (1) at least 2 out of 3 Korean characters in their names matched, (2) their genders were identical, (3) their age difference was less than 5 years, and (4) their addresses was in the same ri. After this alter-identification process, we obtained one complete network that contained 1,593 people and 2,499 ties between them. We then excluded 581 nodes who were (1) nonspouses of survey respondents and (2) living outside of Township K. Therefore, a total of 1,012 nodes and 1,799 ties were included in the analysis, and a matrix of 1,012×1,012

![Fig. 1. Components of the complete network of all of Township K. A name generator was used to collect the data, and a respondent could choose up to 5 discussion partners. Spouses were always regarded as discussion partners, so the maximum possible number of discussion partners was 6. Black squares and white circles refer to male and female respondents, respectively. Arrows indicate selecting a discussion partner and show the direction and number of selections.](image-url)
Table 1. Summary statistics of socioeconomic and health-related factors (n=731)

| Variable                                      | Value             |
|----------------------------------------------|-------------------|
| Age (yr)                                     | 71.8±8.1          |
| Lived in village (yr)                        | 47.5±26.1         |
| Female sex                                   | 420 (57.4)        |
| Education                                    |                   |
| Uneducated                                   | 213 (29.1)        |
| Elementary school/seodang                    | 304 (41.6)        |
| Middle/high school                           | 186 (25.4)        |
| College or higher degree                     | 28 (3.8)          |
| Annual household income of the last year     |                   |
| Refusal                                      | 141 (19.3)        |
| Less than $10,000                            | 364 (49.8)        |
| $10,000 to $20,000                           | 144 (19.7)        |
| More than $20,000                            | 82 (11.2)         |
| No. of chronic diseases ever diagnosed *     | 2.0±1.7           |
| Currently smoking                            | 90 (12.3)         |
| Drinking alcohol                             |                   |
| Not at all                                   | 475 (65.0)        |
| Less than once a week                        | 86 (11.8)         |
| More than once a week                        | 170 (23.3)        |
| Sleeping (hr)                                | 9.4±1.4           |
| Self-Rated Health                            |                   |
| Excellent                                    | 8 (1.1)           |
| Very good                                    | 49 (6.7)          |
| Good                                         | 366 (50.1)        |
| Fair                                         | 245 (33.5)        |
| Poor                                         | 63 (8.6)          |

Values are presented as mean±standard deviation or number (%).

*Chronic diseases include hypertension, metabolic syndrome, diabetes, hyperlipidemia, osteoporosis, cancer, stroke, myocardial infarction, angina pectoris, arthritis (degenerative or rheumatoid), tuberculosis, asthma, cataract, glaucoma, hepatitis B, depression, urinary incontinence and benign prostate hyperplasia. All records of diseases were self-reported by respondent.
past but not anymore, never smoked, and did not smoke in the past but currently smoking. In analyses, smoking behavior was recoded into a binary variable: current smoking status, Drinking status was classified into 3 groups: not drinking at all, drinking less than once a week, and drinking once a week or more.

3. Statistical Analysis

We tested several logistic regression models with different cutoff points and found that parallel regression assumption was violated, but there was no significant change in the major findings. Although specific value of predicted probability on certain outcome value changes when generalized ordered logistic regression is conducted, the main conclusion is retained. Therefore, we decided to use an ordered logistic regression. Model 1 included only socio-demographic covariates, and from model 2 to model 4, we added the variables of community engagement, an egocentric network, and both, respectively. Model 5 contained 2 levels of network variables excluding the network size because it is identical to out-degree centrality in principle: egocentric and complete, Model 6 took all possible variables into account. We used Stata 11 (StataCorp LP., College Station, TX, USA) as the statistical package, and p<0.05 was regarded as indicating a statistically significant result.

RESULTS

Tables 1 and 2 summarize the statistics of health status and socioeconomic and network variables. The mean age of respondents was 71.8±8.1 years, and the proportion of female participants was 57.4%. They had lived in this rural area for 47.5±26.1 years. Most respondents were uneducated (29.1%) or graduated elementary school (41.6%). Almost half of their annual income of the last year was less than $10,000 (49.8%), and the number of chronic diseases was, on average, 2.0±1.7. Nearly half of the respondents answered that their self-rated health was good (50.1%), and one-third reported that it was fair (33.5). Two-thirds of the respondents were currently working (68.8%) and used a senior center (67.7%). They attended religious activities 30.5±55.3 days per year, and 51.2% took part in events at a senior citizens association. Network size was 3.3±1.1 on average, and network density was almost 1. Almost no difference was found for network density, and we speculate the reason is that it is more difficult to be unknown to each other in a small rural village, so it is more natural that one’s discussion partners know each other. On complete network properties, in-degree centrality was 2.0±1.6, and out-degree centrality was 2.3±1.3. Five distinct network components were found, and most members belonged to the largest one (size 768, 78.7%).

Table 3 shows bivariate distributions and analysis of variance (ANOVA)/chi-square test results of selected variables by component. Village characteristics include number of residents in each component, proportion of residents in 5 “ri”s, and the number of years respondents have lived. Size of component is greater than the number of respondents in the component because younger residents (under 60), nonsurvey respondents, are included. ANOVA and chi-square test results showed statistically significant differences between the 5 components (p<0.05). It is notable that respondents of the second largest component mainly consist of “ri” E (88.9%). Differences in self-rated health were not statistically signi-
Table 3. Bivariate table between selected variables and components

| Variable | Component size | Mean overall | p-value<br> \( \ast \) |
|----------|----------------|--------------|-----------------|
|          | 768 | 63 | 3\(-7\) (others) | 2 (dyadic only) | 1 (being alone) |
| Village  | R in component (n) | 624 | 49 | 44 | 83 | 14 |
|          | R in ri A (%)     | 6.0 | 0.0 | 4.2 | 0.0 | 7.1 | 4.9 |
|          | R in ri B (%)     | 26.6 | 3.2 | 32.4 | 31.3 | 42.9 | 26.2 |
|          | R in ri C (%)     | 26.7 | 0.0 | 15.5 | 25.0 | 35.7 | 24.2 |
|          | R in ri D (%)     | 32.3 | 6.3 | 16.9 | 22.9 | 0.0 | 28.3 |
|          | R in ri E (%)     | 8.1 | 88.9 | 31.0 | 20.8 | 14.3 | 16.0 |
|          | Lived in village (yr) | 52.1±24.0 | 34.4±27.0 | 33.2±25.3 | 34.6±30.0 | 45.7±29.6 | 48.1±26.1 | <0.001 |
| Health status<br> Self-rated health | 2.6±0.8 | 2.2±0.6 | 2.5±0.8 | 2.6±0.9 | 2.4±0.9 | 2.6±0.8 | 0.051 |
|          | Chronic disease (n) | 2.2±1.8 | 1.4±1.3 | 1.8±1.8 | 1.9±1.4 | 2.3±1.3 | 2.1±1.7 | 0.032 |
| Socio-demographic<br> Age (yr) | 72.5±8.0 | 70.5±7.3 | 69.8±10.3 | 71.3±8.4 | 74.4±11.4 | 72.1±8.2 | 0.078 |
|          | Female sex (%) | 57.5 | 57.1 | 63.6 | 53.0 | 92.9 | 58.0 | 0.076 |
|          | Married (%) | 77.1 | 85.7 | 63.6 | 79.5 | 0.0 | 75.8 | <0.001 |
|          | Uneducated (%) | 32.1 | 10.2 | 18.6 | 27.7 | 57.1 | 30.0 | <0.001 |
|          | Income ≥$10,000 (%) | 29.2 | 8.2 | 43.2 | 37.4 | 21.4 | 29.4 | <0.001 |
| Network<br> Network size | 3.2±1.2 | 2.9±0.7 | 2.5±1.2 | 3.1±1.5 | 2.1±1.4 | 3.1±1.2 | <0.001 |
|          | In-degree centrality | 2.2±1.7 | 1.9±1.2 | 1.0±0.8 | 0.8±0.4 | 0±0 | 1.9±1.6 | <0.001 |
|          | Out-degree centrality | 2.5±1.3 | 2.2±0.9 | 1.6±0.6 | 1.0±0.2 | 0±0 | 2.2±1.3 | <0.001 |
| Community engagement<br> Currently working (%) | 69.7 | 80.0 | 52.3 | 50.6 | 35.7 | 66.8 | <0.001 |
|          | Senior center use (%) | 72.6 | 55.1 | 43.2 | 42.2 | 57.1 | 66.6 | <0.001 |
|          | OVA (%) | 13.8 | 2.1 | 15.9 | 8.4 | 7.1 | 12.6 | 0.105 |
|          | Non-OVA (%) | 42.4 | 16.7 | 22.7 | 43.4 | 0.0 | 39.2 | <0.001 |
|          | Membership of FCO (%) | 29.8 | 4.2 | 15.9 | 15.7 | 14.3 | 25.8 | <0.001 |

Values are presented as mean±standard deviation unless otherwise indicated.
R, respondents; ri, the smallest administrative district within a village; OVA, organized voluntary activities; FCO, formal community organizations.
All descriptive statistics, except % of residents in each component, were calculated based on information regarding the survey respondents and not the component members. Characteristics of 5 “ris” were measured based on 1,008 observations out of 1,012, because 4 were spouses who did not reside in the village when surveyed.
*Calculated by analysis of variance or chi-square test.
Table 4. Ordered logistic regression models predicting self-rated health: poor, fair, good, very good, and excellent

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|----------|---------|---------|---------|---------|---------|---------|
| Health-related factors |         |         |         |         |         |         |
| No. of chronic diseases | 0.70 (0.63-0.77) | 0.70 (0.63-0.77) | 0.70 (0.63-0.77) | 0.70 (0.63-0.77) | 0.70 (0.63-0.77) | 0.70 (0.63-0.77) |
| Drinking alcohol | Not at all | 1 | 1 | 1 | 1 | 1 |
| | Less than once a week | 1.65 (1.02-2.66) | 1.65 (1.02-2.66) | 1.65 (1.02-2.66) | 1.65 (1.02-2.66) | 1.65 (1.02-2.66) |
| | More than once a week | 2.26 (1.49-3.43) | 2.26 (1.49-3.43) | 2.26 (1.49-3.43) | 2.26 (1.49-3.43) | 2.26 (1.49-3.43) |
| Community engagement | Formal position in village | 1.20 (0.55-2.62) | 1.21 (0.55-2.64) | 1.16 (0.53-2.54) |         |         |
| | Currently working | 1.49 (1.04-2.15) | 1.45 (1.00-2.10) | 1.47 (1.01-2.15) |         |         |
| | Visiting senior center | 1.33 (0.91-1.94) | 1.28 (0.87-1.90) | 1.20 (0.80-1.78) |         |         |
| | Event at senior citizens association | 1.01 (0.71-1.44) | 1.01 (0.71-1.45) | 1.12 (0.78-1.62) |         |         |
| | Organized voluntary activities | 1.23 (0.75-2.03) | 1.30 (0.79-2.15) | 1.17 (0.70-1.93) |         |         |
| | Nonorganized voluntary activities | 1.69 (1.19-2.39) | 1.60 (1.12-2.28) | 1.58 (1.11-2.27) |         |         |
| | Membership of formal community organizations | 2.27 (1.50-3.44) | 2.09 (1.37-3.21) | 1.97 (1.28-3.02) |         |         |
| | Elderly employment programs | 0.76 (0.25-2.28) | 0.68 (0.22-2.10) | 0.64 (0.21-1.98) |         |         |
| Egocentric-level network | Network size | 1.14 (0.98-1.32) | 1.08 (0.92-1.26) |         |         |         |
| | Network density | 0.99 (0.28-3.48) | 0.99 (0.27-3.60) | 1.20 (0.34-4.26) | 1.11 (0.30-4.04) |         |         |
| | Proportion of female alters | 1.59 (0.87-2.92) | 1.48 (0.80-2.76) | 1.56 (0.84-2.90) | 1.47 (0.79-2.76) |         |         |
| | Proportion of kin alters | 0.54 (0.33-0.87) | 0.73 (0.44-1.21) | 0.53 (0.31-0.92) | 0.70 (0.40-1.23) |         |         |
| | Emotional closeness to alters | 1.32 (1.03-1.69) | 1.16 (0.89-1.49) | 1.27 (0.99-1.63) | 1.12 (0.86-1.45) |         |         |
| | Volume of contact with alters (day) | 1.00 (1.00-1.00) | 1.00 (1.00-1.00) | 1.00 (1.00-1.00) | 1.00 (1.00-1.00) |         |         |
| Complete network | In-degree centrality | 1.13 (1.01-1.25) | 1.06 (0.95-1.18) |         |         |         |
| | Out-degree centrality | 0.94 (0.80-1.10) | 0.95 (0.81-1.11) |         |         |         |
| Component size | 768 | 1 | 1 |         |         |         |
| | 63 | 0.30 (0.16-0.55) | 0.34 (0.18-0.64) |         |         |         |
| | 3-7 (others) | 0.60 (0.29-1.25) | 0.69 (0.33-1.47) |         |         |         |
| | 2 (dyadic only) | 0.61 (0.34-1.10) | 0.65 (0.35-1.18) |         |         |         |
| | 1 (being alone) | 2.07 (0.51-8.37) | 2.35 (0.58-9.63) |         |         |         |

Values are presented as odds ratios (95% confidence interval). Odds ratios were obtained by ordered logistic regression. Note that selected unimportant variables are excluded in Table 4. See Appendices 1 (full regression result with odds ratio and 95% confidence interval of all variables) and 2 (pairwise correlation coefficient matrix of selected variables) for details.

From models 1 to 6, the following variables were adjusted: age, sex, marriage, education, annual household income last year, current smoking behavior, sleeping (hr), years lived in village (yr), and frequency of religious activities.

*Reference of each variable is “do not participate in.” * †Network size was replaced by degree of centrality in models 5 and 6.

Model 3 examined the association between egocentric-level network variables and self-rated health after controlling for socio-demographic features. A larger network size was associated with better self-rated health, as confirmed in many previous studies. In addition, older adults who felt closer to their alters reported better health statuses while people who had a higher proportion of relatives in their discussion networks had worse self-rated health statuses. Model 4 controlled for community activities and egocentric level networks together in relation with their associations with self-rated health. Every egocentric-level network variable lost its statistical significance while community activities maintained their statistical significance and effect sizes. We believe that, in a rural Korean village in which many community engagement activities are well organized and embedded into the residents’ everyday activities, the characteristics of egocentric-level networks did not make a difference once the engagement level was taken into account.

1. Complete Network-Level: Degree Centrality

Model 5 examined both in-degree and out-degree centrality. Only in-degree centrality was statistically significant: a respondent who was indicated as a discussion partner by
more people was more likely to report better health status. Out-degree centrality, which is usually examined under the term “network size,” in an egocentric-level network showed no statistical significance. However, even in-degree centrality lost much of its statistical significance when community activity factors were added to model 6. Model 6 revealed that, in our traditional rural Korean village, many network features, such as the network size, emotional closeness, and degree centrality lost their statistical significance once community activities—especially current working status or engagement in nonorganized voluntary activities and membership in formal community organizations—were considered.

2. Complete Network-Level: Component

Older adults who belonged to different components showed discrepancies in their self-rated health statuses even after controlling for all other types of factors in model 6. First, membership in the component with a size of 63, i.e., the second largest group, had a statistically significant and negative effect on self-rated health status compared to that of the largest component, with a size of 768. In other words, even if 2 older adults of the same age had the same number of discussion partners, their self-rated health statuses could differ depending on the component (social group) to which they belong. Second, people who did not have any discussion partner or spouse in Township K (i.e., who were alone) did not show a statistically significant difference from respondents who belonged to the largest component with regard to their self-rated health statuses. Contrary to common sense, they were more likely to report better health statuses, although this difference was not statistically significant.

DISCUSSION

This research attempted to widen the horizon of social gerontology by examining new social network measures at the global (or complete) level and by reevaluating previous network studies. Membership of the components in the global-level network was found to be critical to predict self-rated health. The members of the second largest component, with a size of 63, reported the worst health statuses even after controlling for all other variables, as shown in Table 4. Furthermore, as shown in Table 3, the members of this component were not strikingly different from those of other components in terms of age, female proportion, the number of chronic diseases, years of residence in the village, or network size. Additionally, the proportion of married people was highest in this component. However, the major difference was found in the proportion of residents in each “ri,” the smallest administrative unit. Township K consisted of 5 “ri’s, and all of the survey respondents (or 90% of the members including non-respondents) in the component belonged to a specific “ri.” In other words, they were strongly segregated from the rest of the village despite the fact that the component they belonged to was the second largest.

This result is not the same as numerous previous findings of the negative effects of loneliness or isolation. Former studies examined the evidence of negative effects by using perceived loneliness usually measured by psychologically developed survey questions or social isolation typically scaled by the lack of contacts or ties or both. The social segregation we found in this study is different from perceived loneliness or absence of contacts. Even if a respondent maintained a large social network at the egocentric level and he or she belonged to a relatively large group (component) and, thus, may not have felt lonely, if the component to which he or she belonged was segregated from the rest of the village, his or her self-rated health status could be harmed. This type of social segregation at the group level can only be identified from global-level network data. Given the findings here, these areas require new attention by researchers.

Meanwhile, people who refused to report their household income tended to report the worst self-rated health; we speculate that people with the lowest level of income may avoid answering this question. It was somewhat unexpected that people who drank more reported better health statuses. We believe there are 2 possibilities. First, we may have observed an instance of reverse causality in which people in better health may be able to drink more. Second, considering the social settings of a traditional, rural Korean village, where most gatherings involve alcohol consumption, especially during the winter when the survey was done, drinking is evidence of active social engagement.

Among the factors assumed to measure the amounts of activity, the network size at the egocentric level and the degree of in-degree centrality (how many people named the respondent as a discussion partner) at the global level lost most of their statistical significance once community activities were controlled for. However, the association between community activities and self-rated health was statistically significant even when all other factors were taken into account together. We believe that, in a traditional rural village such as Township K, older adults’ personal networks were well embedded into community activities. Therefore, various community activities could capture the characteristics of personal social resources more comprehensively than narrowly defined discussion networks. This finding is fairly consistent with activity theory. Needless to say, we confirmed only an association and not causality; it is also possible that older adults who felt healthier were more likely to participate in community activities. Reverse or reciprocal causality should also be considered as proposed in studies on frailty and social engagement, network, or support.
Not only active theory but also disengagement theory seemed to be at least partly supported by the findings here. In model 6, in which all types of variables were controlled for, older adults in this component of "being alone" tended to report same health status as people in the largest component of size 768: the odds ratio was 2,354 without statistical significance. Nevertheless, the 95% confidence interval was very wide (0.58–9.63), and the number of people in the "being alone" component was small (n=14). The relationship between health and "being alone" is highly variable unless evidence that those older adults were "selectively disengaged" is found. Further research questions must include whether they maintain social network outside the village and voluntarily disengaged from the rural community. Although further studies are needed to make a conclusion, it should be noted that this result is detectable only when complete social network data are used.

The study has a few limitations. First, cross-sectional data were used, and reverse or reciprocal causality should be tested using panel data. Second, social relationship outside the village was not considered. It is uncertain if a person segregated from the village could be healthier by maintaining a social network from a city or other rural villages nearby or faraway. Third, the generalization outside the rural area must be limited. Geographical boundary is indefinite and provides less restriction in city areas, and the meaning of social network from a city or other rural villages nearby is different. Not only active theory but also disengagement theory must be limited. Geographical boundary is indefinite and provides less restriction in city areas, and the meaning of social network from a city or other rural villages nearby is different.

Conflict of Interest Disclosures: The researchers claim no conflicts of interest.

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Supplementary Materials

Supplementary Tables 1 and 2 can be found via http://dx.doi.org/10.4235/src/sm/agmr-20-149-s002.pdf.

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