

The Reciprocal Causal Relationship between Social Activities and Health with Reference to the Cognitive Function Level among Community-dwelling Older Adults: A Cross-Lagged Panel Analysis

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Purpose: The aim of this study is to examine the reciprocal causal relationship between social activities and health with reference to the cognitive function level among community-dwelling older adults. **Methods:** We conducted a longitudinal data analysis using the 4th (Time 1) and 5th (Time 2) waves from the Korean Longitudinal Study of Ageing adopting cross-lagged panel analysis (CLPA). **Results:** A total of 3,473 community-dwelling older adults were included in the analysis: 2,053 in the normal cognitive function group, 912 in the mild cognitive impairment group, and 508 in the moderate to severe cognitive impairment group. The CLPA revealed that higher levels of social activities at Time 1 significantly influenced better subjective health perception at Time 2 in all three groups. In addition, better subjective health perception at Time 1 significantly influenced higher levels of social activities at time 2 only in the normal cognitive function group. **Conclusion:** This study demonstrates that participating in social activities has positive effects on health regardless of the cognitive function level in community-dwelling older adults. This finding suggests that there is a need to develop strategies that can be used to encourage older adults with cognitive decline to maintain participation in social activities.

Key Words: Social participation, Health, Cognition, Aged, Longitudinal studies

INTRODUCTION

According to the activity theory, participation in social activities is likely to increase life satisfaction and contribute to promoting health for older adults [1]. In Rowe and Kahn's successful aging model, active participation in social activities is emphasized as a key component for successful aging in addition to preventing diseases disability and maintaining physical cognitive function [2]. As the population rapidly ages, many cohort studies in Europe and the United States (US) have reported that participating in social activities has positive health outcomes for older adults [3-5]. Specifically, a 17-year longitudinal study reported that collective social activities reduced the risk of mortality and institutionalization among older adults [3]. In addition, participating in social activities is likely to decrease the risk of physical/cognitive function

decline and the risk of dementia [4,5]. In Korea, positive health outcomes from participating in social activities were found to be relatively large in a group of older adults compared to other age groups [6]. Older adults who participate in more social activities including religious and leisure activities tend to have better cognitive function [7], and those who participated in more alumni and public activities were likely to report better subjective well-being [8]. These study findings suggest that participating in social activities could enhance older adults' health status [7,8].

Regarding the mechanisms underlying the association between social activities and health, social activities are known to play a role in protecting individuals from psycho-social stress or buffering the effects of stress on the human body. Cobb reported that supportive social relationships allow individuals to perceive that they are cared for,

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respected, and members of an entity of mutual obligations [9]. Positive perception and experiences from their social relationships serve as a moderator of life stress, and ultimately protect individuals from stress-related negative health outcomes such as alcoholism, depression, and death [9]. An integrative review shows that supportive social relationships interact with individuals' health behaviors and mental health. These behavioral and mental changes are linked to cardiovascular, neuroendocrine, and immune systems, which, in turn, contribute to decreasing morbidity and mortality [10].

Conversely, there is a stream of research claiming that better health status influences older adults' levels of participation in activities. A cross-sectional study found that limited locomotor activities and chronic diseases (e.g., arthritis, cardiovascular diseases) are associated with lower levels of social participation [11]. A longitudinal study also demonstrated that the level of mobility-related functional ability at 75 years old was significantly related to the level of participation in social activities after five years [12]. Moreover, the better the subjective health status of the elderly, the higher the level of participation in social activities; and the greater the depressive symptoms, the lower the level of participation in social activities [13]. In summary, previous literature has shown that there is a significant relationship between social activity participation and health among older adults. Specifically, two groups of studies exist in terms of the relationship directions of two variables, 1) increased social activities influence positive health outcomes; and 2) better health status influences the level of activity participation.

However, most studies on social activities and health have primarily focused on elderly participants who are cognitively intact or the studies have not considered the cognitive function in the study design. Cognitive impairment refers to a declined state in cognitive domains such as memory, orientation, language, and executive function [14]. According to a national survey on the prevalence of dementia in Korea, the number of older adults with dementia was about 540,000 (9.2%) in 2012, and is expected to be about 2,710,000 (15.1%) by 2050 [15]. In addition, 27.8% of older adults are reported to have mild cognitive impairment, which may increase the risk of later progression to dementia [15]. Older adults with cognitive impairment are physically and socially vulnerable and have been marginalized due to age and cognitive impairment; however, few studies have examined the meaning of daily and social activities in their lives [16].

Research on the relationship between cognitive decline and participation in social activities has only recently been

conducted. In a US national study, social activities decreased by 8% among the elderly with mild cognitive impairment, and by 19% in the elderly with dementia compared to those who are cognitively intact [17]. A longitudinal study consistently reported that the levels of social activity participation decreased as their cognitive function declined among Korean older adults [18]. These findings indicate that older adults who are cognitively impaired are less likely to participate in social activities, but the social activities are still valuable for the older adults who are cognitively impaired because they experience the meaning of pleasure and a sense of belonging through social activities [19]. However, there is a lack of research on what differences exist in the relationship between social activities and health outcomes with reference to the level of cognitive function for older adults.

The purpose of this study is to examine the relationship between social activities and health for community-dwelling older adults with reference to their level of cognitive function. Furthermore, given the two streams of research about social activities and health in terms of the relationship direction, we examined whether higher participation in social activities predicts better health status, whether better health status predicts more active participation in social activities, or whether there is a reciprocal causal relationship in both directions at the same time using national-level longitudinal data.

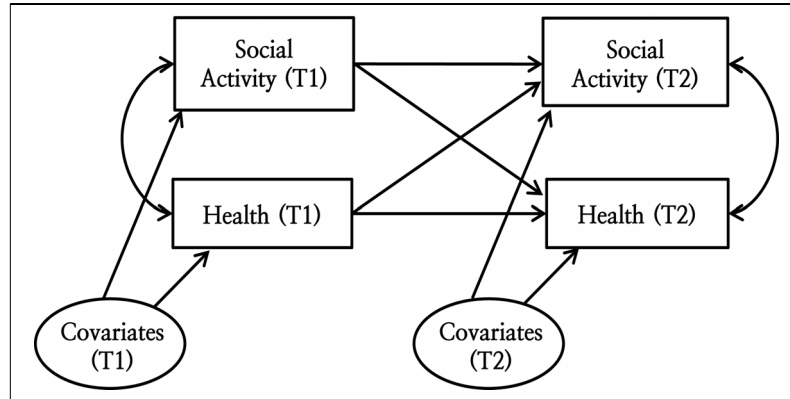
METHODS

1. Study Design

This study is a secondary data analysis research using the 4th and 5th waves of the Korean Longitudinal Study of Aging (KLoSA) to examine the reciprocal causal relationship between social activities and health with reference to the level of cognitive function among community-dwelling older adults. Figure 1 shows the research framework of this study.

2. Data Source and Study Sample

This study used the 4th (2012) and 5th (2014) waves of the KLoSA, which is a national-level longitudinal survey conducted every even-numbered year starting in 2008. The KLoSA collects data regarding social, financial, and health categories. The population of the KLoSA includes all adults aged 45 years and older. Households are selected using a multistage stratified sampling method based on geographical area. Of the 6,892 persons who participated



Covariates included gender, age, income, number of chronic diseases, physical function, and depressive symptoms; T1=2012; T2=2014.

Figure 1. Research framework of this study.

in the 4th and 5th waves of survey, 3,721 persons aged 65 and older were included in this study. A total of 3,473 individuals were finally selected for the analysis after excluding 248 individuals with missing values.

Individuals were divided into three groups with reference to the level of cognitive function from the 4th wave of survey. Cognitive function was assessed using the Korean Mini-Mental State Examination (K-MMSE), which ranges from 0 to 30. Lower scores indicate more cognitive impairment. Based on the K-MMSE scores, study participants were classified into three groups: 1) normal cognitive function ($24 \leq \text{K-MMSE} \leq 30$), 2) mild cognitive impairment ($18 \leq \text{K-MMSE} \leq 23$), and 3) moderate and severe cognitive impairment ($\text{K-MMSE} \leq 17$)[20]. All data released by the Korea Employment Information Service were de-identified.

3. Measures

1) Health

Health was measured as the subjective health status. Subjective health status refers to the level of self-perceived health status and is a major health index that identifies the individual's overall health status [21]. In the KLoSA, the subjective health status was measured using one item "What do you think of your health condition?" with a five-point Likert scale ranging from "best" to "bad." For the purposes of this study, the higher the score, the better the health status using reverse coding.

2) Social activities

Social activities are formal activities working with other members in the community, which is based on Rowe and

Kahn's emphasis on interpersonal relationships [2,8]. The KLoSA measured the extent of participation in seven types of social activities using the question: "Do you participate in any of the following activities?" The seven types of activities included: 1) religious activities, 2) friendship gatherings (e.g., senior centers), 3) leisure activities (e.g., leisure, culture, sports classes), 4) alumni activities (e.g., school or hometown alumni, clan meetings), 5) volunteer activities, 6) public activities (e.g., political parties, civic groups, profitable organizations), and 7) other activities. Each type of activity was coded as 0 or 1 depending on the individual's participation. The total score of social activities was calculated as the sum of the seven dichotomous items, ranging from a possible total of 0 to 7. Higher scores indicate that the individual participated in more social activities.

3) Covariates

Age, gender, household monthly income, number of chronic diseases, physical function, and depressive symptoms were selected as covariates based on previous literature [22,23]. The number of chronic diseases was the sum of diagnosed diseases among 10 listed chronic diseases (i.e., hypertension, diabetes, cancer, lung disease, liver disease, heart disease, cerebrovascular disease, mental problems, arthritis and urinary tract disease). Physical function was measured using 10 items of instrumental activities of daily living (e.g., grooming, housework, preparing meals). Each item was measured by three-point Likert scale from 1 (no help needed) to 3 (complete help needed). The total scores range from 10 to 30 with higher scores indicating the individual needs more help to perform instrumental activities of daily living. Depressive symptoms was meas-

ured using the 10-Item Center for Epidemiological Studies Depression Scale (CESD-10) indicating how much of a particular symptom the individual experienced over the last week. The CESD-10 consists of 10 items with a four-point Likert scale from 1 (less than one day) to 4 (all of the time). A total of 10 items ranges from 10 to 40 with higher scores indicating that the individual is more depressed. The test-retest reliability of the tool was .71 at the time of development [24], and the reliability was Cronbach's $\alpha = .80$ in another study [25].

4. Data Analysis

Demographic characteristics, social activities, and the health of the participants were calculated using descriptive statistics. In addition, the differences of general characteristics, social activities, and health by cognitive level group were tested using χ^2 test and one-way ANOVA. In the one-way ANOVA test, for equal-variance cases, the posttest analysis was performed using Scheffé's test; however, for the non-equal-variance cases, the posttest analysis was performed using the Dunnett T3 test after the Welch test.

Cross-lagged panel analysis (CLPA) was applied to examine the reciprocal causal relationship between social activities and health with reference to the levels of cognitive function. CLPA is the most appropriate longitudinal analysis based on quasi-experiment design for inferring causal relationships between variables using panel data collected at regular time intervals [26]. In particular, CLPA is effectively applicable to examine not only one-way (unidirectional) causal inferences (i.e., Does A cause B?) but also the reciprocal (bidirectional) causal relationship (i.e., Does A cause B and/or does B cause A?) between the variables. CLPA is a specific analysis method of structural equation modeling. In the CLPA model, variables X_1 and Y_1 at the first time-point are the exogenous variables, while variables X_2 and Y_2 at the second time-point are the endogenous variables [27]. To infer a reciprocal causal relationship between variable X and variable Y through CLPA, 1) X and Y must covary; and 2) the data measured at time 1 (X_1, Y_1) must precede the measured data at time 2 (X_2, Y_2). That is, the first occurrence of X_1 according to the measured time order may be the cause of Y_2 , but the later occurrence of Y_2 cannot be the cause of X_1 ; 3) Finally, the relationship between X and Y should not be a spurious relationship, and the basic procedure to do this is to statistically control for the effect of outside variables that may affect the relationship between X and Y.

In this study, after controlling for the covariates and au-

tocorrelation effects of the social activities and health, the reciprocal causal relationships were examined to determine whether the correlation coefficients between social activities (4th) and health (5th) and that between health (4th) and social activities (5th) are statistically significant. If both coefficients are significant, it is possible to infer a reciprocal causal relationship between the two variables, social activities and health. If only one coefficient is significant, it is possible to infer the unidirectional causal relationship. Descriptive statistics and difference tests were conducted with SPSS/WIN 21.0 and CLPA was tested using Mplus 7.0. The maximum likelihood estimation with robust standard errors was applied considering that the endogenous variables were not normally distributed in the CLPA model.

RESULTS

1. General Characteristics of the Participants

Table 1 shows the general characteristics of the 3,473 study participants. About 58.0% of the participants were female, and the mean age was 73.85 at the 4th wave of survey. By categorizing the study participants into three groups with reference to the level of cognitive function, three general health-related conditions (the number of chronic diseases, physical function and depressive symptoms) showed consistent patterns indicating that they were significantly worse in the following order in both waves of data: the normal cognition group, the mild cognitive impairment group, and the moderate/severe cognitive impairment group. For instance, older adults who are moderately or severely impaired in cognition are likely to have more chronic diseases, worse physical function, and more depressive symptoms compared to those who are cognitively intact or have mild cognitive impairment. Although we did not run a difference test between the two waves of data, the mean scores of most variables showed worsening condition over time except for depressive symptoms.

2. Levels of Subjective Health Status and Social Activity

Table 2 shows the levels of subjective health status and social activities among the three groups of older adults according to the levels of cognitive function. It also shows a similar pattern with general health-related conditions in Table 1 (i.e., the scores of perceived subjective health and social activities were the lowest in the group of older adults who were moderately or severely impaired in cog-

Table 1. General Characteristics of the Participants at Each Time Point

| Variables | Time | Total (N=3,473) n (%) or M±SD | Groups | | | χ ² or F | Post-hoc | p |
|-------------------------------------|------|-------------------------------------|---|--|---|---------------------|-----------|--------|
| | | | Normal ^a (n=2,053) n (%) or M±SD | MCI ^b (n=912) n (%) or M±SD | M-S CI ^c (n=508) n (%) or M±SD | | | |
| | | | Female [†] | 2012 | 2,016 (58.0) | | | |
| Age (year) | 2012 | 73.85±6.26 | 72.13±5.41 | 75.01±6.04 | 78.72±6.81 | 288.28 | c > b > a | < .001 |
| Income (10,000 won) | 2012 | 152.97±158.10 | 165.94±149.82 | 136.49±184.01 | 130.18±133.40 | 17.30 | a > b, c | < .001 |
| | 2014 | 148.89±162.63 | 161.65±164.54 | 129.05±155.93 | 132.94±161.98 | 15.68 | a > b, c | < .001 |
| Number of chronic diseases | 2012 | 1.63±1.29 | 1.46±1.21 | 1.80±1.31 | 2.04±1.42 | 54.07 | c > b > a | < .001 |
| | 2014 | 1.85±1.35 | 1.68±1.28 | 2.00±1.38 | 2.28±1.44 | 50.43 | c > b > a | < .001 |
| Physical function [‡] | 2012 | 10.87±2.95 | 10.26±1.18 | 10.73±2.35 | 13.61±5.92 | 309.87 | c > b > a | < .001 |
| | 2014 | 11.32±3.83 | 10.57±2.27 | 11.41±3.73 | 14.23±6.62 | 209.68 | c > b > a | < .001 |
| Depressive symptoms [§] | 2012 | 18.13±5.63 | 16.57±4.72 | 19.31±5.41 | 22.32±6.67 | 278.06 | c > b > a | < .001 |
| | 2014 | 17.75±5.20 | 16.70±4.53 | 18.57±5.30 | 20.52±6.20 | 134.98 | c > b > a | < .001 |

[†]Female; reference group=male; [‡]Instrumental Activities of Daily Living (10~30), lower scores indicate better physical function; [§]10-Item Center for Epidemiological Studies-Depression (CESD-10; 10~40), higher scores indicate higher levels of depressed symptoms; Normal=normal cognitive function group (K-MMSE ≥ 24); MCI=mild cognitive impairment group (K-MMSE: 18~23); M-S CI=moderate to severe cognitive impairment group (K-MMSE ≤ 17).

Table 2. Descriptive Results of Health and Social Activities

| Variables (Min~Max) | Time | Total (N=3,473) n (%) or M±SD (median) | Groups | | | F | Post-hoc | p |
|--------------------------------------|------|---|---|--|---|--------|-----------|--------|
| | | | Normal ^a (n=2,053) n (%) or M±SD (median) | MCI ^b (n=912) n (%) or M±SD (median) | M-S CI ^c (n=508) n (%) or M±SD (median) | | | |
| | | | Perceived subjective health (1~5) | 2012 | 2.72±0.85 (3) | | | |
| | 2014 | 2.64±0.86 (3) | 2.82±0.80 (3) | 2.48±0.84 (2) | 2.19±0.90 (2) | 143.16 | a > b > c | < .001 |
| Number of social activities (0~7) | 2012 | 0.87±0.74 (1) | 1.03±0.74 (1) | 0.75±0.70 (1) | 0.46±0.57 (0) | 158.91 | a > b > c | < .001 |
| | 2014 | 0.85±0.73 (1) | 1.00±0.74 (1) | 0.73±0.66 (1) | 0.45±0.60 (0) | 141.60 | a > b > c | < .001 |
| Religious activities | 2012 | 754 (21.7) | 486 (23.7) | 197 (21.6) | 71 (14.0) | | | |
| | 2014 | 588 (16.9) | 380 (18.5) | 159 (17.4) | 49 (9.6) | | | |
| Friendship gatherings | 2012 | 1,780 (51.3) | 1,219 (59.4) | 413 (45.3) | 148 (29.1) | | | |
| | 2014 | 1,848 (53.2) | 1,267 (61.7) | 422 (46.3) | 159 (31.3) | | | |
| Leisure activities | 2012 | 120 (3.5) | 88 (4.3) | 27 (3.0) | 5 (1.0) | | | |
| | 2014 | 158 (4.5) | 120 (5.8) | 30 (3.3) | 8 (1.6) | | | |
| Alumni activities | 2012 | 353 (10.2) | 306 (14.9) | 43 (4.7) | 4 (0.8) | | | |
| | 2014 | 299 (8.6) | 245 (11.9) | 44 (4.8) | 10 (2.0) | | | |
| Volunteer activities | 2012 | 19 (0.5) | 16 (0.8) | 3 (0.3) | 0 (0.0) | | | |
| | 2014 | 15 (0.4) | 14 (0.7) | 1 (0.1) | 0 (0.0) | | | |
| Public activities | 2012 | 4 (0.1) | 4 (0.2) | 0 (0.0) | 0 (0.0) | | | |
| | 2014 | 5 (0.1) | 4 (0.2) | 1 (0.1) | 0 (0.0) | | | |
| Other activities | 2012 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | | | |
| | 2014 | 40 (1.2) | 27 (1.3) | 6 (0.7) | 7 (1.4) | | | |

Normal=normal cognitive function group (K-MMSE ≥ 24); MCI=mild cognitive impairment group (K-MMSE: 18~23); M-S CI=moderate to severe cognitive impairment group (K-MMSE ≤ 17).

Table 3. Results of the Cross-lagged Panel Analysis

| Variables | Groups | | | | | | | | | | | |
|-------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | Normal | | | | MCI | | | | M-S CI | | | |
| | SA (T1) | Health (T1) | SA (T2) | Health (T2) | SA (T1) | Health (T1) | SA (T2) | Health (T2) | SA (T1) | Health (T1) | SA (T2) | Health (T2) |
| | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) |
| Health (T1) | | | 0.10** (0.02) | 0.33** (0.02) | | | 0.02 (0.03) | 0.28** (0.03) | | | 0.08 (0.04) | 0.25** (0.04) |
| SA (T1) | | | 0.40** (0.02) | 0.05* (0.02) | | | 0.42** (0.03) | 0.06* (0.03) | | | 0.40** (0.04) | 0.12** (0.03) |
| Female | -0.09** (0.02) | -0.10** (0.02) | -0.02 (0.02) | -0.01 (0.02) | -0.03 (0.03) | -0.12** (0.03) | 0.01 (0.03) | -0.03 (0.03) | 0.01 (0.04) | 0.01 (0.04) | -0.03 (0.04) | 0.01 (0.04) |
| Age (year) | -0.09** (0.02) | -0.10** (0.02) | -0.10** (0.02) | -0.08** (0.02) | -0.09** (0.03) | -0.05 (0.03) | -0.02 (0.03) | -0.02 (0.03) | -0.03 (0.05) | 0.06 (0.04) | 0.03 (0.04) | 0.05 (0.04) |
| Income (10,000 won) | 0.17** (0.04) | 0.13** (0.02) | 0.05* (0.02) | 0.04* (0.02) | 0.12** (0.04) | 0.08 (0.04) | 0.06 (0.03) | 0.05 (0.03) | 0.07 (0.04) | 0.13** (0.04) | -0.01 (0.04) | 0.13** (0.04) |
| Number of chronic diseases | 0.00 (0.02) | -0.28** (0.02) | -0.01 (0.02) | -0.15** (0.02) | 0.03 (0.04) | -0.28** (0.03) | -0.09** (0.03) | -0.17** (0.03) | -0.03 (0.05) | -0.22** (0.04) | 0.05 (0.05) | -0.12** (0.03) |
| Physical function | -0.02 (0.02) | -0.11** (0.02) | -0.08** (0.02) | -0.17** (0.03) | -0.08** (0.03) | -0.15** (0.03) | -0.10** (0.02) | -0.26** (0.03) | -0.16** (0.05) | -0.33** (0.04) | -0.11** (0.04) | -0.33** (0.04) |
| Depressive symptoms | -0.07** (0.02) | -0.13** (0.02) | 0.00 (0.02) | -0.16** (0.03) | -0.11** (0.03) | -0.22** (0.03) | -0.11** (0.03) | -0.15** (0.04) | -0.10* (0.05) | -0.25** (0.03) | -0.15** (0.04) | -0.17** (0.04) |

* $p < .05$, ** $p < .01$; Normal=normal cognitive function group (K-MMSE ≥ 24); MCI=mild cognitive impairment group (K-MMSE: 18–23); M-S CI=moderate to severe cognitive impairment group (K-MMSE ≤ 17); SA=social activity; β =standardized coefficient; SE=standard error.

dition, followed by the group of older adults with mild cognitive impairment, and those with normal cognitive function. These differences between the groups by cognitive function were statistically significant in both study waves. Among the seven types of activities, friendship gathering was the most frequent activity in which the older adults participated regardless of the participants' cognitive function, followed by religious activities, and alumni activities. However, the Korean older adults rarely participated in volunteer, public, and other activities.

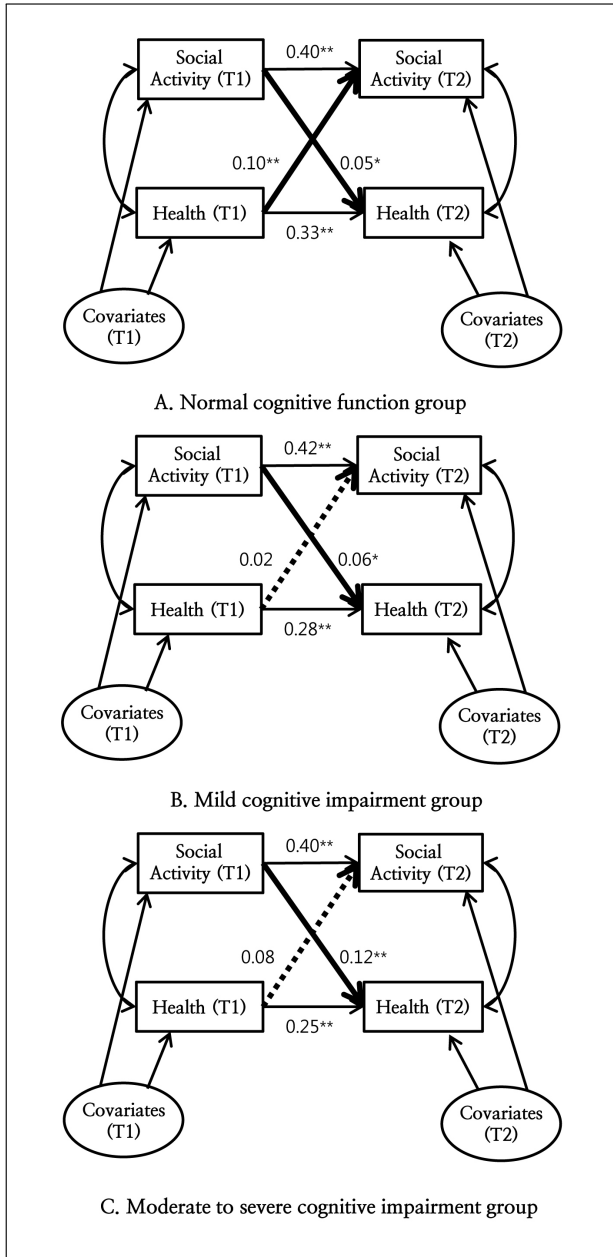
3. Results of CLPA between Social Activity and Health with Reference to Cognition Level

Table 3 and Figure 2 show the results of the analysis of the reciprocal causal relationship between social activities and health in the three groups (the normal cognitive function group, the mild cognitive impairment group, and the moderate/severe cognitive impairment group) after controlling for covariates. In the normal cognitive functioning group, social activities had a significant effect on health after two years ($\beta = .05$, $p = .021$), and health had a significant effect on participation in social activities after two years (β

$= .10$, $p < .001$), indicating that there was a significant reciprocal causal relationship. In the mild cognitive impairment and moderate/severe cognitive impairment groups, social activity had a significant effect on health after two years ($\beta = .06$, $p = .026$; $\beta = .12$, $p < .001$, respectively), but health did not have a significant effect on participation in social activities after two years ($\beta = .02$, $p = .493$; $\beta = .08$, $p = .069$, respectively). In all three groups, higher levels of participation in social activities were associated with higher scores of subjective health status after two years.

DISCUSSION

In this study, we examined the reciprocal causal relationships between social activities and health by level of cognitive function of community-dwelling older adults using CLPA. A major finding for all three groups was that higher levels of social activities are related to better perception of subjective health after two years, which means that participating in more social activities is effective in predicting higher health levels after two years for not only the older adults without cognitive impairment but also for those with mild and moderate/severe cognitive impair-



* $p < .05$, ** $p < .01$; Covariates included gender, age, income, number of chronic diseases, physical function, and depressive symptoms; T1=2012; T2=2014; All coefficients are standardized values.

Figure 2. Cross-lagged panel analysis results.

ment. In the analysis of the opposite path, better health status predicted higher levels of social activities after two years only in the group of older adults who were cognitively intact. Our results suggest that social activities and health have a reciprocal causal relationship in the group of older adults with normal cognitive function, and a causal relationship was found in social activities as a predictor of health for older adults with mild and moderate/severe

cognitive impairment.

A major finding of this study that older adults' participation in social activities is a predictor of better health is consistent with previous studies indicating that social activities have positive effects on physical [3,4], cognitive [5,7] and subjective well-being [8] for older adults. Even for those who are cognitively impaired, participation in social activities is a major requirement for maintaining and promoting health. In Korea, public care services for older adults with cognitive impairment or dementia in Korea are primarily treatment services in hospitals or long-term care services in nursing homes, but there are relatively few community-based services such as daytime care centers [28]. Moreover, community-dwelling older adults with a low level of cognitive function need various levels of support to help them participate in social activities and maintain interpersonal relationships. It is necessary to provide opportunities to participate in social activities with a focus on community resources such as public health centers, elderly welfare centers, day care centers, and dementia support centers. In addition, safe mobile and commuting services are necessary to improve accessibility to the resources for those with a low level of cognitive function.

Subjective health status was also found to be a determinant of participation in social activities after two years in the group of older adults who had normal cognitive function, which is consistent with the results of previous studies [22]. However, this causal relationship was not supported in the group of older adults who were cognitively impaired (both mild and moderate/severe impairment). Even if older adults who are cognitively impaired perceive their own health condition as good, there are many barriers to participating in social activities due to limited mobility support from the family or community. In other words, for older adults with cognitive impairment, the level of health perceived by the individual is insufficient to play an independent role as a predictor of social activity. In terms of policy, the Framework Act on Low Birth Rate in an Aging Society, article 14 (Encouragement of Leisure, Culture & Social Activities) prescribes that "the state and local governments should promote the leisure and cultural activities for older adults and establish a social basis to promote the participation of the older adults in social activities." However, the current implementation system and road map are still insufficient for community practices related to this policy. In academia, the major factors and mechanisms contributing to the participation of older adults' social activities with reference to the cognitive level are yet to be identified. Future studies are needed to ex-

amine what and how support of the family and community acts as a mediator of participation in social activities in order to provide evidence to develop relevant policies.

The descriptive analyses also showed significant differences in the participation of social activities according to the level of cognitive function in the elderly. Specifically, the number of social activities in which they participated was higher in the following order: normal cognitive function, mild cognitive impairment, and moderate/severe cognitive impairment. This is consistent with a previous study in which older adults who experienced severe cognitive function impairment and mild cognitive function impairment had a low level of participation in social activities compared to those who experienced no cognitive decline ($B=-1.09$, $p < .05$; $B=-0.92$, $p < .05$, respectively)[18]. Therefore, it is necessary to endeavor to improve the whole community environment such as the physical environment (e.g., traffic, roads and homes) and psycho-social environment (e.g., a sense of belonging) so that elderly people with cognitive impairment can maintain their participation in social activities. In western countries, the concept of “dementia-friendly communities” has been popular since the early 2000s, with the recognition of the need for a safe and accommodating community for older adults with dementia [29]. Since 2010, there has been active implementation of dementia-friendly communities and efforts have continued to enable older adults with dementia to safely and conveniently participate in community activities in a supportive atmosphere. In Korea, the Sosu Village in Buan-gun, Jeonbuk Province was selected as a pilot project for a rural type of “dementia-safe village” in August 2016.

To create a dementia-friendly environment, the level of awareness of dementia in the community is the most important factor. However, the Ministry of Health and Welfare reported that the level of dementia awareness was 64.7 out of 100, on average, nationwide, and 88.2% of the subjects did not have any education about dementia [15]. In particular, given that the general population has a negative social perception of cognitive impairment and dementia and there is a stigma of the disease compared to other diseases, it is necessary to systematically educate the public and raise fair awareness of dementia. This awareness could be important to create a supportive environment where older adults with cognitive impairment can be socially respected and treated like other person.

Although this longitudinal panel data analysis study is superior to the other cross-sectional studies, there are some limitations. The two-year period in this study might not be sufficient to explain the behavior and to adequately

observe health changes in older adults. Second, participation in social activities was calculated using the sum of seven types of activity items coded as dichotomous (yes or no) variables, so the quality of activity participation (i.e., frequency, commitment) was not considered in the measure of social activity.

CONCLUSION

This study aimed to examine the reciprocal causal relationship between social activities and health with reference to the cognitive function level among community-dwelling older adults. This results showed that a reciprocal causal relationship between social activities and health in all three groups regardless of the cognitive function level. However, current health status was not a predictor of future social activities in older adults with mild and moderate/severe cognitive impairment. Based on the study results, particularly the results related to the longitudinal effects of social activities on older adults' health in the group of those who have cognitive impairment, community interventions to promote social activities for older adults with cognitive impairment should increase. This could ultimately improve older adults' overall health status, which may in turn decrease the national-level social cost to care for older adults in the future.

Encouraging older adults to participate in social activities can support the concept of the “Aging in place (AIP).” AIP emphasizes that older adults should attempt to continue to stay in their homes and communities where they have lived while receiving adequate support or services despite disabilities or limitations [30]. AIP also highlights the preservation of self-reliant living in a familiar community with the individual's identity and intimate interpersonal relationships. To accomplish this goal., it is imperative to develop policy and institutional efforts for older adults with cognitive impairment to 1) provide more opportunities in the community and secure available community resources, 2) improve accessibility to social activities for the elderly by providing mobile and commuting services, and 3) create an aging-friendly community environment.

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