Changes in Social Relationships and Physical Functions in Community-Dwelling Older Adults

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ABSTRACT
Background: Social relationships are associated with physical function. However, little scholarly attention has been focused on the effect of changing social factors on physical function.

Purpose: This study was designed to examine the effects on physical function of changes in social relationships in adults aged 65 years and older.

Methods: This study is part of a longitudinal, prospective cohort study that was conducted on community-dwelling older adults in a suburban area of central Japan. Baseline self-report data were collected in 2011, and a follow-up survey was conducted in 2017. Social relationships were assessed using the Index of Social Interaction, and physical function was evaluated using a subscale of the Kihon Checklist. Chi-square tests, Mann–Whitney U tests, and multiple logistic regression analysis were used to analyze data from 442 older adults who were functionally independent at baseline.

Results: After controlling for covariates in 2011, negative changes in social relationships (odds ratio [OR] = 3.20, 95% CI [1.18, 8.69]) were found to be associated with physical function decline. Moreover, 1-point increases in the different social-relationship values between baseline and follow-up were associated with protective effects against functional decline (OR = 0.71, 95% CI [0.63, 0.80]). Furthermore, median trends between baseline and follow-up revealed associations between decreasing (OR = 4.18, 95% CI [1.53, 11.39]) and continuously low (OR = 2.98, 95% CI [1.42, 6.28]) social relationships and physical function decline.

Conclusions/Implications for Practice: The findings support a strong association between negative changes in social relationships and physical function decline and highlight the importance of promoting social relationships to delay physical function decline in older adults.

KEY WORDS: community-dwelling older adults, disability, nursing, social relationships.

Introduction
Decline in physical function is a common health problem in aging populations that has been shown to be related to depression (Conde-Sala et al., 2019), quality of life (Portellano-Ortiz et al., 2018), and mortality (Eekhoff et al., 2019) in older adults. This, in turn, increases the need for long-term care, which increases the economic burden on society. Thus, measures to maintain physical function in older adults should be taken into consideration to avoid negative health outcomes.

Social relationships have been proposed as an important factor affecting health outcomes. Previous studies have shown that older adults with few social interactions are more likely to experience adverse health outcomes such as increased depression and anxiety (Santini et al., 2020), decline in cognitive function (Shankar et al., 2013), and increased mortality (Gronewold et al., 2020). Conversely, individuals with rich social participation are more likely to report a good health status (Jerliu et al., 2014). Social support contributes to better health-related quality of life in older adults (J. Kim & Lee, 2018). Moreover, it has been argued that the effects of social relationships on health may be equal to or greater than well-established risk factors such as smoking, drinking,

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and physical inactivity (Holt-Lunstad et al., 2010). Thus, maintaining social relationships is an important factor contributing to successful functioning in older populations.

Regarding physical function, the results of previous studies indicate that people with inactive social relationships are more likely to be affected by physical limitations in terms of, for example, having lower functionality on both basic and instrumental activities of daily living (Ćwiklej-Sozańska et al., 2019; Fujiwara et al., 2016) and experiencing a high incidence of functional disability (Teo et al., 2017). The relevant literature has focused primarily on the effect of social relationships on physical function at one time point only, whereas the effects of changes in social relationships on a decline in physical function remain underexamined. Considering that social relationship status may change over time (Lang, 2001), further studies are necessary to explore and extend the current understanding regarding the effects of social relationships on health outcomes at more than one time in older populations.

This study was developed to identify the effects of changes in social relationships on the incidence of physical function decline at two time points to provide evidence to inform both policy and future research. We hypothesized the following: (a) Negative changes in social relationships over time are associated with an increased risk of physical function decline, and (b) a declining trend in social relationships between two time points is a predictor of risk of physical function decline over the long term.

**Methods**

**Design and Participants**

This 6-year longitudinal study used data from a single-center cohort project entitled the “Community Empowerment and Care for Well-Being and Healthy Longevity: Evidence From a Cohort Study” (Anme, 2015), which started in 1991. This survey was conducted in a suburban area in central Japan with a population of around 4,500. Questionnaires were mailed to all of the residents, and interviews were conducted with people who needed assistance in completing the questionnaires.

In this study, data collected during the abovementioned study from individuals aged 65 years or older in 2011 and 2017 were used, respectively, as baseline and follow-up data. In 2011 (baseline), 787 individuals with normal physical function were initially enrolled as participants. Then, in 2017, a follow-up was conducted to assess the incidence of physical function decline among these participants. In the analysis, data from 442 participants were used after excluding participants in the initial group who were lost to follow-up or had missing data in any one of the included variables.

**Measurements**

**Social relationships**

Social relationships were evaluated using the Index of Social Interaction (ISI). The Cronbach’s alpha value for the ISI was calculated as .78, showing high validity and reliability for application among Japanese community residents (Anme, 1997). The ISI includes 18 items comprising five subscales and evaluates a range of social interaction types. The five subscales are as follows: (a) independence (motivation to live, taking an active approach toward life, being motivated to live a healthy life, and having a regular lifestyle), (b) social curiosity (reading newspapers and/or books, trying new equipment [e.g., a video], having hobbies, and a feeling of importance in society), (c) interaction (with family members and nonfamily members), (d) participation (social groups, neighborhood groups, watching television, and playing an active social role), and (e) feelings of safety (having someone to offer counsel and people who can be of support in emergencies). For each item, 0 was assigned when participants answered “rarely” and 1 was assigned when an answer of “always,” “often,” or “sometimes” was given. The total score is equal to the sum of each subscale and ranges from 0 to 18, with higher scores indicating better social interaction.

To assess the effects of changes in social relationships over the 6-year study period, the changes in total ISI scores were first calculated. Changes in ISI scores were assessed by subtracting the 2011 scores from the 2017 scores, with values of 0 and higher indicating a steady or positive change and values below 0 indicating a negative change in social relationships. The steady group was treated as the reference group. Second, the value representing the change in ISI was treated as a continuous variable to examine the effect of 1-point increases in social relationships on physical function. Third, because the ISI score distribution was skewed, we used the median ISI score at baseline (ISI = 17) to split participants into a high group (ISI = 18) and a low group (ISI ≤ 17) and the median ISI score at follow-up (ISI = 16) to split participants into a high group (ISI = 18, 17) and a low group (ISI ≤ 16). Next, we assigned the participants to one of four groups: high to low, low to high, low to low, and high to high (reference). The “high-to-low” group included those whose ISI equaled 18 at baseline and was ≤ 16 at follow-up, the “low-to-high” group included those whose ISI was ≤ 17 at baseline and equaled 17 or 18 at follow-up, the “low-to-low” group included those whose ISI was ≤ 17 at baseline and ≤ 16 at follow-up, and the “high-to-high” group included those whose ISI equaled 18 at baseline and was 17 or 18 at follow-up.

**Physical function**

The physical function of the participants was evaluated using the physical strength subscale of the Kihon Checklist (Fukutomi et al., 2013), which is a comprehensive self-report health checklist designed by Japan’s Ministry of Health, Labour and Welfare. The physical strength subscale has been shown to be a valid instrument for assessing physical function in older adults (Hirose et al., 2017). The subscale’s five items are as follows: (a) “Do you normally climb stairs without support from handrails or a wall?” (b)
“Do you normally stand up from a chair with no aids?” (c) “Do you normally walk for 15 minutes continuously?” (d) “Have you had an experience of falling in the past year?” and (e) “Are you afraid of falling while walking?” For Questions 1–3, the items are scored as 1 = no and 0 = yes, whereas 1 = yes and 0 = no are used for Questions 4 and 5. On the basis of these five questions, participants scoring ≥ 3 were classified as experiencing physical function decline, whereas lower scores were considered within the normal range. Validation of the physical strength domain was established in prior research (Hirose et al., 2017; Satake et al., 2020).

**Covariates**

On the basis of previous studies (Makizako et al., 2019; Tomioka et al., 2017), the covariates used in this study were age, gender, exercise, drinking, smoking, and medical history. The number of chronic diseases was calculated based on participant self-reports of having hypertension, stroke, heart disease, diabetes, hyperlipidemia, lung disease, osteoarticular disease, cancer, immune disease, depression, dementia, eye disease, and ear disease. Age was treated as a continuous variable. Exercise was evaluated by asking participants, “Do you usually exercise?” The participants were classified as physically active if the answer was “always” or “sometimes” and physically inactive if less-frequent responses were given. Drinking status was assessed using one item, “Do you drink?”, with the answer then coded as “every day” if they answered daily drinking and “other” if they gave other answers. Smoking status was classified as current smoker, ex-smoker, and nonsmoker for the respective answers of “every day” or “sometimes,” “smoked but now stopped,” or “do not smoke.”

**Statistical Analysis**

Chi-square (\( \chi^2 \)) tests were used for the categorical variables. Mann–Whitney U tests were used for continuous variables because the distributions were not normal. Logistic regression analysis was used to investigate the association between total changes in social relationships and physical function decline after adjusting for covariates. Moreover, another model was set to assess the association of subgroup trend changes in social relationships and physical functional decline. Data were analyzed using IBM SPSS Statistics Version 22.0 (IBM Inc., Armonk, NY, USA).

**Ethical Considerations**

This study was approved by the ethics committee of the university (Approved Number 1331). The data were anonymized and provided by the municipality via written contracts.

**Results**

Data from 442 participants were analyzed (see Table 1). Over half of the participants were women (53.4%), always/sometimes exercised (66.1%), were non-everyday drinkers (79.6%), and were nonsmokers (63.6%). Two fifths (40%) of the participants had one chronic disease, and 19.7% showed a decline in physical function after 6 years.

As shown in Table 2, the variables of age, exercise, and drinking were significantly associated with those participants who developed self-reported physical function decline after 6 years \( (p < .05) \). Moreover, compared with their normal-function peers, the participants with functional decline were more likely to show negative changes in social relationships \( (p = .001) \), have lower social relationship scores \( (p < .001) \), and be in the “low-to-low” or “high-to-low” group \( (p < .001) \).

The multiple logistic regression model revealed a higher risk of physical function decline in participants with negative changes in ISI scores \( (\text{odds ratio} = 3.20, 95\% \text{ CI [1.18, 8.69]}) \) compared with participants who had maintained social relationships \( \text{(reference) for the 6-year study period. Moreover, those participants showing positive changes in their social relationships revealed no significant decline in physical function} \ (p = .930; \text{see Table 3}). The association between changes in ISI score (the score change was taken as the continuous variable) and functional decline is shown in Table 4, with the results, after controlling for confounding variables, indicating an association between positive change in ISI score and lower risk of functional decline \( (\text{odds ratio} = 0.71, 95\% \text{ CI [0.63, 0.80]}) \).

**Table 1**

Demographic Characteristics of Participants at Baseline \( (N = 442) \)

| Characteristic              | n   | %    |
|----------------------------|-----|------|
| Age (years; mean and SD)   | 71.9| 5.8  |
| Gender                     |     |      |
| Male                       | 206 | 46.6 |
| Female                     | 236 | 53.4 |
| No. of chronic diseases    |     |      |
| 0                          | 121 | 27.4 |
| 1                          | 177 | 40.0 |
| ≥ 2                        | 144 | 32.6 |
| Exercise                   |     |      |
| Always/sometimes           | 292 | 66.1 |
| Do not                     | 150 | 33.9 |
| Drinking                   |     |      |
| Every day                  | 90  | 20.4 |
| Other                      | 352 | 79.6 |
| Smoking                    |     |      |
| Current smoker             | 55  | 12.4 |
| Ex-smoker                  | 106 | 24.0 |
| Nonsmoker                  | 281 | 63.6 |
| ISI (median and [Q25–Q75]; 2011) | 17 | 16–18 |
| ISI (median and [Q25–Q75]; 2017) | 16 | 14–17 |
| Physical function          |     |      |
| Normal                     | 355 | 80.3 |
| Decline                    | 87  | 19.7 |

Note. ISI = Index of Social Interaction.
In the subgroup trend analysis of social relationships (see Table 5), compared with the group with high baseline and high follow-up (reference), the risk of physical function decline was higher in the groups with high or low ISI scores at baseline and low ISI scores at follow-up. This indicates that negative changes or continuing negative trends in ISI

### Table 2
**The Association Between Characteristics at Baseline and Physical Function (N = 442)**

| Characteristic                                      | Physical Function | $\chi^2/Z$ | $p$ |
|-----------------------------------------------------|-------------------|------------|-----|
|                                                     | Normal (n = 355)  |             |     |
|                                                     |                  | $n$        | %  |     |
|                                                     | Decline (n = 87)  |             |     |
|                                                     |                  | $n$        | %  |     |
| Age (years; mean and SD)                            | 70.8              | 4.8        | 76.7 | 6.8 | -7.461 | < .001 |
| Gender                                              |                   |            |      | 1.770 | .183 |
| Male                                                | 171               | 48.2       | 35   | 40.2 |
| Female                                              | 184               | 51.8       | 52   | 59.8 |
| No. of chronic diseases                             |                   |            |      | 5.635 | .060 |
| 0                                                   | 106               | 29.9       | 15   | 17.2 |
| 1                                                   | 138               | 38.9       | 39   | 44.8 |
| ≥ 2                                                 | 111               | 31.2       | 33   | 38.0 |
| Exercise                                            |                   |            |      | 7.004 | .008 |
| Always/sometimes                                    | 245               | 69.0       | 47   | 54.0 |
| Rarely                                              | 110               | 31.0       | 40   | 46.0 |
| Drinking                                            |                   |            |      | 5.253 | .022 |
| Every day                                           | 80                | 22.5       | 10   | 11.5 |
| Other                                               | 275               | 77.5       | 77   | 88.5 |
| Smoking                                             |                   |            |      | 2.620 | .270 |
| Current smoker                                      | 48                | 13.5       | 7    | 8.0  |
| Ex-smoker                                           | 87                | 24.5       | 19   | 21.8 |
| Nonsmoker                                           | 220               | 62.0       | 61   | 70.2 |
| Change in social relationships (grouped by different values) |                   |            |     | 14.477 | .001 |
| Positive                                            | 46                | 13.0       | 4    | 4.6  |
| Negative                                            | 247               | 69.6       | 78   | 89.7 |
| Steady                                              | 62                | 17.4       | 5    | 5.7  |
| Change in social relationships (continuous variable; mean and SD) | | $\chi^2/Z$ | $p$ |
| High to low                                         | 22                | 6.2        | 12   | 13.8 |
| Low to high                                         | 89                | 25.1       | 6    | 6.9  |
| Low to low                                          | 127               | 35.7       | 57   | 65.5 |
| High to high                                        | 117               | 33.0       | 12   | 13.8 |

### Table 3
**Changes in Social Relationships (Grouped by Values Difference) and Physical Function Decline**

| Variable                                           | Unadjusted Model | Adjusted Model | $p$  | $p$  |
|-----------------------------------------------------|------------------|----------------|------|------|
|                                                     | OR               | CI             |      |      |
|                                                     | OR               | CI             |      |      |
| Age                                                 | 1.19             | [1.14, 1.25]   | < .001 | < .001 |
| Exercise                                             | 1.88             | [1.17, 3.05]   | .009  | .004  |
| Drinking                                             | 0.45             | [0.22, 0.90]   | .025  | .065  |
| Change in social relationships                       | 3.92             | [1.52, 10.08]  | .005  | .022  |
| Negative                                             | 1.08             | [0.27, 4.23]   | .914  | .930  |
| Positive                                             | Ref              | Ref            |      |      |

Note: OR = odds ratio; CI = confidence interval.
score are predictive of physical function decline. However, people with low baseline and high follow-up scores showed less physical function decline. Thus, the findings support the beneficial effect of social relationships on physical function maintenance in older adults.

**Discussion**

The effects of changes in social relationships on physical function status in a population of community-dwelling older adults were examined in this study. After 6 years and controlling for potentially confounding factors, negative changes in social relationships were shown to be markedly related to physical function decline. Furthermore, 1-point increases in the different values were shown to have protective effects in terms of preventing functional decline. Finally, the trend subgroup analysis revealed that participants with low median ISI scores at follow-up faced a higher risk of physical function decline, regardless of their baseline ISI scores.

The results of this 6-year longitudinal study indicate that negative social relationships are a factor influencing physical function decline, whereas positive changes in social relationship status have a protective effect on physical function. These findings are consistent with another longitudinal study in which decreased social relations were found to increase the incidence of adverse health outcomes (Davies et al., 2021). Another study revealed a link between having few social relations and functional decline (Mendoza-Núñez et al., 2017). Social relationships provide people with information on health, which may affect health behaviors and influence functional status (Umberger & Montez, 2010).

The key contribution of this study was the subgroup analysis of social relationship changes, the findings of which suggest that negative changes in or negative continuations of social relationships may lead to physical function decline. B. Kim et al. (2015) conducted a 3-year longitudinal study to examine patterns of change in social relations, finding that older adults who remained in or changed to restricted types of social relations reported poor health status over time. Similarly, a multicenter, population-based cohort study revealed restricted social relationship types, including interactions with friends and families, to be related to higher mortality rates than broader social relationship types (Santini et al., 2015). These previous studies focused on patterns in social relationships and did not examine the influence of change in social relationships over time. This study identified different categories of change in social relationships using score differences between two time points and assessed the impact of these differences on physical function over a 6-year time frame. These analyses revealed improving or maintaining

### Table 4

| Variable                              | Unadjusted Model | Adjusted Model |
|---------------------------------------|------------------|----------------|
|                                       | OR   | 95% CI   | p   | OR   | 95% CI   | p   |
| Age                                   | 1.19 | [1.14, 1.25] | < .001 | 1.16 | [1.10, 1.22] | < .001 |
| Exercise                              | 1.88 | [1.17, 3.05] | .009  | 2.01 | [1.14, 3.55] | .016  |
| Drinking                              | 0.45 | [0.22, 0.90] | .025  | 0.47 | [0.21, 1.05] | .065  |
| Change in social relationships         | 0.66 | [0.58, 0.74] | < .001 | 0.71 | [0.63, 0.80] | < .001 |

*Note. OR = odds ratio; CI = confidence interval.*

### Table 5

| Variable                              | Unadjusted Model | Adjusted Model |
|---------------------------------------|------------------|----------------|
|                                       | OR   | 95% CI   | p   | OR   | 95% CI   | p   |
| Age                                   | 1.19 | [1.14, 1.25] | < .001 | 1.16 | [1.11, 1.22] | < .001 |
| Exercise                              | 1.88 | [1.17, 3.05] | .009  | 1.73 | [0.98, 3.05] | .057  |
| Drinking                              | 0.45 | [0.22, 0.90] | .025  | 0.40 | [0.18, 0.88] | .022  |
| Change in social relationships (subgroup by medians) |       |             |     |       |             |     |
| High to low                           | 5.32 | [2.12, 13.35] | < .001 | 4.18 | [1.53, 11.39] | .005 |
| Low to high                           | 0.66 | [0.24, 1.82] | .419  | 0.62 | [0.21, 1.79] | .377  |
| Low to low                            | 4.38 | [2.24, 8.56] | < .001 | 2.98 | [1.42, 6.28] | .004  |
| High to high                          | Ref   | Ref         |       | Ref   | Ref         |     |

*Note. OR = odds ratio; CI = confidence interval.*
positive social relationships as a protective factor against physical function decline. Our findings extend the “changing concept” of social relationships, with both the type and degree of change in social relationships found to relate to physical function.

Most notably, those participants with low levels of social participation at baseline who had increased their social interactivity at follow-up showed relatively less physical function decline. Thus, older adults who strengthen/maintain their social relations in later life may realize benefits in terms of physical function maintenance. A previous longitudinal study conducted over a 17-year period reported on the benefits for older adults of maintaining their level of social interactivity (Finkel et al., 2018). Moreover, Johnson and Barer (1992) suggested that older people continue their social routines as they age and reported that approximately 50% of their 150 older participants (mean age = 89 years) maintained some level of social involvement. These findings may be supported by selectivity theory, under which socioemotional aging supports a shift in which older people narrow their social network activity but maintain good relationships to continue steady social participation with friends, family members, and others in later life (Carstensen et al., 2003). This may promote better health outcomes in older adults. Therefore, it may be possible to reduce the risk of physical function decline in older adults with poor social interactions by promoting social relationships.

This study has several strengths. First, the findings add to the growing body of evidence for the association between changes in social interaction and physical function. Continued enrichment of social interactivity may be a predictor of a lower incidence of physical impairment in older adults. Second, the level of social relationships was examined in this study, which contributed to scholarly research on how changes in social relationships in terms of both type and level of involvement may affect physical function. Third, the ISI measurement was employed in this study to evaluate the various aspects of regular social activities.

Several limitations of this research should be acknowledged. First, the potential confounding factors analyzed in the study were age, gender, medical history, exercise, drinking, and smoking. Other potential confounders such as living status, marital status, educational level, socioeconomic status, and disease categories were not considered. Second, the limited sample size led to a wider confidence interval in the subgroup trend analysis of social relationships. Thus, further studies with larger sample sizes should be conducted. Moreover, the high attrition rate may decrease the validity of the results. Third, physical function was assessed using subjectively reported information. Future studies should include objective measurements, although previous studies have shown that subjective evaluations are generally an acceptable substitute for objective evaluations (Beauchamp et al., 2015). Fourth, data were analyzed at 2 times only (baseline and 6-year follow-up). To further examine the effects of social interactivity on physical function, the trajectory of social relationships based on more data collection times should be taken into consideration in future research. Fifth, we did not assess the extended effects of changes in social relationships on physical status (e.g., considering the degree of positive change).

Conclusions
Maintaining or improving positive social relationships may serve as a protective factor against physical function decline in people aged 65 years and older. Health professionals should pay attention to the longitudinal effects of social relationships on health outcomes and actively take measures to promote social participation to improve successful aging and longevity in older adults.

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Data collection: All authors
Data analysis and interpretation: DJ, KWM
Drafting of the article: DJ, TA
Critical revision of the article: TA

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