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Higher-Level Functional Capacity Associated with Social Frailty in Community-Dwelling Older Adults

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Abstract

***Objectives:** This study aimed to investigate the relationship between higher-level functional capacity and social frailty in community-dwelling older adults.*

***Methods:** This cross-sectional study involved 63 older adults aged 74.7 years on average. Higher-level functional capacity was evaluated using a questionnaire-based scale called the Japan Science and Technology Agency Index of Competence. Social frailty was defined using a questionnaire with five questions. We also assessed for physical frailty, grip strength, walking speed, and appendicular skeletal muscle mass. The factors contributing to the Japan Science and Technology Agency Index of Competence were investigated using multiple regression analyses.*

***Results:** The median score of the Japan Science and Technology Agency Index of Competence was 11.0. The prevalence and total scores of social frailty were 27.0% and 1.0 point. The Japan Science and Technology Agency Index of Competence was significantly associated with social frailty (β = -0.438) and walking speed (β=0.353).*

***Conclusions:** This study demonstrated the significant associations between higher-level functional capacity and social frailty in community-dwelling older adults.*

Keywords: *Japan Science and Technology Agency Index of Competence; Social status; Waking speed; Community-dwelling older adults; Pilot cross-sectional study.*

Introduction

Higher-level functional capacity is the comprehensive ability required for older adults to live independently and actively[1]. Lawton defined and systemized seven stages of competence for older adults, from the lowest and most basic function to the highest. The stages were, in ascending order of complexity, arranged such as life maintenance, functional health, perception and cognition, physical self-maintenance, instrumental self-maintenance (instrumental activities of daily living: IADL), effectance, and social role[1)]. Among them, Lawton positioned IADL, effectance, and social role as higher-level functional capacity. It is especially important for older adults to maintain their abilities for living independently and participate in social activities to extend their healthy life expectancy. Decreased higher-level functional capacityhas been associated with muscle mass, muscle strength, and physical performance[2], as well as with dietary variety[3] and health behaviors, including oral health[4, 5]. In other words, loss of higher-level functional capacity in older adults can lead to a deterioration of their general health. Such capacity should be maintained to ensure the general health and independent living of older adults.

Meanwhile, apart fromthe deterioration of individual function and behaviors (e.g., decreased physical function and health care, intemperance), social statusisalso related to higher-level functional capacity. An eight-year longitudinal survey that used the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) suggested that older adults are likely to lose their social role with advancing age[6]. In older adults, the decline of higher-level functional capacity has a negative impact on social aspects as well. Indeed, recent reports have indicated that social disconnectedness and perceived isolation are factors associated with physical health in older adults[7–9]. Therefore, in assessing older adults'ability to live independently, attention must be given to social aspects as an indicator. However, few studies have examined the effects of higher-level functional capacity on the social aspects among modern older adults.

Social frailty is one of the indicators that reflectthe negative social aspects in older adults and is interrelated with the physical and psychological components of frailty.Social frailty has been shown to be associated with both physical functions measured by grip strength and walking speed and cognitive function[10]. A study reported that participants with social frailty show a risk of approximately 1.7 times for disability incidence compared with those with normal status[11]. Thus, the assessment of social frailty should include the social aspects that are essential for healthy independent living among older adults.

Therefore, we hypothesized that social frailty and decline in individual function may be related to the capacity to live independently in older adults. The present study aimed to investigate the relationship between higher-level functional capacity and social frailty in community-dwelling older adults.

Materials and Methods

Study Design and Participants

This pilot cross-sectional study involved 108 community-dwelling older adults (19men, 89women). They were recruited through local senior centers and local newspaper advertisements in Ibaraki City. The inclusion criteria were as follows: aged 65 years or older, able to walk by themselves (regardless of the use of walking aids), and able to understand and follow our instruction. The exclusion criteria were as follows: participants who needed supportor participants who were assigned to a community support project. The participants in acommunity support projectwere older adults who were at high risk for requiring support based on the Kihon Checklist (KCL), butdid not require long-term care. Finally, data from 63 community-dwelling older adults (mean age 74.7 ± 6.3 years, 12 men, 51 women, 81.0% women) were analyzed (Fig. 1). This study was approved by the research ethics committee of Aino University (2019-011)and was conducted in compliance with the Declaration of Helsinki. We provided a verbal explanation of the purpose of this study to and obtained written informed consent from all participants.

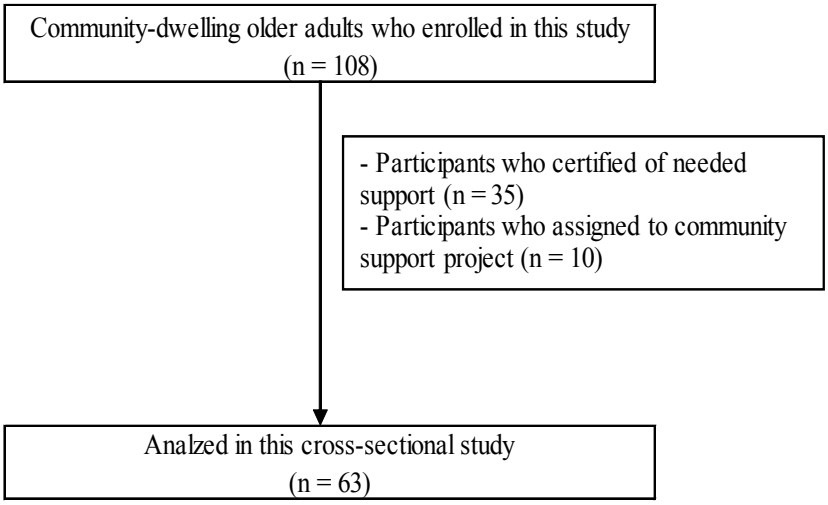

Figure 1. *Participant inclusion criteria flowchart*

Basic Characteristics

From August to December 2019, we measured the height and body weight of all participants. Using questionnaires, we examined the participants' socio demographic characteristics (age, sex), cognitive function, number of medications, chronic diseases (e.g., hypertension, hyperlipidemia, diabetes), higher-level functional capacity, physical frailty, and social frailty. Subsequently, all participants were assessed for grip strength, walking speed, and appendicular skeletal muscle mass.

For the assessment of cognitive function,we used the cognitive part of KCL consisting of 25 yes/no questions. This cognitive part is called the KCL-Cognitive Function (KCL-CF), which consists of three yes/no questions about subjective memory complaints (questions 18, 19, and 20)[12, 13]. The questions are as follows: (1) "Do your family or your friends point out your memory loss?"; (2) "Do you make a call by looking up phone numbers?"; (3) "Do you find yourself not knowing today's date?". We used the total score of these three questions. KCL-CF has been shown to predict incident dementia[13].

Assessment of Higher-Level Functional Capacity

Higher-level functional capacity was evaluated using a questionnaire-based scale called the Japan Science and Technology Agency Index of Competence (JST-IC) (Table 1)[14-16]. The evaluation scale of JST-IC considers the lifestyles of modern older adults (e.g., the use of mobile phones) that cannot be evaluated by TMIG-IC.The JST-ICconsists of four categories regarding "usage of technology,""collecting information and health literacy,""daily life management," and "social participation". Further, a questionnaire consists of 16 items belonging to four factors (four items per category) identified through factor analysis. The score in the JST-IC was the number of ''Yes'' answers, with a maximum score of 16 points, with higher scores indicating higher competence.

Table 1. *Japan Science and Technology Agency Index of Competence (JST-IC)*

Domain	Item
Usage of technology	
	1) Can you use a mobile phone?
	2) Can you use the ATM?
	3) Can you operate a video recorder, such as a Blu-ray recorder or DVD player?
	4) Can you send an e-mail using a mobile phone or computer?
Collecting information and health literacy	5) Are you interested in news and events from overseas?
	6) Can you determine the credibility of health-related information?
	7) Do you enjoy art, films or music?
	8) Do you watch educational/cultural programs?
Daily life management	9) Do you follow any measures to prevent yourself from becoming a victim of crimes, such as fraud, purse snatching and a sneak thief?
	10) Do you try to be creative while doing daily tasks (i.e., cleaning, cooking)?
	11) Can you take care of an ill person?
	12) Do you take care of your grandchildren, family members, or acquaintances?
Social participation	13) Do you participate in regional festival or events?
	14) Do you participate in neighborhood association or a residents' association?
	15) Would you be able to assume a managerial position, such as an organizer in a residents' association or group activities?
	16) Do you engage in charity or volunteer activities?

The participants were asked to choose 'Yes (able to do)' or 'No (unable to do)' for each question; answer scored 1 point for 'yes' and zero for 'no'. Source: Suzuki T. (2018).[16]

Assessment of Physical and Social Frailty

For determining physical frailty, we used the criteria applied in a large-scale cohort study in Japan that amended the Cardiovascular Health Study (CHS) scale developed Freid et al.[17, 18]. The CHS scale is composed of five conditions: (1) shrinking, measured as weight loss; (2) weakness, measured as grip strength; (3) poor endurance and energy, measured by questionnaires; (4) slowness, measured as decreased walking speed; and (5) low physical activity level, measured by questionnaires, defined as endorsing three or more items, with the total score being taken as representative.Physical frailty has been reported to be significantly associated with instrumental activities of daily living (IADL) limitation[19].

To assess the participants' social frailty, we used a five-item questionnaire: living alone (yes), going out less frequency compared with last year (yes), sometimes visiting friends (no), feeling helpful toward friends or family (no), and talking with someone every day (no)[11]. Participants matching two or more components were considered frail, with the total score being taken as representative.Social frailty reportedly exacerbates IADL disability in community-dwelling older adults[20].

Assessment of physical function

Grip strength and walking speed were measured as physical function assessments. Grip strength was measured twice on each hand using a dynamometer (Digital Handgrip Meter KEEP, MACROSS Inc. Tokyo, Japan) in a standing position, and the maximum value was taken as representative.For measuring walking speed, we asked the participants to walk once on a flat surface at their comfortable walking speedfor 6 m. Two markers indicated the start and end of the 6-m path, and the acceleration and deceleration paths were set at 1 m apart from the 6-m path.

Appendicular skeletal muscle mass was assessed via multifrequency bioelectrical impedance analysis using In BodyS10 (InBody Japan, Tokyo, Japan). In BodyS10 uses a tetrapolar, eight-point tactile electrode system that separately measures impedance of the arms, trunk, and legs at six different frequencies (1, 5, 50, 250, 500, and 1,000 kHz) for each segment. The posture at measurement is standing barefoot on the measuring equipment. Pinching-type electrodes are attached to the thumbs and middle fingers of the upper extremities and to the heels of the lower extremities. We derived skeletal muscle mass as the sum of the muscle mass of the four limbs, and then calculated the skeletal muscle index (SMI; kg/m^2). Low muscle mass has shown a significant association with IADL disability in Japanese older adults[2].

Statistical Analysis

Data are expressed as a mean ± standard deviation or median (interquartile range) or frequency (percentage) values. We used the Shapiro–Wilk test to examine the normality of the variables. We also conducted Spearman's rank-order correlations to assess the associations between the JST-IC and the following measured variables: age, sex (0 = female, 1 = male), the KCL-CF, chronic diseases (0 = no, 1 = yes), the total physical frailty score, the total social frailty score[21], grip strength, walking speed, and SMI. A multiple regression analysis using a forced entry method was conducted with the JST-IC as the independent variable; each physical function that was significantly related to the JST-IC as the dependent variables with age and sex as confounding factors.To confirm multicollinearity between input variables, we calculated the variation inflation factor (VIF). SPSS 26 for Windows (IBM Japan Tokyo, Japan) was used for all analyses. Statistical significance was set at $P<0.05$.

Results

Table 2 summarizes the characteristics and outcome measures of the participants. Overall, the medianscore of JST-IC was 11.0 (9.0–13.0) points. Of 63 participants, five (7.9 %) showed physical frailty and 17 (27.0 %) showed social frailty. The median total scores for physical and social frailty were 1.0 (0.0–1.0) and 1.0 (0.0–2.0) points, respectively. Two participants with pacemakers were excluded from SMI measurement.

The correlations between the JST-IC scores and the measured outcomes are shown in Table 3. The JST-IC scores were significantly correlated with social frailty, grip strength, and walking speed, and showed a tendency to increase with age. Table 4shows the results of the multiple regression analyses. The multiple regression analysesindicated that social frailty (β= -0.438) and walking speed (β= 0.353) were independent determinants of the JST-ICscore. The adjusted $R^2$was .185. As all VIFswere <10.0, the possibility of multicollinearity was low.

Table 2. *Characteristics of the study participants (N = 63)*

Characteristics	Mean ± SD or median (IQR) or frequency (%)
Age (years)	74.7 ± 6.3
Women, *n* (%)	51 (81.0)
Height (cm)	154.6 ± 7.4
Weight (kg)	55.7 ± 8.5
KCL-CF (score), median	1.0 (1.0–3.0)
Number of medicines per day, median	2.0 (1.0-3.0)
Chronic disease	
Hypertension, *n* (%)	22 (34.9)
Hyperlipidemia, *n* (%)	8 (12.7)
Diabetes, *n* (%)	8 (12.7)
JST-IC (score), median	11.0 (9.0–13.0)
Physical frailty (score), median	1.0 (0.0–1.0)
Physical frailty, *n* (%)	5 (7.9)
Social frailty (score), median	1.0 (0.0–2.0)
Social frailty, *n* (%)	17 (27.0)
Grip strength (kg), median	23.1 (19.7–27.8)
Walking speed (m/second), median	1.3 (1.2–1.5)
SMI (kg/m^2)	6.3 ± 1.0*

Data are presented in mean ± standard deviation or median (interquartile range, IQR) or frequency (percentage). *Missing values for SMI (*n* = 2) owing to pacemaker implantation. JST-IC: Japan Science and Technology Agency Index of Competence; KCL-CF: Kihon Checklist-Cognitive Function; SMI: skeletal muscle index

Table 3. *Correlations between JST-IC scores and measured outcomes*

Variable	JST-IC (score)	
	Correlation coefficient	*P*
Age (years)	0.127	0.062
Sex (0 = Female, 1 = Male)	0.031	0.808
KCL-CF	-0.071	0.581
Chronic disease (0 = no, 1 = yes)		
hypertension	-0.149	0.244
hyperlipidemia	0.067	0.601
diabetes	-0.045	0.727
Physical frailty* (score)	-0.221	0.082
Social frailty* (score)	-0.312	0.013
Grip strength (kg)	0.270	0.033
Walking speed (m/second)	0.327	0.009
SMI (kg/m^2)	0.120	0.357

JST-IC: Japan Science and Technology Agency Index of Competence; KCL-CF: Kihon Checklist-Cognitive Function; SMI: skeletal muscle index. *The total score was used for the variables of physical frailty and social frailty.

Discussion

This cross-sectional study suggested thatJST-IC scores were related to social frailty and walking speed.Our results showed that for community-dwelling older adults to live independently, their physical function must be improved and social involvement promoted. A strength of this study is that it is the first cross-sectional investigation on the relationship between the JST-IC and social frailty.

The JST-IC measures the ability of older adults living alone to live independently and actively. The national standard value of this index is about 11 points in older adults aged 65–74 years[14, 15]. In community-dwelling older adults, the JST-IC scoresranged from 10 to 12 points[22–24]. The present results showed similar scores to these values. Thus, our participants had age-appropriate higher-order living function.

We found a significant association between JST-IC scores and social frailty. The prevalence of social frailty in this study was 27%, which was high compared with other studies[10, 25, 26]. This result may be affected by the small size and bias of the sample of our study(i.e., living alone). Suzuki et al. reported that JST-IC scores are significantly associated with social networks, psychological well-being, and physical fitness[16]. In an analysis of the subitems of social frailty, Makizako et al. showed that participants who lack a social network (e.g., talking with someone every day (no)) compriseapproximately 90% of the total samples and have significantly lower muscle strength compared with those who talked with someone every day[25]. Regarding the relation between social status and psychological well-being, Puts et al. suggested that health and social problems, lack of good relationships with family or friends, and lack of information collecting might negatively affect psychological well-being[27].Kawachi et al. also confirmed that social ties play a beneficial role in maintaining psychological well-being[28]. In a study using the Tilburg Frailty Indicator, which is a questionnaire containing the social status of frailty, Freitag et al. reported that frailty is negatively correlated to physical health[29]. In other words, it was inferred that the JST-IC demonstrated a decline in physical health status, including physical functions, lack of good relationships with family or friends, and lack of information gathering, through higher-level functional capacity. Since social frailty represents social vulnerabilities caused by social isolation, lack of relationships, and inactivity, we speculated that there was a significant relationship between the JST-IC score and social frailty.

In our study, the JST-IC score was also associated with walking speed.Walking speed is strongly linked to lower extremity function and physical activity[30]. Further, walking speed has been associated with cognitive function. In a prospective study among older adults, aged 60 to over 90 years old,Gale et al. presented evidence that walking speed and the cognitive domains of executive function and processing speed may change in parallel with increasing age[31]. Additionally, executive function is independently associated with a walking speed that requires high attentional demand[32]. The JST-IC has four subscales: usage of technology (e.g., mobile phones and computers), information gathering and health literacy, daily life management, and social participation. In particular, memory and executive function are important for memorizing device operation proceduresas well as the selection and judgment of information. In other words, maintaining walking speed may play an important role in maintaining cognitive function necessary for independent living. Therefore, in this study, we considered that the JST-IC score, which reflects higher-level functional capacity, would be related to walking speed.

The present study had a number of limitations, mainly the small sample size and cross-sectional design. The smallsample may have resulted in a selection bias in the recruitment of participants. Therefore, the prevalence of social frailty may have been higher than that in previous studies[10, 25, 26]. Meanwhile, the cross-sectional nature of our study made it difficult to determine whether the decline in higher-level functional capacity reduced walking speed and social frailty. Another limitation was that the KCL-CF was used to evaluate cognitive function. The KCL-CF has been shown to predict incident dementia and is useful to detect frailty in older adults[12, 13]. However, because we did not have a clear exclusion criterion for the overall score of this evaluation,we might have been able to determine the actual cognitive function of our participants using this assessment.In the future, the causality of the JST-IC decline should be investigated with a large sample size.

Conclusion

Higher-level functional capacity could be associated with social frailty and walking speed. Maintenance of lower extremity function required for the mobility is important. In addition, preventing social frailty through increasing social activities and social networks might be effective in maintaining the ability forindependent living incommunity-dwelling older adults.

Conflict of Interest: The authors have no conflicts of interest to declare.

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