Handgrip strength as a predictor of higher-level competence decline among community-dwelling Japanese elderly in an urban area during a 4-year follow-up

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A B S T R A C T

This 4-year observational study examined whether handgrip strength can predict functional decline in higher-level competence in a cohort of urban community-dwelling Japanese elderly. Subjects were 406 community-dwelling Japanese, 65 years or older at baseline who scored as "independent in higher-level competence" (11 and over) according to the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC). Independent variables were handgrip strength and usual walking speed at baseline survey. Dependent variables were functional status in higher-level competence at 4-year follow-up. Logistic regression analysis, after adjustment for age and body mass index (BMI), revealed that handgrip strength was significantly correlated with decline of higher-level competence in both sexes. Usual walking speed was significantly correlated with decline in higher-level competence only in women. This study revealed that handgrip strength is a predictor for decline in higher-level competence in urban community-dwelling Japanese elderly men and women. Results suggest that handgrip strength may be used to screen for functional capacity decline in community-dwelling elderly.

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1. Introduction

Muscle strength is known to decline with age (Lindle et al., 1997). In recent years, the aged-related loss of muscle strength has been widely considered to be one of the major causes of disability in the elderly (Rantanen et al., 1999) and loss of muscle strength in the elderly has emerged as one of the most prevalent problems in elderly people (Manini and Clark, 2012; Mitchell et al., 2012).

In Japan, people have a long life expectancy (79.64 years in men and 86.39 years in women in 2010) and the country has the highest proportion of elderly in the world (23.3% in 2011) (Cabinet Office of Japan, 2011). Because of large population growth in urban areas in the 1950s and 1960s, during a period of high economic activity, the elderly population in these areas is expected to increase. As a result, it is predicted that medical expenses will rise and the need for long-term care insurance will grow.

Lawton proposed 7 stages of competence in the elderly, ranging from the lowest and most basic function to the highest, in ascending order of complexity: life maintenance, functional health, perception and cognition, physical self-maintenance, instrumental self-maintenance (instrumental activities of daily living [IADLs]), effectance and social role (Lawton, 1972). This model has been confirmed and has been used as the theoretical framework for the development of new scales worldwide. TMIG-IC was designed to measure 3 higher-level competence stages above physical self-maintenance in community-dwelling elderly Japanese, that is, instrumental self-maintenance (IADLs), intellectual activity (effectance in Lawton) and social role (Koyano, Shibata, Nakazato, Haga, & Suyama, 1991; Koyano, Hashimoto, Fukawa, Shibata, & Gunji, 1993). Some reports have shown an association between aged-related loss of muscle strength and difficulties with basic activities of daily living (BADLs) and IADLs (Brill, Macera, Davis, Blair, & Gordon, 2000; Ishizaki, Watanabe, Suzuki, Shibata, & Haga, 2000). However, few studies have reported a relationship between muscle strength and higher-level competence among community-dwelling elderly (Haga et al., 1997).

There are a number of ways to measure muscle strength, for example, handgrip strength, knee extension strength and trunk extension strength. Among them, handgrip strength has been found to be useful for assessing approximate total body muscle strength (Bassey and Harries, 1993; Kallman, Plato, & Tobin, 1990; Lauretani et al., 2003; Rantanen, Era, Kauppinen, & Heikkinen, 1994; Rantanen et al., 1998). It can be measured safely, easily and reliably, and it is portable and does not require large or expensive

equipment (Bassey, 1997; Rantanen, Era, & Heikkinen, 1997). Thus, handgrip strength is a suitable tool for public health research in a community setting. Moreover, there have been no longitudinal studies about the relationship between handgrip strength and higher-level competence among elderly living in an urban area.
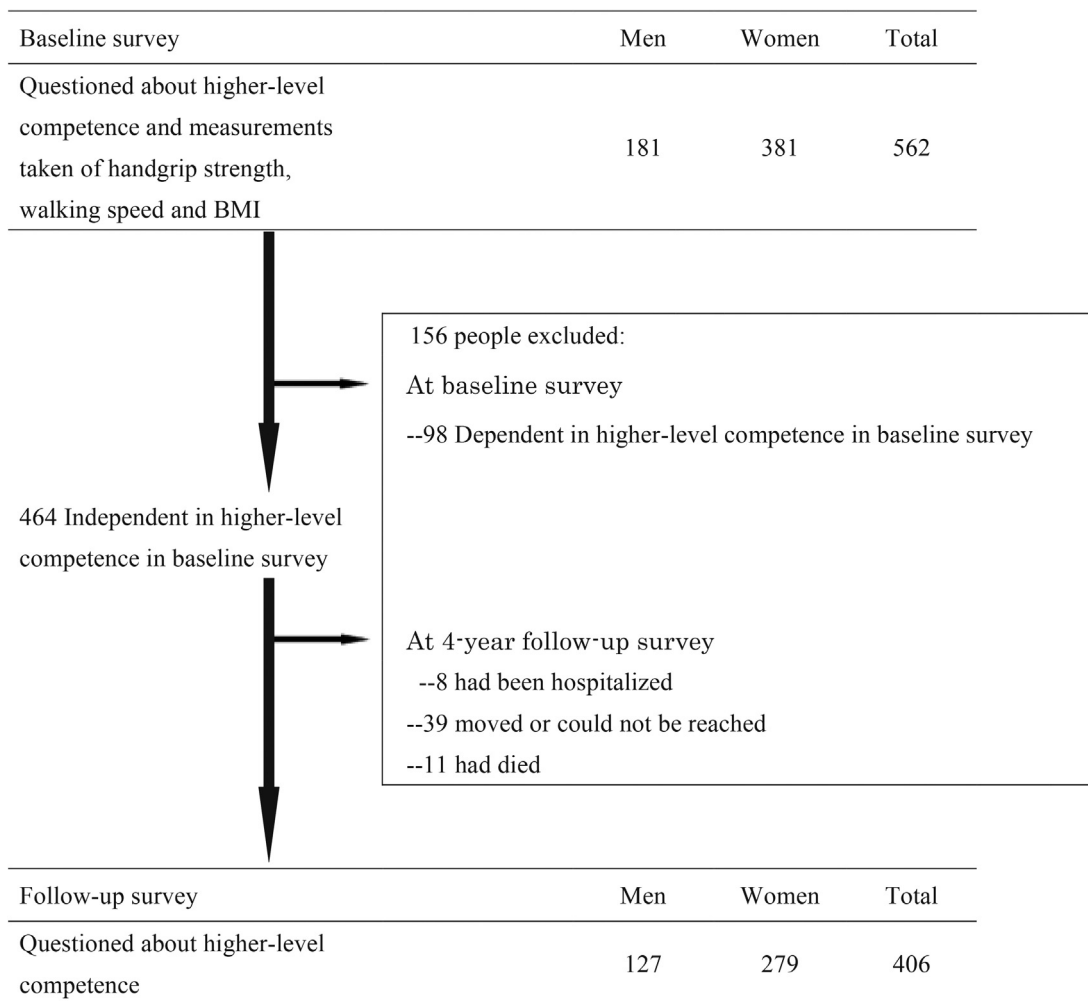
This study aimed to examine handgrip strength as a useful tool for the prediction of decline of higher-level competence in a 4-year observation of a cohort of Japanese urban community-dwelling elderly.

2. Subjects and methods

2.1. Subjects

Participants were Japanese elderly living in Takatsuki City. Takatsuki City is home to 84 222 individuals aged 65 years or older; the proportion of elderly in the population in this city was 23.3% in 2011. Takatsuki City is an urban area and suburb in the northern part of Osaka Prefecture, where welfare centers for the aged and community centers are the main organizations that provide social support to community-dwelling elderly. All participants were recruited through local newspapers and by the local welfare commissioner. A total of 562 elderly participants aged 65–94 years who registered at or used these centers were recruited into this study. We used a questionnaire to confirm that participants were independent in terms of BADLs. BADLs were measured using a modified Katz's activities of daily living (ADL) scale, which consists of 5 items: bathing, dressing, walking, continence and feeding (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). We limited the subjects of this study to those who were independent in higher-level competence according to the baseline survey, the TMIG-IC. The baseline survey, which included questions about higher-level competence and measurements of handgrip strength, walking speed and BMI was carried out in May and June 2007. The 464 participants who were independent in higher-level competence according to the baseline survey were followed up for 4 years. The follow-up survey, which included questions about higher-level competence, was carried out in May and June 2011. At the time of the follow-up survey, 8 had been hospitalized, 39 had moved or could not be reached and 11 had died. Therefore, 58 people who had died, had been hospitalized, had moved or could not be located at 4 years were excluded, so a total of 406 subjects (127 men and 279 women) were analyzed in the present study (Fig. 1). Outcome events in this study were defined as new onset of decline in higher-level competence. We mailed the questionnaire to participants 2 weeks before the planned collection date and collected the questionnaires in person. During the collection, we checked to ensure that participants had

Baseline survey	Men	Women	Total
Questioned about higher-level competence and measurements taken of handgrip strength, walking speed and BMI	181	381	562

156 people excluded:

At baseline survey

--98 Dependent in higher-level competence in baseline survey

464 Independent in higher-level competence in baseline survey

At 4-year follow-up survey

--8 had been hospitalized

--39 moved or could not be reached

--11 had died

Follow-up survey	Men	Women	Total
Questioned about higher-level competence	127	279	406

BMI, body mass index.

Fig. 1. Flowchart of participants in this study.