



Associations of total amount and patterns of objectively measured sedentary behavior with performance-based physical function

Yung Liao^{a,b,*}, Hsiu-Hua Hsu^c, Ai Shibata^d, Kaori Ishii^b, Mohammad Javad Koohsari^{b,e,f}, Koichiro Oka^b

^a Department of Health Promotion and Health Education, National Taiwan Normal University, 162, Heping East Road Section 1, Taipei, Taiwan

^b Faculty of Sport Sciences, Waseda University, 2-579-15 Mikajima Tokorozawa, Saitama 359-1192, Japan

^c Graduate School of Sport Sciences, Waseda University, 2-579-15 Mikajima Tokorozawa, Saitama 359-1192, Japan

^d Faculty of Health and Sport Sciences, University of Tsukuba, 3-29-1 Otsuka Bunkyo, Tokyo 112-0012, Japan

^e Behavioural Epidemiology Laboratory, Baker Heart and Diabetes Institute, Level 4, 99 Commercial Rd, Melbourne, Victoria 3004, Australia

^f Mary MacKillop Institute for Health Research, Australian Catholic University, Level 6, 215 Spring Street, Melbourne, VIC 3000, Australia

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ABSTRACT

Although greater sedentary time has been found to be associated with negative health impacts, little is known whether the specific pattern of sedentary behavior (i.e. sedentary bouts, breaks and durations) are associated with physical function among older adults. The present study examined the associations between objectively measured sedentary behavior and physical function among older Japanese adults. A total of 174 male and 107 female community-dwelling older Japanese adults aged 65–84 years (mean age: 74.5 ± 5.2 years) were recruited. Sedentary behavior and physical activity were assessed using a triaxial accelerometer. Physical function was measured through hand grip strength, eye-open one leg standing, 5-m walking, and timed up and go tests. Forced-entry multiple linear regression models adjusted for potential confounders were performed. After adjustment, total daily sedentary time and duration of prolonged sedentary bouts (both ≥ 30 min) were positively associated with time spent on the 5-m walking stage and timed up and go tests in older women; however, no significant associations were observed in older men or the whole sample. This paper highlights the importance of developing sedentary behavior change strategies for interventions aiming to improve mobility in older women. Further evidence from a prospective study is required to establish directions of causality between sedentary behavior and mobility.

1. Introduction

Japan is one of the rapid aging societies where 26.7% of its population was aged 65 or older in 2015. This proportion is predicted to be 38.8% by 2050 (Statistics Bureau, 2017). Older adults are at risk of declining physical function (Guralnik and Simonsick, 1993), which is related to higher risk of fall, functional limitations and disability, and mortality (Manton, 1988; Smee et al., 2012; Toraman and Yildirim, 2010; den Ouden et al., 2013). Declining physical function has also been considered a principal reason for losing physical independence (Fried et al., 2004; Wang et al., 2002). Therefore, identifying modifiable behavioral factors associated with physical function among older adults in rapid aging societies is necessary.

Sedentary behavior has emerged as a new behavioral risk factor for

many non-communicable diseases (Sedentary Behaviour Research, 2012). More sedentary time is associated with increased risk of metabolic syndrome, obesity, impaired mental health, and mortality among older adults (Balboa-Castillo et al., 2011; Bankoski et al., 2011; Inoue et al., 2012; Pavey et al., 2015). In addition, the key health consideration for older adults is maintaining a sufficient level of physical function to safely and independently perform regular daily activities (Department of Health, 2010). Sedentary behavior could be particularly important for older adults' physical function because reduced energy expenditure, lack of skeletal muscular contractions and raised inflammatory markers through prolonged sedentary time could contribute to accelerated loss of muscle mass and strength (Gianoudis et al., 2015; Schaap et al., 2009). Therefore, to prevent or postpone declining physical function, a more in-depth understanding of the association

* Corresponding author at: Department of Health Promotion and Health Education, National Taiwan Normal University, Taiwan 162, Section 1, Heping E. Rd., Taipei 106, Taiwan.

E-mail addresses: liaoyung@ntnu.edu.tw (Y. Liao), kyoshuka@toki.waseda.jp (H.-H. Hsu), shibata.ai.ga@u.tsukuba.ac.jp (A. Shibata), ishiikaori@waseda.jp (K. Ishii), javad.koohsari@baker.edu.au (M.J. Koohsari), koka@waseda.jp (K. Oka).

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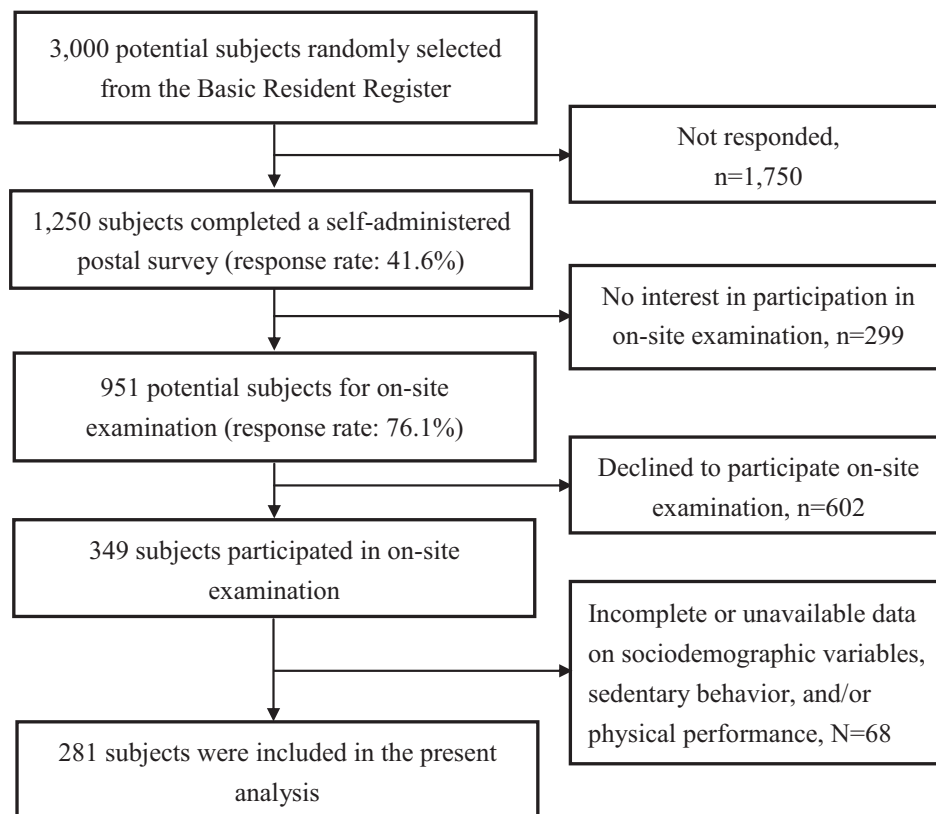


Fig. 1. Flow chart of participants selection process.

between sedentary behavior and physical function among older adults is needed.

Evidence has verified the negative relationships of self-reported and objectively measured sedentary behavior with aspects of physical performance such as muscle strength, mobility, and balance in older adults, independently of their moderate-to-vigorous physical activity (MVPA) (Hamer and Stamatakis, 2013; Manas et al., 2017; Seguin et al., 2012). However, most related studies have used self-reporting methods to assess sedentary behavior, which is a major limitation because older adults may have difficulty accurately recalling their total sedentary times or durations of specific sedentary behaviors (Van Cauwenberg et al., 2014). Although some studies have employed objective sedentary behavior measures, such studies are limited in several respects. First, most of these studies have been conducted in Western countries such as the United States, United Kingdom, Canada, and Portugal (Cooper et al., 2015; Fleig et al., 2016; Rosenberg et al., 2016; Santos et al., 2012). In comparison with Western countries, Japanese older adults may have different lifestyle patterns and gender role (Amagasa et al., 2017), which could possibly lead to different outcomes. Only one such study was conducted in Japan; however, this study was limited because of a small sample size of institutionalized older women ($N = 19$) (Ikezoe et al., 2013). Second, although older men and women were found to have different sedentary behavioral patterns and physical characteristics such as skeletal muscle mass (Bellettiere et al., 2015; Jankowski et al., 2008; Janssen et al., 2000; Matthews et al., 2008), few studies have examined the association between sedentary behavior and physical function separately by gender. Finally, although two studies have reported that breaks in sedentary behavior were positively associated with physical performance in older adults (Davis et al., 2014; Sardinha et al., 2015), little is known regarding whether total and specific patterns of objectively measured sedentary behavior are associated with physical function. Given that prolonged and unbroken sedentary time has negative impacts on health (Hamilton et al., 2007;

Dunstan et al., 2012), specific patterns of sedentary time can also be considered in terms of the number and duration of sedentary bouts. For the public health prevention practices, it is of value to further explore these modifiable factors related to physical function, such as total sedentary time, sedentary bouts (i.e., periods of uninterrupted sedentary time), breaks (i.e., nonsedentary bout between two sedentary bouts), and duration (i.e., the length of continuous sedentary time). Therefore, the present study examined the associations of total amount and patterns of objectively measured sedentary behavior with performance-based physical function among older Japanese men and women.

2. Materials and methods

2.1. Participants

Data from a cross-sectional survey conducted in 2013 were used in this study. A total of 3000 older Japanese adults aged 65–84 years and living in Matsudo City, Chiba Prefecture, Japan, were randomly selected from the Basic Resident Register according to gender and age bracket (65–69, 70–74, 75–79, and 80–84 years). This study involved two stages of data collection: a self-administered postal survey and on-site examinations.

In first stage, each potential respondent was sent a written consent form and questionnaire on their background that included questions on age, level of education, marital status, family income, and behavioral factors through the postal service. A total of 1250 older adults responded to this questionnaire by regular postal mail (response rate: 41.6%) and asked whether or not they were interested in taking part in additional examination. Those who showed their interest in additional examination ($n = 951$; response rate: 76.1%) were formally sent a letter requesting participation in the on-site examination via postal mail. However, 602 of those declined to participate; thus, 349 older adults who agreed to participate were ultimately enrolled in the present study

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