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Original Article

The Reference Values for the Chair Stand Test in Healthy Japanese Older People: Determination by Meta-analysis

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Abstract. [Purpose] The aim of this study was to determine the reference values for the chair stand test (CST) in healthy older Japanese people. [Methods] Relevant research articles for the 5-repetition chair stand test (CS-5) and the 30-second chair stand test (CS-30) were identified by electronic database and manual searching. Research articles involving healthy Japanese people aged 60 years and older were included in a meta-analysis. Weighted means of the CS-5 and CS-30 were estimated by the random effect model as the reference values for the CST. Further, the effects of age and sex on the reference values were analyzed by a meta-regression analysis. [Results] Seven articles (21 data) and three articles (14 data) were included in the meta-analyses for the CS-5 and CS-30, respectively. The reference value for the CS-5 was estimated as 8.50 sec [95% confidence interval (CI): 7.93–9.07]; age and sex were not associated with this reference value. The reference value for the CS-30 was estimated as 17.26 times [95%CI: 15.98–18.55], and age was significantly associated with this value. [Conclusion] When the CS-5 and CS-30 are used to evaluate elderly Japanese people, the reference values for the CS-5 and CS-30 determined in this study would be useful indices.

Key words: Chair stand test, Meta-analysis, Older people

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INTRODUCTION

The chair stand test (CST)[1, 2)] is one of the physical performance tests for older people, and it is reported to be associated with muscle strength around the knee joint[1, 3, 4)]. It is believed that the CST is able to assess muscle strength around the knee joint in older people in the clinical setting without a hand-held dynamometer. The CST has been demonstrated to be a simple and feasible physical performance test, even for evaluating older people with limited mobility[5)]. Furthermore, prospective cohort studies have demonstrated that the CST is a predictor of decreased activities of daily living (ADL) and falls in older people[6–8)].

A previous study, a meta-analysis, reported a reference value as an assessment criterion for the CST[9)]. On the other hand, the results of the CST and the muscle strength around the knee joint have been reported to show ethnic differences[10, 11)]. Nevertheless, the reference value[9)] reported previously did not consider ethnic differences. The aim of this study was to determine the reference values for the CST in healthy older Japanese people by meta-analysis taking ethnicity into account.

SUBJECTS AND METHODS

Research articles published from January 1994 to September 2013 that reported data for the CST were searched. For the CST, data including the CS-5[1)] and the CS-30[2)] were analyzed in the meta-analysis. The CS-5 is a task that involves standing up from a chair 5 times as fast as possible, and the time that it takes to complete the task is measured. On the other hand, the CS-30 is a task that involves repeatedly standing up from a chair for 30 seconds as fast as possible, and the number of stand-ups completed during 30 seconds is counted.

Relevant research articles were sought from electronic databases: PubMed, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Igaku Chuou Zasshi (an electronic database that consists of medical research articles in Japan). Furthermore, a manual search was also conducted from the indices of relevant scientific journals (Geriatrics & Gerontology International, Japanese Journal of Geriatrics, Japanese Journal of Public Health). The terms “sit to stand”, “5-repetition Chair Stand test (CS-5)”, “30-second Chair Stand test (CS-30)”, “chair stand

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Table 1. The reference values for the chair stand test

Model	Test		Reference values [95%CI]	Heterogeneity
Random effect	CS-5[†]		8.50 [7.93–9.07] sec	Q =1413.92 (df=20), p<0.0001
Random effect	CS-30[‡]		17.26 [15.98–18.55] times	Q=189.42 (df=13), p<0.0001
Mixed effect	CS-30	60s[§]	22.15 [14.35–29.95] times	QE=55.62 (df=10), p< 0.0001
		70s[§]	18.45 [9.35–27.55] times	
		80s[§]	14.75 [4.35–25.15] times	

[†]Five-repetition chair stand test, [‡]Thirty-second chair stand test, [§]The value was estimated by the following formula: 44.35 − 0.37 [95%CI: −0.50 to −0.24] * age.

test", "chair rising test", "elderly", "older people", and "aged" were used in combination for the search.

The searches were limited to peer-reviewed research articles published in English or Japanese. The retrieved articles were examined by three reviewers (TN, MA, NK) based on the following inclusion criteria determined according to previous studies[12, 13]: (1) the articles involved Japanese people; (2) the articles involved community-dwelling people who were aged 60 years and older; (3) the articles involved older people with good functioning, defined as those with independent ADL, independent instrumental ADL (IADL), and participation in social activities; (4) the articles did not involve frail older people and patients who had specific diseases, such as neuromuscular diseases and hip fractures; (5) the sample size and the mean and standard deviation (SD) of the CST were all described in the text; and (6) information about the CST measurement method was described. The functioning of subjects was judged by the same criteria as in previous studies[12, 13]. The above inclusion criteria were adopted to minimize data variation among the studies.

The articles fulfilling the above criteria were summarized to obtain the article information (title, authors, and citation), information about the participants (age, sex, and functioning), CST measurement method, sample size, and the mean and SD of the CST. All information was tabulated and input into a computer database to perform further statistical analysis (described below). When multiple CST values were reported in an article (e.g., data reported by sex and age group), the data for each group were entered into the database.

Weighted means and 95% confidence intervals (95%CIs) were calculated from the data that fulfilled the inclusion criteria for the analysis as reference values for the CST. Weighted means were calculated by the DerSimonian-Laird method. Furthermore, the effects of age and sex on the reference values for the CST were analyzed by a mixed effect model (meta-regression analysis). Statistical analysis was performed using R programming language and environment (R version 2.15.3)[14] and the metaphor package for R (version 1.8-0)[15]. The significance level was set at 5%.

RESULTS

A total of 1,169 articles were identified from electronic database and manual searching. However, 1,060 articles that did not fulfill the inclusion criteria were excluded after checking their titles and abstracts. Furthermore, 99 articles were excluded after checking their full texts, as they did not fulfill the inclusion criteria. Thus, 7 articles (21 groups)[5,16–21] and 3 articles (14 groups)[22–24] were included for estimation of the reference values for the CS-5 and the CS-30, respectively. For the measurement methods of the CS-5 and CS-30 in all articles fulfilling the criteria, participants were instructed to sit in a chair with their feet fixed shoulder-width apart and repeatedly stand up from the chair as fast as possible.

Studies with CS-5 data involved 6,050 subjects (men 494, women 1,659, unknown 3,897; mean age 69.0–80.7 years). The reference value for the CS-5 was 8.50 sec (95%CI=7.93–9.07 sec) (Table 1). Age and sex were not significantly associated with the reference value for the CS-5 in the mixed effect model analysis. Studies with CS-30 data involved 661 subjects (men 209, women 317, unknown 135; mean age 62.6–83.2 years). The reference value for the CS-30 was 17.26 times (95%CI=15.98–18.55 times) (Table 1). Age was significantly associated with the reference value for the CS-30 in the mixed effect model analysis, but sex was not. The reference value for each age group shown in Table 1 was estimated using the formula determined from the mixed effect model.

DISCUSSION

The reference values for the CS-5 and CS-30 in older Japanese people who were independent in ADL were determined using the methodology of meta-analysis in the present study. For the CS-5, a reference value has been previously estimated[9], but ethnic differences in the CS-5 were not considered in that study. When the reference values for the CS-5 estimated by the present study and previous study[9] were compared, that for the CS-5 in the present study was 8.50 sec and that for the CS-5 in the previous study was 12.10 sec. Thus, the reference value for the CS-5 in the present study tended to be shorter than that in the previous study. The present finding is in agreement with the finding of a previous report[10] that suggested ethnic differences in the CS-5. This indicates that the reference value for the CS-5 estimated by the present study appears to be specific and useful for older Japanese people. On the other hand, no reference value for the CS-30 has been previously reported. The reference value for the CS-30 found in the present study, also appears to be specific and useful for older Japanese people.

The CS-5 was not significantly associated with age and

sex in the present study. On the other hand, a significant association was found between the CS-30 and age. Therefore, the reference value for the CS-30 in healthy older people appears to decrease with age. A previous study indicated that the CS-30 was significantly related to age, as in the present study[2]. The reason why there is a difference in the effect of age between the CS-5 and the CS-30 is not obvious from the data and analysis in the present study. In conclusion, when the CS-30 is used as a physical performance test in older people, age must be taken into account.

This study had several limitations. First, the sample size for estimation of the reference value for the CS-30 was smaller than that for the CS-5. Therefore, the validity of the reference value for the CS-30 may be relatively lower than that for the CS-5. Second, height has been shown to affect the CST result[10]. However, the effect of height on the reference values for the CS-5 and CS-30 could not be clarified in the present study, since the height data were insufficient for reliable analysis.

In this study, the reference values for the CS-5 and the CS-30, variations of the CST, were determined for healthy older Japanese people. The CST can be measured using just a chair and a stop watch. Therefore, the CST is a simple and feasible physical performance test for older people and rehabilitation patients in the clinical setting[25]. When the CS-5 and CS-30 are used to evaluate older Japanese people, the reference values for the CS-5 and CS-30 estimated in this study would be useful indices.

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REFERENCES

1) Guralnik JM, Simonsick EM, Ferrucci L, et al.: A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol, 1994, 49: M85–M94. [Medline] [CrossRef]
2) Jones CJ, Rikli RE, Beam WC: A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport, 1999, 70: 113–119. [Medline] [CrossRef]
3) Lord SR, Murray SM, Chapman K, et al.: Sit-to-stand performance depends on sensation, speed, balance, and psychological status in addition to strength in older people. J Gerontol A Biol Sci Med Sci, 2002, 57: M539–M543. [Medline] [CrossRef]
4) Corrigan D, Bohannon RW: Relationship between knee extension force and stand-up performance in community-dwelling elderly women. Arch Phys Med Rehabil, 2001, 82: 1666–1672. [Medline] [CrossRef]
5) Kim MJ, Yabushita N, Kim MK, et al.: Alternative items for identifying hierarchical levels of physical disability by using physical performance tests in women aged 75 years and older. Geriatr Gerontol Int, 2010, 10: 302–310. [Medline] [CrossRef]
6) Zhang F, Ferrucci L, Culham E, et al.: Performance on five times sit-to-stand task as a predictor of subsequent falls and disability in older persons. J Aging Health, 2013, 25: 478–492. [Medline] [CrossRef]
7) den Ouden ME, Schuurmans MJ, Arts IE, et al.: Association between physical performance characteristics and independence in activities of daily living in middle-aged and elderly men. Geriatr Gerontol Int, 2013, 13: 274–280. [Medline] [CrossRef]
8) Tiedemann A, Shimada H, Sherrington C, et al.: The comparative ability of eight functional mobility tests for predicting falls in community-dwelling older people. Age Ageing, 2008, 37: 430–435. [Medline] [CrossRef]
9) Bohannon RW: Reference values for the five-repetition sit-to-stand test: a descriptive meta-analysis of data from elders. Percept Mot Skills, 2006, 103: 215–222. [Medline]
10) Aoyagi K, Ross PD, Nevitt MC, et al.: Comparison of performance-based measures among native Japanese, Japanese-Americans in Hawaii and Caucasian women in the United States, ages 65 years and over: a cross-sectional study. BMC Geriatr, 2001, 1: 3–9. [Medline] [CrossRef]
11) Liang MT, Bassin S, Dutto D, et al.: Bone mineral density and leg muscle strength in young Caucasian, Hispanic, and Asian women. J Clin Densitom, 2007, 10: 157–164. [Medline] [CrossRef]
12) Kamide N, Takahashi K, Shiba Y: Reference values for the Timed Up and Go test in healthy Japanese elderly people: determination using the methodology of meta-analysis. Geriatr Gerontol Int, 2011, 11: 445–451. [Medline] [CrossRef]
13) Kamide N, Takahashi-Narita K, Kawamura A, et al.: Determination of the reference value and systematic bias of the functional reach test in Japanese elderly people by mete-analysis. J Clin Gerontol Geriatr, 2012, 3: 122–126. [CrossRef]
14) R Core Team: (2013):R: A language and environment for statistical computing. R Foundation for statistical Computing, Veinna, Austria. http://www.R-project.org/ (Accessed Nov. 8, 2013)
15) Viechtbauer W: Conducting meta-analyses in R with the metafor package. J Stat Softw, 2010, 36: 1–48.
16) Kim MJ, Seino S, Kim MK, et al.: Validation of lower extremity performance tests for determining the mobility limitation levels in community-dwelling older women. Aging Clin Exp Res, 2009, 21: 437–444. [Medline] [CrossRef]
17) Kim MJ, Yabushita N, Kim MK, et al.: Mobility performance tests for discriminating high risk of frailty in community-dwelling older women. Arch Gerontol Geriatr, 2010, 51: 192–198. [Medline] [CrossRef]
18) Kim MJ, Yabushita N, Tanaka K: Exploring effective items of physical function in slow walking speed and self-reported mobility limitation in community-dwelling older adults. Geriatr Gerontol Int, 2012, 12: 50–58. [Medline] [CrossRef]
19) Shimada H, Suzuki T, Suzukawa M, et al.: Performance-based assessments and demand for personal care in older Japanese people: a cross-sectional study. BMJ Open, 2013, 3: 1–7. [Medline] [CrossRef]
20) Takai I: [A study of factors influenced by self-efficacy for exercise among community-dwelling elderly men in urban areas]. Nippon Ronen Igakkai Zasshi, 2012, 49: 740–745 (in Japanese, English abstract). [Medline] [CrossRef]
21) Morita M, Takamura N, Kusano Y, et al.: Relationship between falls and physical performance measures among community-dwelling elderly women in Japan. Aging Clin Exp Res, 2005, 17: 211–216. [Medline] [CrossRef]
22) Cao ZB, Maeda A, Shima N, et al.: The effect of a 12-week combined exercise intervention program on physical performance and gait kinematics in community-dwelling elderly women. J Physiol Anthropol, 2007, 26: 325–332. [Medline] [CrossRef]
23) Kawabata Y, Hiura M: The CS-30 test is a useful assessment tool for predicting falls in community-dwelling elderly people. Rigakuryoho Kagaku, 2008, 23: 441–445 (in Japanese, English abstract). [CrossRef]
24) Nakatani T, Nadamoto M, Miura K, et al.: validation of a 30-sec chair-stand test for evaluating lower extremity muscle strength in Japanese elderly adults. Jpn J Phys Educ Hlth Sport Sci, 2002, 47: 451–461 (in Japanese, English abstract).
25) Bohannon RW, Eriksrud O: What measure of lower extremity muscle strength best explains walking indepedency? J Phys Ther Sci, 2001, 13: 1–3. [CrossRef]