J. Phys. Ther. Sci.
24: 747–749, 2012

Development of the "10-second Open-Close Stepping Test" (OCS-10) and Fundamental Study of Its Measurement Values through a Comparison of Healthy Young People and Community-Dwelling Elderly

Kaoru Kobayashi, RPT, MS[1,2], Yukinobu Hiiragi, RPT, PhD[1], Hitoshi Maruyama, RPT, PhD[1]

[1] *Department of Physical Therapy, Faculty of Health Science, International University of Health and Welfare: 2600-1 Kitakanemaru, Ohtawara-city, Tochigi 324-8501, Japan. TEL: +81 287-24-3018, FAX: +81 287-24-3938, E-mail: kkobayashi@iuhw.ac.jp*

[2] *Physical Therapy Section, Health Science Program, Health and Welfare Science Course, Graduate School of International University of Health and Welfare*

Abstract. [Purpose] The "10-second Open-Close Stepping Test" (OCS-10) is simple, can be conducted anywhere, and requires no special equipment. In order to use the OCS-10 for the elderly, its reliability and characteristics for younger individuals and the elderly were examined. [Subjects] Younger subjects were 27 individuals (young group). Elderly subjects were 29 individuals under age 75 (young old group) and 34 individuals over age 75 (old old group) who could walk without assistance. [Methods] The OCS-10 was performed twice with an interval of 30 seconds between, and the measurement values were recorded. To compare measurement values among the young group, young old group and old old group, the best results from the 2 rounds of testing were used in analysis. The test duration was 10 seconds. [Results] The ICCs for each group were 0.93, 0.89, and 0.84 for the young group, young old group, and old old group, respectively. [Conclusion] The OCS-10 provides consistent measurement values for both younger individuals and the elderly, though the results are more consistent in younger individuals. In addition, the OCS-10 should allow accurate discernment of a decline in physical functions due to aging and accompanying loss of agility.
Key words: 10-second open-close stepping test (OCS-10), Reliability, Measurement value

(This article was submitted Mar. 13, 2012, and was accepted Apr. 5, 2012)

INTRODUCTION

In recent years, opportunities to conduct physical therapy with older patients have increased as the birthrate has declined and the population has aged. Signs of an increase in the elderly population were noted in the early 20th century in the United Kingdom. Sheldon[1] noted the importance of addressing falls as part of geriatric medicine. In Japan, studies of falls were conducted in the 1990s as described in many reports. Previous studies of the risk of falling have often concentrated on the legs and focused on parameters such as muscle weakness, loss of balance, and impaired gait[2]. Toraman et al.[3] reported on risk factors and they stated that a loss of agility increased the risk of falling. In the same vein, Berg et al.[4] reported that supporting one's weight when taking a quick step while one's posture is off-balance is crucial for the prevention of falls. In addition, Ikezoe et al.[5] examined the relationship between existing stepping tests and falls, and they reported that individuals with a history of falls scored significantly lower than individuals with no history of falls. However, dedicated testing equipment is needed to conduct iterations of the stepping test, and this equipment is expensive; therefore, it is seldom used in clinical settings. To resolve this problem, we developed the "10-second Open-Close Stepping Test" (OCS-10) as described by the Japan Health Promotion & Fitness Foundation[6]. The test is simple, can be conducted anywhere, and requires no special equipment. "Both Feet Opening and Closing" (BFOC) was described as a test for assessing agility as part of a strength test. Thus, the current authors view the OCS-10 as a way to assess agility in accordance with BFOC, and fundamental studies of the OCS-10 were conducted to facilitate its use in place of existing stepping tests. In addition, the OCS-10 was studied in healthy younger individuals and was reported to have good intra-rater and inter-rater reliability at a test time of 10 seconds[7]. However, our previous studies only examined younger individuals, so the test needs to be examined in the community-dwelling elderly.

Therefore, in the present study, we conducted the OCS-10 for the elderly, in older to examine its reliability and compare its characteristics between younger individuals and the elderly.

Table 1. Subjects characteristics

	Young group	Young old group	Old old group
Gender (male/female)	17/10	8/21	3/31
Age (years)	20.6 ± 4.2	70.5 ± 2.9	78.7 ± 3.0
Height (cm)	165.9 ± 8.3	154.9 ± 7.7	147.7 ± 6.7
Weight (kg)	58.7 ± 10.4	53.3 ± 7.3	50.0 ± 7.9
Body Mass Index (kg/m^2)	21.2 ± 2.5	22.3 ± 2.7	22.8 ± 2.8

Mean ± SD

SUBJECTS AND METHODS

Subjects

The younger subjects were 27 individuals (young group) (17 males and 10 females: mean age 20.6 ± 4.2 years). The elderly subjects were 29 individuals under age 75 (young old group) (8 males and 21 females: mean age 70.5 ± 2.9 years) and 34 individuals over age 75 (old old group) (3 males and 31 females: mean age 78.7 ± 3.0 years) who could walk without assistance (Table 1). Subjects with motor paralysis in the central nervous system were excluded. The tester was a physical therapist with 8 years of clinical experience. This study was approved by the Research Ethics Committee of University. The study was fully explained to subjects beforehand and their consent was obtained.

Methods

The OCS-10 was conducted by first explaining verbally how the OCS-10 would be conducted and then demonstrating how to perform the test. Once subjects understood how to perform the test, they practiced. The OCS-10 was conducted as follows. The subjects sat in a chair with no arm rests with both feet (bare feet) placed in the center of a simple measurement board (30×30×3 cm) devised by the authors. The subject's hands were used to hold both sides of the chair. As soon as the rater gave the signal "Start" the subject opened the legs and spread the feet as quickly as possible, touching the floor beside the board with the forefoot or entire sole of the foot, and then quickly returned the feet and legs to their original position. This series of actions constituted one iteration, and the tester counted how many iterations subjects were able to perform during the 10 seconds of the test (Fig.1). Test duration was measured with a timer (TM-11: Custom Co., Ltd.), and the tester visually counted the number of iterations performed. When a subject did not bring the feet back to their starting position as the test progressed, this incomplete iteration was counted as 0.5 of an iteration and added to measurement values.

Testing was done after subjects had practiced sufficiently. After an additional round of practice, the test was performed twice with an interval of 30 seconds between, and the measurement values were recorded. To compare the measurement values among the young group, young old group and old old group, the best results from the 2 rounds of testing were used in analysis. The test duration was 10 seconds which was measured with a timer.

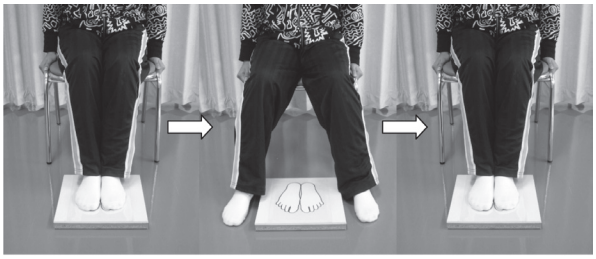

Fig.1. Implementation of the OCS-10

In the statistical analysis, the intra-class correlation coefficient (ICC) was used to determine intra-rater reliability for 2 rounds of testing for each group. In addition, the coefficient of variation (CV) (%) was calculated based on the mean and standard deviation (SD) of the 2 rounds of testing for each group. ANOVA was used to compare test results among groups, and Tukey's procedure was then used for multiple comparison. The statistical software SPSS 15.0 J for Windows was used, with significance accepted at values of $p<0.05$.

RESULTS

The ICC and CV (%), used to measure intra-rater reliability and the results of the first and second rounds of testing for each group, are shown in Table 2. Significant differences in measurement values between the young group and the young old group and old old group were noted, but not between the measurement values of the young old group and old old group (Table 3).

DISCUSSION

OCS-10 is simple, can be conducted anywhere, and requires no special equipment. The current study was a basic study of the OCS-10 conducted for younger individuals and the elderly. Their results for 10 seconds of testing were compared. In addition, measurement values were compared by dividing the elderly into subjects under age 75 and those over age 75. The reliability results indicate that all of the groups had a high ICC. Tsushima[8] stated that an ICC of 0.7 or better indicates a high level of reliability. In accordance with rough criteria for the reliability coefficient[9], the test was deemed to have "great" reliability for the young group

Table 2. Measurement values (time) for each group and ICC, CV (%)

	1st round	2nd round	ICC (1.1)	CV
Young group	20.3 ± 2.7	20.6 ± 2.5	0.93* (0.85–0.97)	2.5
Young old group	14.3 ± 2.4	15.0 ± 2.5	0.89* (0.79–0.95)	3.8
Old old group	14.0 ± 2.3	14.9 ± 2.6	0.84* (0.70–0.92)	5.6

Mean ± SD, ( ) 95% Confidence interval, *$p<0.05$

Table 3. Measurement values (time) for each group

	Young group	Young old group	Old old group
Measurement values (maximum)	20.8 ± 2.5*	15.0 ± 2.5	15.0 ± 2.5

Mean ± SD, *$p<0.05$

and "good" reliability for the young old group and old old group. Thus, the OCS-10 provides consistent measurement values for both young and elderly individuals. The young old group and old old group had significantly lower scores compared to the young group but the difference in scores of the young old group and old old group was not significant. We think this is due to the method of implementation of the OCS-10. OCS-10 is conducted in a sitting position, was muscle strength and balance ability are unaffected compared to the standing position. In addition, agility unaffected by gender, and showed no differences in these measurement values.

We consider OCS-10 as a way of assessing agility which is consistent with BFOC. Agility involves musculature (e.g. muscle strength), the nervous system, skeletal system, and other systems[10]; and reduced musculature and a diminished nervous system are linked to loss of agility. Musculature and the nervous system are reported to diminish due to aging, one cause of which is diminished nervous system function. Brown[11] stated that motor units decrease with age. They reported that changes in the nervous system of the elderly causes changes in motor unit recruitment during muscular exertion. In addition, Demura[12] reported that muscle atrophy accompanying aging is particularly marked in fast-twitch fibers, and that this atrophy is closely associated with muscle weakness. In other words, a decline in physical functions is evident as a loss of agility in the elderly, and they will consequently have lower scores compared to younger individuals. Our findings indicate that the OCS-10 provides consistent measurement values for both younger and elderly individuals, though the results were more consistent for younger individuals. In addition, the OCS-10 should allow accurate discernment of the decline in physical functions due to aging and accompanying loss of agility.

This study examined the reliability of the OCS-10 and compared measurement values between younger and elderly individuals. The association between falls by the elderly and other forms of physical performance was not discussed. This is a limitation of this study, and additional studies need to be performed in the future to examine this issue. In addition, the validity of the OCS-10 in relation to agility should be examined to determine its criterion-related validity with respect to other stepping tests.

REFERENCES

1) Sheldon JH: On the natural history of falls in old age. BMJ, 1960, 2: 1685–1690. [Medline] [CrossRef]
2) American Geriatric Society: Guideline for the prevention of falls in older persons. J Am Geriatr Soc, 2001, 49: 664–672. [Medline] [CrossRef]
3) Toraman A, Yildirim NU: The falling risk and physical fitness in older people. Arch Gerontol Geriatr, 2010, 51: 222–226. [Medline] [CrossRef]
4) Berg WP, Alessio HM, Mills EM, et al.: Circumstances and consequences of falls in independent community-dwelling older adults. Age Ageing, 1997, 26: 261–268. [Medline] [CrossRef]
5) Ikezoe T, Ichihashi N, Shima H, et al.: Predicting the probability for falls of the institutionalized elderly using the stepping test. PT Journal, 2009, 43: 989–995 (in Japanese).
6) Ono M, Iwagaki S, Miyazaki Y, et al.: The fitness test program. Tokyo: Japan Health Promotion & Fitness Foundation, 2001, pp 19–20.
7) Kobayashi K, Maruyama H: Intra-rater and Inter-rater reliability of "Modified putting legs together and apart". The 5th Beijing International Rehabilitation Forum abstract journal, 2010, 1: 89.
8) Tsushima E: Learn medical data analysis in SPSS. Tokyo: Tokyo Tosho, 2009, pp 195–214.
9) Kuwahara Y, Saito T, Inagaki Y: Consideration of the inter-rater and intra-rater reliability (repeatability, reliability). Kos, 1993. 41: 945–952 (in Japanese).
10) Yamaguchi H, Yamada Y, Hayashida M: How to measure agility. Rigakuryouhou, 2005, 22: 66–72 (in Japanese).
11) Brown WF: Methods for estimating numbers of motor units in biceps-brachialis muscles and losses of motor units with aging. Muscle Nerve, 1988, 11: 423–432. [Medline] [CrossRef]
12) Demura S, Sato S: Characteristics of muscular function in older people. Japan Society of Physiological Anthropology, 2000, 5: 53–58 (in Japanese).