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Original Article

Differences in gait velocity and trunk acceleration during semicircular turning gait with and without bag in females of very advanced age

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Abstract. [Purpose] Gait velocity and trunk acceleration during semicircular turning gait with and without carrying a hand-held bag were compared in females of very advanced age. [Subjects and Methods] Ten female volunteers of very advanced age who could walk independently were recruited for this study. Gait velocity and trunk acceleration were measured using an accelerometer during semicircular turning gait with and without carrying a hand-held bag. [Results] Gait velocity during semicircular turning gait was greater with the bag than without the bag. [Conclusions] Trunk stability during semicircular turning gait was higher when the subjects carried a bag. Additional arm load could be considered during gait training in females of very advanced age.
Key words: Trunk acceleration, Adults of very advanced age, Stair negotiation

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INTRODUCTION

Cautious gait patterns, characterized by lower walking velocity, reduced stride length, and decreased arm swing, are a common behavior in older adults when facing serious balance threats such as when turning[1)]. Humans generally swing their arms in opposition to their legs during walking, which increases gait velocity and facilitates balance of the angular momentum generated in the lower body[1, 2)]. Thus, rhythmic arm swings play an important role for postural stability during walking[2)]. However, little is known regarding the effect of arm movement during turning in females of very advanced age. Therefore, the purpose of the present study was to investigate the effect of carrying a bag on gait velocity and trunk acceleration during semicircular turning gait in females of very advanced age.

SUBJECTS AND METHODS

Ten community-dwelling females of very advanced age (80.9 ± 5.5years [mean ± SD]) with a mean height of 149.4 ± 3.7 cm and a mean body weight of 50.8 ± 6.9 kg who could walk independently were recruited. All the participants were older than 75 years, could walk independently without any assistive device, and scored more than 24 in the Korean version of the mini-mental state examination. None of the participants had neurological diseases, major orthopedic diseases, or significant visual, auditory, or vestibular impairments. Ethics approval was obtained from the Inje University Ethics Committee for Human Investigations, and written informed consent was obtained from all the participants. Gait velocity and trunk acceleration during semicircular turning gait with and without a hand-held bag were measured with atri-axial accelerometer (dimensions: 35 × 35 × 13 mm; mass:13.7 g, Fit Dot Life, Suwon, KOR). The range of the sensors was selected to be ± 2 gin the acquisition software (Fitmeter manager 2, ver. 1.2.0.14, KOR). The walking velocity was calculated by dividing the distance by the time

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required to complete the locomotor task. Trunk acceleration in the anterior-posterior, medial-lateral, and vertical directions was calculated using root mean squares of different directions[3]. The semicircular turning maneuver consisted of walking 3 m in a straight line, following a 2.36-m semicircular curve with a radius of 0.75 m, and walking 3 m back in a straight line. An accelerometer was fixed with double-sided adhesive tape over the L3 spinous process. The participants holding a bag (dimensions: 350 × 270 × 20 mm; mass: 0.2 kg) by the hand straps in the right hand were asked to walk along the above curve barefoot at a self-determined speed. The data were analyzed using the SPSS statistical package (version 18.0 for Windows, Chicago, IL, USA). Differences in gait velocity and trunk acceleration were analyzed using the paired t-test for comparisons between tasks. The significance level was set at $p<0.05$.

RESULTS

There were no differences in directional trunk accelerations between the tasks ($p>0.05$).The anterior-posterior and medial-lateral acceleration amplitudes were 1033.5 ± 218.9 cm/s^2 and 919.0 ± 205.5 cm/s^2, respectively, without the bag and 952.6 ± 116.4 cm/s^2 and 850.0 ± 201.8 cm/s^2 with the bag. The gait velocity during semicircular turning gait with the bag (67.2 ± 13.6 cm/s) was significantly greater than that without the bag (59.0 ± 8.8 cm/s, $p<0.05$).

DISCUSSION

Our findings indicate that the trunk control during semicircular turning gait was more stable with the bag than without the bag in females of very advanced age. Trunk control is important for stable walking in the elderly, and trunk and arm movements are coordinated with each other[1]. During semicircular turning, the outer leg produces greater plantar-flexor forces to propel the body forward because it must travel a greater distance. In addition, maintaining balance becomes more challenging when the center of mass moves in the medial-lateral direction during turning owing to the asymmetric movement of the inner and outer limbs[4]. However, in order to maintain the coordination between the movements of the upper and lower limbs, the arm swing on one side has to be limited while the arm swing amplitude on the opposite side has to be increased[5]. In addition, according to Nakakubo et al., intentionally increasing arm swing improves trunk stability in the medial-lateral direction and increases walking velocity in the elderly[1]. The results of the present study suggest that additional armload could be considered during gait training in females of very advanced age. The effects of various turning angles and load weights on trunk acceleration amplitude should be investigated in further studies.

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