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ORIGINAL RESEARCH

Strategies adopted by younger and older adults while operating a non-pedal tricycle

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Abstract
Background: Exercises that could prevent gait impairment of older adults should be implemented in such a way that practitioners can keep motivation and adherence independent of older adults fitness levels.
Objective: This study describes how younger and older adults use a non-pedal tricycle to transport their bodies along a pathway.
Methods: Nine younger (24 ± 4.9 y) and nine older (66 ± 4.0 y) adults participated in this study. They moved along a straight pathway at a self-selected comfortable speed with reflective markers on their main lower limb landmarks. A computerized gait analysis system with infrared cameras was used to obtain kinematic data to calculate spatial-temporal parameters and lower limb angles.
Results: Overall, participants from both groups were able to perform the task moving at a similar mean speed, with similar stride length and ankle joint excursion. Older adults had higher cadence (mean difference of 17 steps/min; 95% CI = 0.99–1.15) and hip excursion (mean difference of 12°; 95% CI = 28–33), longer stance duration (mean difference of 3.4%; 95% CI = 56.2–59.5), and lower knee excursion (mean difference of 6°; 95% CI = 47.9–53.8) than younger adults.
Conclusion: Older adults were able to transport their body with a non-pedal tricycle with more hip and less knee excursion than younger adults. Professionals that work with the older population should look at and take into consideration the use of non-pedal tricycles in exercise protocols and investigate the long-term impacts.

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Introduction

According to the World Health Organization,[1] the world population of people more than 60 years of age will reach more than two billion people in the next 43 years. Data from the Instituto Brasileiro de Geografia e Estatística – IBGE[2] revealed that in 2013, there were more than 23 million people over 60 years of age, constituting 13% of the Brazilian population. This institute indicated that by 2020, the elderly population in Brazil will be more than 30 million and the number of people over 80 years old will increase 14%.[2] Because life expectancy will continue to increase, it is imperative to provide older adults with opportunities to maintain independence and improve quality of life for as long as possible.

Older adults might be more fragile and functionally dependent in physical domains. Consequently, they may have difficulty performing daily activities, which decreases their autonomy.[3] Exercise is one of the best ways to reduce morbidity throughout the life span and to maintain independence.[4] Different interventions have been used in older adults, such as stretching, dancing, localized gymnastics, and yoga.[5]

It is important to select appropriate exercises that best fit the needs of the older population. It is also important to use devices that allow intervention protocols that practitioners can use to sustain motivation and adherence, considering that older adults might have different fitness levels. In this study, the authors considered the use of a non-pedal tricycle, a new device based on an equipment that has been used mainly in Europe, known as ''PETRA RaceRunning'' tricycle[6] (Fig. 1). This device contains one front and two back wheels, a saddle, a trunk support that the users can lean their trunk on anteriorly, and an open rear frame that permits lower limb movements in different modes. There is no pedaling system and the propulsion is through foot contact with the ground. The tricycle has been used as a means of locomotion, and for health-related exercise and balance training.

Figure 1 Illustration of the non-pedal tricycle adapted for the study. *Note*: The arrows indicate the adaptation made to enable adjustments to the front and back wheels in order to have the non-pedal tricycle either higher or lower depending on the height of the user.

Although the non-pedal tricycle has been employed among individuals with different gait impairments and in different settings,[6] there is a lack of information regarding the method individuals use to transport their body from one point to another using this equipment. Considering that the non-pedal tricycle could be employed for an exercise protocol for the older population, the aim of this study was to describe how younger and older adults use a non-pedal tricycle to transport their bodies along a pathway.

Methods

Sample

Nine younger and nine older adults, conveniently sampled, participated in this cross-sectional study. The authors excluded participants with any known musculoskeletal injuries or neurological disorders, anyone taller than 1.8 m, with body mass index greater than 35 kg/m^2, and who had undergone any surgical procedure that could influence their movement. The younger adults were either undergraduate or graduate students recruited from the university where the study took place. Older adults were recruited from the local community, through personal contact. Mean measurements of participants (±SD) for younger and older participants, respectively, were: age of 24 (±4.9) and 66 (±4.0) years, height of 1.65 (±0.09) and 1.60 (±0.05) meters, body mass of 61.9 (±7.7) and 61.0 (±12.2) kg, and body mass index of 22.7 (±2.2) and 23.9 (±4.4) kg/m^2. None of the participants had previous experience with the device or experimental procedures and all of them reported that they were healthy and free of any known disorder.

The Institutional Ethics Committee of Universidade Cruzeiro do Sul, São Paulo, SP, Brazil approved the study protocol (#182/2014). In addition, all procedures were performed with the adequate understanding and written consent of all participants.

Experimental procedures

The device used in this study was a non-pedal tricycle (Fig. 1) that was manufactured based on the measurements for a middle size ''PETRA RaceRunning'' tricycle.[6] The authors made one adaptation to the new device to enable adjustments to the front and back wheels in order to make the non-pedal tricycle either higher or lower depending on the height of the user.

Reflective markers were placed on each subject on the sacrum, bilaterally on the superior iliac crest, the midpoint of the lateral femur, the lateral knee joint axis, the midpoint of the lateral tibia, the lateral malleolus, the calcaneus, and the second metatarsal head, based on the Vicon Plug-in Gait model,[7] to define the pelvis, thigh, shank, and foot segments. A computerized gait analysis system (VICON Bonita 10) with seven infrared cameras recorded kinematic data. A calibration trial was conducted prior to testing wherein each participant stood upright to record the neutral position (baseline) of lower body segments and joints.

Before data acquisition, the saddle and the wheels were adjusted according to the height of the participant to accommodate the participant comfortably on the non-pedal

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