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Motor Recovery, Tonus of the Plantar Flexor Muscles, and Age are Predictors of the Lower Limb Motor Coordination in Stroke Survivors

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Abstract

Motor coordination (MC) or dexterity refers to the ability to perform a motor task in an accurate, rapid, and controlled manner. Adequate coordination of the lower limbs is important for the performance of activities of daily living and for an independent life and in stroke individuals, MC impairments contribute significantly to disability. The Lower Extremity Motor Coordination Test (LEMOCOT) was developed to assess the motor coordination of the lower limbs and is a simple test with good clinical utility, adequate psychometric properties, and has been considered one of the best to assess lower limb MC. Many factors may predict MC, such as age, gender, body mass index, and muscular strength, but these factors may depend upon the characteristics of the investigated sample. Menezes et al. investigated the potential predictors of the lower limb MC, assessed by the LEMOCOT scores, in stroke survivors, and found that motor recovery, tonus of the plantar flexor muscles, and age reached significance ($p<0.05$), explaining 54% of the variance in the LEMOCOT scores. These findings could help rehabilitation professionals to evaluate MC deficits and plan interventions aimed at improving MC of the lower limbs for stroke subjects, based upon the knowledge of the possible factors that could contribute to MC impairments.

Keywords: Motor skills; Lower extremity; Stroke

Introduction

Stroke is the leading cause of adult disabilities worldwide [1]. It is well known that the negative motor impairments following upper motor neuron damage, e.g., loss of strength and dexterity, mostly contribute to disabilities [2]. Motor coordination (MC) or dexterity refers to the ability to perform a motor task in an accurate, rapid, and controlled manner [3] and usually tests under conditions where some temporal and spatial accuracy are required. Adequate coordination of the lower limbs is important for the performance of activities of daily living and for an independent life [4] and in stroke individuals, MC impairments contribute significantly to disability [2,4].

Once that evaluation of MC is important in individuals with neuromusculoskeletal disorders, especially of the lower limbs, the Lower Extremity Motor Coordination Test (LEMOCOT) was developed to assess this condition [5]. It is a simple test with good clinical utility [5], adequate psychometric properties [6], and has been considered one of the best to assess lower limb MC [7]. The patients sat on an adjustable chair with their feet resting flat on thin rigid foam, heels on the proximal target, and with knees at 90° of flexion. Then, after a familiarization trial, they were instructed to alternately touch the proximal and distal targets placed 30 cm apart with their big toe, for 20 s. They were instructed not to sacrifice the accuracy of the touches nor the quality of the movement to increase speed, and the number of touched targets was counted and registered for analyses.

Many factors may predict MC, such as age, gender, body mass index, and muscular strength, but these factors may depend upon the characteristics of the investigated sample [8-12]. In healthy older adults, for example, age and gender were associated with MC scores [11]. Pinheiro et al. investigated the predictors of the LEMOCOT scores with 320 healthy subjects and found that younger men had higher scores. Age and gender together explained 48% of the variance in the LEMOCOT scores for the dominant and 44% for the non-dominant lower limb ($125<F<148$; $p<0.001$) [8].

Once that stroke is a high cause of chronic disability and one of the most devastating neurological condition [13,14], to identify the factors that could affect the MC could help to select variables to be considered in the evaluation and interventions aimed at improving MC of the lower limbs. Thus, Menezes et al. investigated the potential predictors of the MC of the paretic lower limb, as assessed by the LEMOCOT scores, in individuals with stroke [15]. They conducted an observational study in 106 chronic stroke patients with mean age of 59 ± 12.1 years and a mean time since the onset of the stroke of 60.2 months [15]. The potential predictors selected by the authors were based on previous studies with other population and were: motor recovery of the lower limb, assessed by the Fugl-Meyer (FM) lower limb section scores; tonus of the knee extensor and ankle plantar flexor muscles, assessed by the Modified Ashworth Scale (MAS); lower limb sensation, assessed by the FM lower limb sensation scores; and isometric strength of the paretic hip flexor and knee flexor/extensor muscles, assessed by the hand-held dynamometer [15]. The regression analysis results showed that only motor recovery of the lower limb, tonus of the plantar flexor muscles, and age reached significance ($p<0.05$) and, consequently, were kept in the model. Lower limb motor recovery alone explained 46% ($F=89.0$; $p<0.001$) of the variance in the LEMOCOT scores [15]. When tonus of the plantar flexor muscles was included in the model, the explained variance increased to 51% ($F=56$; $p<0.001$). By adding age, the explained variance increased to 54% ($F=41.8$; $p<0.001$). Motor recovery

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was positively associated with the LEMOCOT scores, while the tonus of the plantar flexor muscles and age were negatively correlated [15].

Furthermore, the prediction equation for the LEMOCOT scores of the paretic lower limb was created based on regression analyses: 0.98 (FM) −3.58 (MAS) − 0.18 (age) + 5.13, with a standard error of the estimate of 7.92 [15]. The FM, used to assess the motor recovery, is one of the most established and common outcome measures used in stroke rehabilitation [16]. The MAS, used to assess the tonus of the plantar flexor muscles, is a quick and easy measure used in research or clinical practice [17]. Information regarding the participants' age generally are obtained during the first interview with the patients and also is a quick and easy data to obtain. Thus, the prediction equation for the LEMOCOT scores of the paretic lower limb is easy to calculate and should be generalizable to similar samples of this study, although this needs to be formally tested.

Final Considerations

To identify the potential predictors of the MC of the paretic lower limb with stroke subjects, assessed by an instrument considered one of the best (LEMOCOT), is important to research and clinical practice. These findings could help rehabilitation professionals to make successful decisions, evaluating and planning interventions for stroke subjects, based upon the knowledge of the possible factors that could contribute to MC impairments.

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