IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
September 2020 Vol.:16, Issue:3

Gait and Functional Mobility in Multiple Sclerosis

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Rida Ul Jannat*[1], Vikash Kumar[2], Muhammad Awais Rehan[3]

[1]Punjab Health Facilities Management Company, District Sahiwal, Pakistan.
[2]Ravi General Hospital, District Ghotki Sindh, Pakistan.
[3]Demonstrator at Government Khawaja Muhammad Safdar Medical College, Sialkot, Pakistan.

Submission: 22 August 2020
Accepted: 28 August 2020
Published: 30 September 2020

HUMAN JOURNALS

www.ijsrm.humanjournals.com

Keywords: Gait, Functional Mobility, Multiple Sclerosis

ABSTRACT

Introduction: Gait is a complicated process involving coordination of multiple systems within the body (e.g., central nervous, musculoskeletal, and cardiovascular system). **Objectives:** The main objective of the study is to analyse the gait and functional mobility in multiple sclerosis. **Material and methods:** This descriptive study was conducted in Lahore General Hospital during September 2019 till February 2020. The data was collected from 17 outdoor patients. Eligibility criteria included ages 18–70 years, level of neurologic disability as measured by the Expanded Disability Status Scale (EDSS) score from 1.0 to 6.5, and the ability to independently walk (with or without an assistive device) for at least 20 m. **Results:** The data was collected from 17 outdoor patients. Stimulation was well-tolerated across participants and with side effects of itching, tingling, and head pain. No side effect reached an intensity level of >7 (rated on a 0- to 10-point scale) for any participant, and all side effects resolved at the end of the stimulation period. All participants completed the 20-min aerobic exercise maintaining the targeted moderate level. The average HR during the session was 110.9 ± 4.0 beats/min. There were no significant side effects of the intervention, as well as of the time and time × intervention interactions for gait speed and TUG time, respectively. These findings indicate no immediate effect on walking and functional mobility performance with either tDCS paired with aerobic exercise or aerobic exercise alone. **Conclusion:** It is concluded that gait variability is elevated in individuals with MS and is potentially clinically significant as well. Additionally, a number of factors have been linked to gait variability in MS, including disability level, assistive device use, dual-task performance, and fatigue.

INTRODUCTION

Gait is a complicated process involving coordination of multiple systems within the body (e.g., central nervous, musculoskeletal, and cardiovascular system). To walk, a person's nervous system must send signals to control a large number of muscles while simultaneously processing sensory information in order to monitor and refine movements, all while maintaining an upright stance. Given the multitude of muscles and neural processes involved, gait variability likely arises from a combination of factors[1].

Multiple sclerosis (MS) is the leading cause of progressive functional impairments in younger adults of working age. Multiple sclerosis symptoms are often variable across individuals and can affect motor, sensory, and cognitive functions. Loss of mobility is a key concern due to the interference with independence and the ability to complete activities of daily living. Multiple factors contribute to the degeneration of MS ambulatory ability, such as muscle weakness, abnormal walking mechanisms, balance problems, spasticity, and fatigue[2]. While there is no typical pattern of MS gait disturbance, impairments often include reductions in gait velocity and step length. Symptomatic treatment is an important topic for the management of MS, with a strong unmet need for non-pharmacologic options to preserve and recover from MS-related walking impairments[3].

Weakness on one side of the body is a hallmark of multiple sclerosis (MS) and has been determined to be a significant contributor to the progressive worsening of walking abilities. Currently, there are no efficient rehabilitation strategies targeting strength asymmetries and/or gait impairments in people with MS (PwMS). Many of the current treatments, including pharmaceuticals, are only mildly effective and are often very expensive[3]. Thus, a practical, inexpensive, and effective adjunct treatment is required. One possible modality that fulfills these requirements is transcranial direct current stimulation. tDCS uses small currents applied to the scalp to increase the excitability of cortical neurons by increasing their spontaneous firing rate[4].

Aerobic exercise has demonstrated benefit in MS, with aerobic training shown to improve gait speed, stride length, and walking distance. Transcranial direct current stimulation may interact with exercise training enhancing the acute effect on motor functions and promote long-lasting benefits. Thus, the use of tDCS during aerobic exercise may enhance the therapeutic effects via greater activation of neuroplastic mechanisms[5].

Objectives

The main objective of the study is to analyse the gait and functional mobility in multiple sclerosis.

MATERIAL AND METHODS

This descriptive study was conducted in Lahore General Hospital during September 2019 till February 2020. The data was collected from 17 outdoor patients. Eligibility criteria included ages 18–70 years, level of neurologic disability as measured by the Expanded Disability Status Scale (EDSS) score from 1.0 to 6.5, and the ability to independently walk (with or without an assistive device) for at least 20 m. Potential participants were excluded if they had any history of brain trauma or seizures, any skin disorder or skin sensitive area near the stimulation locations, or were unable to understand the informed consent process and/or study procedures.

For the current analyses, we analyzed gait and functional mobility measures before and after the first tDCS + exercise session. Both the active and sham participants completed 20 min of stimulation during exercise using a recumbent combination arm/leg elliptical ergometer. The exercise period included heart rate (HR) monitoring via wristband to ensure that each participant met the recommended target HR for the physical exercise for MS, training at moderate intensity corresponding to 60–80% of age-predicted maximum HR.

To measure changes in gait and functional mobility, the instrumented 10-m walking test and the instrumented Timed Up and Go (TUG) test were measured using a single wearable inertial sensor. Both tests were performed twice consecutively, the first time for familiarization, and the second time for data capture.

Statistical Analysis

The collected data were analyzed using the statistical package SPSS version 25 (SPSS, Inc., Chicago, IL, USA). Descriptive analyses were generated for demographic and clinical variables of the two arms. The normal distribution of the dependent variables (gait velocity and TUG time) was assessed by the Kolmogorov–Smirnov test.

RESULTS

The data was collected from 17 outdoor patients. Stimulation was well-tolerated across participants and with side effects of itching, tingling, and head pain. No side effect reached an intensity level of >7 (rated on a 0- to 10-point scale) for any participant, and all side effects resolved at the end of the stimulation period. All participants completed the 20-min aerobic exercise maintaining the targeted moderate level. The average HR during the session was 110.9 ± 4.0 beats/min. There were no significant main effects of the intervention, as well as of the time and time × intervention interactions for gait speed and TUG time, respectively. These findings indicate no immediate effect on walking and functional mobility performance with either tDCS paired with aerobic exercise or aerobic exercise alone.

Table No. 01: *Post-hoc* pairwise comparison of gait speed and TUG time pre-intervention and post-intervention

	Active group (*n* = 9)			**Sham group (*n* = 8)**		
	Pre-intervention	**Post-intervention**	**Comparison pre vs. post *p*-value**	**Pre-intervention**	**Post-intervention**	**Comparison pre vs. post *p*-value**
Gait speed (m/s)	0.92 ± 0.31	0.95 ± 0.32	0.456	0.96 ± 0.35	0.96 ± 0.34	0.558
TUG time (s)	14.48 ± 4.11	14.34 ± 4.02	0.195	15.19 ± 4.56	14.58 ± 4.33	0.103

Values are reported as mean ± SD.

DISCUSSION

The majority of research concerning gait variability in individuals with MS characterizes variability of gait parameters over relatively short distance walks (≤10 meters). Understanding walking behavior, including gait variability, during shorter walks, may be applicable to many activities of daily life such as maneuvering about the home or crossing the street. Another potential explanation for why investigations focus on shorter walks is the limitations of data collection equipment[7] Pressure sensitive electronic walkways are commonly used to measure gait parameters but are typically less than 10 meters long. Additionally, data collection using optical motion capture for overground walking is limited by the capture size. However, the development and refinement of accelerometer-based mobility monitoring has been implemented successfully in persons with MS and may potentially provide means to measure gait variability over larger distances[8].

One of the first investigations to report on variability of walking function examined variability in the timed 25-foot walk. Importantly, variability in walking performance was viewed as random fluctuations (e.g., noise) that must be filtered to reveal significant changes in walking function[9]. The goal of the investigation (, EDSS ranging from 1.0 to 3.5) was to quantify natural variability in timed 25-foot walk performance in persons with MS over a 1-year period in order to determine a threshold for "meaningful change" in performance. Results demonstrated that timed 25-foot walk performance may naturally vary up to 20% over a 1-year period in persons with MS[10]. Therefore, it is suggested that changes in timed 25-foot walk time of 20% or more indicate meaningful change in walking function. It was also found that those with greater disability had the greater variability in 25-foot walk performance than those with less variability. This observation indicates that variability in performance-based test is related to disability[11].

CONCLUSION

It is concluded that gait variability is elevated in individuals with MS and is potentially clinically significant as well. Additionally, a number of factors have been linked to gait variability in MS, including disability level, assistive device use, dual-task performance, and fatigue. However, further research is needed to more fully characterize and to understand the clinical impact of gait variability in individuals with MS.

REFERENCES

1. Kelleher KJ, Spence W, Solomonidis S, Apatsidis D. The characterisation of gait patterns of people with multiple sclerosis. DisabilRehabil. (2010) 32:1242–50.
2. Kesselring J, Beer S. Symptomatic therapy and neurorehabilitation in multiple sclerosis. Lancet Neurol. (2005) 4:643–52.
3. Comi G, Radaelli M, Soelberg Sorensen P. Evolving concepts in the treatment of relapsing multiple sclerosis. Lancet. (2017) 389:1347–56. 10.1016/S0140-6736(16)32388-

4. Dunn J, Blight A. Dalfampridine: a brief review of its mechanism of action and efficacy as a treatment to improve walking in patients with multiple sclerosis. Curr Med Res Opin. (2011) 27:1415–23.
5. Ayache SS, Chalah MA. The place of transcranial direct current stimulation in the management of multiple sclerosis-related symptoms. Neurodegener Dis Manag. (2018) 8:411–22.
6. Woods A, Antal A, Bikson M, Boggio P, Brunoni A, Celnik P, et al. . A technical guide to tDCS, and related non-invasive brain stimulation tools. ClinNeurophysiol. (2016) 127:1031–48.
7. Lefaucheur JP, Antal A, Ayache SS, Benninger DH, Brunelin J, Cogiamanian F, et al. . Evidence-based guidelines on the therapeutic use of transcranial direct current stimulation (tDCS). ClinNeurophysiol. (2017) 128:56–92.
8. Fritsch B, Reis J, Martinowich K, Schambra HM, Ji Y, Cohen LG, et al. . Direct current stimulation promotes BDNF-dependent synaptic plasticity: potential implications for motor learning. Neuron. (2010) 66:198–204.
9. Kronberg G, Bridi M, Abel T, Bikson M, Parra LC. Direct current stimulation modulates LTP and LTD: activity dependence and dendritic effects. Brain Stimul. (2017) 10:51–8.
10. Nitsche MA, Paulus W. Excitability changes induced in the human motor cortex by weak transcranial direct current stimulation. J PhysiolLond. (2000) 527:633–9.
11. Goldsworthy MR, Hordacre B. Dose dependency of transcranial direct current stimulation: implications for neuroplasticity induction in health and disease. J PhysiolLond. (2017) 595:3265–6.