



Review

Gait deficits in people with multiple sclerosis: A systematic review and meta-analysis



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ARTICLE INFO

Article history:

Received 29 February 2016

Received in revised form 19 September 2016

Accepted 26 September 2016

Keywords:

Multiple sclerosis
Mobility limitations
Gait
Accidental falls
Postural balance

ABSTRACT

Background: Multiple Sclerosis (MS) results in postural instability and gait abnormalities which are associated with accidental falls.

Objective: This systematic review and meta-analysis aims to quantify the effect of MS on gait to inform the development of falls prevention interventions.

Methods: A systematic literature search identified case-control studies investigating differences in gait variables between people with MS and healthy controls. Meta-analysis examined the effect of MS on gait under normal and fast paced conditions.

Results: Forty-one studies of people with Expanded Disability Status Scale (EDSS) 1.8 to 4.5 were included, of which 32 contributed to meta-analysis. A large effect of MS was found on stride length (Standardised Mean Difference, SMD = 1.27, 95% CI{0.93, 1.61}), velocity (SMD = 1.12, 95% CI{0.85, 1.39}), double support duration (SMD = 0.85, 95% CI{0.51, 1.2}), step length (SMD = 1.15, 95% CI{0.75, 1.5}) and swing phase duration (SMD = 1.23, 95% CI{0.06, 2.41}). A moderate effect was found on step width and stride time with the smallest effect found on cadence (SMD = 0.43, 95% CI{0.14, 0.72}). All effect sizes increased for variables investigated under a fast walking pace condition (for example the effect on cadence increased to SMD = 1.15, 95% CI{0.42, 1.88}).

Conclusions: MS has a significant effect on gait even for those with relatively low EDSS. This effect is amplified when walking at faster speeds suggesting this condition may be more beneficial for assessment and treatment. No studies investigated the association between these deficits and falls. Further investigation relating to the predictive or protective nature of these deficits in relation to falls is warranted.

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1. Introduction

Multiple Sclerosis (MS) is a neurodegenerative disease characterised by the inflammatory-mediated demyelination of axons throughout the central nervous system [1]. With a predominantly young age of onset, MS is currently the leading cause of disability in young-middle aged adults in the developed world [2]. MS is notably heterogeneous in both its symptomatic presentation and clinical progression [3] with motor, sensory and cognitive impairments frequently observed in varying magnitudes [4]. These impairments predispose a reduction in postural control resulting in instability for people with multiple sclerosis (pwMS) stemming from a diversity of constraints and systems [5].

In terms of functional capacity, postural instability during gait poses a significant threat to the quality of life of the individual. Up to 85% of this population report mobility impairments [6] and gait is perceived as the most important bodily function across the MS disability spectrum [7]. Postural instability during gait increases an individual's likelihood of experiencing a fall [8,9]. PwMS frequently display a cautious gait pattern hypothesised to be an attempt to reduce such postural instability and increase the overall control of the movement [10]. However such proactive responses may contradictorily precipitate a loss of postural control through a reduction in quality of certain gait variables in favour of increasing the quality of others, consequently increasing the likelihood of falls occurring [10]. Falls are associated with significant physical, psychological and social morbidity for pwMS [11–13]. Fall rates in this population are considerably high; with recent literature indicating that approximately 56% will experience a fall in any three-month period [14]. Consistently studies report that the majority of these falls occur during activities involving gait [15–17] and an association between gait tasks and accidental falls in pwMS has been well documented [9].

The association between postural instability, gait abnormalities and falls in this population suggest that these are key factors that must be addressed by falls prevention interventions. To this end, the assessment, maintenance and promotion of mobility have become increasingly important in this development of falls prevention strategies for pwMS [18,19]. Understanding the extent of and quantifying the deficits in gait is key to developing theory based interventions to reduce falls for pwMS.

A number of primary research studies have quantified the deficits in gait in pwMS when compared to their healthy peers. To date, no review has systematically pooled the evidence from these studies to quantify the totality of these deficits and investigate their association with falls. Accordingly, this systematic review and meta-analysis aims to identify and quantify deficits in gait in pwMS when compared to a healthy population, with the goal of informing falls prevention interventions for this population.

2. Methods

2.1. Study design

This study consists of a systematic review and meta-analysis of case-control studies. The recommendations of the Meta-analysis of Observational Studies in Epidemiology (MOOSE) group [20] were followed to standardise the conduct and reporting of the review.

2.2. Search strategy

A literature search was conducted in May 2015. The search was carried out by a PhD student (L.C.) through the following databases; Ebsco (Academic Search Complete, AMED, CINAHL, Medline, PsychArticles, PsychInfo, SportDiscus, Biomedical Reference Collection), Scopus and Web of Science. A combination of the following keywords and MeSH headings were utilised as search terms: multiple sclerosis OR MS AND balance OR postural control OR postural stability OR postural balance OR postural equilibrium OR postural sway OR postural instability OR dynamic stability OR dynamic control. The full search string is available on request. The search was supplemented through the searching of references lists of returned articles and the use of the same search terms in Google Scholar.

2.3. Study identification

The population of interest was ambulatory pwMS with a definite diagnosis of MS (as defined in the individual studies). Case-control studies were the only studies identified as appropriate for inclusion where the outcomes of pwMS were compared to those of a healthy control group. Studies were included if they contained an exposure of gait for both groups. Outcomes of interest were the variables of gait including spatiotemporal parameters, kinetic and kinematic variables. Articles published in all languages were considered and there was no limit to year of publication. Studies were excluded if they consisted of other observational or experimental study designs or if case populations other than pwMS were included.

Following the removal of duplicates, one author (L.C.) assessed titles and abstracts of the total search for relevance based on the above criteria. Three authors (L.C., S.C. and R.G.) then independently assessed the remaining full text articles for eligibility. Where a disagreement over the eligibility of a study occurred, all three authors deliberated until a consensus was reached. Study authors were contacted to provide additional information on study status where abstracts were returned without the availability of a full text or in cases where all relevant data was not reported in the study. Where duplicate studies contained the same outcomes from

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