



## Short communication

# Reliability of spatial–temporal gait parameters during dual-task interference in people with multiple sclerosis. A cross-sectional study



Marco Monticone<sup>a,\*</sup>, Emilia Ambrosini<sup>a,b</sup>, Roberta Fiorentini<sup>a</sup>, Barbara Rocca<sup>a</sup>,  
Valentina Liquori<sup>a</sup>, Alessandra Pedrocchi<sup>b</sup>, Simona Ferrante<sup>b</sup>

<sup>a</sup> Physical Medicine and Rehabilitation Unit, Salvatore Maugeri Foundation, Institute of Care and Research (IRCCS), Scientific Institute of Lissone, Milan, Italy

<sup>b</sup> Neuroengineering and Medical Robotics Laboratory (NearLab), Department of Electronics, Information, and Bioengineering, Politecnico di Milano, Milan, Italy

## ARTICLE INFO

## Article history:

Received 11 December 2013

Received in revised form 11 June 2014

Accepted 27 June 2014

## Keywords:

Reliability

Minimum detectable change

Dual tasking

Gait

Multiple sclerosis

## ABSTRACT

**Purpose:** To evaluate the reliability and minimum detectable change (MDC) of spatial–temporal gait parameters in subjects with multiple sclerosis (MS) during dual tasking.

**Method:** This cross-sectional study involved 25 healthy subjects (mean age  $49.9 \pm 15.8$  years) and 25 people with MS (mean age  $49.2 \pm 11.5$  years). Gait under motor–cognitive and motor–motor dual tasking conditions was evaluated in two sessions separated by a one-day interval using the GAITRite<sup>®</sup> Walkway System. Test–retest reliability was assessed using intraclass correlation coefficients (ICCs), standard errors of measurement (SEM), and coefficients of variation (CV). MDC scores were computed for the velocity, cadence, step and stride length, step and stride time, double support time, the % of gait cycle for single support and stance phase, and base of support.

**Results:** All of the gait parameters reported good to excellent ICCs under both conditions, with healthy subject values of  $>0.69$  and MS subject values of  $>0.84$ . SEM values were always below 18% for both groups of subjects. The gait patterns of the people with MS were slightly more variable than those of the normal controls (CVs: 5.88–41.53% vs 2.84–30.48%).

**Conclusions:** The assessment of quantitative gait parameters in healthy subjects and people with MS is highly reliable under both of the investigated dual tasking conditions.

© 2014 Elsevier B.V. All rights reserved.

## 1. Introduction

Multiple sclerosis (MS) is the most frequent neurological disease causing permanent disability in young adults [1].

People with MS frequently have neuromuscular deficits such as ataxia, early muscle fatigue, spasticity and sensory disturbances, which limit gait and considerably affect their everyday living activities [2,3]. Subtle walking alterations can be detected at an early stage of the disease as patients walk more slowly, with shorter steps, and spend a larger percentage of the gait cycle in double feet support [4].

Although the walking deficits of subjects with MS have traditionally been attributed to neurological impairments of the locomotor system, there is growing evidence that cognition may play an important role [5]. Indeed, simultaneously performing cognitive tasks decreases walking ability [6,7], and the more is the disability, the higher is the dual-task cost [5].

Dual-task difficulties have a strong impact on daily life activities that often require the ability to perform two actions concurrently. The understanding of how the dual-task paradigm affects walking parameters in a specific pathology is crucial in the planning and assessment of rehabilitation, and in monitoring the degenerative process. A population-specific reliability analysis of gait parameters during dual-task paradigms is essential to discriminate a real deterioration or improvement in the gait performance from a normal variability between consecutive measures.

Gait parameters demonstrated to be reliable during dual-task in older adults and subjects with dementia [8,9]. Since it has not been investigated in multiple sclerosis, the aim of this study was to evaluate the reliability of gait parameters in this population during dual-task interference.

## 2. Methods

This cross-sectional study was approved by the hospital's Institutional Review Board.

\* Corresponding author. Tel.: +39.039.4657277; fax: +39 039 4657279.

E-mail address: [marco.monticone@fsm.it](mailto:marco.monticone@fsm.it) (M. Monticone).

**Table 1**  
Demographic and clinical characteristics of the study population.

| Characteristics                         | MS subjects<br>(n = 25) | Healthy subjects<br>(n = 25) | P-value |
|-----------------------------------------|-------------------------|------------------------------|---------|
| Age (years)                             | 49.2 ± 11.5             | 49.9 ± 15.8                  | 0.93    |
| Gender (male/female)                    | 5/20                    | 8/17                         |         |
| Body mass index<br>(kg/m <sup>2</sup> ) | 23.4 ± 4.1              | 25.0 ± 5.3                   | 0.33    |
| Disease duration<br>(years)             | 11.0 ± 7.1              | –                            |         |
| EDSS                                    | 5.4 ± 0.8               | –                            |         |
| MMSE                                    | 28.6 ± 1.9              | –                            |         |

EDSS = expanded disability status scale; MMSE = mini mental state examination.

The inclusion criteria were a diagnosis of secondary progressive multiple sclerosis; an expanded disability status scale (EDSS) score of 4–5.5 [10]; an age of 18–65 years. The exclusion criteria were cognitive impairment (Mini Mental State Examination [MMSE] < 18/30); orthopedic disorders that may impair balance; pregnancy; steroid, anti-psychotic drug treatment.

The control group consisted of age-matched healthy volunteers.

The spatio-temporal gait parameters (velocity, cadence, step and stride length, step and stride time, double support time, the % of gait cycle in single support and stance phase, and base of support) were acquired and computed by the GAITRite<sup>®</sup> Walkway System, a mat able to identify footfall contacts. Right and left parameters were averaged. The GAITRite<sup>®</sup> was embedded in a straight 30-m walking track. Data acquisition was repeated in two consecutive days for each patient. On each day, the subject completed a randomised sequence of two tests separated by a 15-min break:

- 1) *Motor-cognitive dual task walking (MC)*: The patients walked while a word list generation test was administered. The subjects had to say as many words as possible starting with a given initial letter within 30 s. The initial letter was communicated five seconds before the test started; for each subject, same initial letter was used on day 1 ("F") and day 2 ("P").
- 2) *Motor-motor dual task walking (MM)*: The patients walked carrying a tray with glasses.

An *a priori* power analysis showed that 22 was the minimum sample size required to establish that a reliability coefficient of

0.80 was significantly different from a minimally acceptable reliability coefficient of 0.50 considering  $\alpha = 0.05$  and  $1-\beta = 0.80$  [11].

A paired *t*-test was used to compare the test–retest sessions in order to ensure the absence of any systematic error [12].

The relative reliability of the gait parameters was assessed by the intra-class correlation coefficient, ICC(2,1) (0.70–0.85 and >0.85 indicated good and excellent reliability, respectively [13]).

For each group of subjects, absolute reliability was assessed computing the standard error of measurement (SEM), estimated as the square root of the mean square error term in the repeated measure ANOVA [12].

The smallest change in score for each relevant gait parameter that is likely to reflect a true change rather than a measurement error was estimated by the minimum detectable change (MDC). The MDC was calculated as follows:  $MDC = SEM 1.96\sqrt{2}$ , where 1.96 is the *z*-score associated with the 95% level of confidence, and the square root of 2 reflects the additional uncertainty introduced by using difference scores based on measurements made at two time points.

The coefficient of variation (CV) was first computed separately for the two tests and then averaged [12].

### 3. Results

Table 1 reports the subjects' characteristics. There were no significant differences in age or in the body mass index between the two populations.

The gait speed in MC condition was lower than MM condition for both groups. A reduction of 35% and 21% was obtained in the control and MS group, respectively (Table 2). The paired *t*-test showed the absence of any systematic error ( $p > 0.05$ ) in most conditions. However, for the patients' group a significant improvement in six gait parameters of the retest trial was found for the MM condition, and in one parameter (single support phase) for the MC condition.

The relative reliability of all of the gait parameters was good to excellent under both conditions in the two groups (Table 3). In the control group, SEM and MDC values were always below 18% and 49% of the mean, respectively. Patients showed comparable values (SEM < 17% and MDC values < 44%). In both groups, the highest values were found for the double support time and the base of

**Table 2**  
Mean and standard deviation of gait parameters in healthy and MS subjects during test and re-test trials.

| Gait Parameter                         | Task | Healthy subjects |                |         | MS subjects   |               |         |
|----------------------------------------|------|------------------|----------------|---------|---------------|---------------|---------|
|                                        |      | Test             | Re-test        | P-value | Test          | Re-test       | P-value |
| Velocity (cm/s)                        | MM   | 129.15 ± 21.53   | 132.51 ± 24.28 | 0.17    | 69.11 ± 25.40 | 75.59 ± 26.93 | <0.01   |
|                                        | MC   | 83.27 ± 16.36    | 84.61 ± 15.07  | 0.56    | 54.73 ± 17.59 | 57.65 ± 19.34 | 0.14    |
| Cadence (steps/min)                    | MM   | 116.05 ± 10.83   | 117.21 ± 11.06 | 0.32    | 88.29 ± 16.71 | 91.06 ± 16.58 | 0.01    |
|                                        | MC   | 89.70 ± 12.99    | 91.23 ± 12.94  | 0.36    | 76.20 ± 14.23 | 77.80 ± 13.60 | 0.32    |
| Step length (cm)                       | MM   | 66.61 ± 7.93     | 67.62 ± 9.27   | 0.20    | 45.87 ± 10.17 | 48.58 ± 10.49 | <0.01   |
|                                        | MC   | 55.50 ± 5.96     | 55.62 ± 6.39   | 0.87    | 42.73 ± 8.97  | 43.93 ± 10.04 | 0.11    |
| Stride length (cm)                     | MM   | 133.41 ± 15.38   | 135.37 ± 18.40 | 0.21    | 92.04 ± 20.38 | 97.32 ± 20.86 | <0.01   |
|                                        | MC   | 111.37 ± 11.83   | 111.29 ± 12.76 | 0.96    | 85.56 ± 18.00 | 87.99 ± 20.12 | 0.11    |
| Step time (s)                          | MM   | 0.52 ± 0.05      | 0.52 ± 0.05    | 0.34    | 0.70 ± 0.15   | 0.68 ± 0.13   | 0.07    |
|                                        | MC   | 0.68 ± 0.11      | 0.67 ± 0.10    | 0.30    | 0.81 ± 0.15   | 0.80 ± 0.15   | 0.31    |
| Stride time (s)                        | MM   | 1.04 ± 0.10      | 1.03 ± 0.10    | 0.31    | 1.41 ± 0.30   | 1.37 ± 0.27   | 0.08    |
|                                        | MC   | 1.37 ± 0.24      | 1.35 ± 0.20    | 0.29    | 1.63 ± 0.30   | 1.59 ± 0.29   | 0.36    |
| Double support time (s)                | MM   | 0.28 ± 0.06      | 0.27 ± 0.07    | 0.44    | 0.57 ± 0.24   | 0.52 ± 0.21   | 0.05    |
|                                        | MC   | 0.45 ± 0.11      | 0.44 ± 0.09    | 0.77    | 0.71 ± 0.28   | 0.66 ± 0.25   | 0.06    |
| Single support phase<br>(% gait cycle) | MM   | 36.62 ± 1.82     | 36.99 ± 2.27   | 0.11    | 30.39 ± 4.28  | 31.48 ± 3.91  | 0.01    |
|                                        | MC   | 33.77 ± 1.60     | 33.52 ± 2.17   | 0.46    | 28.91 ± 4.31  | 29.84 ± 4.07  | 0.03    |
| Stance phase (% gait<br>cycle)         | MM   | 63.38 ± 1.81     | 63.03 ± 2.26   | 0.12    | 69.41 ± 4.24  | 68.33 ± 3.86  | 0.01    |
|                                        | MC   | 66.23 ± 1.61     | 66.49 ± 2.16   | 0.45    | 70.90 ± 4.28  | 70.17 ± 4.15  | 0.07    |
| Base of support (cm)                   | MM   | 7.70 ± 1.79      | 7.42 ± 2.29    | 0.47    | 11.90 ± 4.46  | 11.05 ± 4.42  | 0.08    |
|                                        | MC   | 8.52 ± 2.78      | 8.32 ± 2.36    | 0.67    | 12.07 ± 4.56  | 11.98 ± 5.42  | 0.86    |

The *P*-value of the paired Student *t*-test is reported. MM = motor–motor dual task; MC = motor-cognitive dual task.

Download English Version:

<https://daneshyari.com/en/article/6205994>

Download Persian Version:

<https://daneshyari.com/article/6205994>

[Daneshyari.com](https://daneshyari.com)