The Role of Information Processing Speed in Clinical and Social Support Variables of Patients with Multiple Sclerosis

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Background and Purpose Information processing speed is one of the most impaired cognitive functions in multiple sclerosis (MS). There are two tests widely used for evaluating information processing speed: the Symbol Digit Modalities Test (SDMT) and the Paced Auditory Serial Addition Test (PASAT). To analyze the relationship between processing speed and the clinical and social support variables of patients with MS.

Methods A group of 47 patients with relapsing-remitting MS was studied, 31 were women and 16, men. Age: 39.04±13.17, years of schooling: 13.00±3.87, Expanded Disability Status Scale (EDSS): 2.78±1.81, and disease evolution: 8.07±6.26. Instruments of measure; processing speed: SDMT, PASAT, clinical variables: EDSS, Fatigue Severity Scale (FSS), Beck’s Depression Inventory II (BDI-II), and social support: Medical Outcomes Study Social Support Survey (MOS).

Results Significant correlations were found between information processing speed and psychiatric, motor disability and social support variables. The SDMT correlated significantly and negatively with BDI-II, FSS, EDSS, and MOS (p<0.05), whereas the PASAT correlated negatively with FSS and positively with MOS (p<0.05). Information processing speed appeared as the performance predictor of these variables. The SDMT produced significant changes in EDSS (R²=0.343, p=0.000); FSS (R²=0.109, p=0.031); BDI-II (R²=0.124, p=0.018), and MOS (R²=between 0.212 and 0.379, p<0.05).

Conclusions Information processing speed has influence on the clinical variables and the social support of patients with MS. These aspects are important to bear in mind for therapeutic approach.

Key Words multiple sclerosis, cognition, social support.

INTRODUCTION

Cognitive impairments are frequent symptoms of multiple sclerosis (MS). It is estimated that 40–70% of the patients have cognitive deficits, and information processing speed (IPS) is one of the most affected functions. IPS is a primary cognitive function, which is extremely important for the functionality of higher cognitive processes as it influences downward processes such as learning, memory, word retrieval, and executive function. Although no consensus on the definition of IPS as a neuropsychological construct has been reached, a prominent definition by Shanahan proposed a broad definition of processing speed as an underlying cognitive efficiency at understanding and acting upon external stimuli, which includes integrating low level perceptual, higher level cognitive, and output speed. Previous studies have analyzed the impact that processing speed has on emotional and clinical variables, and on different aspects of the MS patients’ quality of life.

There are two tests widely used for evaluating IPS: the Symbol Digit Modalities Test
Regarding the specific relation between cognitive function and the clinical variables of the patients is still under investigation. Also, the network of social support and its relationship with cognitive variables such as IPS is a field scarcely evaluated in this pathology. The aim of the present study is to analyze, in a group of patients with MS, the relationship between IPS and clinical variables such as disability, disease evolution, fatigue and depression, as well as its relationship with the social support perceived by the patients.

METHODS

Participants
A group of 47 patients diagnosed with Relapsing-Remitting Multiple Sclerosis (RRMS) were evaluated—of which 31 were women and 16, men,—, who had been treated at the Unit of Demyelinating Diseases of the General Hospital of Acute Diseases J. M. Ramos Mejía, Buenos Aires City. Participants were selected based on an incidental, non-probability sampling strategy. The patients who had attended neurological consultation and met inclusion and exclusion criteria were asked to participate in the study. They all signed an informed consent. Both the study and the informed consent were approved by the Ethics Committee of the institution (approval date: November 1, 2017).

As inclusion criteria, the following were established: being more than 18-years-old, having a diagnose of RRMS as per Poser et al.,34 and Mcdonald criteria,35 having a minimum of seven years of schooling, and being able to understand and appropriately carry out the test,—, a medical history of events of disease onset, and having had relapses or corticoids administration four weeks previous to the study.

Instruments of measure

Clinical variables
Motor disability was measured through the EDSS,36 and fatigue through the Fatigue Severity Scale (FSS).37 Depression
was measured through Beck’s Depression Inventory II (BDI-II) as adapted to Argentina by Brenlla and Rodriguez. The higher the score in the MOS, the better social support.

**Statistical analysis**

The data were analyzed through the SPSS statistical package version 21.0 (IBM Corp., Armonk, NY, USA). The degree of significance used was p<0.05. Descriptive statistics for the patients’ demographic and clinical variables were obtained. Pearson correlation coefficient was implemented in order to study the relationship between IPS, clinical variables and the social support perceived by the patients. A simple linear regression analysis was conducted in order to assess the impact of processing speed (independent variable) on each one of the clinical variables (dependent variables). In order to identify to what extent processing speed can predict social support, a stepwise regression was conducted. Scores from EDSS, BDI-II, and FSS were added in each regression analysis (block 1) to control the influence that motor disability, depression and fatigue have in estimating the relationship between processing speed (block 2) and each score of social support (dependent variable).

**RESULTS**

The group of patients was composed of 31 women (66% of the total) and 16 men (34%). The mean for age was 39.04 ± 13.17 years-old, and for years of schooling, 13.00 ± 3.87. Patients had an EDSS mean of 2.78 ± 1.81, and the mean for years of disease evolution was 8.07 ± 6.26 years. BDI-II mean was 12.13 ± 10.67, and FSS mean was 4.07 ± 1.79, representing mild levels of depression and fatigue as reported by patients. Results are shown in Table 1.

Significant associations were found between IPS and most of the clinical variables, as can be observed in Table 2. The scores that the patients obtained in the SDMT correlated significantly and negatively with measures of motor disability, fatigue and depression, whereas the scores obtained in the PASAT correlated significantly and negatively with measures of fatigue. No associations were found between IPS and the years of disease evolution.

| Table 1. Clinical and demographic data of patients with multiple sclerosis (n=47) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Age                             | Minimum         | Maximum         | Mean            | SD              | Minimum         | Maximum         | Mean            | SD              |
| 14.00                           | 67.00           | 39.04           | 13.17           |                 | Minimum         | Maximum         | Mean            | SD              |
| Years of schooling              | 3.00            | 22.00           | 13.00           | 3.87            |                 |                 |                 |                 |
| EDSS                            | 0.00            | 7.00            | 2.78            | 1.81            |                 |                 |                 |                 |
| Evolution (years)               | 1.00            | 27.00           | 8.07            | 6.26            |                 |                 |                 |                 |
| FSS                            | 1.00            | 7.00            | 4.07            | 1.79            |                 |                 |                 |                 |
| BDI-II                          | 0.00            | 38.00           | 12.13           | 10.67           |                 |                 |                 |                 |

BDI-II: Beck’s Depression Inventory II, EDSS: Expanded Disability Status Scale, FSS: Fatigue Severity Scale, SD: standard deviation.
Regarding social support, significant and positive associations were found between IPS and the scores obtained by the patients in the social support survey. The SDMT correlated with the total score of the survey, as well as with its three dimensions—emotional/informational, affective and instrumental—, while the PASAT correlated significantly with the dimension of emotional support and with the number of family members whom patients can rely on as their network of support.

In order to analyze the influence of IPS on the clinical variables under evaluation, the scores obtained by the patients in the SDMT and PASAT were added as independent variables in a linear regression model, as performance predictors in EDSS, FSS, and BDI-II. The result was a model that explains to a large extent the variance in the clinical variables.

The regression model implemented with the SDMT explains 34.3% of the variance in EDSS \((p=0.000)\), as well as 10.9% of the variance in FSS \((p=0.031)\), and 12.4% in BDI-II \((p=0.018)\). Processing speed, measured through the SDMT, appeared as the performance predictor of the mentioned variables, demonstrating a significant relationship between processing speed and EDSS, FSS, and BDI-II. The model implemented with the PASAT was not significant (Table 3).

Regarding social support, when the variables of EDSS, FSS, and BDI-II were controlled, SDMT produced a model that explains 53.7% of the variance of the MOS total score \((p=0.032)\), 54.4% of affective support \((p=0.004)\), and 45.9% of instrumental support \((p=0.010)\). The PASAT was not a significant predictor after the clinical variables were controlled (Table 4).

**DISCUSSION**

Changes in IPS are frequent symptoms of MS that can interfere in different aspects of the patients’ life. The study of these variables is relevant for the treatment MS patients. The aim of this study is to describe the relationship between IPS and clinical variables such as motor disability, disease evolution, fatigue and depression, as well as its relationship with the social support perceived by patients with MS.

The results obtained confirm that IPS is a cognitive function that highly predicts clinical aspects and the social support of patients with MS. Patients with a greater degree of motor disability, depression, fatigue, and with a weaker network of social support, also had slow processing speed. On the other hand, in this study no associations were found between processing speed and the years of disease evolution. These findings are consistent with the previously reported by Sundgren et al., who found that IPS was the cognitive function most strongly associated with motor disability. Other authors do not report such association.26 Regarding disease evolution, previous studies coincide with our results in that there is no correlation between processing speed and the years of disease evolution.24,42 However, Dusankova et al.22 found that patients who had more years of disease evolution performed worse in IPS tasks; but in that case, patients had different disease’ subtypes, which might explain those results. Meanwhile, the results obtained concerning fatigue severity are consistent with previous studies that show that there is a relationship between IPS and fatigue in patients with MS.20,23,27 Jougleux-Vie et al.24 dismiss that relationship, but they measured fatigue with a different instrument than ours. In this study, we also found a strong influence of IPS on the patients’ degree of depression, a relationship that has been previously described.18,19,23,27
An interesting finding is the relationship between processing speed and the network of social support, both in the quantitative and qualitative aspects. When the influence of speed on social support was analyzed, it was found that patients with slow IPS had weaker social relations in terms of quality. Patients who were experiencing a slowdown receive fewer demonstrations of affection and have less help of material resources, than those who are not in that stage. There are previous studies that report variations in the social support of patients with MS, but its relationship with cognition—and specifically, with IPS—has not been studied. Our findings are consistent with those of Glanz et al., who found that there is a strong correlation between the SDMT and one dimension of social support, although they used a different method of measure than ours. Barker-Collo describes that there is a strong relationship between IPS and the social relations of patients with MS, and although in that case the network of social support was not specifically evaluated, the patients who had a slow IPS ranked lower in the items related to social relations of a quality of life scale.

The reported findings reaffirm the importance of considering the processing speed in the different aspects of MS patients, and specifically consider the variable of social support, which has not been especially highlighted in previous studies about quality of life in MS patients. This last finding is highly relevant because an adequate social support is really necessary in patients suffering from this kind of diseases, and it would be especially affected in patients with slow processing. Even though there are treatments of cognitive stimulation and physical activity that collaborate with the rehabilitation of different cognitive functions, including the speed of processing, studying in more detail the processing speed could help the development of specific training programs that are really necessary.

It is essential to aim towards the need of taking into consideration IPS when treating patients with MS, since it has an important influence on the clinical aspects and the social network of the patients. As it mentioned above, the last point has special importance, given the prominence of social relations in the therapeutic treatment and rehabilitation process of chronic diseases, as well as in the patients’ quality of life.

Conflicts of Interest
The authors have no financial conflicts of interest.

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