The Symbol Digit Modalities Test is an Effective Cognitive Screen in Pediatric Onset Multiple Sclerosis (MS)

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Objective

To evaluate the Symbol Digit Modalities Test (SDMT) as a tool for the identification of pediatric MS patients at risk for cognitive impairment.

Background

One-third of pediatric MS patients have some degree of cognitive impairment on neuropsychological testing. Cognitive deficits in pediatric MS patients overlap with those found in adults but may be difficult to identify during routine monitoring visits. A brief and sensitive screening procedure is needed. The Symbol Digit Modalities Test (SDMT) is a test of information processing speed widely used across studies of cognitive functioning in adults with multiple sclerosis (MS). Information is lacking on the utility of the SDMT as a screening tool in pediatric MS.

Methods

Seventy (70) consecutive outpatients with pediatric-onset MS underwent clinical evaluations including the SDMT and were compared to those with other pediatric neurological diagnoses (OND, n=40) and healthy controls (HC, n=32) (see Table 1). OND patients were pediatric patients who came to the Lourie Center for diagnostic evaluation and did not meet criteria for MS; the most common diagnoses included optic neuritis, ADEM, NMO, and migraine.

At the time of the outpatient visit, all MS participants and OND participants were neurologically evaluated with a structured clinical assessment, which included determination of their Expanded Disability Status Scale (EDSS; administered by LBK). Disease duration based on symptom onset and annual relapse rate prior to the time of the evaluation were calculated. For MS participants, the presence or absence of optic neuritis in each patient's history was determined, and for those evaluated after June 2010, optical coherence testing (OCT) was performed.

A subset of the MS group and all healthy controls also completed neuropsychological evaluation within one year of SDMT administration. For group comparisons, raw SDMTs were converted to z scores based on published age- and gender-based normative data[16]. Impaired SDMT performance was defined as falling one standard deviation or more below the normative mean. For the subset of patients with neuropsychological testing, each neuropsychological measure was converted to an age-normative z score using published normative data.

Table 1. Demographic and Clinical Characteristics of Groups

Characteristic	MS mean (±sd) or n (%)	OND mean (±sd) or n (%)	Control mean (±sd) or n (%)
Age	16.4 (2.5) n= 70	13.9 (3.3)* n= 40	16.3 (3.02) n = 32
%female	44 (63) n= 70	21 (52.5) n= 40	24 (73) n= 32
Race	n= 65	n= 34	n= 30
Caucasian	37 (55)	26 (76)	26 (81)
African American	22 (33)**	2 (6)	0 (0)
Asian	0 (0)	4 (12)	2 (6)
Mixed/other	8 (12)	2 (6)	4 (13)
% Hispanic	19 (29) n= 67	6 (18) n= 34	9 (29) n= 32
Characteristics of MS group	Mean (±sd)	Median	Range
EDSS at testing n= 43 median; range	1.35 (±1.27)	1.0	0.0-4.0
Disease duration (years) n= 27 Median; range	2.55 (±1.52)	2.64	0.16-6.34
Relapses n= 70 Median; range	2.87 (±2)	2.0	1.0-9.0

*significantly lower than MS (p<0.001) and HC groups (p=0.01)
**significantly higher proportion than OND or HC group (p<0.001)

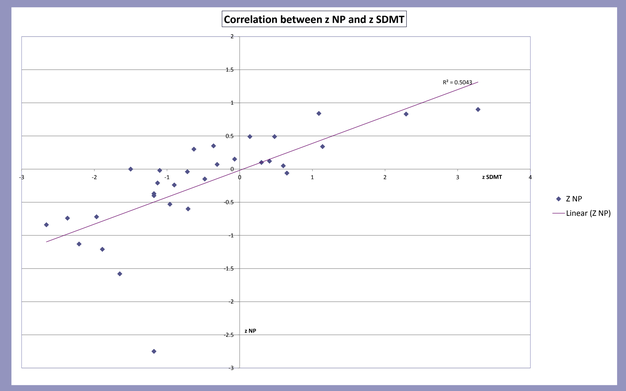

Figure 1. SDMT z score is predictive of neuropsychological evaluation aggregate z-score in the pediatric MS group (n=31)

Results

- The MS group's SDMT z scores were significantly lower than the HC group, *t* (100)=-2.38, p=0.02, and were also lower than the OND group approaching significance, *t* (108)=-1.78, p=0.08. The OND group had a lower mean performance than the HC group but this difference was not significant (p=0.48). Each group's mean SDMT z score fell within the average range. However, 37% of the MS group had scores in the impaired range compared to 20% of the OND group and 9% of the controls, c^2 (2, *N*=142)= 9.85, p=0.007.
- For the HC and MS participants combined, SDMT z score was significantly correlated with both NP z score (r=0.62, p<0.001; shown in **Figure 1**) and percent impairment (r=-0.47, p<.001).
- Linear multiple regression for age, EDSS, duration of illness, and number of relapses explained 42% of the variance in SDMT scores but only EDSS was a uniquely significant predictor, beta=-0.46, p=0.01.
- For the MS participants, worse (lower) SDMT performances were moderately correlated with both a higher EDSS score (r=-0.55, p<0.001) and older age (r=-0.36, p<0.001).
- OCT measures were not significantly correlated to SDMT performance (r=-0.10, p=0.59 and r=-0.18, p =0.35 for right and left eye, respectively). Further, those with a history of optic neuritis were less likely to be impaired on the SDMT (24% versus 49%, Fisher's exact p=0.03).

Conclusions

- As in adults with MS, the SDMT appears to be a sensitive and effective screen for cognitive function in pediatric MS.

- Patients found to have a SDMT in the impaired range or those with marked decline on repeated visits would be the best candidates for neuropsychological evaluation to confirm and classify the degree of cognitive impairment.

References

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