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The impact of upper limb dysfunction on activities of daily living in Multiple Sclerosis patients

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Introduction

- Rehabilitation for people with Multiple Sclerosis (MS) has focused primarily on mobility and lower limb function.
- Upper limb dysfunction has an important impact on everyday tasks. Additionally, upper limb impairment can have negative repercussions on perceived quality of life in these individuals.
- The role of upper limb impairment, however, has been greatly understudied, and few interventions have focused on the rehabilitation of the upper extremities.

Purpose

- This study examined the relationship between upper extremity function, fitness, and activities of daily living (ADL) involving the upper limbs in persons with and without MS.

Methodology

Sample Description

- 84 participants
 - Mild MS (n = 20)
 - Moderate MS (n = 22)
 - Severe MS (n=21)
 - Control (no-MS) (n = 21)
- Participants recruited from the central Illinois region through advertisement¹
- Disability status, cognitive function, and overall fatigue were assessed for sample characterization.

Data Collection

- Participants completed a self-reported upper limb activity of daily living questionnaire, a manual dexterity test (Nine-Hole Peg Test), two upper extremity fitness tests (grip strength and upper extremity cardiorespiratory fitness), and a self-reported quality of life questionnaire.

Statistical Analysis

- Differences in upper limb ADLs across groups were examined using one-way ANOVA.
- Relationships between variables were examined using bivariate Pearson correlation coefficients (*r*).

Results

Table 1 – Participant characteristics by level of disability¹

Characteristic	Control (n=21)	Mild MS (n=20)	Moderate MS (n=22)	Severe MS (n=21)
Age, y	51 (10.6)	49.7 (9.4)	51.8 (6.9)	54.6 (6.4)
Sex, % female	76.2	61.9	72.7	81.0
Height, cm	171.34 (9.8)	173.1 (12.3)	170.4 (7.6)	166.1 (9.1)
Weight, kg	74.1 (17.8)	78.8 (15.2)	81.1 (19.6)	74.5 (23.9)
EDSS, median, (IQR)	0.0 (0)	3.0 (1.5)	4.25 (0.5)	6.5 (0.5)
Disease duration, y	0.0 (0)	8.9 (6.3)	14.5 (8.9)	16.0 (9.5)
Disease course, % RRMS	0.0	100.0	86.4	47.6
Cognition, SDMT score	65.3 (12.3)	60.6 (12.7)	51.9 (13.4)	41.6 (10.0)
Employment Status, % employed	95.2	81.0	40.9	9.5
Fatigue Impact	11.1 (9.9)	22.9 (17.2)	42.9 (12.7)	47.2 (12.7)
Quality of Life, Physical	20.5 (1.5)	31.0 (8.8)	45.3 (12.2)	63.7 (13.5)
Quality of Life, Psychological	10.7 (2.2)	14.1 (3.5)	20.3 (6.0)	22.1 (7.2)

Abbreviations: EDSS, Expanded Disability Status Scale; MS, Multiple Sclerosis; RRMS, Relapsing-Remitting Multiple Sclerosis
¹Data are presented as mean (standard deviation), unless otherwise noted.

Table 2 – Upper extremity function and fitness assessed by different testing modalities by level of MS disability¹

Variable	Control (n=21)	Mild MS (n=20)	Moderate MS (n=22)	Severe MS (n=21)
Self-reported upper limb function	23.9 (1.3) ^{##}	22.5 (2.8) ^{##}	19.3 (4.4) [*]	15.1 (4.4)
NHPT Total, seconds	40.4 (4.8) [*]	42.2 (4.9) [*]	55.9 (27.5) [*]	75.3 (30.1)
Dominant Hand	19.6 (2.2)	20.6 (2.7)	25.2 (7.2)	36.7 (25.7)
Non-Dominant Hand	20.9 (3.1)	21.6 (3.0)	30.8 (20.8)	38.5 (17.9)
Grip Strength, kg	67.1 (21.9) [*]	76.5 (22.5) [*]	64.9 (17.8)	50.7 (15.6)
VO ₂ , mL/kg/min	22.1 (18.0) [*]	17.4 (5.3)	14.9 (5.0)	12.0 (2.7)
Peak Power, mL/kg/min	77.4 (31.8) [*]	80.7 (29.2) [*]	64.8 (19.7) [*]	41.0 (10.9)

Abbreviations: NHPT, Nine-hole peg test; MS, Multiple Sclerosis
¹Data are presented as mean (standard deviation)
^{*}Indicates statistically significant difference compared to severe MS group
^{##}Indicates statistically significant difference compared to moderate MS group

Table 3 – Correlation coefficients between upper extremity function and fitness, and symptomatic variables in the overall MS sample

	LLFDI	NHPT (D)	NHPT (ND)	Grip	ARM VO ₂	ARM PP	SDMT	MFIS	MPQ	MSIS Phys.	MSIS Psych.
LLFDI	-	-0.37 ^{**}	-0.54 ^{**}	-0.44 ^{**}	0.40 ^{**}	0.54 ^{**}	0.45 ^{**}	-0.50 ^{**}	-0.32 [*]	-0.73 ^{**}	-0.63 ^{**}
NHPT (D)	-0.37 ^{**}	-	0.29 [*]	-0.30 [*]	-0.05	-0.34 ^{**}	-0.40 ^{**}	0.12	0.02	0.36 ^{**}	0.19
NHPT (ND)	-0.54 ^{**}	0.28 [*]	-	-0.23	-0.20	-0.36 ^{**}	-0.31 [*]	0.16	-0.05	0.39 ^{**}	0.36 ^{**}
Grip	0.00	-0.30 [*]	-0.23	-	0.67 ^{**}	0.78 ^{**}	0.35 ^{**}	-0.44 ^{**}	-0.19	-0.44 ^{**}	-0.40 ^{**}
ARM VO ₂	-0.40 ^{**}	-0.05 ^{**}	-0.20	-0.67 ^{**}	-	0.83 ^{**}	0.47 ^{**}	-0.50 ^{**}	-0.41 ^{**}	-0.49 ^{**}	-0.46 ^{**}
ARM PP	0.54 ^{**}	-0.34 ^{**}	-0.36 ^{**}	0.78 ^{**}	0.83 ^{**}	-	0.55 ^{**}	-0.49 ^{**}	-0.27 [*]	-0.59 ^{**}	-0.45 ^{**}

Statistically significant at the ^{**}p<0.001, ^{*}p<0.05
Abbreviations: LLFDI, Late Life Function and Disability Inventory; NHPT (D), Nine-Hole Peg Test Dominant hand; NHPT (ND), Nine-Hole Peg Test Non-Dominant hand; ARM PP, Arm Peak Power; SDMT, Symbol Digit Modalities Test; MFIS, Modified Fatigue Impact Score; MPQ, McGill Pain Questionnaire; MSIS phys., physical Multiple Sclerosis Impact Scale; MSIS psych., psychological Multiple Sclerosis Impact Scale

Conclusion

- These findings demonstrate a pattern of increasing upper limb impairment with increasing disability status.
- The deterioration of upper extremity function and fitness in people with MS might have an important impact on ADL's, and in turn, repercussions on perceived physical and psychological quality of life.

Next Steps

- Through strength and aerobic training programs, there is potential to target and improve upper limb function to minimize the effects on participation in daily living and improve perceived quality of life in people with MS.

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- [Clinical Exercise Physiology Lab](#)
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