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Upper Extremity involvement in persons with MS: overall, by age by disease severity

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Disclosures

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- Albert Lo is an employee of Eli Lilly and Company in early phase clinical development for neurodevelopment. Eli Lilly has no involvement in this study.

Background

- Relative to the lower extremity, we have less understanding of upper extremity (UE) involvement in persons with multiple sclerosis (pwMS)
- Better understanding of UE involvement in MS will help to prioritize the design and selection of future UE rehabilitative interventions

Objectives

- These data are part of a larger study designed to characterize the UE in MS across domains of the International Classification of Functioning, Disability & Health
  - To identify deficits in ICF domains that maybe most clinically significant
- To characterize UE body functions and capacity among pwMS, with a spectrum of disease severity
- To determine whether functions and capacity vary by age and disability level

Subject Population

- N=400 pwMS were randomly selected from those patients receiving care at the Mandell Center for MS located in Hartford, CT
- Inclusion criteria:
  - (1) a clinical diagnosis of MS
  - (2) receive MS care at the Mandell Center
  - (3) score of $\geq$22 MMSE
  - (4) 18 years of age or older
- Exclusion criteria:
  - (1) unwilling or unable to complete assessments,
  - (2) persons with acute hand injuries or surgeries and other co morbidities that currently and directly influence UE or hand function
- 267 (67%) of those randomly selected agreed to participate
  - No subjects screened out due to eligibility criteria

Study Design

- Observational, cross-sectional study
- One time comprehensive assessment, including several measures of:
  - Body function
  - Capacity (as measured in a standard environment)
- Age and disability level (PDDS) were obtained from self-report or participants' charts
  - Patient Determined Disease Steps (PDDS) is a self reported measure that is correlated with the EDSS

Outcome Measures

- Measures of Body Function included:
  - **Active Range of Motion (aROM):**
    - shoulder
    - elbow
    - forearm
    - wrist and
    - index finger
  - **Isometric Arm Strength (biodex):**
    - shoulder abduction and adduction
    - wrist flexion and extension
  - **Grip Strength**
  - **Grip Endurance**
  - **Coordination:**
    - Finger to Nose Test (FTN)
  - **Sensation:**
    - Vibration sensation (Vibratron II)
    - Tactile sensation (monofilaments)

- All measures were assessed on both the dominant and non-dominant sides

Outcome Measures

- Measures of Capacity included:
  - **Fine motor dexterity**
    - Nine Hole Peg Test (NHPT)
  - **Gross motor dexterity**
    - Box and Block Test (BBT)
  - **Performance based test of the upper extremity**
    - Test d'Evaluation des Membres Superieurs de Personnes Agees (TEMPA)

Statistical Methods

- Prevalence of impairment were reported
  - Strength, grip strength, grip endurance*, FTN, 9HPT, BBT, TEMPA*
    - ≥2 s.d. worse than the norms
  - Vibration sensation
    - ≥ 2.5 s.d. worse than norms
  - Tactile Sensation:
    - No norms available; reported as 5 categories on sensation ability
    - Presented diminished protective sensation or worse
  - aROM:
    - Norms only available for passive ROM;
    - Presented in mean, s.d. and range for each measure
- Differences in % impairment (≥2 s.d.) from norms by grouped age and PDDS were compared using χ^2 tests.

*compared to age 60+ year old gender-specific norms

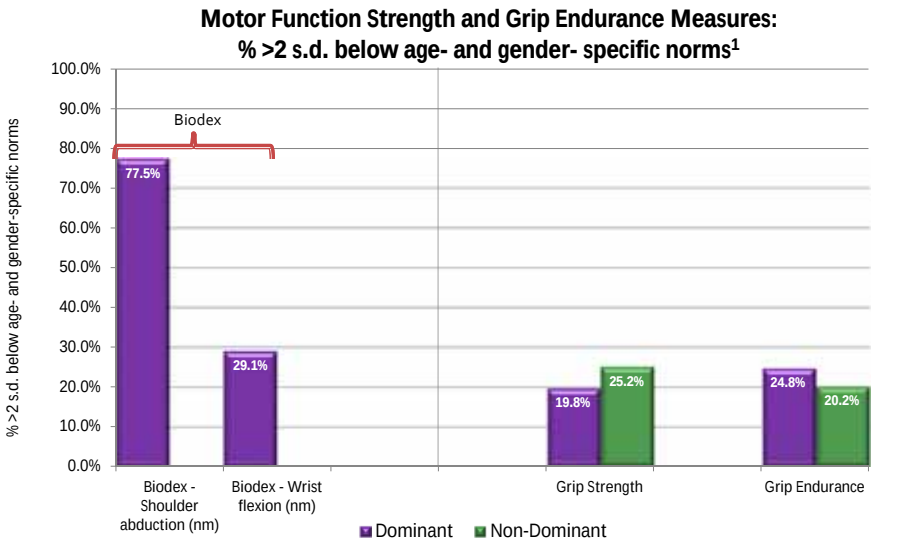
Distribution of Subject Characteristics

	n	%	Mean (s.d.)	range
PDDS Score			3.8 (2.1)	1 - 8
1-2	88	34.5		
3-5	110	43.1		
6-8	57	22.4		
Age			48.8 (11.6)	20 - 73
<40	59	22.1		
40 to <50	67	25.1		
50 to <60	90	33.7		
60+	51	19.1		
MS Duration			12.4 (8.8)	1 - 47
≤5 yrs	68	25.5		
>5 to ≤10 yrs	67	25.1		
>10 to ≤20 yrs	86	32.2		
>20 yrs	46	17.2		
Gender				
Male	62	23.2		
Female	205	76.8		

Active ROM

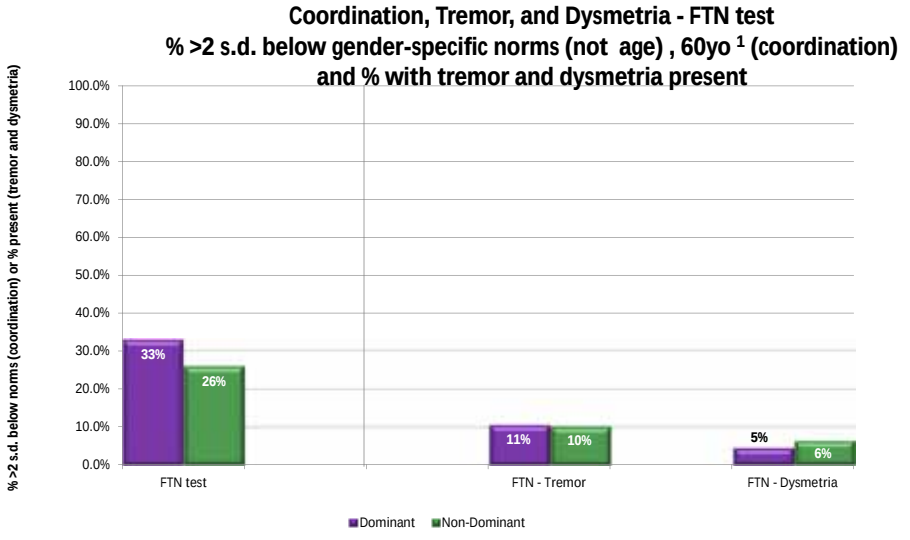
AROM Measures	Dominant			Non-Dominant		
	Mean	S.D.	Min-Max	Mean	S.D.	Min-Max
Shoulder						
Internal Rotation	68.1	12.3	12.0 - 118.0	68.4	12.8	13.0 - 135.0
External Rotation	93.3	13.5	19.0 - 127.0	91.1	18.0	-74.0 - 120.0
Flexion	167.3	16.2	85.0 - 187.0	166.2	20.1	10.0 - 185.0
Abduction	170.2	28.0	80.0 - 225.0	169.3	31.2	60.0 - 220.0
Extension	55.0	9.4	30.0 - 85.0	56.0	9.6	28.0 - 81.0
Elbow						
Flexion	149.5	4.8	125.0 - 162.0	149.5	5.1	110.0 - 165.0
Extension	-2.7	7.6	-46.0 - 13.0	-2.1	6.7	-32.0 - 12.0
Forearm						
Supination	85.4	11.2	0.0 - 117.0	85.2	14.6	-94.0 - 118.0
Pronation	77.4	10.3	0.0 - 110.0	78.2	8.8	20.0 - 103.0
Ulnar Deviation	30.8	4.8	15.0 - 44.0	32.4	5.3	13.0 - 54.0
Radial Deviation	19.6	5.1	2.0 - 35.0	20.4	5.3	1.0 - 36.0
Wrist						
Flexion	78.4	9.4	46.0 - 100.0	77.9	10.3	19.0 - 100.0
Extension	60.9	9.7	15.0 - 85.0	62.5	11.2	-5.0 - 84.0
Index Finger						
MCP Flexion	80.3	11.5	29.0 - 102.0	81.5	10.5	37.0 - 100.0
MCP Extension	31.0	10.3	-5.0 - 55.0	33.4	11.9	-15.0 - 65.0

Strength and Endurance



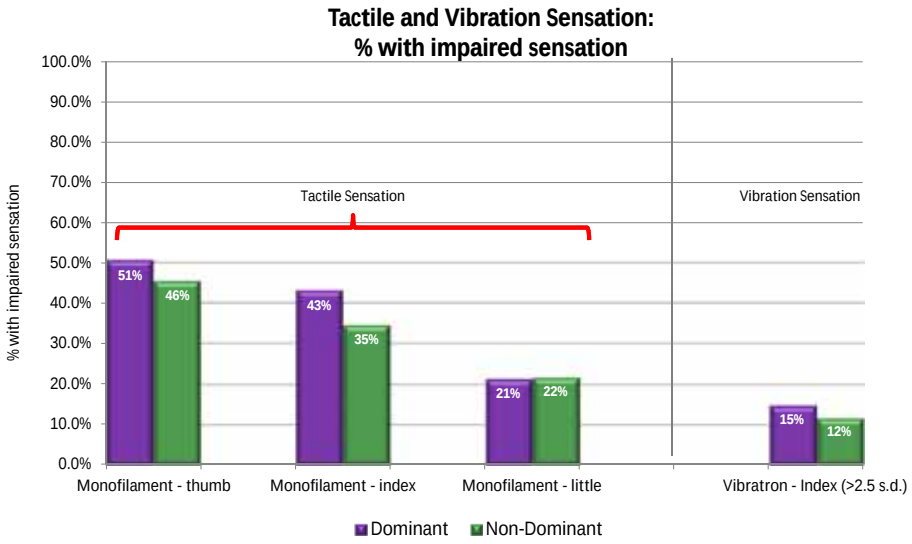
[1]Note: Biodex norms available for dominant side only; grip endurance is compared to age 60-69 year old gender-specific norms

Coordination

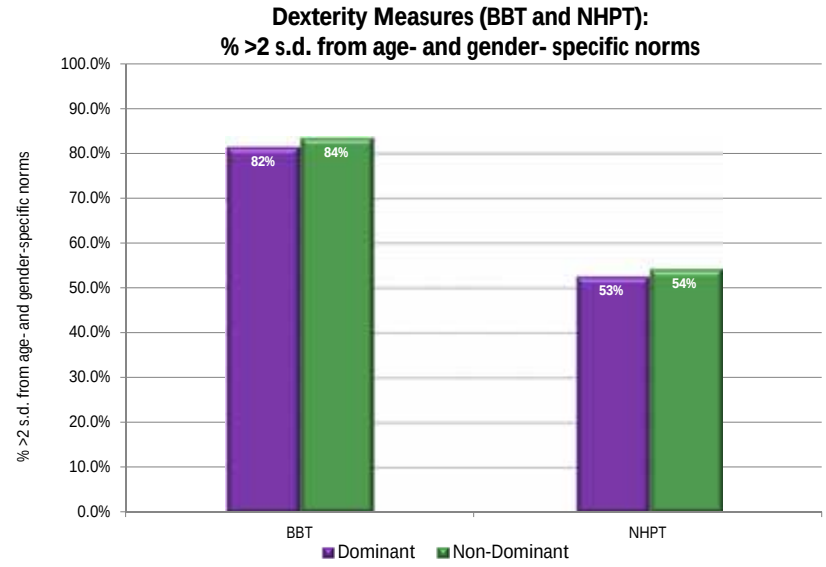


[1]Note: FTN is compared to age 60+ year old gender-specific norms

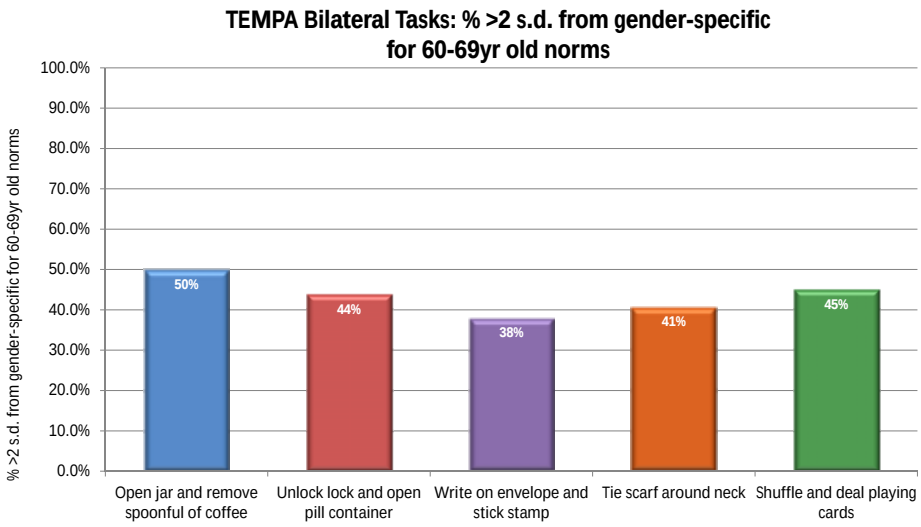
Sensation



Dexterity



TEMPA Bilateral Tasks



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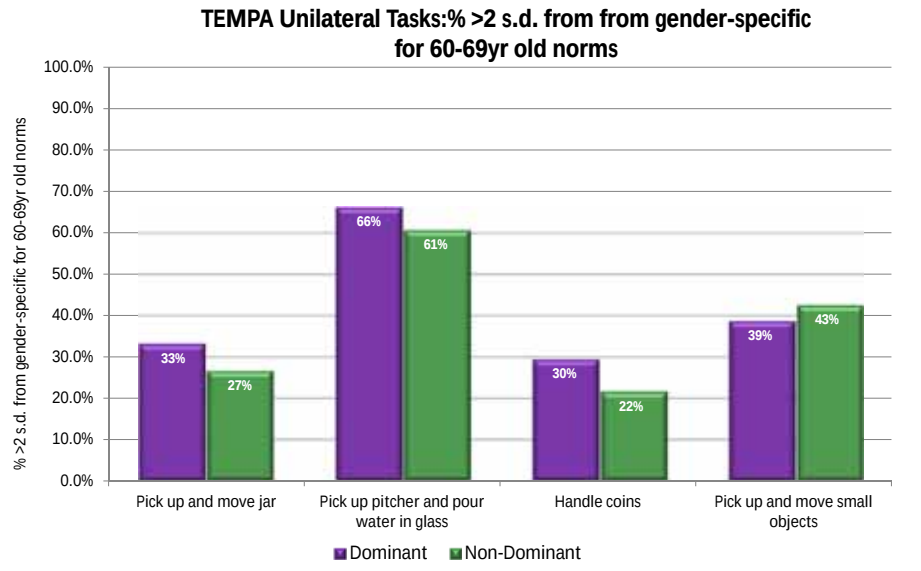
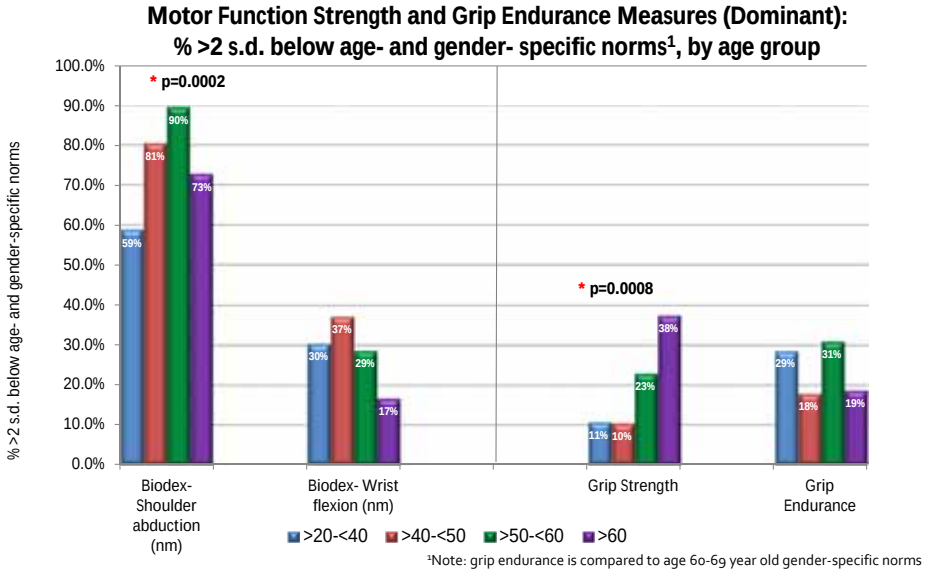
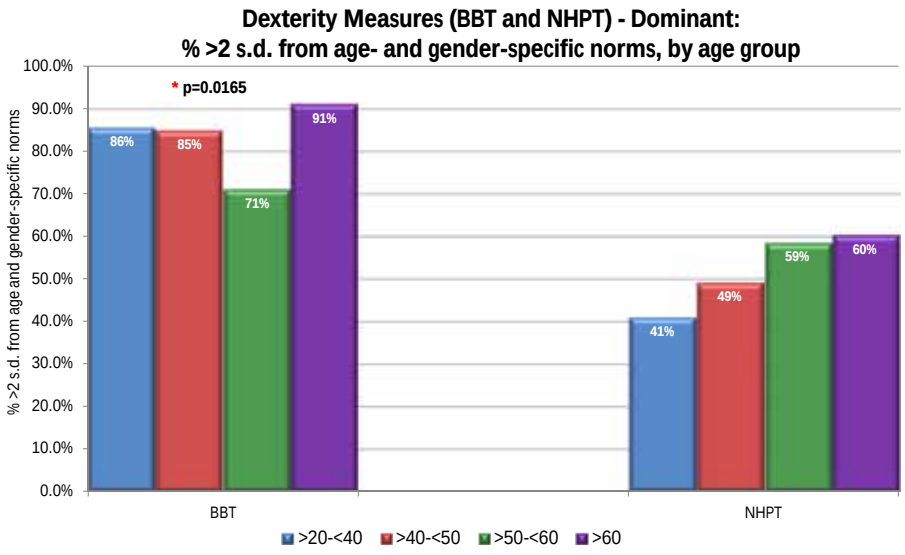


Strength and Endurance (dominant) by Age Group

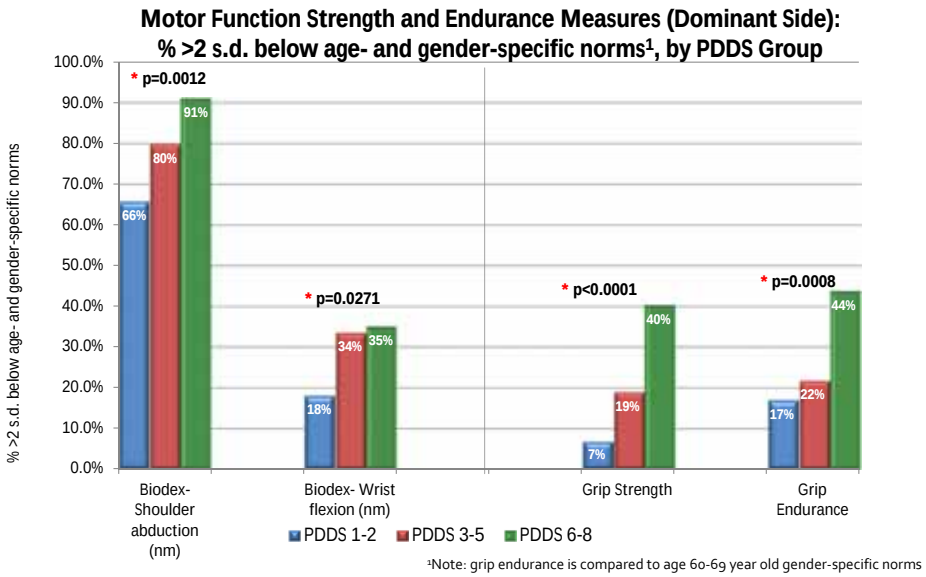


[1]Note: grip endurance is compared to age 60-69 year old gender-specific norms

Dexterity (dominant) by Age Group

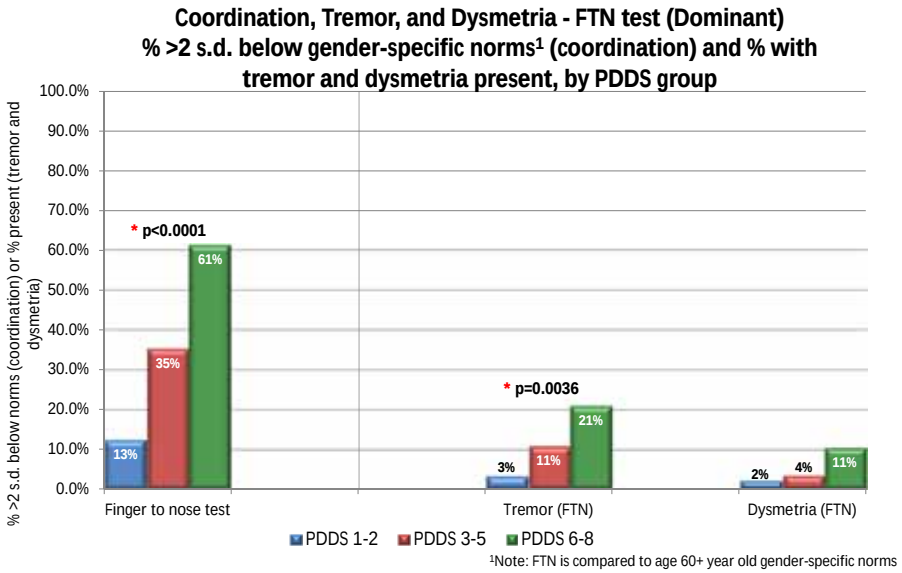


Strength and Endurance (dominant) by PDDS Group



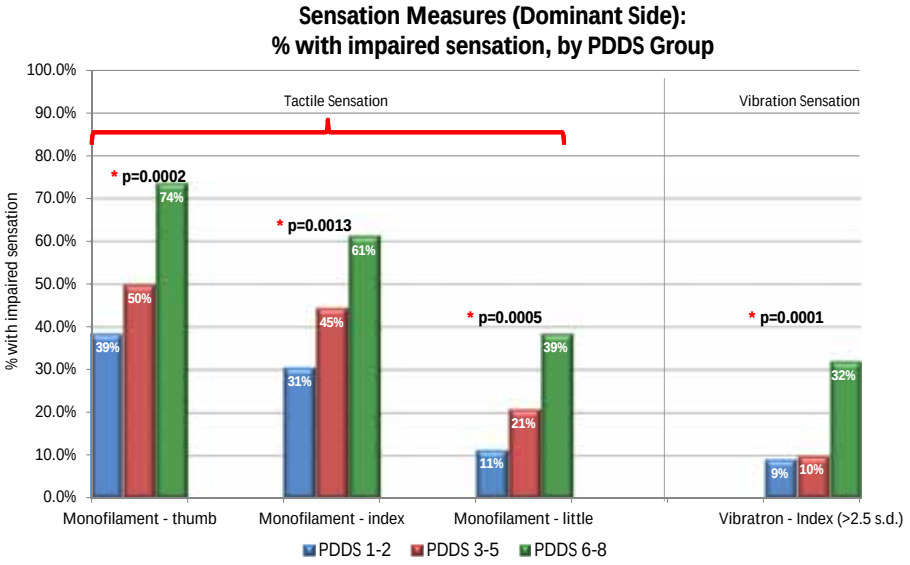
[1]Note: grip endurance is compared to age 60-69 year old gender-specific norms

Coordination (dominant) by PDDS Group

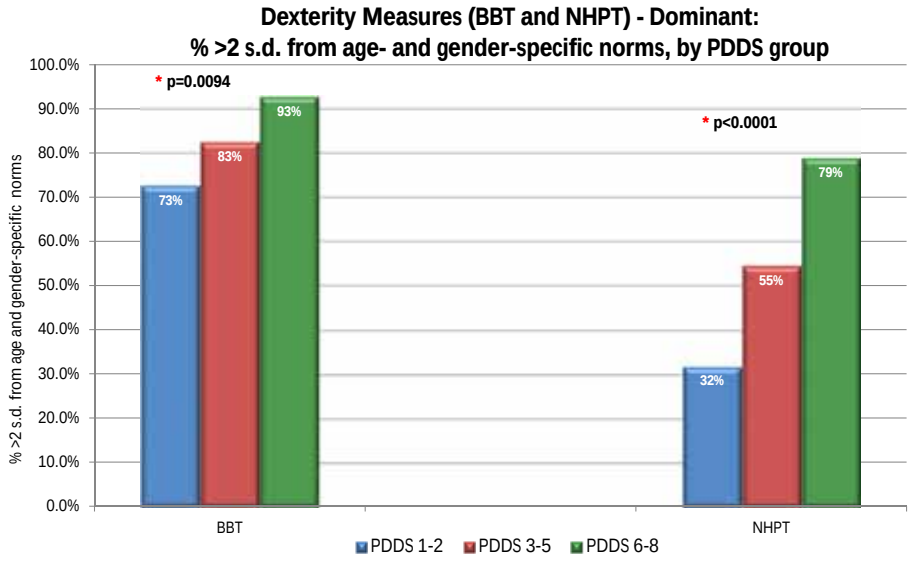


[1]Note: FTN is compared to age 60+ year old gender-specific norms

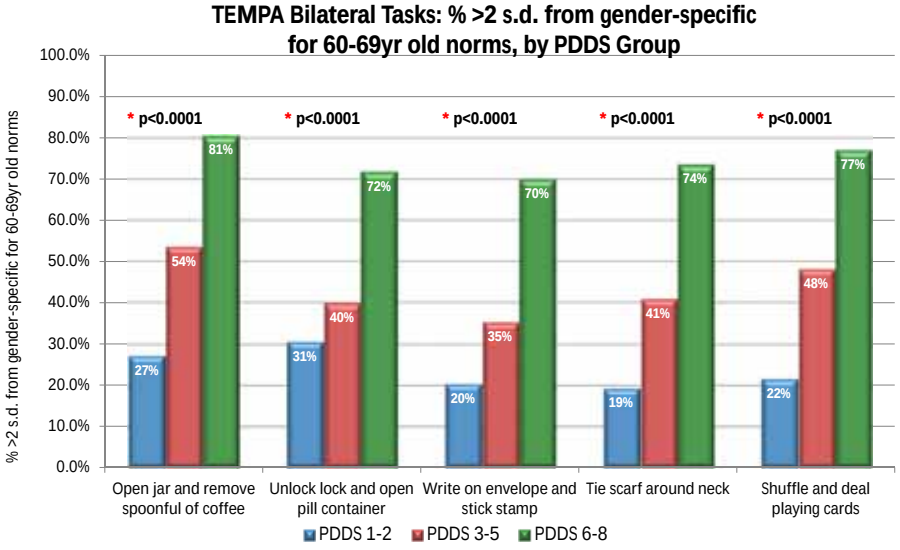
Sensation (dominant) by PDDS Group



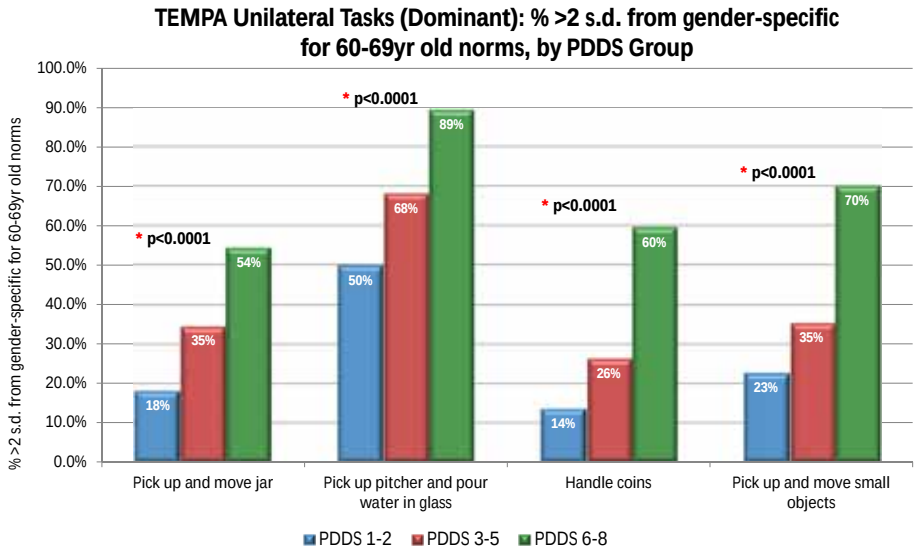
Dexterity (dominant) by PDDS group



TEMPA scores (bilateral tasks) by PDDS Group



TEMPA scores (dominant) by PDDS Group



Conclusions

- Age and PDDS are associated with most UE body function and capacity measures
- Impairment prevalence was likely underestimated, as age and gender specific normative values were not available for every test. Normative data usually for the elderly (10-20 yr older than the cohort age mean, 49 yo)
- Shoulder impairment was most common, and consistently seen among strength, BBT and TEMPA measures
- Frequency of impairments in the UE were observe regardless of disability even among those with a lower PDDS score

Future Directions

- The next step will focus on understanding the relationships among and between measures of different ICF levels (body function and activities & participation *capacity*, and *performance*)
- Future goals are to design and test interventions informed by these data to improve UE function in pwMS.

Thank you

(More data to be presented at the MS BRAIN Symposium, October 2016, Hartford)

Questions?

PDDS Scale

Instructions: Please read the choices listed below and choose the one that best describes your own situation. **This scale focuses mainly on how well you walk**. You might not find a description that reflects your condition exactly, but please mark the **one** category that describes your situation the closest.

0 **Normal:** I may have some mild symptoms, mostly sensory due to MS but they do not limit my activity. If I do have an attack, I return to normal when the attack has passed.

1 **Mild Disability**: I have some noticeable symptoms from my MS but they are minor and have only a small effect on my lifestyle.

2 **Moderate Disability:** I don't have any limitations in my walking ability. However, I do have significant problems due to MS that limit daily activities in other ways.

3 **Gait Disability:** MS does interfere with my activities, especially my walking. I can work a full day, but athletic or physically demanding activities are more difficult than they used to be. I usually don't need a cane or other assistance to walk, but I might need some assistance during an attack.

4 **Early Cane**: I use a cane or a single crutch or some other form of support (such as touching a wall or leaning on someone's arm) for walking all the time or part of the time, especially when walking outside. I think I can walk 25 feet in 20 seconds without a cane or crutch. I always need some assistance (cane or crutch) if I want to walk as far as 3 blocks.

5 **Late Cane:** To be able to walk 25 feet, I have to have a cane, crutch or someone to hold onto. I can get around the house or other buildings by holding onto furniture or touching the walls for support. I may use a scooter or wheelchair if I want to go greater distances.

6 **Bilateral Support:** To be able to walk as far as 25 feet I must have 2 canes or crutches or a walker. I may use a scooter or wheelchair for longer distances.

7 **Wheelchair / Scooter:** My main form of mobility is a wheelchair. I may be able to stand and/or take one or two steps, but I can't walk 25 feet, even with crutches or a walker.

8 **Bedridden:** Unable to sit in a wheelchair for more than one hour.

Monofilaments (Tactile Sensation)

Monofilament	Grams	Clinical Classification
2.83	0.07	Normal
3.61	0.4	Diminished Light Touch
4.31	2.0	Diminished Protective Sensation
4.56	4.0	Loss of Protective Sensation
6.65	447	Untestable