Determinants of fatigue in MS

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The Multiple Sclerosis Council for Clinical Practical Practice Guidelines defines fatigue as:

*a subjective lack of physical and/or mental energy that is perceived by the individual or caregiver to interfere with usual and desired activities*
MS fatigue (FSS)

Motor parameters
- force
- twitch interpolation
- brain activation (fMRI)
- transcranial magnetic stimulation (TMS)
Subjects

- 20 R-R, 7 ♂, 20-58
- MS: 1-23 years, median: 4
- EDSS: 0-5, median: 2.5
- 21 matched controls
Raw data

A. Maximal voluntary contractions

B. Submaximal contractions

E. Sustained contraction

F. Force transducer
Analyse

Association between FSS-scores and:

- MVCs ♂ ♀
- Central activation
- TMS-data
- Motor fatigue
  - central fatigue
  - peripheral fatigue
Central activation

Ulnar nerve stimulation
(double pulse, 10 ms interval)
Estimated central activation-2

Estimate twitch @ 100% MVC
-> 100- eTwitch

\[ y = -0.9265x + 83.166 \]

\[ R^2 = 0.9499 \]
MVC Z-score

- MVC ♂
  - Patients
  - Controls – reference

- MVC ♀
  - Patients
  - Controls - reference
Results

- **MVC**
  - patients: ♀ 26 ± 8 ♂ 39 ± 6N
  - controls: ♀ 31 ± 7 ♂ 44 ± 7N
  - Z-scores: p<0.03

- **Voluntary activation**
  - patients: 95 ± 5
  - controls: 93 ± 8

- **Estimated voluntary activation**
  - patients: 103 ± 17
  - controls: 113 ± 10 (p=0.03)
Results 2-min contraction

- **Motor fatigue**
  - patients: 61% ± 17
  - controls: 63% ± 12

- **Peripheral fatigue**
  - patients: 23% ± 25
  - controls: 39% ± 21
  - group (p=0.04)
Results 2-min contraction

- Central fatigue (mean twitch)
  - patients: 37% ± 20
  - controls: 18% ± 10 (p=0.001)

- Central fatigue (motor fatigue-peripheral fatigue)
  - patients: 37% ± 21
  - controls: 24% ± 23 (p=0.08)
Association with FSS in MS

• Motor fatigue
  • $R^2=0.10$, $p=0.18$

• MVC Z-score
  • $R^2=0.13$, $p=0.01$

• Voluntary activation (mean)
  • $R^2=0.25$, $p=0.03$

• Voluntary activation (calculated)
  • $R^2=0.29$, $p=0.02$
Association with FSS in MS

Sex differences in the fatigability of arm muscles depends on absolute force during isometric contractions

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• Motor fatigue en MVC Z-score
  • $R^2=0.45$, $p=0.01$
Association with FSS corrected for depression

- MVC Z-score
  - $R^2=0.64$, $p=0.001$

- Motor fatigue en MVC Z-score
  - $R^2=0.77$, $p=0.001$
Conclusion

MS patients
• weaker
• lower central activation

FSS in MS patients is associated with
• force measurements and central activation during sustained contraction
• Combination of HADS and force measurements
Conclusion