

Simplified protocols and indices of aerobic capacity among patients suffering from multiple sclerosis with mild neurological disability

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Background

Patients with Multiple Sclerosis (MS) have an impaired aerobic capacity. This impairment is associated to functional outcomes at all levels of the International Classification of Functioning, Disability and Health. Moreover, its improvement is associated to secondary benefits.

Currently, peak oxygen uptake (VO_{2peak}) is considered the Gold Standard for the assessment of aerobic capacity. However, two inherent characteristics of these tests limit their use in clinical research and routine. First, the gas exchange analysis is costly, requires time and expertise, is poorly available and time-consuming in clinical routine, and requires the patient to wear an uncomfortable mask. Secondly, the need of a maximal effort is limited by other frequent impairments of patients with MS: cognitive issues, fatigue, muscle weakness, motivation...

Objectives

To determine the feasibility and criterion validity of simplified indices (*i.e.*, indices that do not rely on either gas exchange analysis or maximal exercise, or both) of aerobic capacity among patients with MS presenting mild neurological disability (Expanded Disability Status Scale ≤ 4).

Materials and methods

27 patients with MS (19 women; mean age 45 years), with mild neurological disability ($EDSS \leq 4$), performed a maximal exercise test, with gas exchange analysis, on a cycle ergometer.

The initial work rate (WR) was 0 W, maintained for 2 minutes. Resistance was then increased in a stepwise way, in order to obtain an increase of 25W every two minutes. Exercise was stopped at volitional exhaustion.

Maximality was checked through primary criterion (plateau of the VO_2) and secondary criteria (Borg scale ≥ 17 , heart rate (HR) $\geq 90\%$ of predicted HR_{max} , respiratory exchange ratio (RER) ≥ 1.10).

Among others, the following indices were derived from the test and compared with the Gold standard, VO_{2peak} .

	With GEA	Without GEA
Maximal	VO_{2peak}	PWR-based prediction (1)
Submaximal	$OUES_{submax}$ (2)	$WCI_{65\%HR_{reserve}}$ (3)

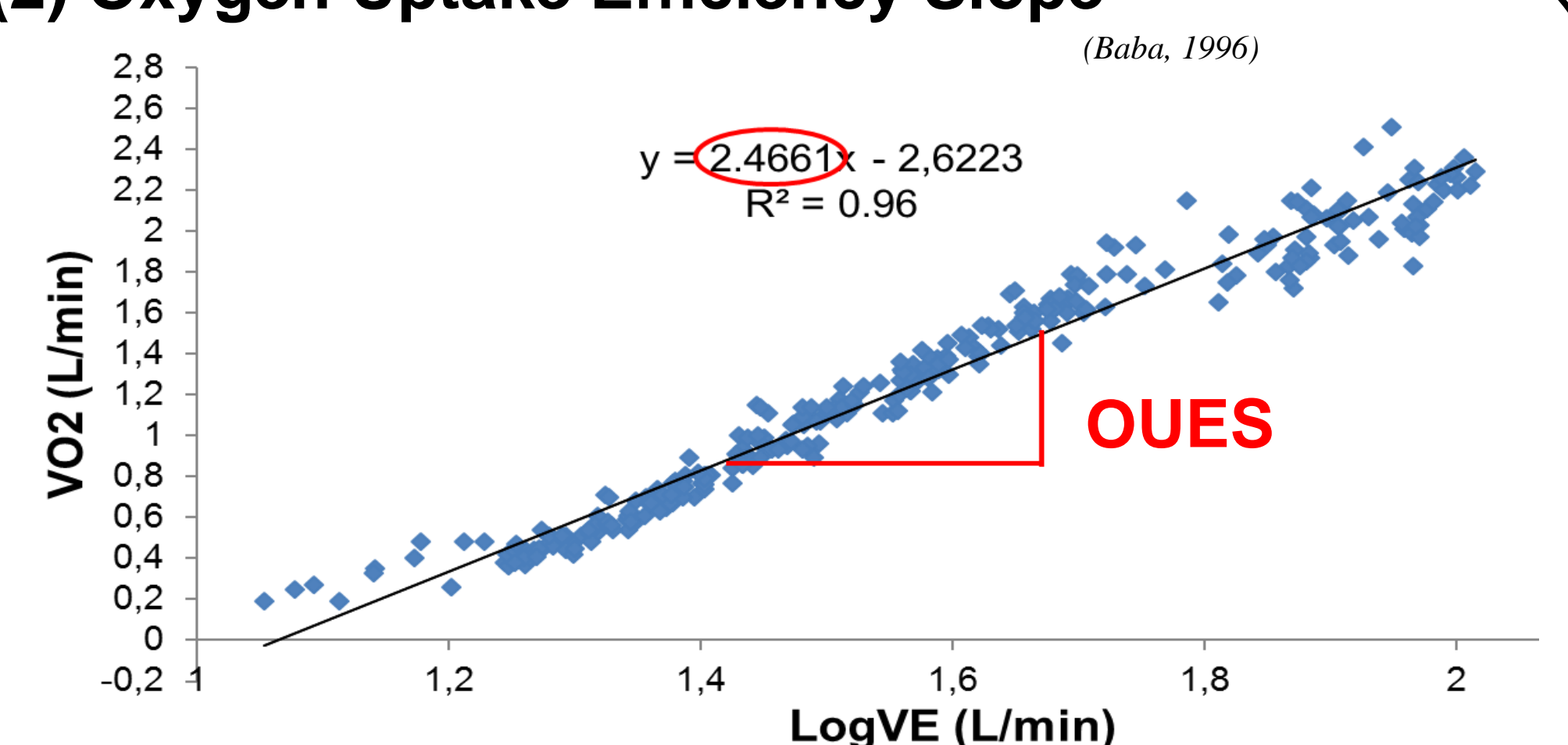
GEA: Gas Exchange Analysis; $OUES_{submax}$: Oxygen Uptake Efficiency Slope based on submaximal exercise effort; PWR: Peak Work Rate; $WCI_{65\%HR_{reserve}}$: Working Capacity Index at 65% of the heart rate reserve.

(1) Peak Work Rate-based prediction equation

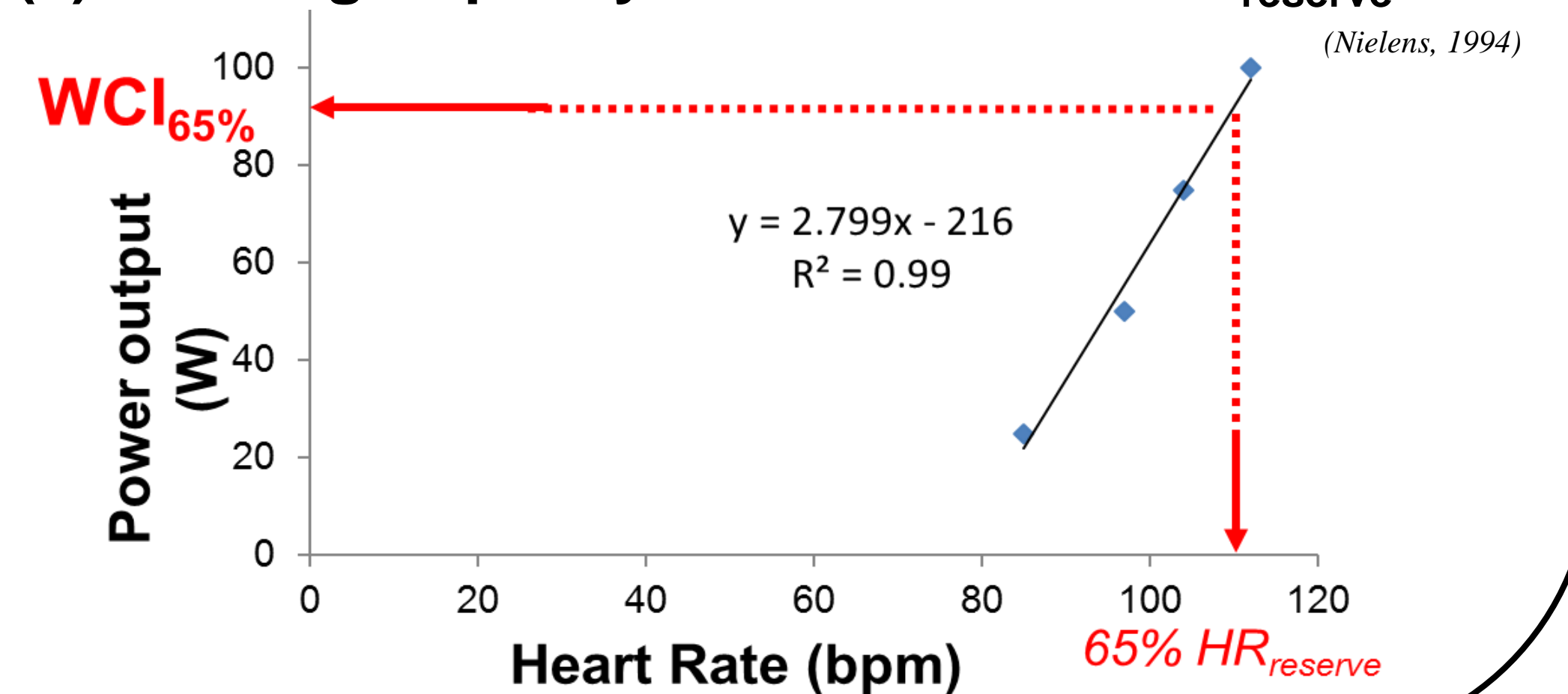
Predicted VO_{2peak}

$$= 9.39 \text{ PWR (W)} + 7.7 \text{ weight (kg)} - 5.88 \text{ age (y)} + 136.7 \text{ ml/min}$$

(2) Oxygen Uptake Efficiency Slope



(3) Working Capacity Index at 65% of $HR_{reserve}$



Number of patients complying with maximal exercise criteria

• Primary: Plateau of VO_2 : 17/27 (63%)

• Secondary (if 2/3 → maximal)

1) Borg scale: 23/27 (85%)

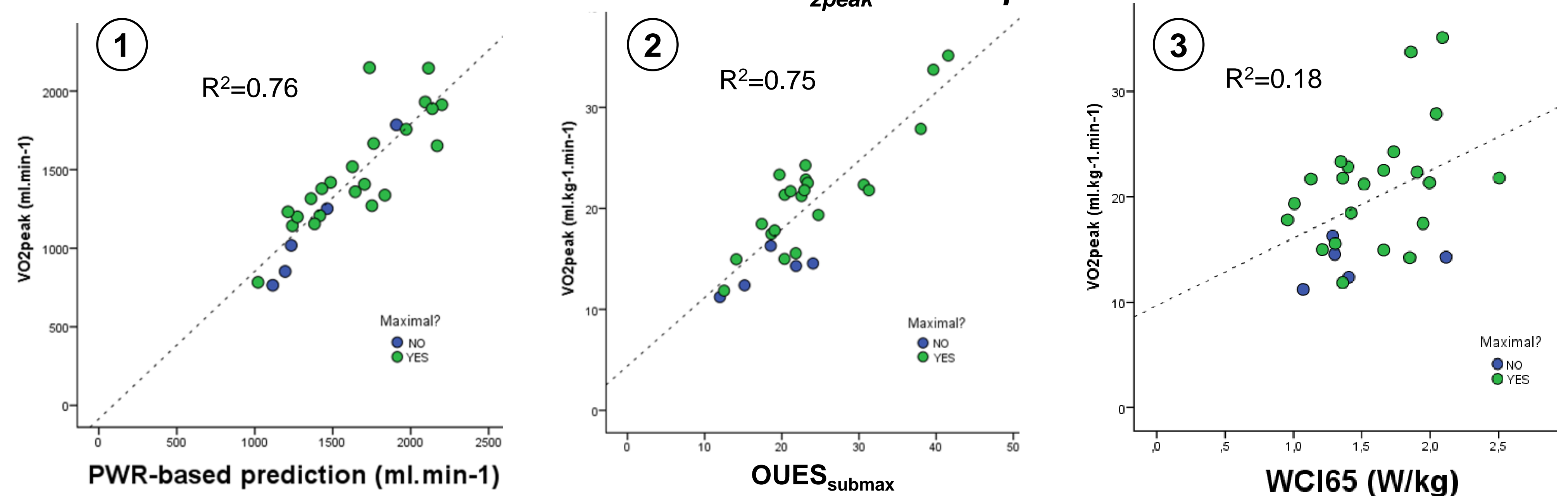
2) HR: 15/27 (56%)

3) RER: 22/27 (85%)

→ Maximal: 22/27 (81%)

Results

Relations between VO_{2peak} and simplified indices



Discussion-Conclusion

- 1) PWR-based prediction equation is valid, but could also be limited by other impairments. The burden of the test is considerably lessened as we do not have to use a gas exchange analyser.
- 2) $OUES_{submaximal}$ is feasible and valid among patients with MS. It could replace VO_{2peak} in the assessment of the aerobic capacity of patients with MS, removing the need to perform a maximal exercise. The optimal protocol and duration in order to be the most valid, precise and reliable, remains to be elucidated.
- 3) Unfortunately, no submaximal index that does not rely on gas exchange analysis was found valid. Further research is needed to develop and validate such user-friendly indices.

→ The assessment of aerobic capacity among patients with MS requires either gas exchange analysis or maximal exercise testing, or both. The modality to use should be decided based on the context.

References

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