Interrater and intrarater reliability of ventilatory thresholds determined in individuals with spinal cord injury

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Introduction and aim

- Physical capacity is generally reduced in individuals with spinal cord injury (SCI). Handcycling training (e.g. training for The HandbikeBattle) is a good way to improve physical capacity. Individualized training regimes are, however, necessary. These regimes are often based on ventilatory thresholds (VTs).

- **Aim:** To study whether VTs during arm ergometry could be determined in individuals with spinal cord injury (SCI), and to study the intra- and interrater reliability of VT1 and VT2 determination.

Methods

- **Participants:** 11 individuals with tetraplegia, 19 individuals with paraplegia (total N = 30).
- **Graded arm crank ergometry exercise test, 1-min increments.**
- **Two sport physicians assessed all tests twice (random, blinded)**
- **VT1 and VT2 were determined in all tests:** 240 VTs in total.
- **Power output (PO), heart rate (HR) and oxygen uptake (VO2) at each VT was calculated.**
- **PO, HR and VO2 at each VT was compared between sessions (intrarater) and raters (interrater).**
- **Statistics:** paired samples t-test, intraclass correlation coefficients (ICC) and Bland Altman plots.

Results

- Of the 240 VTs to be assessed, 217 VTs (90%) could be determined.
- Of the 23 undetermined VTs, 9% were VT1 and 91% were VT2.
- Of the 23 undetermined VTs, 30% were related to tests in individuals with tetraplegia.
- For VTs that could not be determined in individuals with paraplegia, test duration was significantly shorter.

For the VTs that could be determined:

- **Systematic differences:** no systematic differences between sessions and raters.
- **Relative intrarater reliability** between sessions for PO, HR and VO2 at VTs was high to very high for the total group (ICC: 0.94 – 1.00), group with paraplegia (ICC: 0.88 – 1.00) and group with tetraplegia (ICC: 0.89 – 1.00).
- **Relative interrater reliability** between raters for PO, HR and VO2 at VTs was high to very high for the total group (ICC: 0.89 – 0.97), group with paraplegia (ICC: 0.82 – 0.97) and group with tetraplegia (ICC: 0.85 – 0.93).
- **Absolute reliability** between sessions and raters varied, with relatively wide 95% LoA (Figure 1).

Conclusions

- 90% of VTs could be determined.
- Most of the thresholds that could not be determined were VT2s and related to tests in individuals with tetraplegia.
- For the VTs that could be determined, the relative intrarater reliability was high to very high with relatively small 95% LoA in the Bland Altman plots.
- The relative interrater reliability was high to very high with a varying absolute agreement.

Clinical message

- VTs might be a promising method to define training intensity for most recreationally active individuals with SCI.
- However, critical evaluation of the VTs is necessary and other training intensity measures should be considered when one or both VTs cannot be determined.

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**Figure 1. Bland Altman plots showing varying absolute agreement**

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