Tethered swim performance in Para swimmers with physical impairment

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Swimming performance is fundamentally determined by the amount of propulsion a swimmer can generate while minimizing their resistance in the water.

(Toussaint HM, Beek PJ., 1992)
Can maximal fully-tethered swimming provide an objective assessment of the impact that physical impairments have on swimming propulsion?

Study aims

1. Examine the influence of type and severity of physical impairment on tether force measures.

2. Establish the relationships between tether force measures and maximal freestyle swim performance in Para swimmers with physical impairment.
Design

Single session, two tests conducted in order:
  • Maximal freestyle swim speed
  • 30 s fully-tethered swim trial

Eighty swimmers with and without physical impairment
  • Para swimmers (n = 70)
    • Male (n = 44) and female (n = 26)
    • Limb deficiency (n = 29), hypertonia (n = 24), impaired muscle power (n = 17)
  • Able-bodied swimmers (n = 10)
    • Male (n = 6) and female (n = 4)
Procedure

- 30 s all-out effort
- Tether forces recorded at 100 Hz

Maximum propulsive force
Average propulsive force
- Absolute (N)
- Normalised to body (N·kg⁻¹)
Fatigue index (%) 

Results

PForce: $\tau = .55, p < .001$

CSSmax: $\tau = .63, p < .001$

ADrag: $\tau = .38, p < .01$

Better performance

Greater swimming impairment
Results

Variance explained: 73.2 %

Better performance

Swim speed (m.s^{-1})

Maximum tether force (N/kg)

- Female
- Male
- Hypertonia
- Impaired muscle power
- Limb deficiency
Results

Variance explained: 72.4%

Variance explained: 56.7%

Variance explained: 80.5%
Summary

• Tether force measures decrease with greater severity of impairment as defined by the current classification system, and explain most of the variance in maximal freestyle swim speed in Para swimmers.

• Understanding the impact of physical impairment on swimming propulsion is key to effective classification for these swimmers.

• Active and passive drag might be more important for Para swimmers with hypertonia and impaired muscle power. An impairment-specific approach is required.
Thank you for your attention.

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