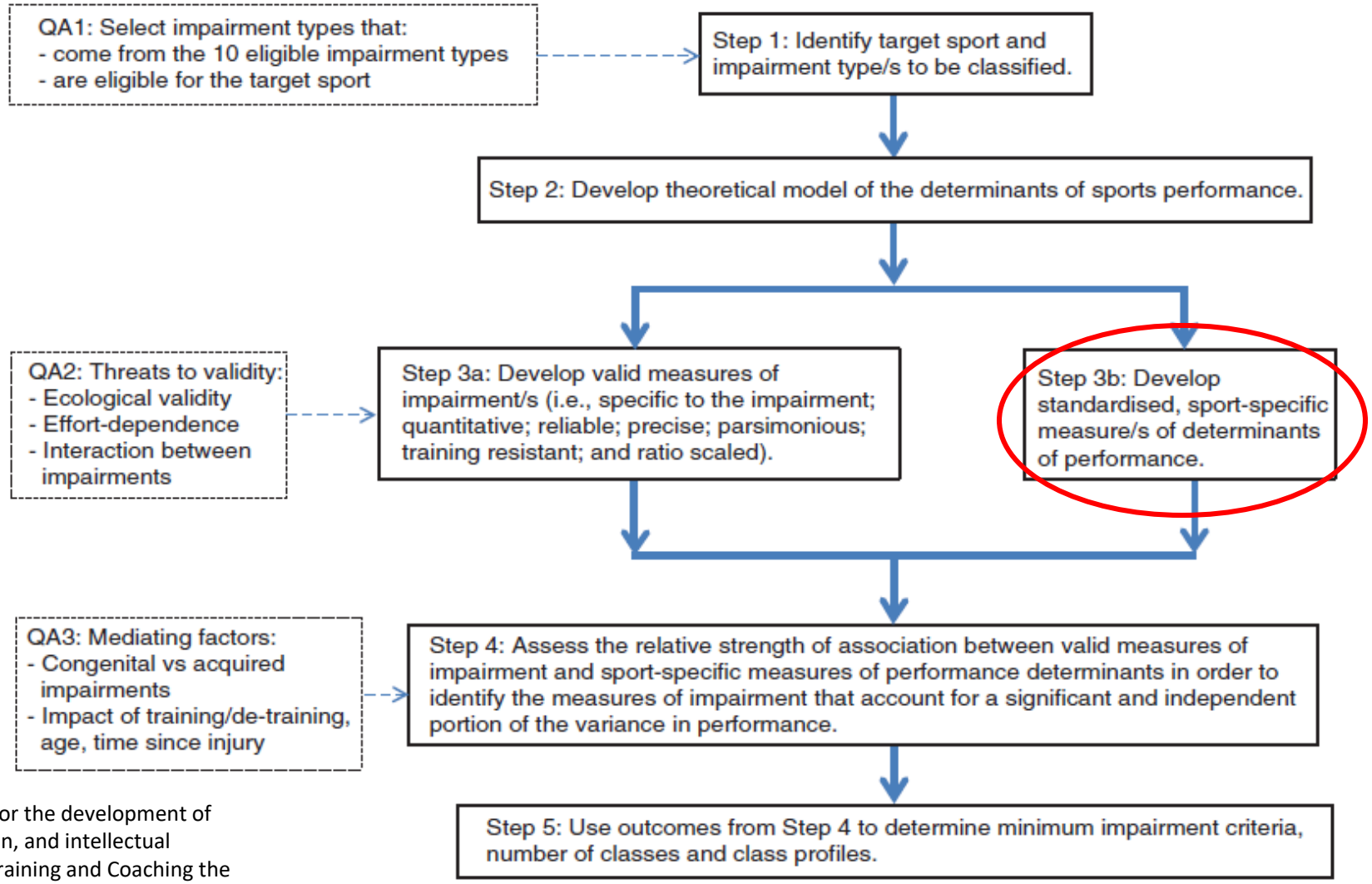
Tethered swim performance in Para swimmers with physical impairment

Luke Hogarth, University of the Sunshine Coast, Australia.

Brendan Burkett, University of the Sunshine Coast, Australia.

Carl Payton, Manchester Metropolitan University, United Kingdom.

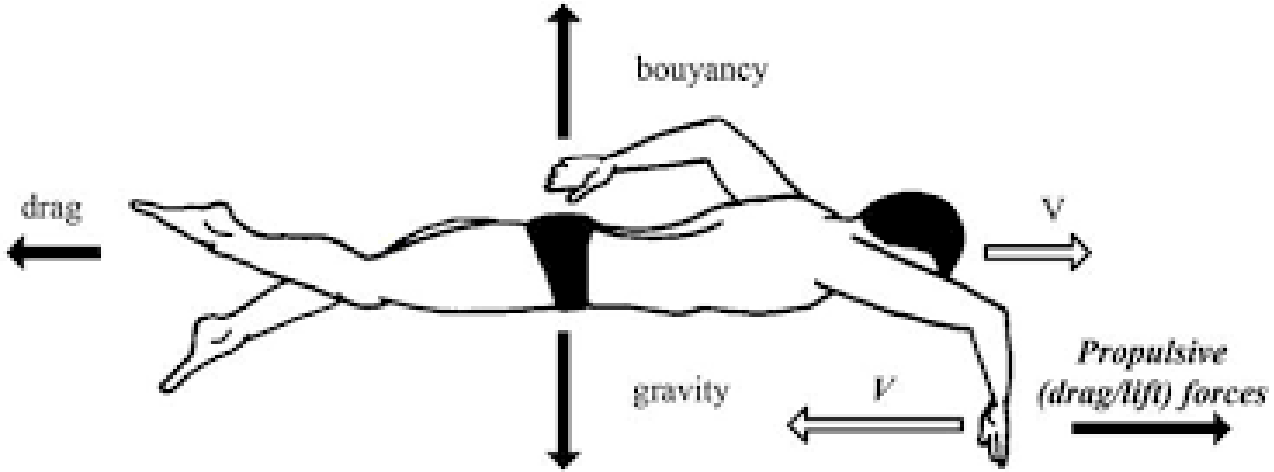
Context



Tweedy SM, Mann D, Vanlandewijck YC. Research needs for the development of evidence-based systems of classification for physical, vision, and intellectual impairments. In: Vanlandewijck YC, Thompson WR, eds. Training and Coaching the Paralympic Athlete: John Wiley & Sons, Ltd.; 2016. pp. 122-149.

Background

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:

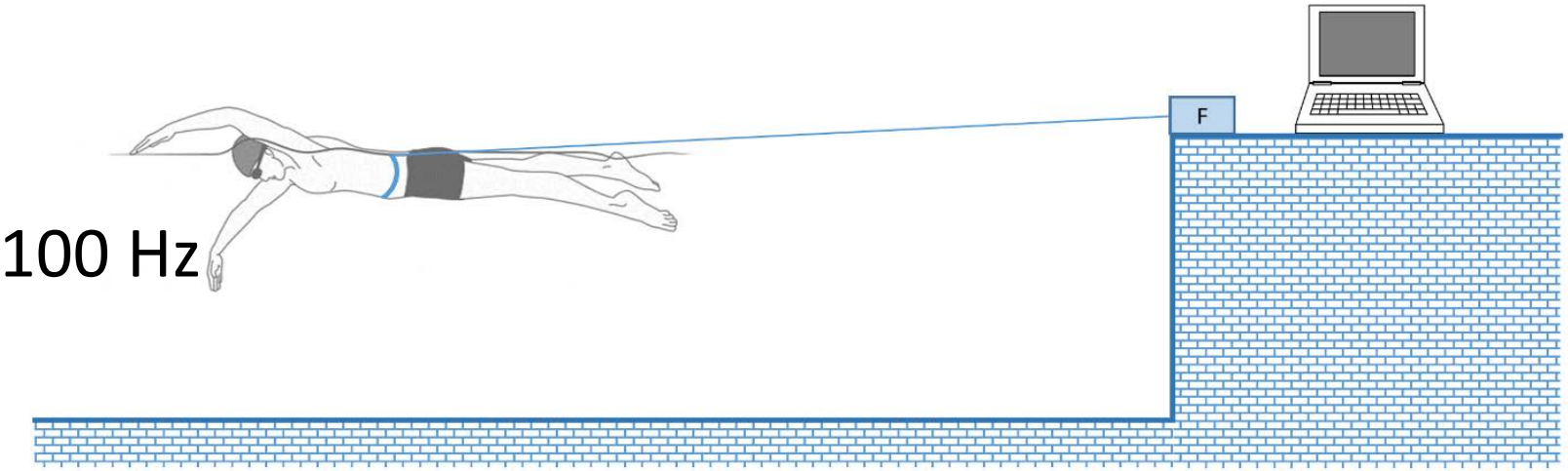
- Maximal freestyle swim speed
- 30 s fully-tethered swim trial

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

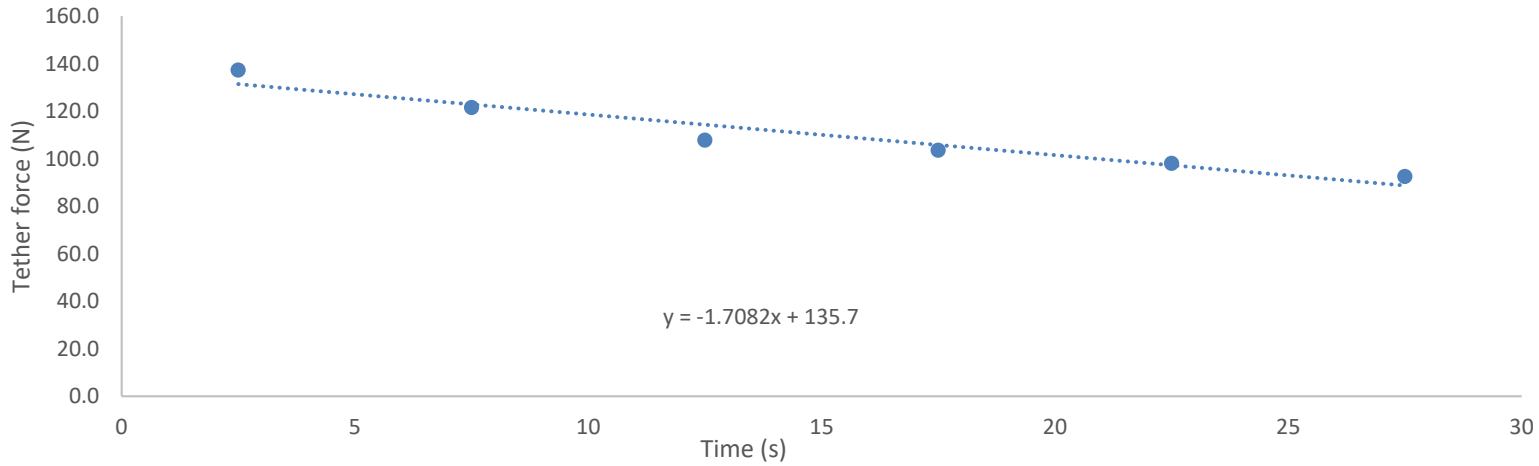


Maximum propulsive force

Average propulsive force

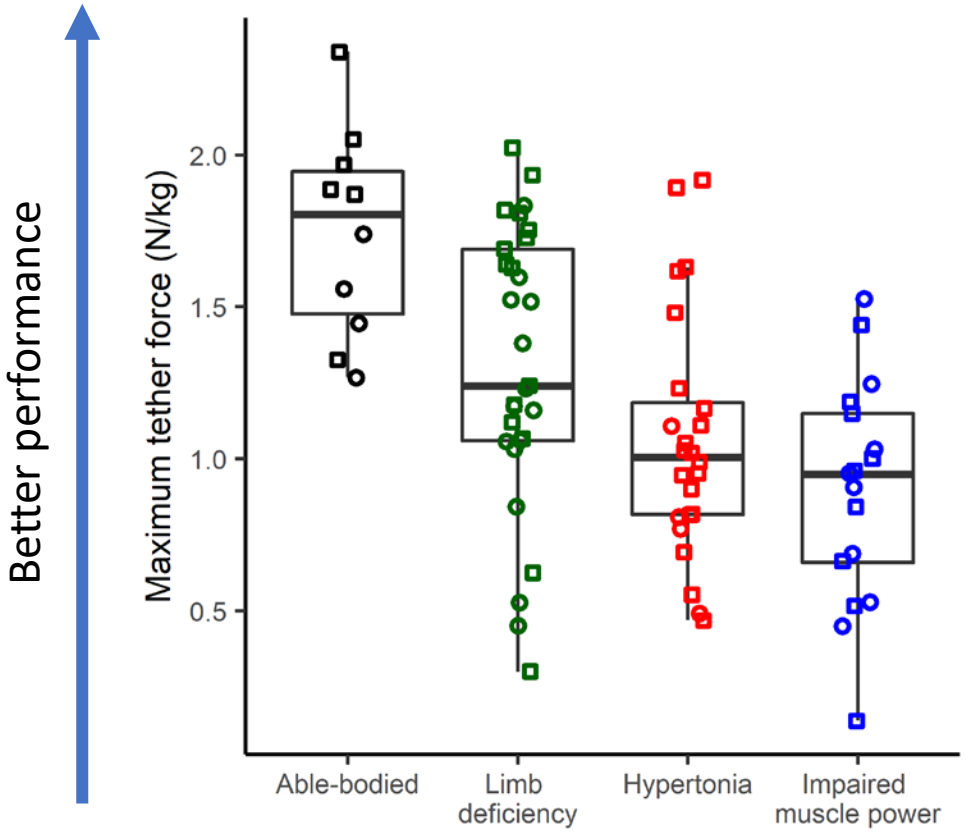
- Absolute (N)
- Normalised to body ($N \cdot kg^{-1}$)

Fatigue index (%)



(Morouco PG, Vilas-Boas JP, Fernandes RJ., 2012; Lee CJ, Sanders RH, Payton CJ.,2014)

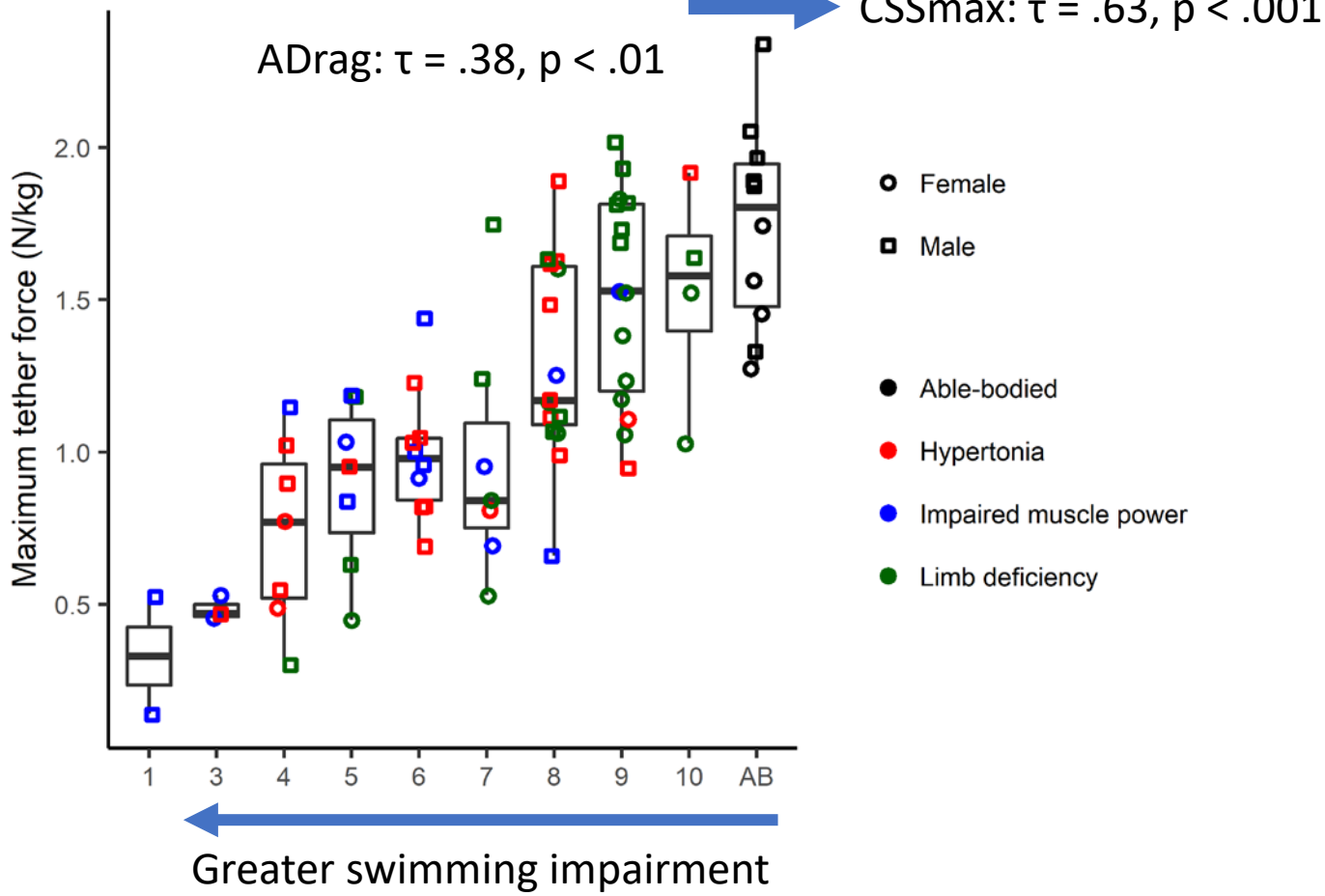
Results



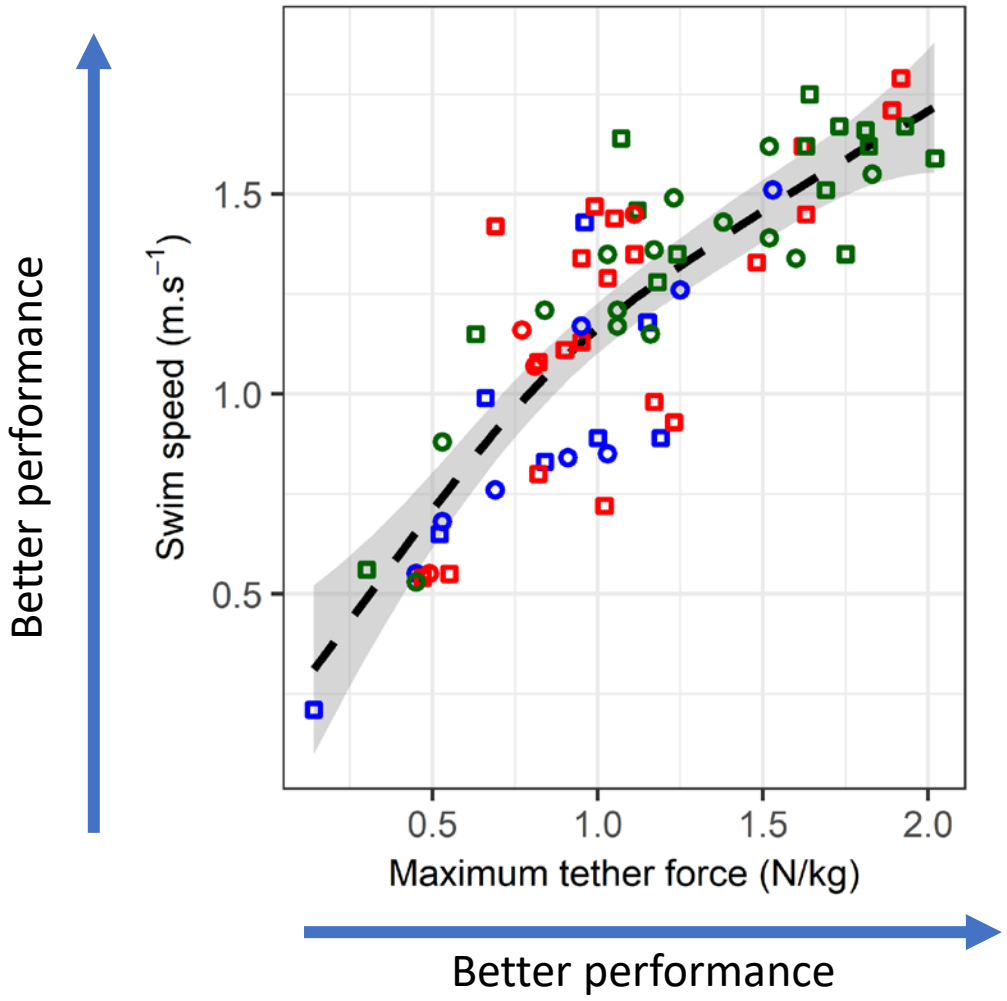
PForce: τ = .55, p < .001

ADrag: τ = .38, p < .01

CSSmax: τ = .63, p < .001



Results

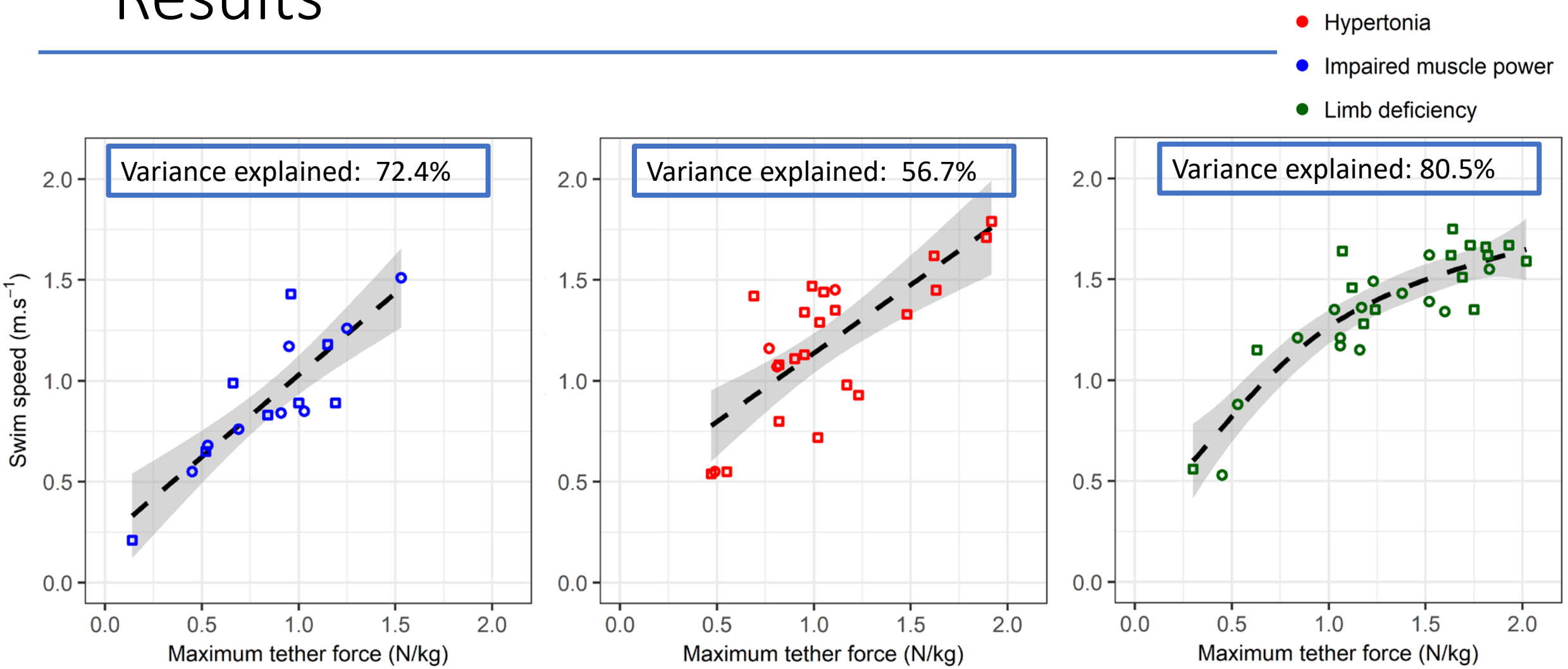


Variance explained: 73.2 %

- Female
- Male

- Hypertonia
- Impaired muscle power
- Limb deficiency

Results


Hypertonia
Impaired muscle power
Limb deficiency
Variance explained: 72.4%
Variance explained: 56.7%
Variance explained: 80.5%
Swim speed (m.s^{-1})
Maximum tether force (N/kg)
0.0
0.5
1.0
1.5
2.0

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.

Acknowledgements

lhogarth@usc.edu.au