The association between lower leg impairments and RaceRunning performance

Towards an evidence based classification system of RaceRunning as a Paralympic event

Marietta van der Linden
Nicola Tennant
Sadaf Jahed
Martine Verheul

CPISRA
access to sport

Queen Margaret University
EDINBURGH

THE UNIVERSITY OF EDINBURGH

What is RaceRunning?

- Light weight 'trike' with chest support and without pedals

- Allows athletes with limited or no walking ability to propel themselves independently

- Expected health benefits which the majority would not experience from any other sport: bone health & cardiovascular health

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

RaceRunning propulsion styles

Because of the design of the running bike and the range of abilities of the athletes, a range of propulsion techniques is used.

RaceRunning propulsion styles

Because of the design of the running bike and the range of abilities of the athletes, a range of propulsion techniques is used.

Current Para-athletics classification
for track athletes with
hypertonia, ataxia or athetosis

- Ambulant athletes (T35-T38)
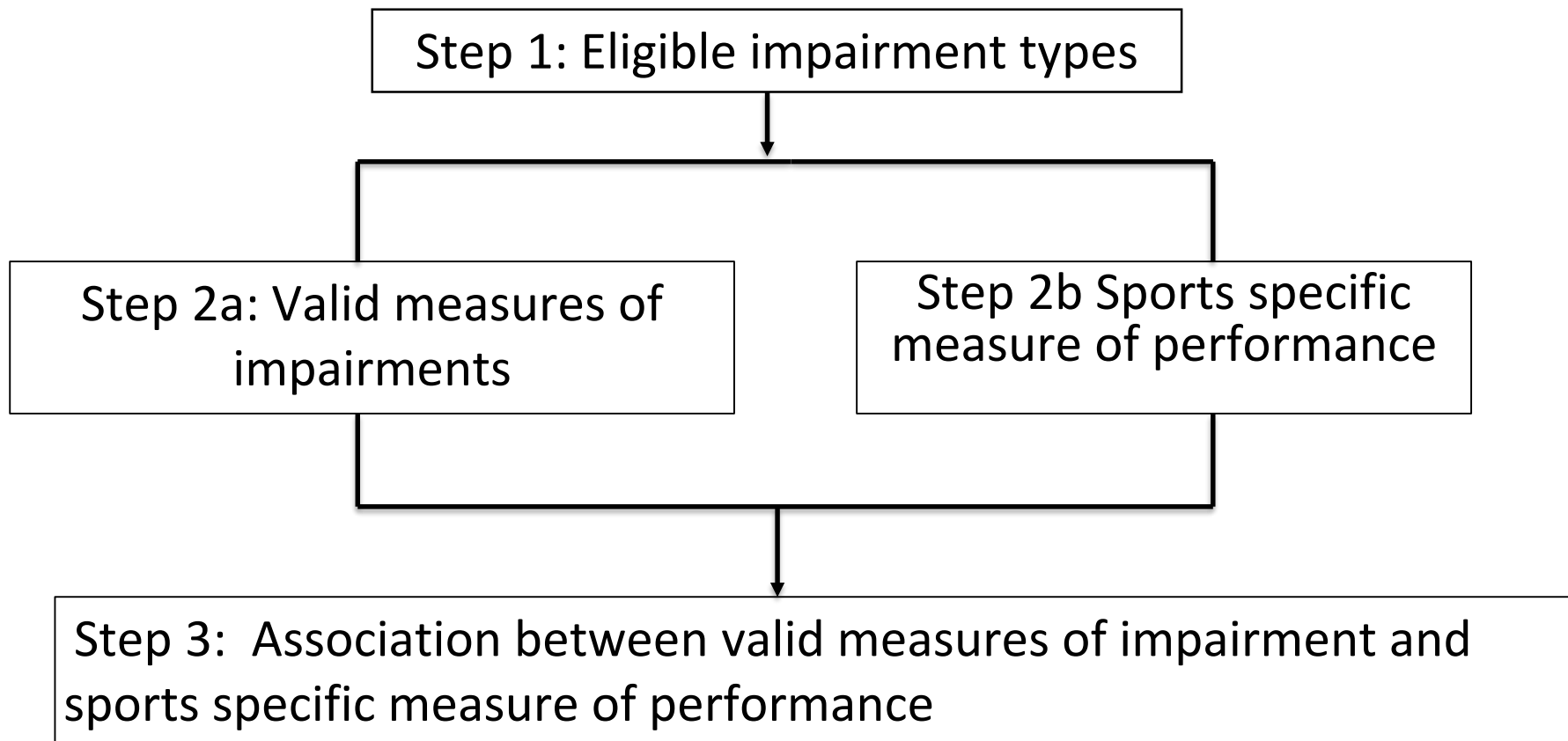
- Wheelchair athletes (T31-T34)

➢RaceRunning as a future para-athletic event?

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport

Evidence based IPC classification

Step 1: Eligible impairment types

Step 2a: Valid measures of impairments

Step 2b Sports specific measure of performance

Step 3: Association between valid measures of impairment and sports specific measure of performance

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

Step2a: Valid measures of impairments

ICF [1]	CPISRA RR classification	CP literature[2]
b735 Muscle tone functions	Spasticity: ASAS	MAS, ASAS, instrumented spasticity measures
b760 Control of voluntary movement functions	Ability to control individual joint movements	Selective motor control: SCALE/SMC
	Trunk control	TCMS/TIS
b710 Mobility of joint functions	Range of motion (manual goniometry)	Range of motion (manual goniometry)
b730 Muscle power functions	Propulsion power	MMT & isokinetics

[1]Schiarti et al. (2015) iCF Body structures and Functions for children and youth with CP
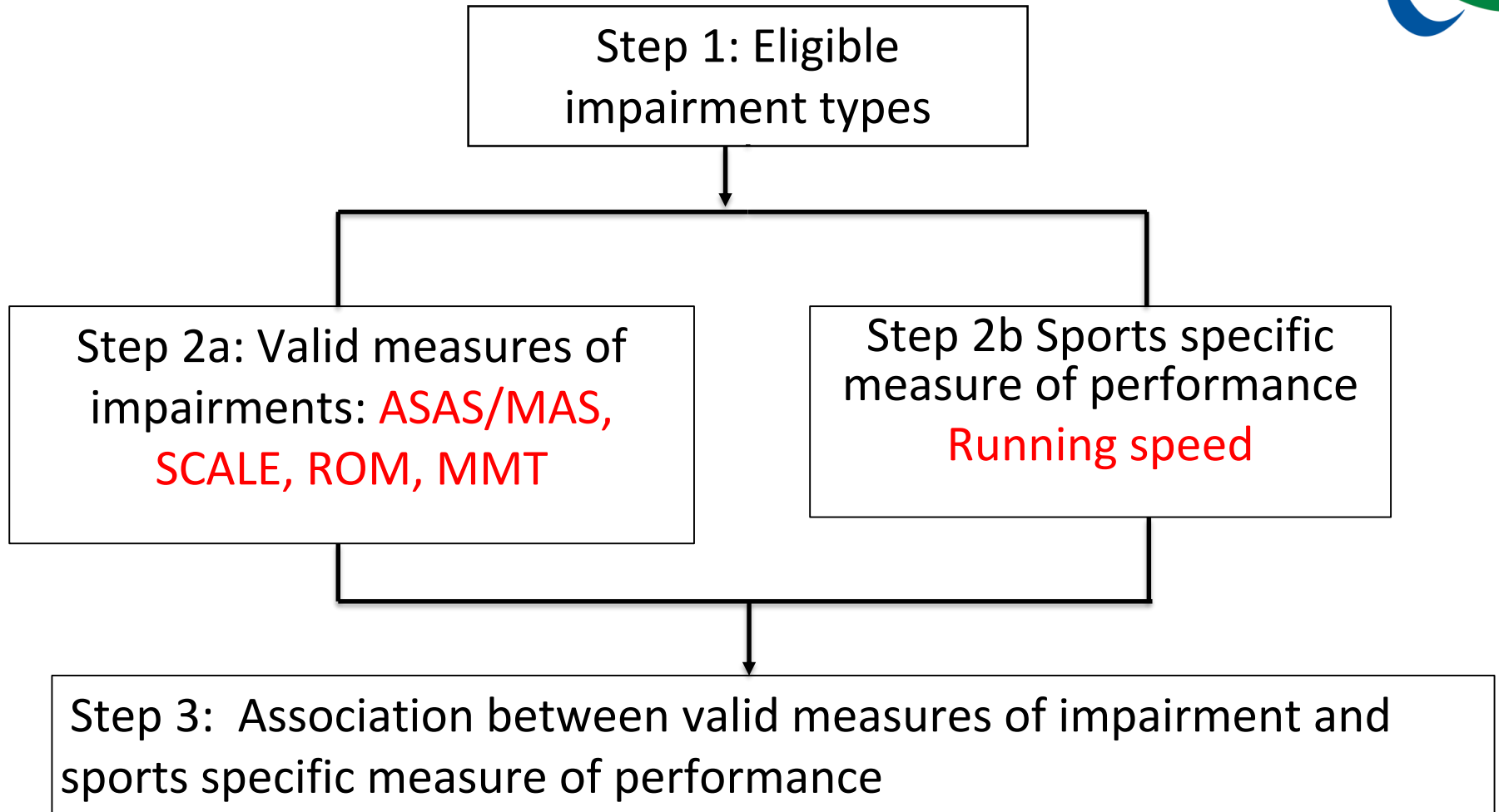[2]Balzer et al. (2017), Kim & Park (2011), Ross et al. (2007), Desloovere et al. (2006)

Evidence based IPC classification

Step 1: Eligible impairment types

↓

Step 2a: Valid measures of impairments: ASAS/MAS, SCALE, ROM, MMT

Step 2b Sports specific measure of performance Running speed

↓

Step 3: Association between valid measures of impairment and sports specific measure of performance

Sports specific measure

- Maximum Static Step length
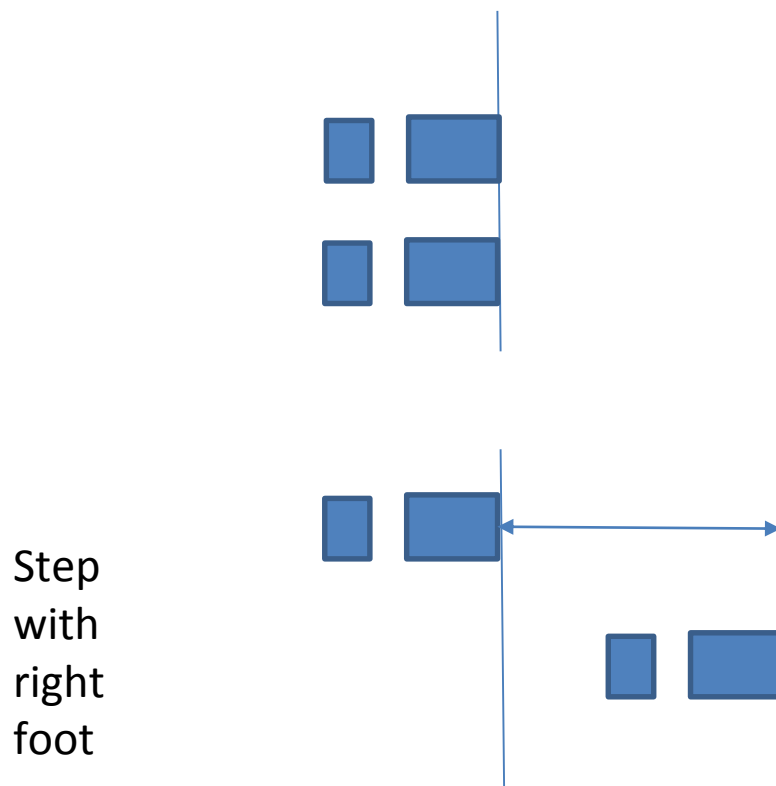
Step
with
right
foot

Participating athletes (2016)

- 16 males, 15 females
- Average age: 23(±7), range 14-42
- CP (29) TBI (1), Brain Tumour (1)
- Hypertonia (17), ataxia (3), athetosis (1)
  mixed (8), NA (2)
- RR1 (11) RR2(12) RR3(8)
- GMFCS II (9), III (9), IV (11), V (2)
- Years RR : 4.3(2.9) years (1.5-11)
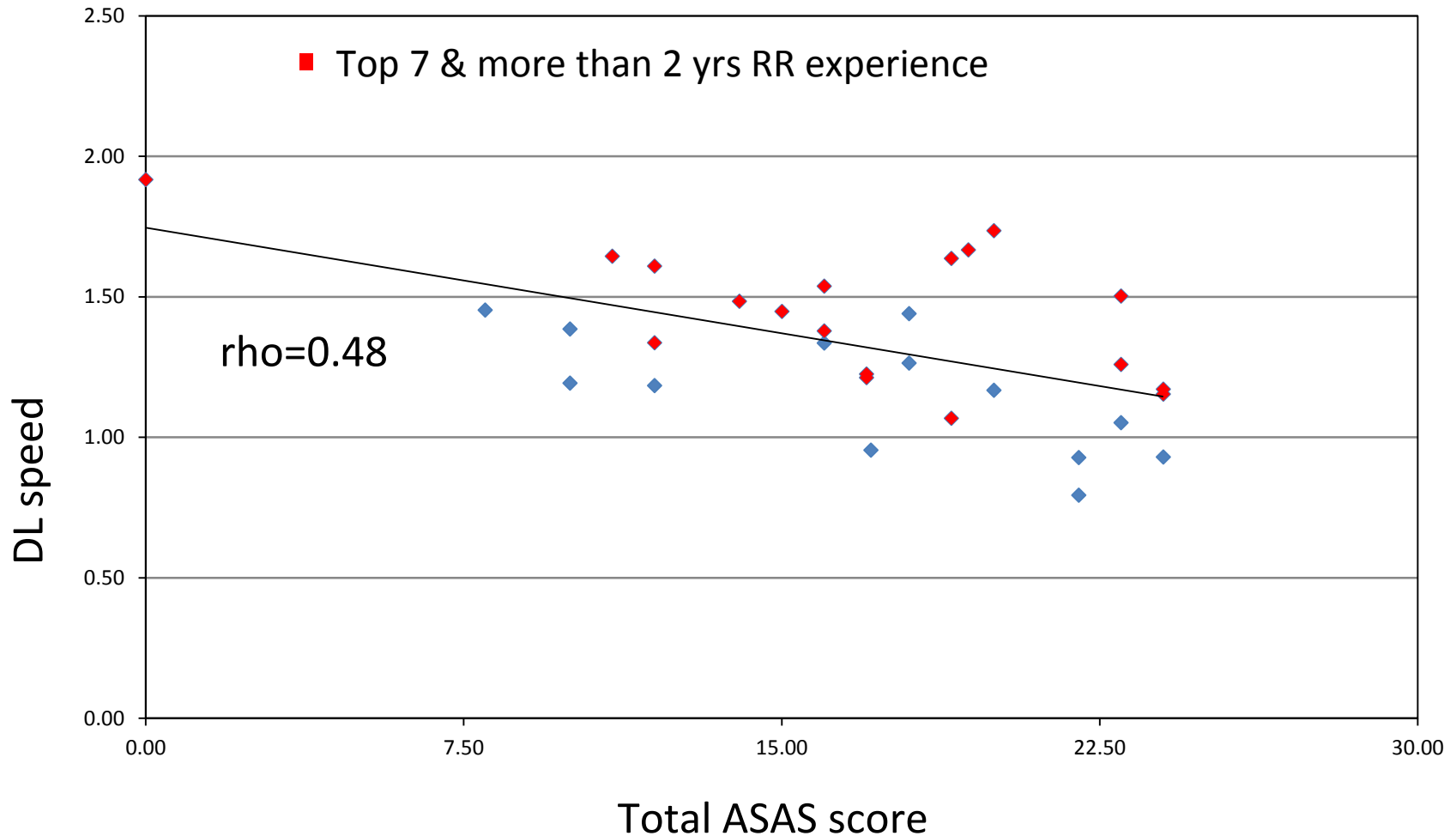
RESULTS...

- Lower limb spasticity (ASAStot)

- Lower limb spasticity (MAStot)

- Lower limb Muscle strength (MMTtot)

- Selective Voluntary Motor Control (SCALE)

- Passive knee extension

- Maximum static step length

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

Australian Spasticity Assessment Score

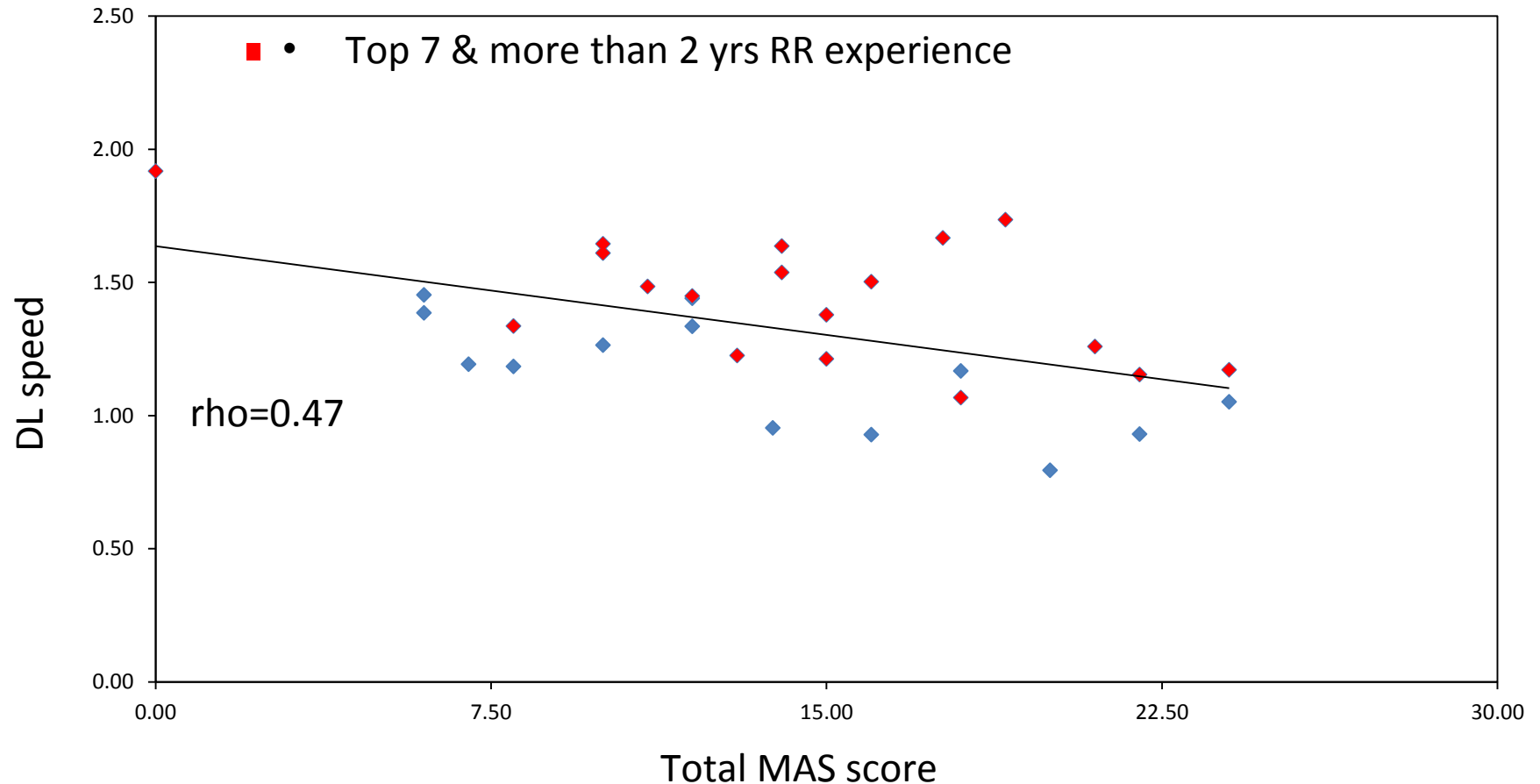# RESULTS…

- Lower limb spasticity (ASAStot)
- Lower limb spasticity (MAStot)
- Lower limb Muscle strength (MMTtot)
- Selective Voluntary Motor Control (SCALE)
- Passive knee extension
- Maximum static step length

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY AND REHABILITATION RESEARCH

CPISRA
access to sport

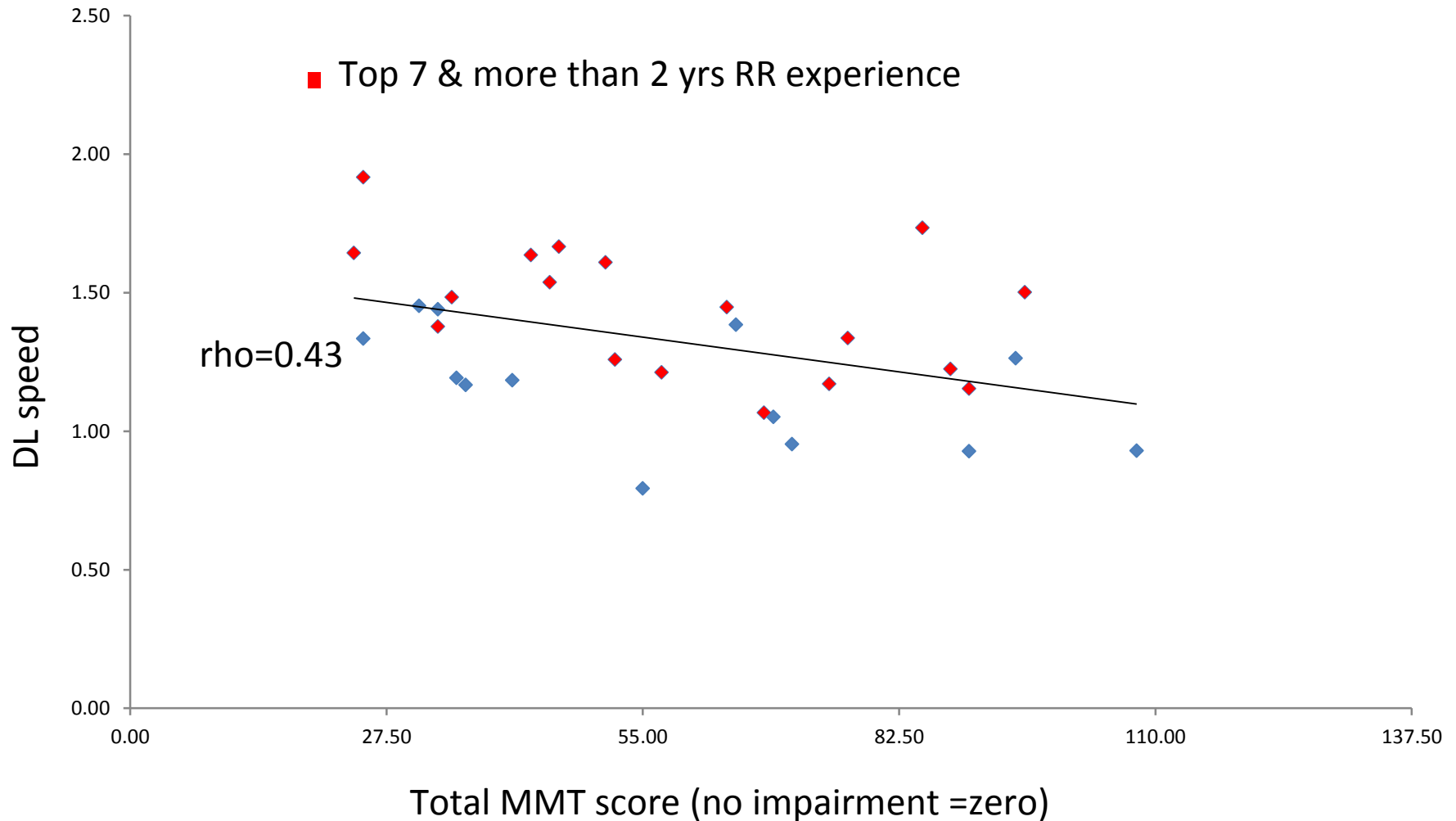THE UNIVERSITY OF EDINBURGH

Modified Ashworth Scale

rho=0.47

RESULTS…

- Lower limb spasticity (ASAStot)
- Lower limb spasticity (MAStot)
- Lower limb Muscle strength (MMTtot)
- Selective Voluntary Motor Control (SCALE)
- Passive knee extension
- Maximum static step length

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

Manual Muscle Test

Top 7 & more than 2 yrs RR experience

rho=0.43

DL speed

Total MMT score (no impairment =zero)

RESULTS…

- Lower limb spasticity (ASAStot)
- Lower limb spasticity (MAStot)
- Lower limb Muscle strength (MMTtot)
- Selective Voluntary Motor Control (SCALE)
- Passive knee extension
- Maximum static step length

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport
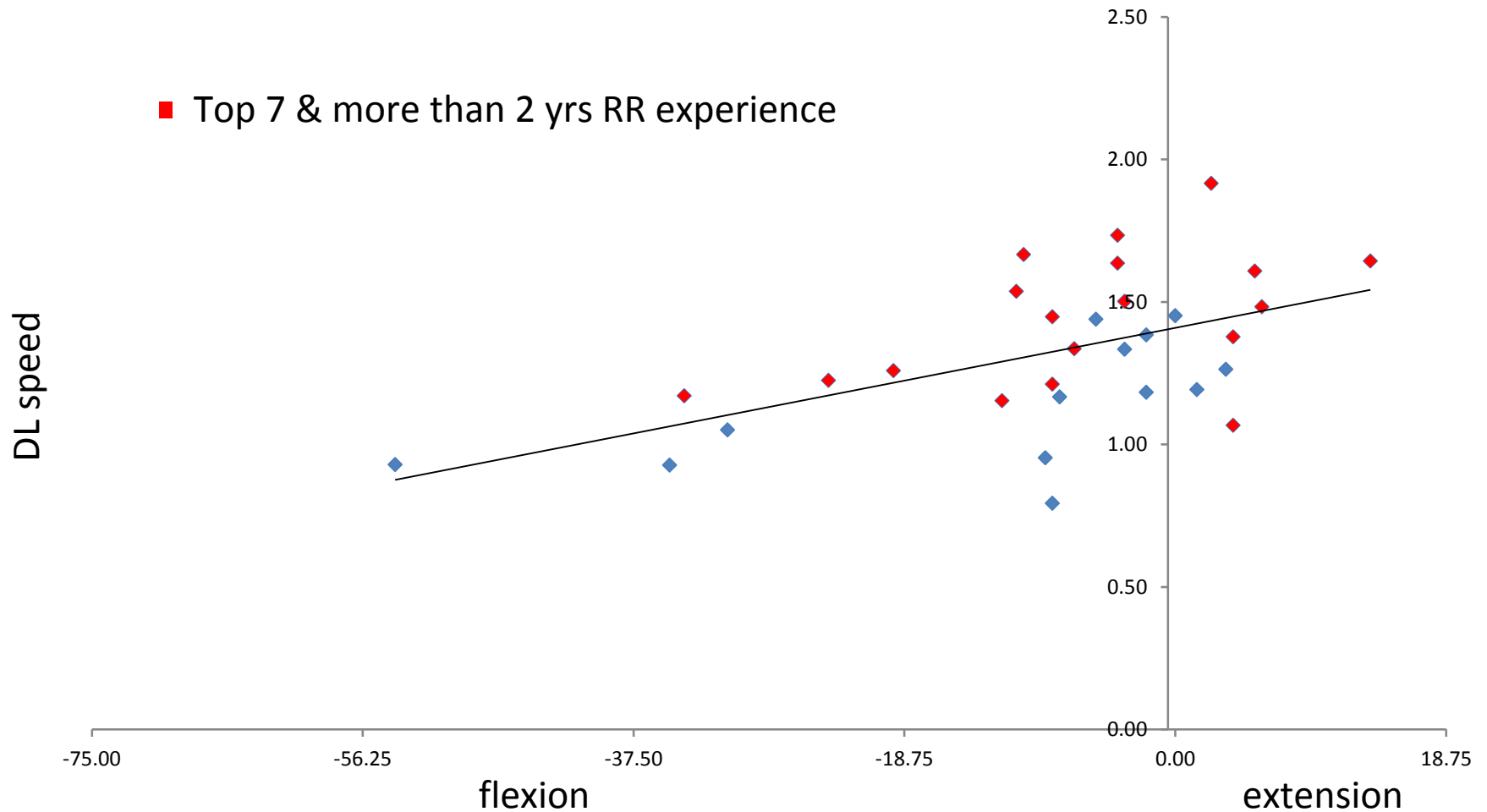

THE UNIVERSITY OF EDINBURGH

SCALE

RESULTS…

- Lower limb spasticity (ASAStot)
- Lower limb spasticity (MAStot)
- Lower limb Muscle strength (MMTtot)
- Selective Voluntary Motor Control (SCALE)
- Passive knee extension
- Maximum static step length

Passive knee extension

RESULTS…

- Lower limb spasticity (ASAStot)
- Lower limb spasticity (MAStot)
- Lower limb Muscle strength (MMTtot)
- Selective Voluntary Motor Control (SCALE)
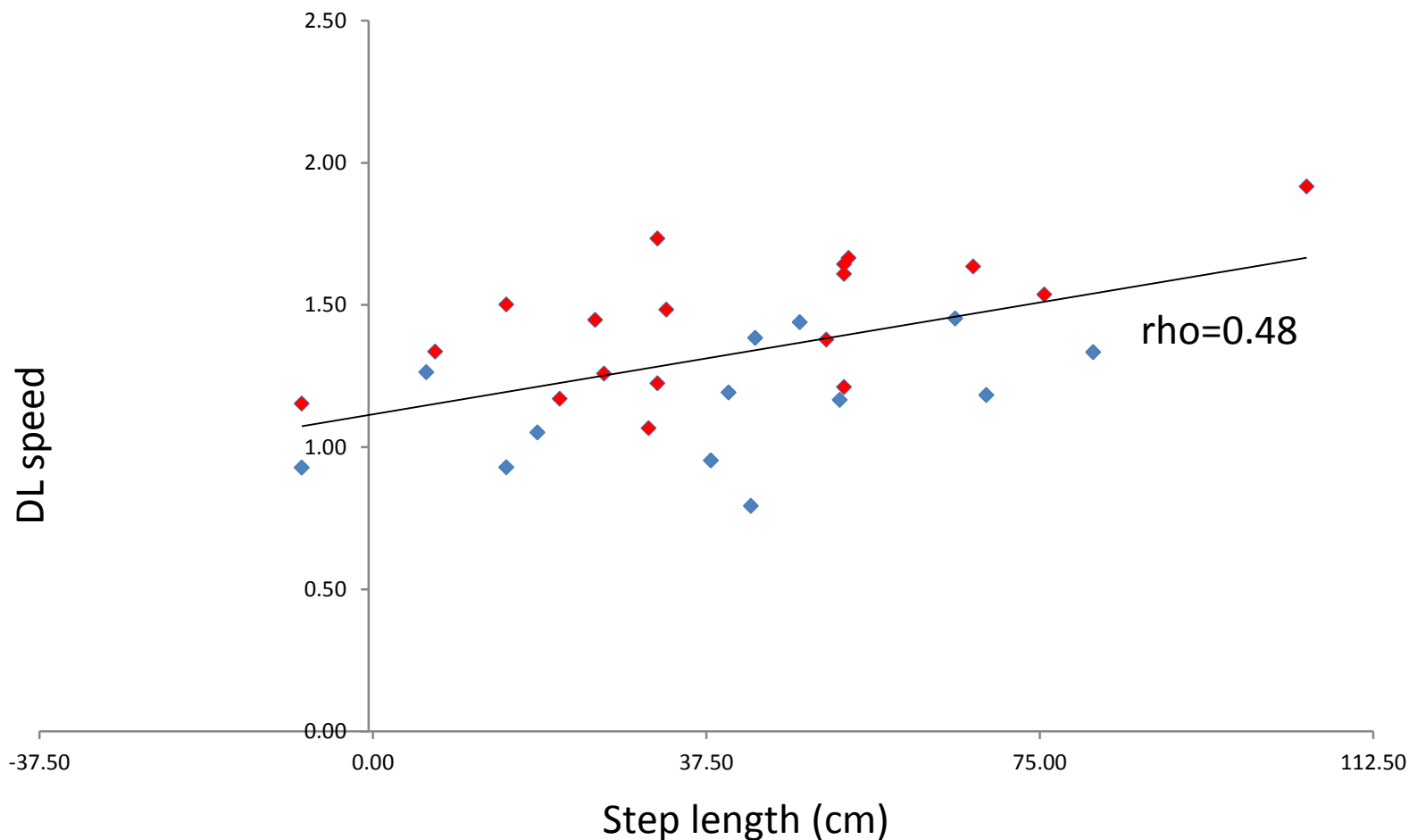- Passive knee extension
- Maximum static step length

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

Maximum static step length

So what do we know now?

- Spasticity, lack of muscle strength, lack of selective motor control and a knee flexion contracture of ≥ 20° are negatively associated with 100 m race speed.

- Experience of the athlete may need to be considered when interpreting results.

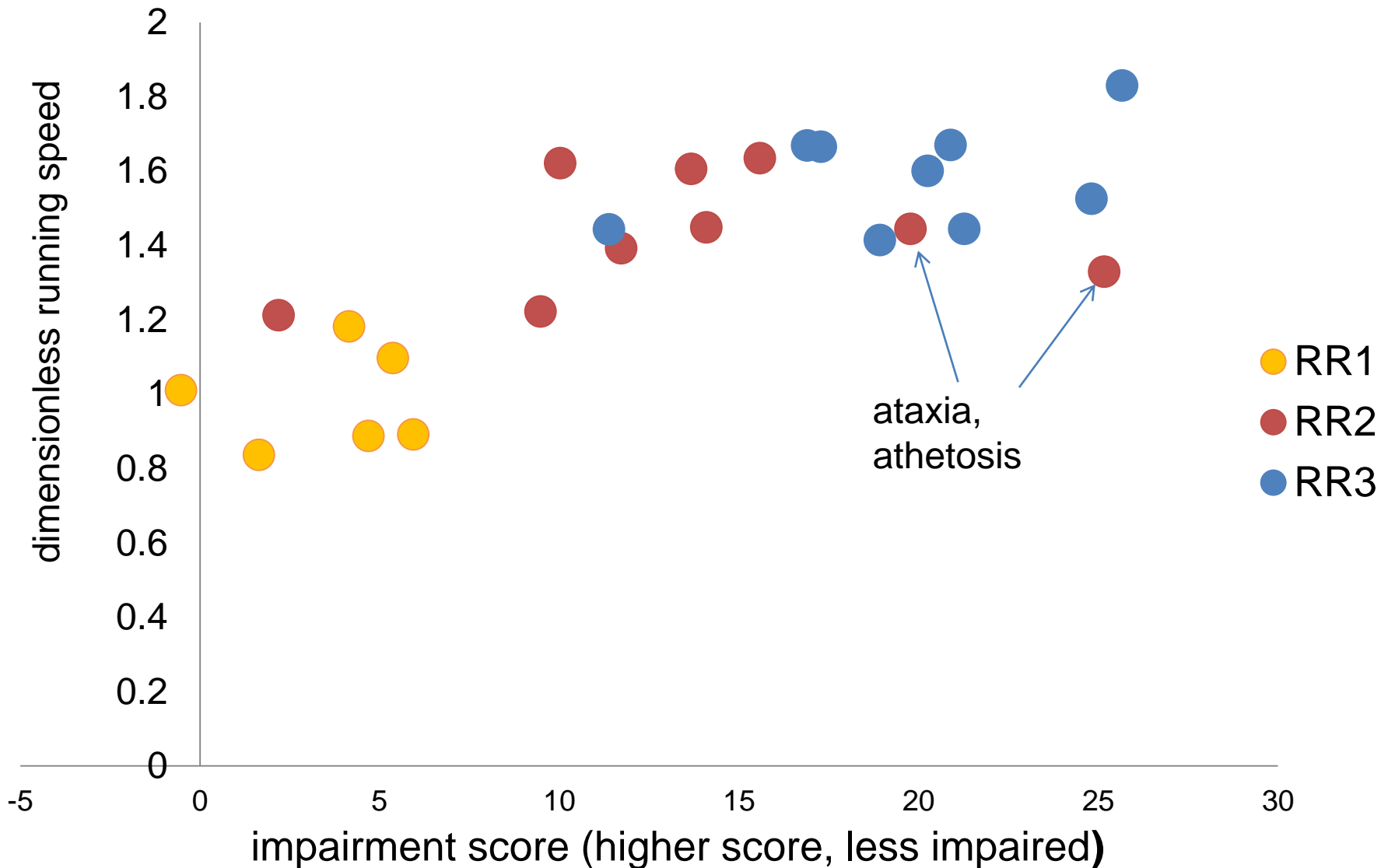# 21st International RaceRunning Camp & Cup, Copenhagen, July 2017

- Trunk Control Measurement Scale
- Multi joint co-ordination test

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

Total score with beta coefficients for SCALE, ASAS & TCMS

Ongoing & future research

- Expert consensus (Delphi)
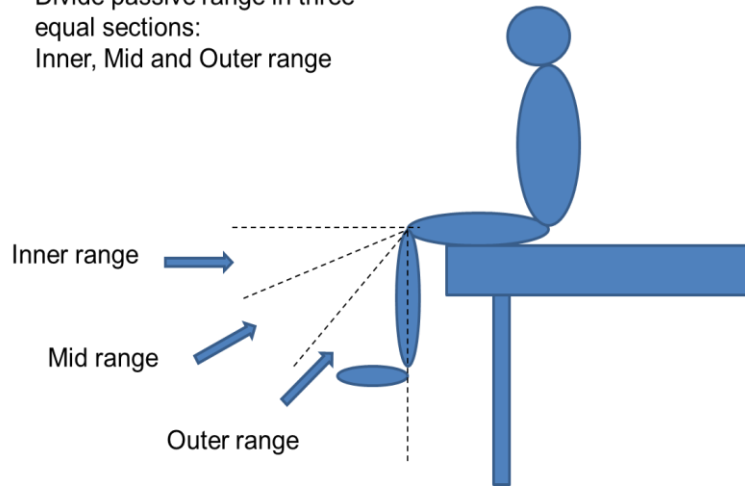- Performance measures (motion analysis)
- Ratio scale measures

THANK YOU!

Manual Muscle Testing

Divide passive range in three
equal sections:
Inner, Mid and Outer range

Inner range →

Mid range

Outer range

Daniels and Worthingham Scale

0	None	No visible or palpable contraction
1	Trace	Visible or palpable contraction with no motion
2	Poor	Full ROM gravity eliminated
3	Fair	Full ROM against gravity
4	Good	Full ROM against gravity, moderate resistance
5	normal	Full ROM against gravity, maximal resistance

		SCORE
Outer	0	17
	1	16
	2	15
	3	14
	4	13
	5	12
Mid	0	11
	1	10
	2	9
	3	8
	4	7
	5	6
Inner	0	5
	1	4
	2	3
	3	2
	4	1
	5	0

Queen Margaret University
CENTRE FOR HEALTH, ACTIVITY
AND REHABILITATION RESEARCH

CPISRA
access to sport

THE UNIVERSITY OF EDINBURGH

METHODS:
Selected impairment measures

- Spasticity (MAS, ASAS[1])

(hip flexors, hip adductors, knee extensors, plantar flexors)

- Muscle strength (MMT)

 (hip extensors, hip abductors, hip flexors, knee extensors)

- Selective voluntary motor control (SCALE[2])

- Passive Range of Motion (goniometry)

1Love et al
2Fowler et al, Balzer et al