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# Evaluating a battery of tests designed to predict running performance in runners with brain impairments recruited from Kenya and Australia.

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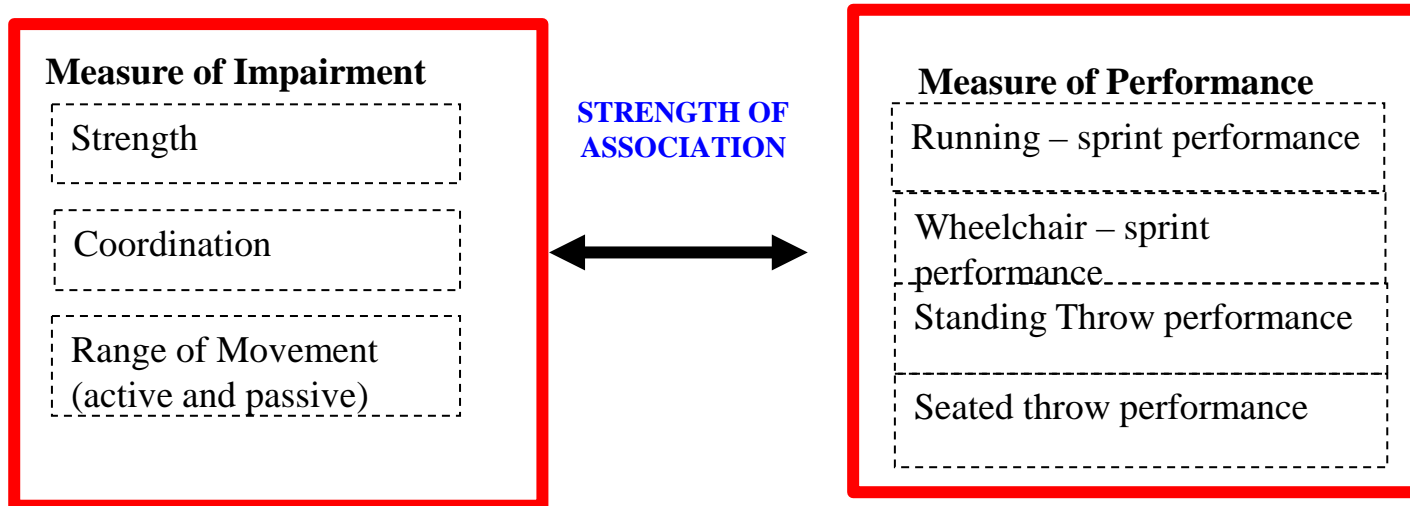
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# Background – Classification in Paralympic Athletics

## *Conceptual Map IPC Athletics*

Purpose of Classification is to “*promote participation in sport by people with disabilities by minimising the impact of impairment on the outcome of competition*” ([Tweedy and Vanlandewijck 2011](#))

### *IPC Concept Map for Athletics*



*IPC Concept map – Athletics classification (Tweedy & Vanlandewijck, 2011)*

# Background

## Current challenges with *Research Measurement Methods of Impairment*

Impairment classification may come from the classification outcome

Stage 1

### Measure of Impairment

The possibility of measures of impairment responding to training means that *well-trained athletes could be competitively disadvantaged by being placed into a class with athletes less-impaired than themselves*

Strength

STRENGTH OF  
ASSOCIATION

Coordination

Range of Movement  
(active and passive)

### Measure of Performance

Running + sprint performance

Wheelchair – sprint performance

Standing Throw performance

Seated throw performance

Stage 2

### Current project Training Assessment Tests (TAT)

Running indicators

Wheelchair indicators

Throws standing indicators

Throws seated indicators

### TAT – Research Required:

- Normal values
- Reliability
- Predictive validity (better trained = better test performance)

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## Background

### Valid Training Assessment Tests – TATs

#### *Criteria*

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IPC Position Stand states a valid TAT for running will be:

- 1) predictive of performance evaluating the maximum number of body structures and functions required for athletic performance;
- 2) emphasise functioning of one or more structures and functions that are impaired; and
- 3) be *highly training responsive*, where through effective training athletes who are trained will perform better on the battery for a given amount of impairment ([Tweedy and Vanlandewijck 2011](#)).

## Background

# Reliability and Validity of TAT for Running – Non-disabled participants (Beckman & Tweedy, 2009)

Previous research established a battery of TAT for running in ND.

The results

- TATs were reliable (ICCs 0.80–0.98 )
- Moderate to strong correlations with running performance (30- 60m sprint) for Standing Broad jump, 10 m skip and 4 bounds).

Future direction  
for research  
evaluation in AWD

Original article

## Towards evidence-based classification in Paralympic athletics: evaluating the validity of activity limitation tests for use in classification of Paralympic running events

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### ABSTRACT

**Objective:** To classify Paralympic athletes, classifiers use test batteries to obtain an objective, pre-competition estimate of an athlete's training level. Five tests were evaluated to determine which combination explained the maximum variance in running performance in a non-disabled population. A non-disabled sample was required to permit psychometric evaluation of the tests without the confounding influence of impairment, and to provide an indication of normative performance.

**Design:** Sixty-seven non-disabled participants (male and female; mean (SD) age 24.78 (6.53) years) completed a six-test battery comprising a 30 m sprint (criterion activity limitation test) and five supplementary activity limitation tests: standing broad jump, four bounds, 10 m skip, running in place and split jumps.

**Results:** Test reliability was high for all tests (intraclass

how much they affect each of the four fundamental activities of Paralympic athletics: running, jumping, throwing and wheelchair propulsion. In the lexicon of the *International classification of disability, functioning and health*,<sup>3</sup> impairments are classified according to how much activity limitation they cause.<sup>2</sup>

The methods used to assess and classify impairments should be reliable and be based on research indicating how much impairments of varying type, location and severity affect the four core activities of Paralympic athletics. This paper is one of a series that will provide an evidence base for classifying impairments of coordination, range of movement and strength.

Although evidence-based methods for classifying impairments must primarily use valid and reliable

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# Aim

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The aim of this experiment was to evaluate the validity of a battery of novel tests designed to predict running performance in runners with brain impairments (RBI).

We posited that valid tests will show a strong and significant association with running performance in runners with brain impairments and non-disabled runners.

Specifically

1. Determine whether RBI were significantly different from Non-Disabled participants performance on the TATs
  2. Determine the strength of association between TATs and run performance in RBI and Non-disabled participants
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# Methods

## *Participants*

Three groups of males (n = 65)

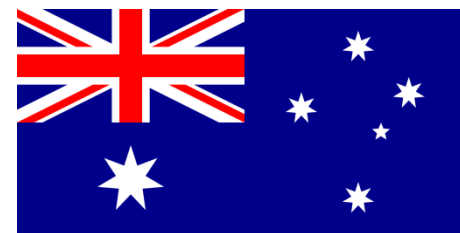
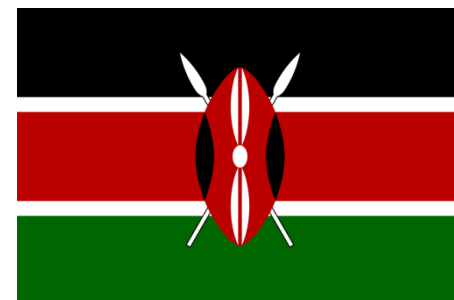
Group 1: n= 28 ND participants from UQ

Group 2: n= 13 RBI recruited from Brisbane

Group 3: n= 24 RBI recruited from Kenya

*Inclusion criteria: RBI comprise male athletes with CP, stroke, with features of hypertonia, ataxia, athetosis, dystonia, Eligible for Paralympic competition, with known medical diagnosis and DOB, regular participation in sport.*

**Exclusion criteria:** Lower limb deformity, Dysmelia, club foot, upper limb impairment



# Methods

## TAT battery and Performance tests

### TATs

- Stand Broad Jump (m) and SBJ normalised to standing height
- 4 Bounds (m) and 4 Bounds normalised to standing height
- Running in Place (s)
- Split jump (s)



Figure 1. Split jump activity Beckman & Tweedy (2009)

### Performance

- Time 0-60m
- Acceleration 0-15m
- Top Speed 30-60m



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# Methods

## *Statistical analysis*

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- Outliers identified as  $\pm 3.0$  z-scores, normality testing
  - One-way ANOVA to determine if a difference between 3 groups existed
  - Spearman's correlation to evaluate the strength of association between each TAT and performance
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# Results

## Descriptives characteristics

Group		N	Mean±SD	Range
Age (yrs)	ND	28	23.11±4.08*	16.00-30.00
	RBI – Bris	13	24.31±9.38*	15.00-45.00
	RBI - Kenya	24	27.83±6.16*	19.00-41.00
Weight (kg)	ND	28	76.66±9.46	55.00-93.00
	RBI - Bris	13	69.11±9.58	56.00-80.00
	RBI - Kenya	24	52.97±6.08	42.27-67.86
Height (cm)	ND	28	180.49±6.77	172.00-198.60
	RBI - Bris	13	176.28±8.76	164.40-197.30
	RBI – Kenya	24	165.50±5.65	154.80-175.50

There was a statically significant difference between groups determined by One-way ANOVA between groups 1, 2 and 3 ( $p < 0.05$ ) for all variables except marked with \* (age)

# Results

## Descriptives Performance

	Group	N	Mean±SD	Range
<b>Time to 60m 0-60m</b>	ND	28	8.43±0.53	7.57-9.84
	RBI - Bris	13	9.69±1.20	8.32-13.00
	RBI – Kenya	24	11.46±2.02	9.17-17.18
<b>Acceleration 0-15m</b>	ND	28	2.76±0.19	2.45-3.29
	RBI - Bris	13	3.18±0.31	2.77-4.05
	RBI – Kenya	24	3.53±0.50	2.92-4.57
<b>Top Speed 30-60m</b>	ND	28	3.76±0.27	3.30-4.35
	RBI – Bris	13	4.31±0.64	3.65-5.96
	RBI - Kenya	24	5.23±0.96	4.01-7.20

There was a statically significant difference between groups determined by One-way ANOVA between groups 1, 2 and 3 ( $p<0.05$ ) for all variables.

# Results

## Descriptives TAT

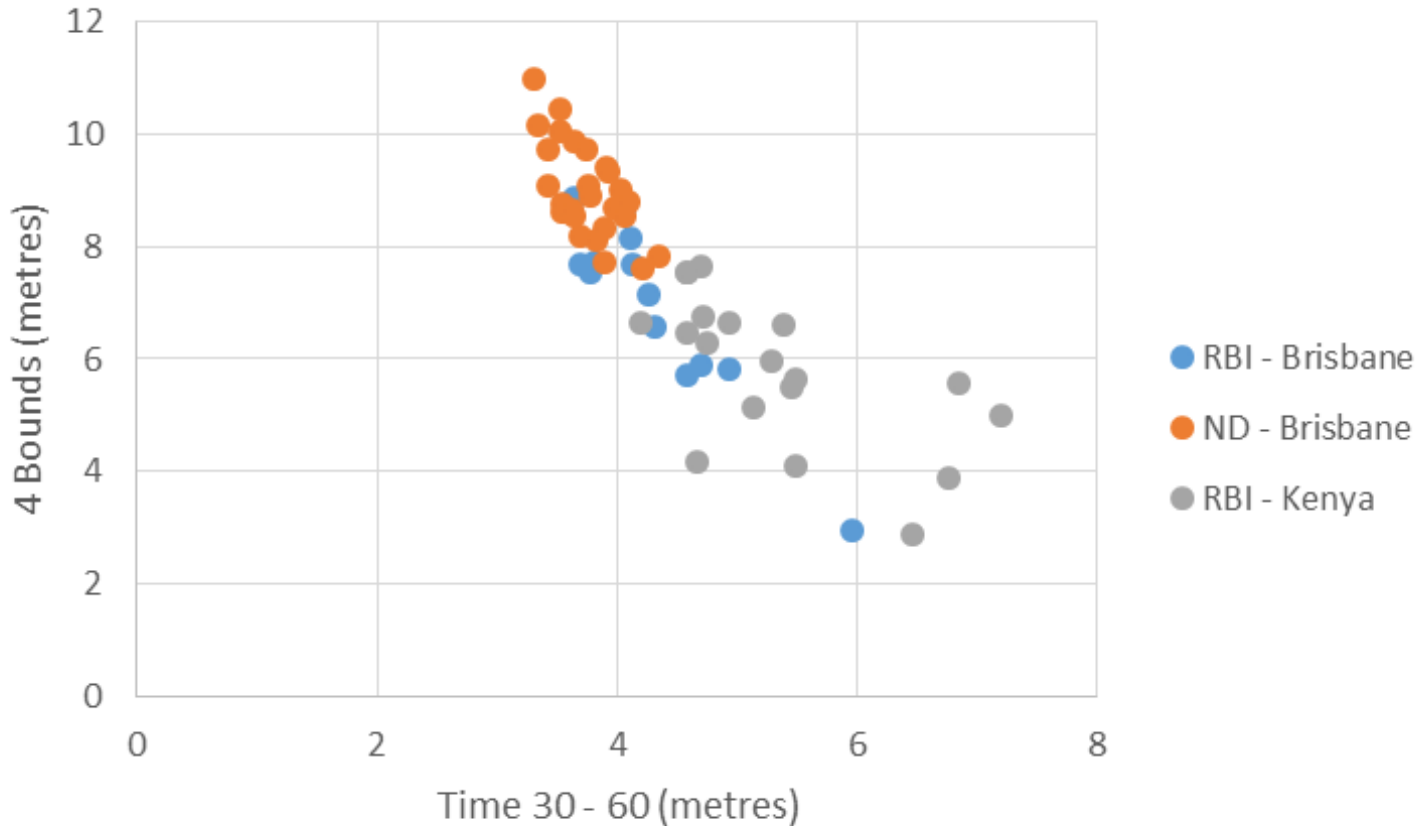
TAT	Group	N	Mean±SD	Range
Four Bounds (m)	ND	28	8.99±0.83	7.62-10.97
	RBI - Bris	13	6.95±1.59	2.95-8.85
	RBI - Kenya	21	5.92±1.35	2.87-7.87
Four Bound rel Ht (m)	ND	28	4.98±0.39	4.30-5.96
	RBI - Bris	13	3.93±0.80*	1.74-4.69
	RBI - Kenya	21	3.57±0.81*	1.70-4.97
SBJ (m)	ND	28	2.32±0.24	1.78-2.83
	RBI - Bris	13	1.67±0.29	1.15-2.20
	RBI - Kenya	21	1.39±0.34	0.89-1.88
SBJ rel Ht (m)	ND	28	1.28±0.12	1.00-1.54
	RBI - Bris	13	0.95±0.16	0.65-1.19
	RBI - Kenya	22	0.81±0.25	0.18-1.11
Running in Place (RIP) (s)	ND	27	5.16±0.85	3.98-6.84
	RBI - Bris	12	9.60±2.59	5.08-14.12
	RBI - Kenya	19	13.34±3.97	6.98-21.57
Split Jump (SJ) (s)	ND	27	11.96±1.24	9.13-14.52
	RBI - Bris	10	21.97±4.32	15.75-27.84
	RBI - Kenya	21	31.55±13.36	16.61-61.74

There was a statically significant difference between groups determined by One-way ANOVA between groups 1, 2 and 3 ( $p<0.05$ ) for all variables except marked \* (Four Bound rel Ht RBI Bris and Kenya )

# Results

## Spearman's correlations

		Performance			
TAT	n	Sprint time 0-60m (p-value)	Acceleration 0-15m (p-value)	Top Speed 30-60m (p-value)	
Four Boun					
Four Boun RelHt (m)					
SBJ (m)					
SBJ rel Ht					
Running in (RIP) (s)					
Split Jump (SJ) (s)	ND	27	0.32 (0.105)	0.29 (0.150)	0.31 (0.117)
	RBI - Bris	10	0.26(0.47)	0.30(0.405)	0.30(0.0405)
	RBI - Kenya	21	0.436*(0.048)	0.46*(0.036)	0.388(0.082)



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# Discussion

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The aim of this experiment was to evaluate the validity of a battery of novel tests designed to predict running performance in runners with brain impairments.

## Key outcomes

- Activities which emphasised lower limb power - unilateral activity (Four bounds) - are good predictors in ND and RBI
  - In RBI – RIP and SJ significantly correlated with running performance (Kenya), suggesting Kenya may have been more impaired than Bris.
    - Consistent with Beckman & Tweedy hypothesis that in the presence of impairment RIP and SJ tests would be more predictive of performance.
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## Practical implications

### Hypothetical example of two athletes

Activity	Athlete 1	Athlete 2
Strength score (N)	295N	310N
Four bounds (m)	2.87m	7.62m
Behaviour	Untrained	Trained

Hypothetical class cut point is an impairment score of 295N.

Two athletes with the same impairment profile – could be placed in different classes if impairment score alone was the used to determine class allocation.

- Possibility that Athlete 1 - not well trained - could be competitively advantaged by being placed into a class with athletes who are more impaired than themselves

This experiment contributes to evidence-based classification, by reducing the likelihood of erroneous classification by providing a battery of TATs which objectively determine how well-trained an athlete is.

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