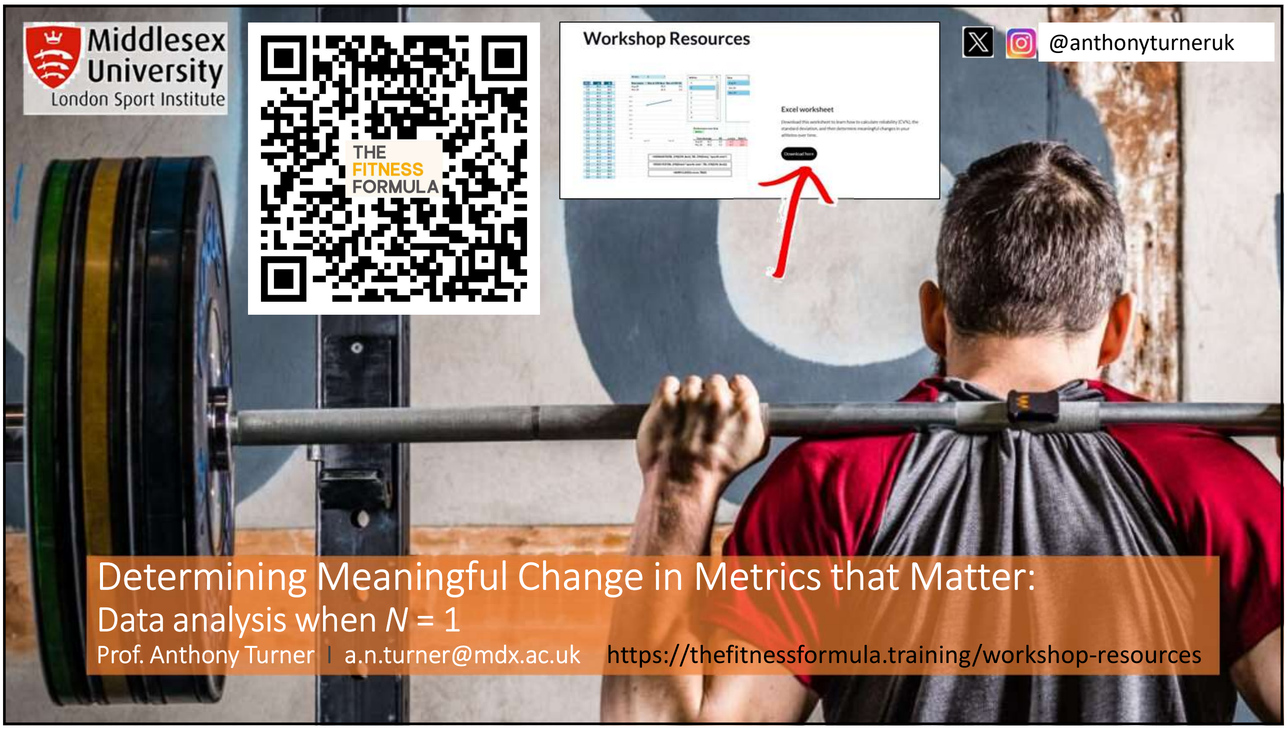


Presentation aim. How to:

1. Choose a test that informs your practice
2. Filter out the noisy, pointless metrics
3. Determine how much you trust the remaining metrics
4. Analyse each athlete's data
5. Set targets for each athlete

Step 1. Choosing a test
...that informs your practice

Identifying what to test and train through a needs analysis

Coach's Physical KPI's	Cover lots of distance	Be fast	Be agile	Multiple sprints	Win aerial challenges	Win tackles (protect ball)	Be robust
Physical quality	Aerobic capacity	Speed & acceleration	CoDS	RSA	Power	Strength	Symmetry & ROM
Test	MAS	10 m & 30 m, RSI	Pro-agility (inc. decel)	30 m x 6, 20 s rest	CMJ (inc. Loaded jumps	IMTP	OHS & Nordboard
Exercises	HIIT, SIT, SSG	SPD and Accel drills, plyometrics	Deccel and agility	HIIT, SIT, SSG	Power training (ballistics)	Strength training (squats)	Hams, adductors, glutes, eccentrics, unilateral

Choosing a test

Biological Basis

- Is there a justifiable link between the metric of interest and athletic performance?
- Does a theoretical cause and effect relationship exist?

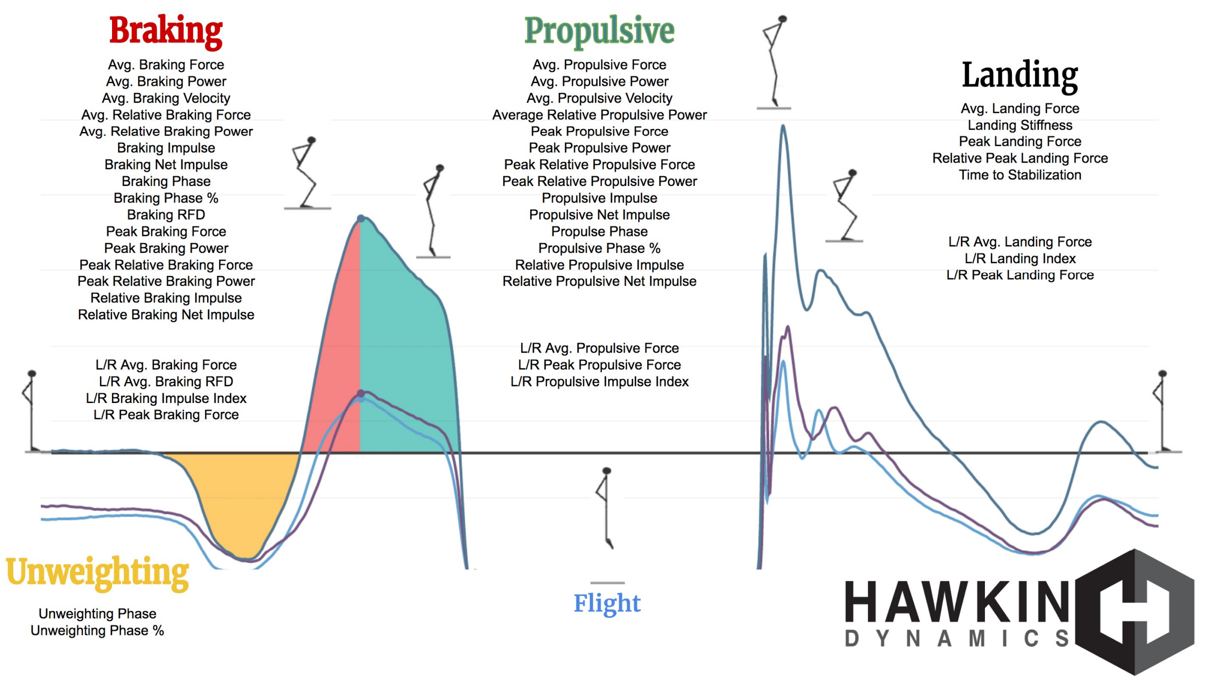
Feasibility

- Logistics surrounding its implementation including: cost, time and staffing.
- How long does it take to produce a report for coaches?
- Is the right culture in place?

Sensitivity

- To what accuracy can it detect true changes?
- Realistically, can you actually inform practice off the back of this measure?

Step 2. Filter the noise

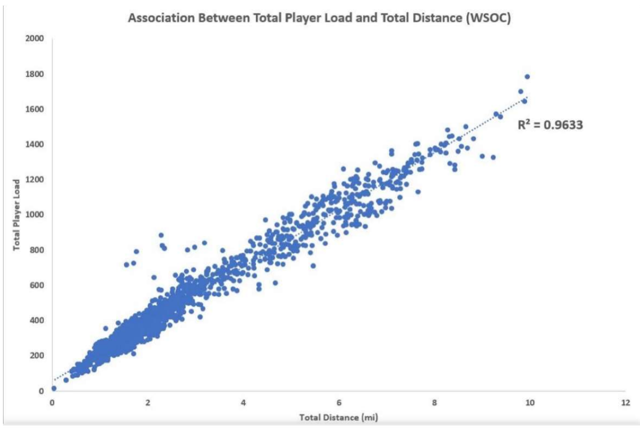


Jason Avedesian, PhD
Director of Sports Science - Olympic Sp...
8h •

It's likely you're looking at too many GPS metrics to quantify external demands.

96% of the variance in Total Player Load is explained by total distance!

Data from ~1700 data points in WSOC.



Original Research — Journal of Strength and Conditioning Research

Intra- and Interday Reliability of Weightlifting Variables and Correlation to Performance During Cleans

Angela M. Sorensen,[1] Shyam Chavda,[1] Paul Comfort,[2] Jason Lake,[3] and Anthony N. Turner[1]

[1]London Sports Institute, Middlesex University, London, United Kingdom; [2]Human Performance Laboratory, University of Salford, Salford, United Kingdom; and [3]Department of Sport and Exercise Sciences, University of Chichester, Chichester, United Kingdom

Level one: Which variables are reliable?

Level 2: Which variables are highly correlated (multicollinearity)?

Level 3. Of the correlated variables which one statistically or logically best explains the performance outcome

Results

Sixteen of the 70 variables analyzed were found to have good to excellent intra- and interday ICC (0.779–0.994 and 0.969–0.996, respectively) and CV (0.64–6.42 and 1.14–6.37, respectively) values (30,36). Using the Pearson's correlation coefficients (r = 0.5–1.0 at $p < 0.005$), these 16 variables were also shown to have strong correlations (r = 0.880–0.988) to cleans performed at 90% 1RM. From these 16 variables, bar work variables that were used to calculate bar power variables were then excluded because they are derived from the same force and displacement data and represented duplicate data. The resulting variables were further assessed for multicollinearity, which can be seen in Table 3. This system of filtering resulted in a total of 11 variables exhibiting "good to excellent" ICC with a CV of ≤10% for both intraday and interday reliability measures and with correlations to clean performance as reported in Table 2.

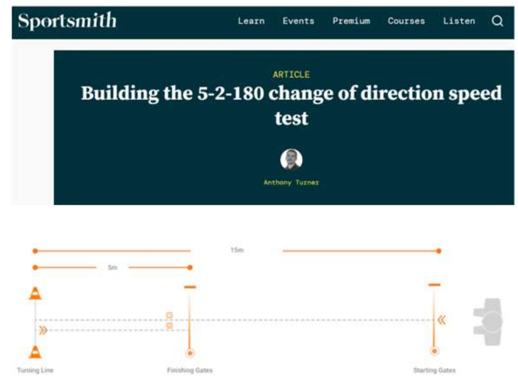


Figure 1: Traditional 5-0-5. To ensure the athlete reaches ≥ 95% of their max 10 meter speed, place timing gates at the start line.

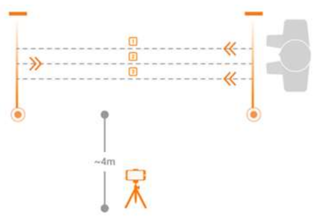
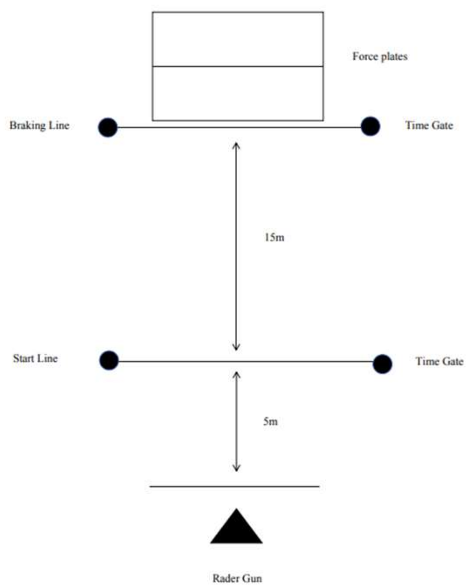


Figure 1 Maximal horizontal deceleration test design



Just because you can, doesn't mean you should!

Complexity Bias.

The tendency to prefer more complex or sophisticated options over simpler ones, often because they sound more important or impressive.

If you start with the wrong metric, or a valid yet noisy one, there is no form of analysis that can save you from rubbish data and meaningless inferences.

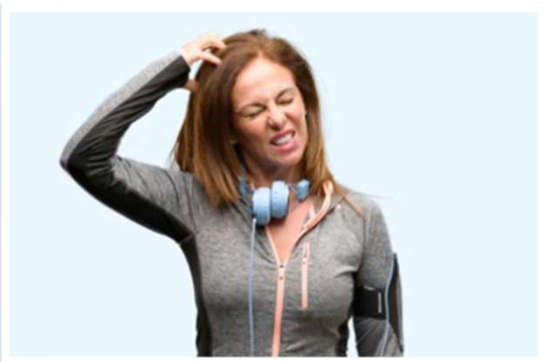
Step 3. Is the metric reliable

…How much should I trust it?

Explain this to your athlete

You bench press 3 times in a week

- In session 1 you bench 70 kg
- In session 2 you bench 72 kg
- In session 3 you bench 69 kg

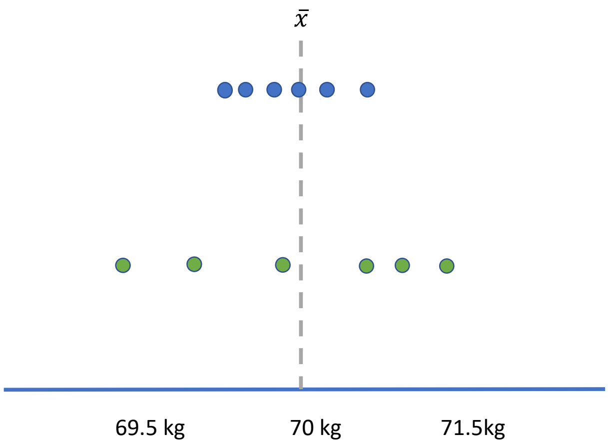


What about this…

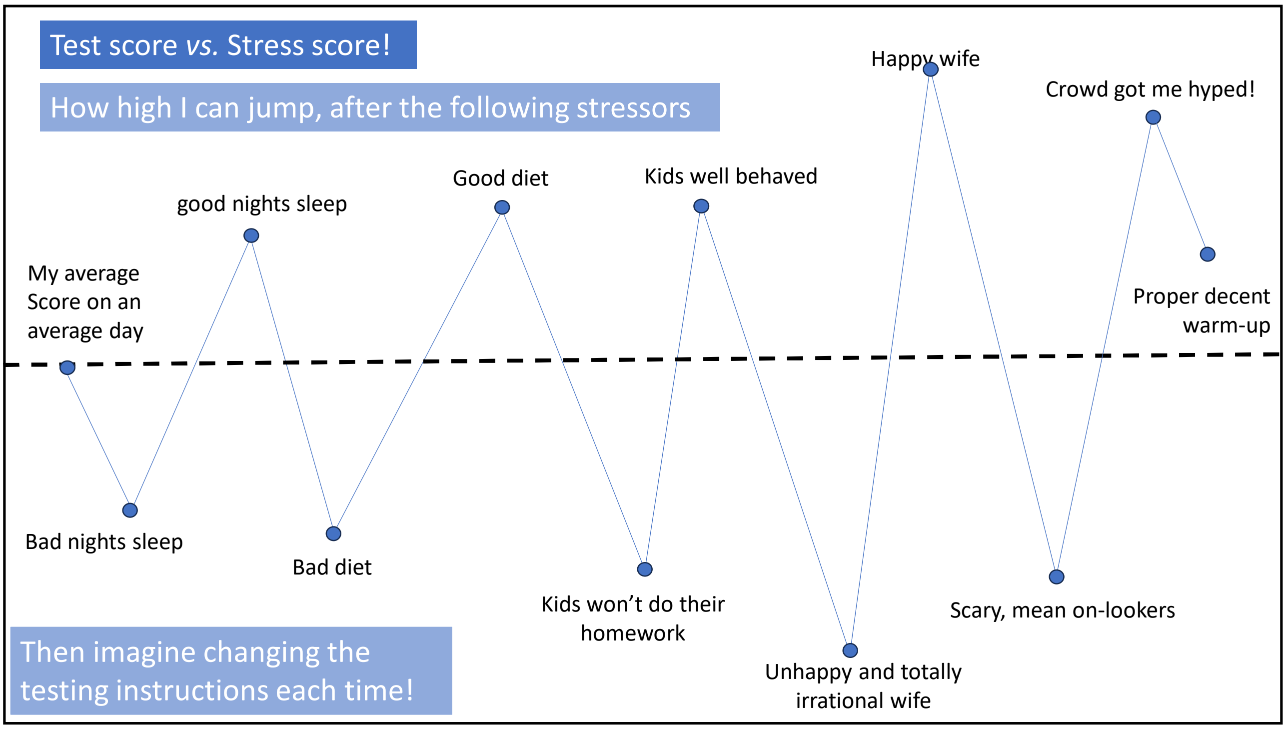
You weigh yourself everyday for 5 days

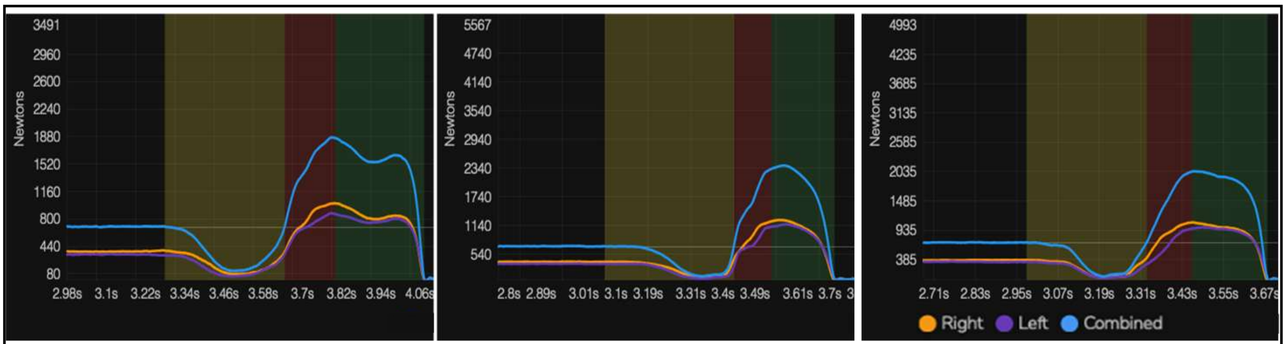
- On day 1 you weigh 70 kg
- On day 2 you weigh 70.5 kg
- On day 3 you weigh 69.9 kg
- On day 4 you weigh 70.1
- On day 5 you weigh 70.3

Which weighing scale would you buy?




Trial 1 = 4.8 s
Trial 2 = 4.6 s
Trial 3 = 4.3 s


Test score *vs.* Stress score!
How high I can jump, after the following stressors
My average Score on an average day
Bad nights sleep
good nights sleep
Bad diet
Good diet
Kids won't do their homework
Kids well behaved
Unhappy and totally irrational wife
Happy wife
Scary, mean on-lookers
Crowd got me hyped!
Proper decent warm-up
Then imagine changing the testing instructions each time!



Metric	“high as you can"	“fast as you can”	“Fast and high”
Height (cm)	51	43	49
CM depth (cm)	41	25	31
Ave Braking F (N)	1477	1669	1496
Braking phase (s)	0.15	0.11	0.13
Ave Propulsive F (N)	1512	1866	1697
Propulsive phase (s)	0.27	0.18	0.22
TTT	0.79	0.64	0.7
mRSI	0.64	0.67	0.7

Coefficient of variability (CV)

CV % = (SD/mean) *100

- CV of 10% suggests that the SD is 10% of the mean. The higher the CV, the less consistent the data points
- CV best measure of reliability if comparing tests with different units
- E.g., which is more reliable, jump height system with an SD of **3 cm**, or peak force system with an SD of **100 N**?
- Mean score = **40 cm** and **2000 N** respectively. Therefore:

Jump height system

3/40 = 0.075 *100 = 7.5 %

Peak force system

100/2000 = 0.05 *100 = 5 %

```
=STDEV.P(C5:E5)/AVERAGE(C5:E5)*100
```

CMJ_1	CMJ_2	CMJ_3	CV %
38.1	43.6	47.7	9.1
34.1	35.7	36	2.4
42.8	42.2	41.9	0.9
50.4	52.2	52.2	1.6
37	36.1	36.9	1.1
42.1	40.7	45.1	4.3
44.5	42.3	45.2	2.8
37.9	33.3	39.6	7.2
43.6	44.9	37.4	7.8
35.4	40.1	39.5	5.4
45.3	44.4	43.9	1.3
46.6	47.7	47.7	1.1
30.2	31	31.5	1.7
50.8	51.2	53.7	2.5
41	46.7	36.4	10.2
43.7	40.4	43	3.4
43.6	44.1	48.9	5.2
43.6	44.8	43.5	1.3
51.6	50.4	53.6	2.5
27.8	28.5	28.7	1.4
29	28.3	30.9	3.7
29	27.7	26.3	4.0
30.3	35.7	34.2	6.8
34.9	36.1	35.4	1.4
39.7	40.3	40.8	3.7

STEDV.P or **STDEV.S** ?

So how much do we actually need to improve by?

Need to calculate 1.3% of the AVERAGE

=(44 / 100)*1.3 = 0.6
= STDEV.P

Issues using the average CV?

Table 2. Reliability of countermovement jump concentric force–time and

	Trial 1 Mean ± SD	Trial 2 Mean ± SD	%CV (LCI, UCI)
CON Duration (ms)	2.80 ± 0.50	2.86 ± 0.58	4.67 (3.84, 5.49)
CON Impulse (Ns)	158.46 ± 45.23	158.77 ± 45.82	1.62 (1.03, 2.20)
CON Mean Force (N)	1273 ± 319	1265 ± 321	2.15 (1.81, 2.48)
CON Mean Power (W)	1633 ± 544	1630.7 ± 553	3.20 (2.55, 3.86)
CON Peak Force (N)	1605 ± 407	1612 ± 418	2.91 (2.44, 3.37)
CON Peak Velocity ($m \cdot s^{-1}$)	2.38 ± 0.26	2.38 ± 0.28	1.44 (0.89, 1.99)
CON RFD ($N \cdot s^{-1}$)	720 ± 1138	759 ± 1244	**76.45 (66.86, 86.03)**
CON RPD ($W \cdot s^{-1}$)	14,673 ± 6521	14,308 ± 6599	7.15 (6.08, 8.21)
Jump Height (Flight) (cm)	27.30 ± 6.41	27.46 ± 6.36	2.92 (2.49, 3.35)
Jump Height (Imp-Dis) (cm)	26.01 ± 6.40	26.17 ± 7.09	3.21 (2.09, 4.33)
Jump Height (Imp-Mom) (cm)	25.96 ± 6.39	26.13 ± 7.09	3.20 (2.08, 4.33)
Lower Limb Stiffness ($N \cdot m^{-1}$)	4971 ± 3081	6181 ± 10,643	**10.21 (7.59, 12.82)**
Peak Power (W)	2979 ± 972	2955 ± 982	2.48 (1.88, 3.08)
RSI-modified ($m \cdot s^{-1}$)	0.37 ± 0.11	0.37 ± 0.12	5.81 (4.87, 6.75)

Lacks detail

Pick one

Are you calculating jump momentum?

Just because you can doesn't mean you should!

Same thing

sports MDPI

Article

Identifying Reliable and Relatable Force–Time Metrics in Athletes—Considerations for the Isometric Mid-Thigh Pull and Countermovement Jump

Justin J. Merrigan [1,*], Jason D. Stone [3], W. Guy Hornsby [1,2] and Joshua A. Hagen [1]

Table 1. Countermovement jump eccentric force–time curve metrics an

	Trial 1 Mean ± SD	Trial 2 Mean ± SD	%CV (LCI, UCI)
Dip Depth (cm)	−30.57 ± 8.48	−31.23 ± 9.82	7.66 (5.00, 10.32)
ECC Braking Impulse (Ns)	60.84 ± 72.54	60.11 ± 67.76	**14.53 (11.36, 17.70)**
ECC Braking RFD (N·s⁻¹)	4780 ± 2060	4924 ± 2446	**10.86 (9.26, 12.45)**
ECC Decel. Impulse (Ns)	95.56 ± 50.31	95.26 ± 51.46	6.34 (4.13, 8.55)
ECC Decel. RFD (N·s⁻¹)	5661 ± 2890	5841 ± 3256	**10.38 (8.56, 12.20)**
ECC Duration (ms)	479.3 ± 76.0	479.2 ± 93.7	6.41 (4.50, 8.31)
ECC Mean Braking Force (N)	843.8 ± 193.2	846.6 ± 199.2	3.38 (2.71, 4.05)
ECC Mean Decel. Force (N)	1222 ± 309	1224 ± 329	3.43 (2.71, 4.15)
ECC Mean Force (N)	689.9 ± 149.7	689.8 ± 149.6	0.06 (0.05, 0.08)
ECC Mean Power (W)	438.0 ± 142.1	442.5 ± 151.1	6.83 (4.74, 8.92)
ECC Peak Force (N)	1573 ± 406	1584 ± 429	3.34 (2.70, 3.97)
ECC Peak Power (W)	1223 ± 525	1239 ± 602	9.24 (6.74, 11.74)
ECC Peak Velocity (m·s⁻¹)	−1.23 ± 0.30	−1.23 ± 0.33	6.26 (4.04, 8.47)

If this changes, so too must braking ***F***

Lacks detail

Same thing?

Good case to choose this one!

sports MDPI

Article

Identifying Reliable and Relatable Force–Time Metrics in Athletes—Considerations for the Isometric Mid-Thigh Pull and Countermovement Jump

Justin J. Merrigan, Jason D. Stone, W. Guy Hornsby and Joshua A. Hagen

PODSF

(Prof. Jason Lake)

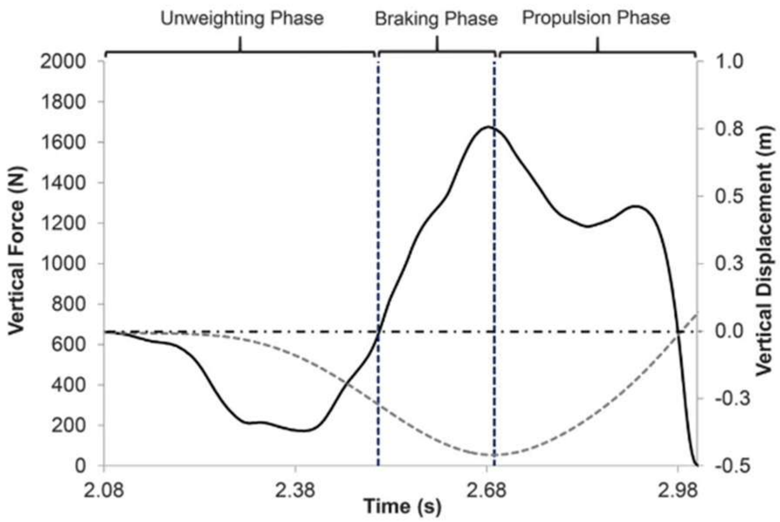
Fluffy
Theoretically sound but practically useless

Person
Determines context

Outcome
JH

Driver
Mean braking ***F***
Mean propulsive ***F***

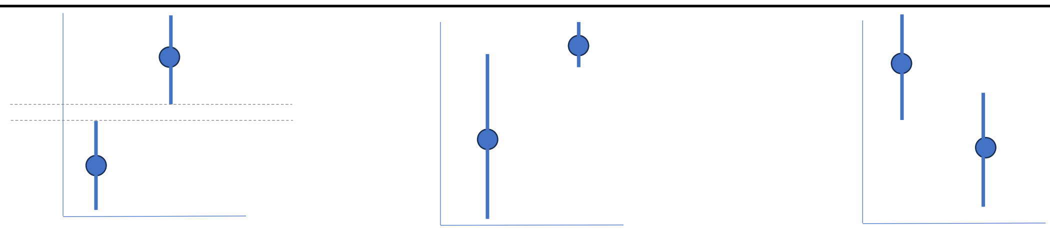
Strategy
brake *t* + Prop *t* = TTT
CoM displacement



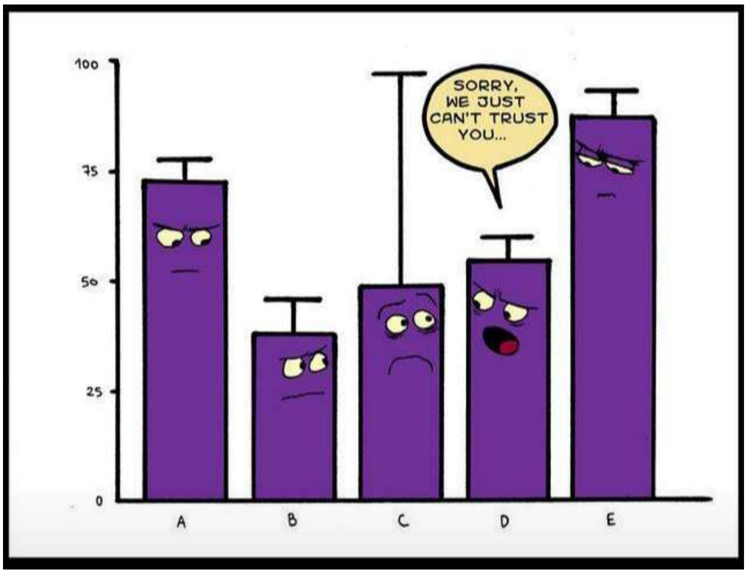
McMahon et al., 2018. Understanding the key phases of the CMJ F-t curve. SCJ

Step 4. Individual athlete analysis

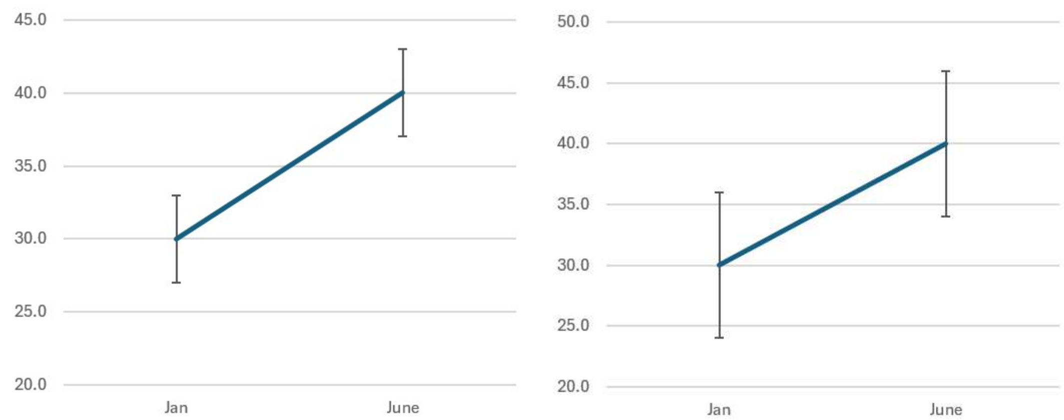
…determining meaningful change



Athlete	Testing session 1						Testing session 2						Performance
	CMJ_1	CMJ_2	SD	CMJ_best	LL	UL	CMJ_1	CMJ_2	SD	CMJ_best	LL	UL	
A	43.7	42.8	0.6	43.7	43.1	44.3	45.6	44.6	0.7	45.6	44.9	46.3	better
B	34.8	36	0.8	36.0	35.2	36.8	39.2	41.2	1.4	41.2	39.8	42.6	better
C	42.8	40.2	1.8	42.8	41.0	44.6	43.2	42.1	0.8	43.2	42.4	44.0	same
D	46.2	45.8	0.3	46.2	45.9	46.5	47.4	48.3	0.6	48.3	47.7	48.9	better
E	37	36.2	0.6	37.0	36.4	37.6	37.9	38.8	0.6	38.8	38.2	39.4	better
F	45.1	44	0.8	45.1	44.3	45.9	46.2	45.6	0.4	46.2	45.8	46.6	same
G	36	41.2	3.7	41.2	37.5	44.9	40.4	42.4	1.4	42.4	41.0	43.8	same
H	38.5	39.6	0.8	39.6	38.8	40.4	40.1	43.3	2.3	43.3	41.0	45.6	better
I	41.9	44.9	2.1	44.9	42.8	47.0	45.6	46.4	0.6	46.4	45.8	47.0	same
J	37.5	40.1	1.8	40.1	38.3	41.9	42.3	43.8	1.1	43.8	42.7	44.9	better
K	42.7	45.3	1.8	45.3	43.5	47.1	45	45.9	0.6	45.9	45.3	46.5	same
L	47.7	45.8	1.3	47.7	46.4	49.0	46.2	48.1	1.3	48.1	46.8	49.4	same
M	31.5	30.1	1.0	31.5	30.5	32.5	36.4	38.3	1.3	38.3	37.0	39.6	better
N	33.8	36.7	2.1	36.7	34.6	38.8	37.8	40.1	1.6	40.1	38.5	41.7	same
O	46.7	45.1	1.1	46.7	45.6	47.8	43.9	47	2.2	47.0	44.8	49.2	same
P	43.7	42.7	0.7	43.7	43.0	44.4	42.6	44.2	1.1	44.2	43.1	45.3	same
Q	40.4	41.2	0.6	41.2	40.6	41.8	38.4	37.8	0.4	38.4	38.0	38.8	worse



68% (1 SD) or 95% (2SD) CI



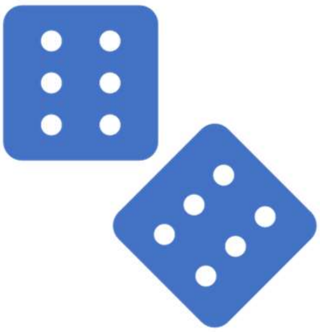
Well, 1.96 x SD = 95% CI to be exact!

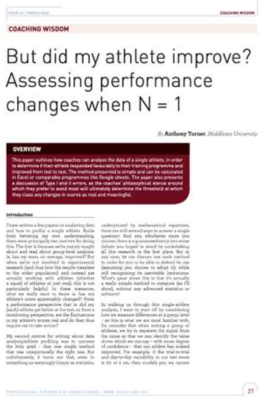
Type I or Type II error? That is the question

- ***A Type I error is a false-positive*** – you claim a difference when there is none
- ***Type II error is a false-negative*** – you claim no difference when there was one

Club philosophy: Risk *vs.* Reward

- **Do you prefer to play it safe or be sensitive to smaller changes? Perhaps a philosophical question.**
- **There is no right or wrong answer. Sometimes you'll be right, sometimes you'll be wrong.**
- **Therefore, need to focus on the consequences of each scenario to help you choose.**





COACHING WISDOM

But did my athlete improve? Assessing performance changes when N = 1

Reducing the noise (*SD)*

The tester

- Expert
- Strict
- Coaching cues

The athlete:

- Homogenous group
- Technique
- Motivation
- Biological variability

Post CMJ – Pre CMJ Variability

The environment

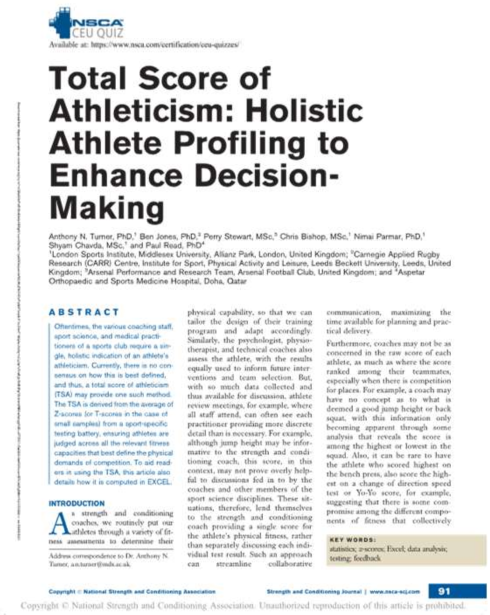
- Temperature
- Audience
- competition
- Music

The equipment

- Recording frequency
- Calibration
- Unobtrusive

Step 5. Comparison with teammates …to set realistic targets

z scores and the TSA



NSCA CEU QUIZ
Available at: https://www.nsca.com/certification/ceu-quizzes/

Total Score of Athleticism: Holistic Athlete Profiling to Enhance Decision-Making

Anthony N. Turner, PhD,[1] Ben Jones, PhD,[2] Perry Stewart, MSc,[3] Chris Bishop, MSc,[1] Nimai Parmar, PhD,[1] Shyam Chavda, MSc,[1] and Paul Read, PhD[4]
[1]London Sports Institute, Middlesex University, Allianz Park, London, United Kingdom; [2]Carnegie Applied Rugby Research (CARR) Centre, Institute for Sport, Physical Activity and Leisure, Leeds Beckett University, Leeds, United Kingdom; [3]Arsenal Performance and Research Team, Arsenal Football Club, United Kingdom; and [4]Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

ABSTRACT

Oftentimes, the various coaching staff, sport science, and medical practitioners of a sports club require a single, holistic indication of an athlete's athleticism. Currently, there is no consensus on how this is best defined, and thus, a total score of athleticism (TSA) may provide one such method. The TSA is derived from the average of Z-scores (or T-scores in the case of small samples) from a sport-specific testing battery, ensuring athletes are judged across all the relevant fitness capacities that best define the physical demands of competition. To aid readers in using the TSA, this article also details how it is computed in EXCEL.

INTRODUCTION

As strength and conditioning coaches, we routinely put our athletes through a variety of fitness assessments to determine their physical capability, so that we can tailor the design of their training program and adapt accordingly. Similarly, the psychologist, physiotherapist, and technical coaches also assess the athlete, with the results equally used to inform future interventions and team selection. But, with so much data collected and thus available for discussion, athlete review meetings, for example, where all staff attend, can often see each practitioner providing more discrete detail than is necessary. For example, although jump height may be informative to the strength and conditioning coach, this score, in this context, may not prove overly helpful to discussions fed in to by the coaches and other members of the sport science disciplines. These situations, therefore, lend themselves to the strength and conditioning coach providing a single score for the athlete's physical fitness, rather than separately discussing each individual test result. Such an approach can streamline collaborative communication, maximizing the time available for planning and practical delivery.

Furthermore, coaches may not be as concerned in the raw score of each athlete, as much as where the score ranked among their teammates, especially when there is competition for places. For example, a coach may have no concept as to what is deemed a good jump height or back squat, with this information only becoming apparent through some analysis that reveals the score is among the highest or lowest in the squad. Also, it can be rare to have the athlete who scored highest on the bench press, also score the highest on a change of direction speed test or Yo-Yo score, for example, suggesting that there is some compromise among the different components of fitness that collectively

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KEY WORDS:
statistics; z-scores; Excel; data analysis; testing; feedback

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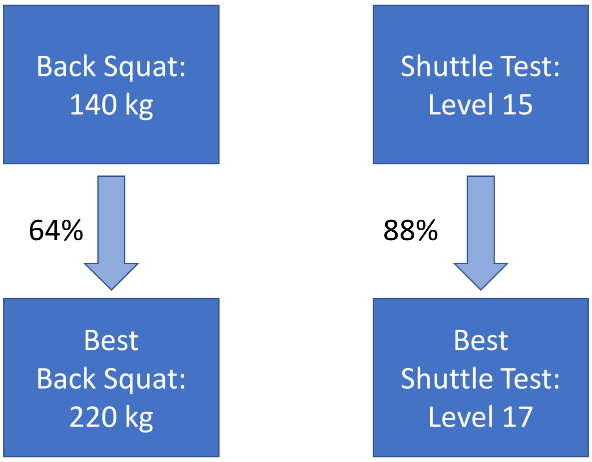
So, are they fit or not!?

But is that score any good!?

Are they getting any better!?

Is that score any good and which test did they do best on?



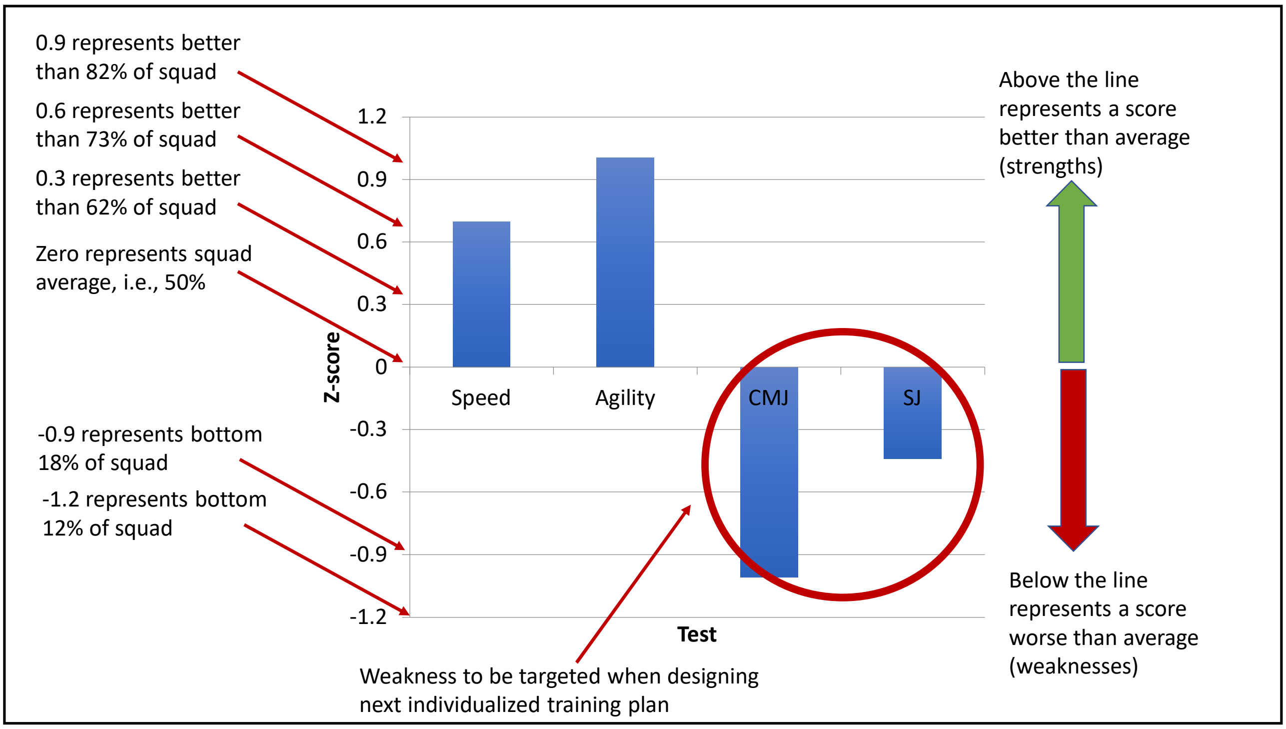
- But maybe the team is fit and they all scored well on the shuttle test…
- Level 15 may have been one of the lowest
- Conversely, there may only be a few strong athletes, so 140kg is really good!

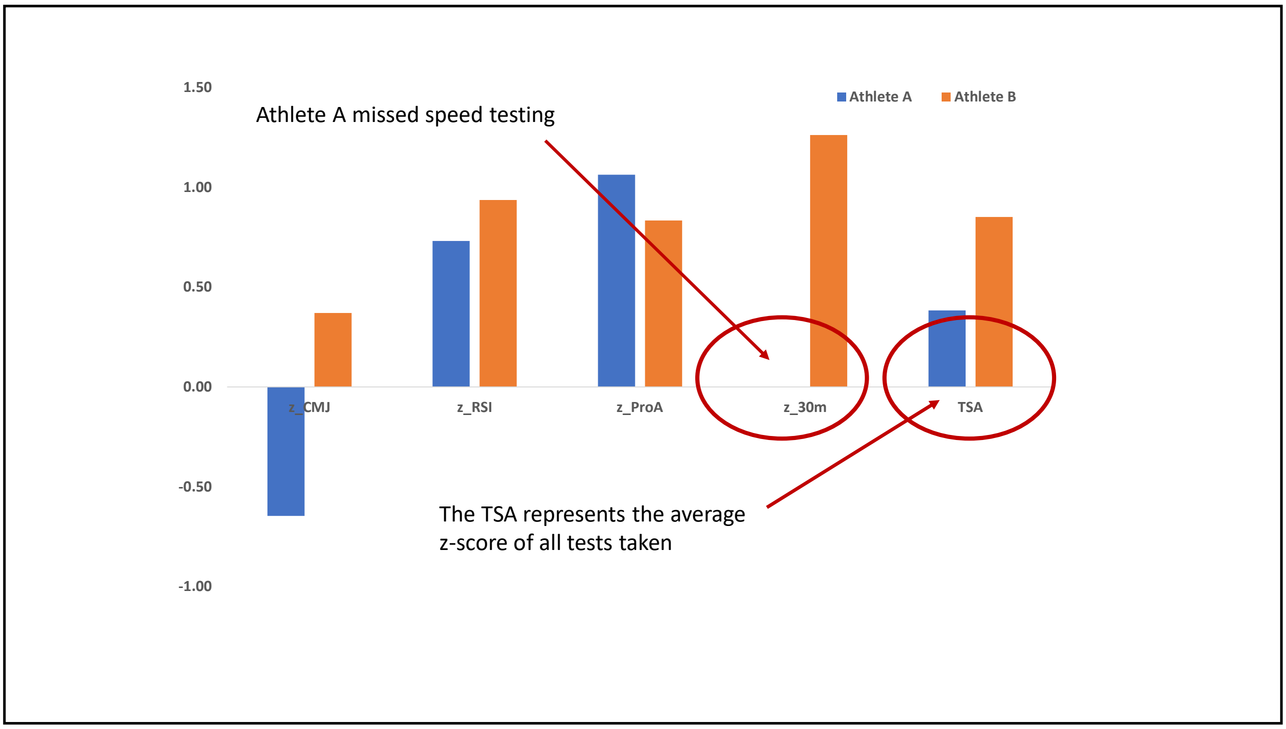
Turn test scores into a *z*-scores

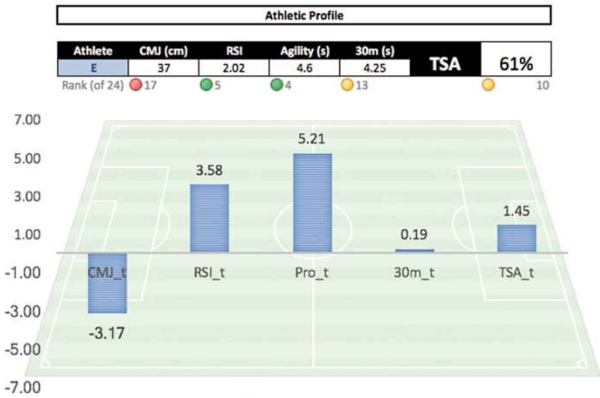
- *Z*-scores tell you how many SD's a score is from the mean
- If a *z*-score = 0, it is identical to the mean score
- If a *z*-score = 1, it is 1 SD above the mean
- If a *z*-score = -1, it is 1 SD below the mean

VLOOKUP =(S2-S$26)/S$27

	S	T	U	V	AE	AF	AG	AH	AI	AJ
1	Best_CMJ	Best_RSI	Best_ProA	Best_30m	z_CMJ	z_RSI	z_ProA	z_30m	TSA	Rank
2	47.7	1.6	5	4.5	S$27	-0.23	0.15	-1.49	-0.23	18
3	36	1.63	4.9	4.46	-0.77	-0.16	0.38	-1.25	-0.45	19
4	42.8	1.72	6.4	4.19	0.06	0.05	-3.06	0.41	-0.64	20
5	52.2	2.5	4.4	4.34	1.21	1.83	1.52	-0.51	1.01	2
6	37	2.02	4.6	4.25	-0.65	0.73	1.06	0.04	0.30	10
7	45.1	1.81	4.8	4.16	0.34	0.25	0.60	0.59	0.45	7
26	42.29	1.70	5.1	4.26						
27	8.16	0.44	0.44	0.16						


0.9 represents better than 82% of squad
0.6 represents better than 73% of squad
0.3 represents better than 62% of squad
Zero represents squad average, i.e., 50%
-0.9 represents bottom 18% of squad
-1.2 represents bottom 12% of squad
Z-score
1.2
0.9
0.6
0.3
0
-0.3
-0.6
-0.9
-1.2
Speed
Agility
CMJ
SJ
Test
Weakness to be targeted when designing next individualized training plan
Above the line represents a score better than average (strengths)
Below the line represents a score worse than average (weaknesses)


1.50
1.00
0.50
0.00
-0.50
-1.00
Athlete A
Athlete B
Athlete A missed speed testing
z_CMJ
z_RSI
z_ProA
z_30m
TSA
The TSA represents the average z-score of all tests taken



Total Score of Athleticism

Profiling Strength and Power Characteristics in Professional Soccer Players After Anterior Cruciate Ligament Reconstruction to Assess Readiness to Return to Sport

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Investigation performed at Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

Background: There is no consensus on the optimal testing procedure to determine return-to-sport (RTS) readiness after anterior cruciate ligament (ACL) reconstruction. Current approaches use limb symmetry across a range of tests, but this does not consider a patient's level of athleticism or benchmarks relative to his or her noninjured counterparts.

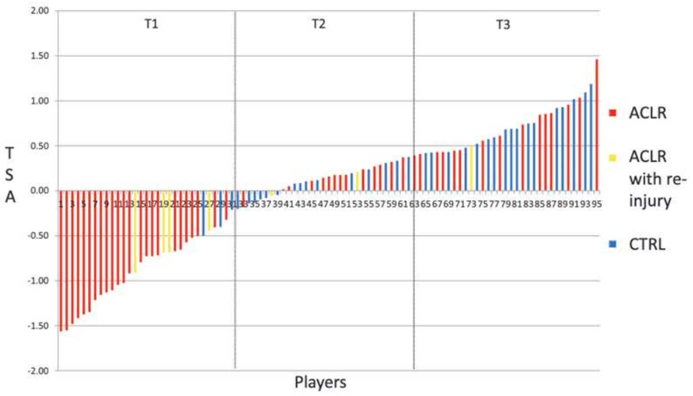
Purpose: To examine the utility of the Total Score of Athleticism (TSA), a composite scale including strength, power, and reactive strength assessments, to aid RTS decision-making.

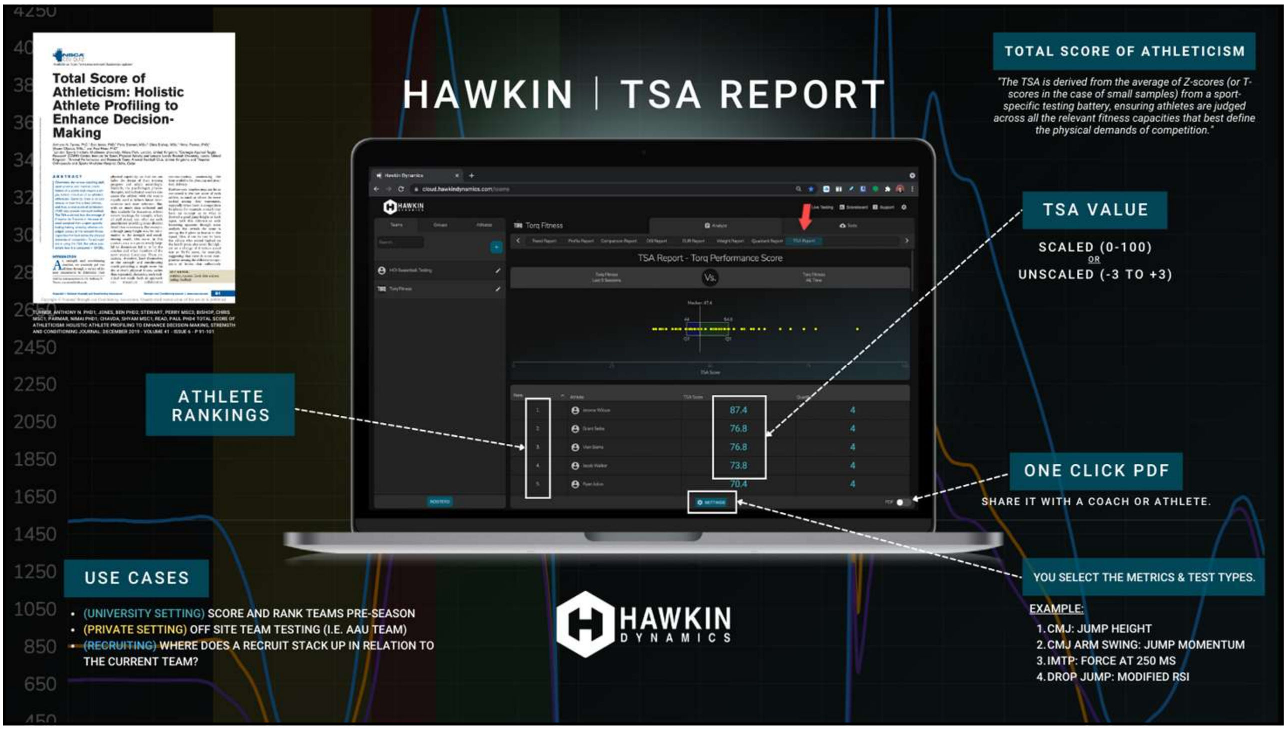
Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A total of 95 professional soccer players (60 who underwent ACL reconstruction [mean age, 25.1 ± 12.6 years] and 35 who were uninjured [mean age, 23.8 ± 2.8 years]) completed a battery of tests including isokinetic knee extension and flexion torque, bilateral and unilateral countermovement jump height, relative peak power, and reactive strength index–modified. The TSA score (derived from *Z* scores) was calculated, and we (1) examined differences between the ACL-reconstructed and uninjured groups at the time of RTS, (2) assessed the predictive ability of the TSA to identify the player's status (ACL reconstruction vs uninjured control), and (3) included a case series to discuss the characteristics of players who sustained a subsequent injury within 4 months after RTS.

Results: A large difference between the ACL-reconstructed and uninjured groups in the TSA score ($d = 0.84$; $P < .0001$) was evident. For every additional increase of 1 unit in the TSA score, the odds of belonging to the ACL-reconstructed group decreased by 74% (95% CI, 0.19-0.56). By visual inspection, the frequency of reinjured players was higher in the low (4/7) TSA tertile compared with the medium (2/7) and high (1/7) TSA tertiles.

Conclusion: Preliminary evidence indicates that the TSA may be a useful RTS readiness tool, as the composite score derived from strength and power measures was different in soccer players at the time of RTS after ACL reconstruction compared with healthy matched controls. There was also a higher frequency of low TSA scores in players who sustained a second injury after RTS. Therefore, it is recommended to routinely administer RTS tests encompassing strength, power, and reactive strength qualities each season across the largest possible number of players (ideally teammates).




HAWKIN | TSA REPORT
Total Score of Athleticism: Holistic Athlete Profiling to Enhance Decision-Making
TOTAL SCORE OF ATHLETICISM
"The TSA is derived from the average of Z-scores (or T-scores in the case of small samples) from a sport-specific testing battery, ensuring athletes are judged across all the relevant fitness capacities that best define the physical demands of competition."
TSA VALUE
SCALED (0-100)
OR
UNSCALED (-3 TO +3)
ATHLETE RANKINGS
TSA Report - Torq Performance Score
87.4
76.8
76.8
73.8
70.4
ONE CLICK PDF
SHARE IT WITH A COACH OR ATHLETE.
YOU SELECT THE METRICS & TEST TYPES.
EXAMPLE:
1. CMJ: JUMP HEIGHT
2. CMJ ARM SWING: JUMP MOMENTUM
3. IMTP: FORCE AT 250 MS
4. DROP JUMP: MODIFIED RSI
USE CASES
(UNIVERSITY SETTING) SCORE AND RANK TEAMS PRE-SEASON
(PRIVATE SETTING) OFF SITE TEAM TESTING (I.E. AAU TEAM)
(RECRUITING) WHERE DOES A RECRUIT STACK UP IN RELATION TO THE CURRENT TEAM?
HAWKIN DYNAMICS