OUTPUT

2.0

LEVERAGING NORMATIVE DATA

Comparing Normatives from Thousands of Athletes' Personal Bests.

FOREWORD

The content of this ebook is intended to provide valuable insights and guidance to athletes, trainers, and sports enthusiasts. However, we would like to bring to your attention that certain pages within this book may contain duplicated content, presenting both metric and imperial versions of the information.

The inclusion of duplicate content is done with the intention of accommodating readers from different regions and backgrounds, as metric and imperial systems are commonly used in various parts of the world. By offering both versions, we aim to ensure that athletes can easily access and comprehend the normative data, regardless of their preferred measurement system.

While we have taken great care in presenting the normative data accurately, we strongly advise consulting with professionals, trainers, or experts within the athletic field to validate and tailor the information to your specific circumstances. The content within this ebook should not be considered a substitute for professional advice, personalized training programs, or medical guidance.

We hope that this book proves to be a valuable resource in comparing and leveraging normative data for your athletic pursuits.

By gathering normatives from thousands of Output users / athletes' personal bests, Output Sports provides comprehensive and informative tables for various strength metrics. This wealth of information assists in setting appropriate training targets, identifying areas for improvement, and ultimately optimizing athletic performance.

FITNESS TESTING: A BRIEF HISTORY

If we consider the definition of the word 'fitness' as being related to a person's capability in performing a task, it shouldn't be a surprise to find that as long as humans have been engaged in tasks that require some amount of physical effort, there has been some form of testing to measure its effectiveness. An acknowledgement of the importance of fitness dates back thousands of years, with training designed to improve performance in soldiers documented in many of the ancient civilizations.

Several militaries had loosely defined fitness requirements, which related to a person's battle-ready capabilities, but it wasn't really until after the Renaissance period and the development of more modern approaches to science that we started to understand the human body at a mechanistic level and notice that structured, progressive exercise could create documented adaptations. However, when it comes to standardised fitness testing to rank a person's task-specific ability, this is a much more modern pursuit. At least in the context of creating large scale, normative values anyway, with testing protocols and scoring developed and being introduced after the turn of the 20th century.

In the late 20th century, it was the creation of a new science 'exercise physiology' that started to document how humans responded to different types of physical stress in relation to sports performance. And that led to the development of more sport-specific and sport-related testing that has evolved into what we know as modern athlete assessment, which includes everything from simple field tests (that inform us how the body performs as an entire system at a given task), to more detailed assessment (specific components of metabolism that allow us to target specific adaptations at a cellular level through our coaching).

NORMATIVE DATA: OVERVIEW

Normative data is the statistical treasure trove of sports science. It provides valuable insights into an athlete's physical attributes and capabilities.

Normative data in sports science refers to a collection of standardized measurements and performance statistics derived from a representative sample of individuals within a specific population. This data serves as a reference point or benchmark against which an athlete's individual performance or characteristics can be evaluated and compared. By comparing an athlete's results to the normative data, we gain a deeper understanding of their strengths, weaknesses, and areas for improvement.

Imagine a coach assessing the agility of a soccer player using a series of timed tests. Without normative data, the coach might only have a standalone time measurement, providing limited context about the player's agility.

However, armed with a dataset of agility measurements from soccer players of similar age, gender, and skill level, the coach can now gauge whether the player's performance is above average, average, or below average. This information becomes invaluable when designing training routines tailored to the athlete's specific needs.

THE PURPOSE OF TESTING:

It is logical that the type of testing we use to inform our practice is related to the demand of the sport. However, in many sports there are likely to be more generic, baseline fitness requirements required to perform that activity, even if that requirement may not on the face of it be key to success in the sport itself.

For example, if an athlete in a heavily skill-dominant sport such as motor racing does not have at least a solid amount of strength and endurance, no matter how skilled they are, the demands of racing will mean they do not have a solid foundation to perform their 'skill'. Understanding where the athlete is relative to these foundational 'markers' of performance is key.
Fitness testing is important for several reasons:

- Identify if an athlete has enough general fitness to perform specific fitness.
- Rank athletes in that sport by traits that may determine sporting success.
- Understand the make-up of elite athletes and determinants of success.
- Measure the determinants of performance and target specific areas for improvement.
- Measure and monitor progress as a response to our interventions.

STRENGTH TESTING

Strength is the expression of task-specific maximal force in a muscle or group of muscles and can be measured in several ways. The most common and accessible method is 1-repetition maximum testing, performed during compound lifts such as the squat, deadlift or bench press.

The problem with strength testing and "normative values" is that studies can use very different protocols. A squat or bench press could be performed in any number of unstandardized ways, depending on range of motion and how strict the researchers are on adhering to this. Even in terms of reporting, some research will report absolute values whilst others will report relative to bodyweight.

Which of these measures is most important to you will depend largely on the "why" you are measuring strength... and in what sport. This is why it is important when comparing our athlete values against the literature, to understand the exact testing method and protocol being used, otherwise comparisons may become meaningless.

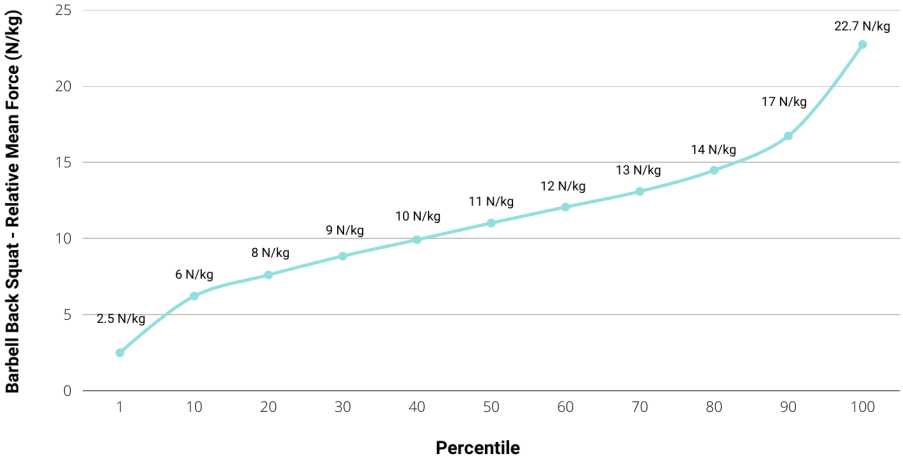
BARBELL BACK SQUAT STRENGTH

Relative Mean Force	
1st-10th Percentile	2-6 N/kg
10th-30th Percentile	6-9 N/kg
30th-50th Percentile	9-11 N/kg
50th-70th Percentile	11-13 N/kg
70th-90th Percentile	13-17 N/kg
90th-100th Percentile	17-23 N/kg

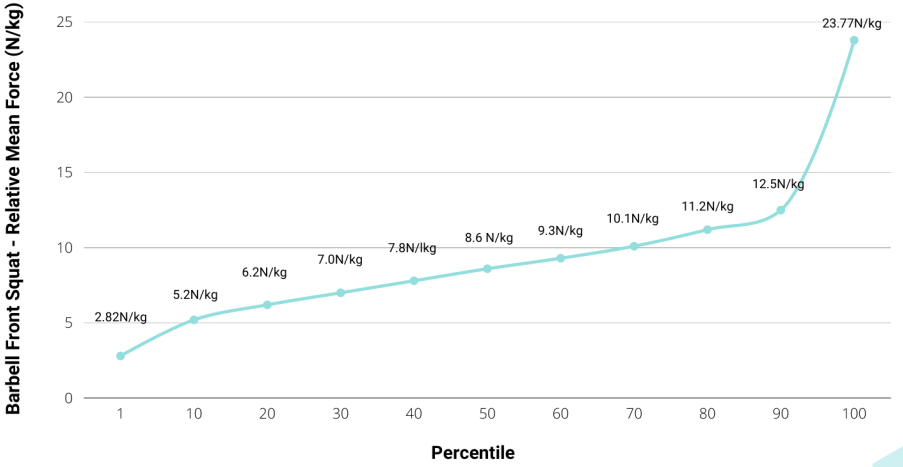
BARBELL FRONT SQUAT STRENGTH

Relative Mean Force	
1st-10th Percentile	2.82-5.2 N/kg
10th-30th Percentile	5.2-7.0 N/kg
30th-50th Percentile	7.0-8.6 N/kg
50th-70th Percentile	8.6-10.1 N/kg
70th-90th Percentile	10.1-12.5 N/kg
90th-100th Percentile	12.5-23.77 N/kg

BARBELL BACK SQUAT - RELATIVE MEAN FORCE



BARBELL FRONT SQUAT - RELATIVE MEAN FORCE



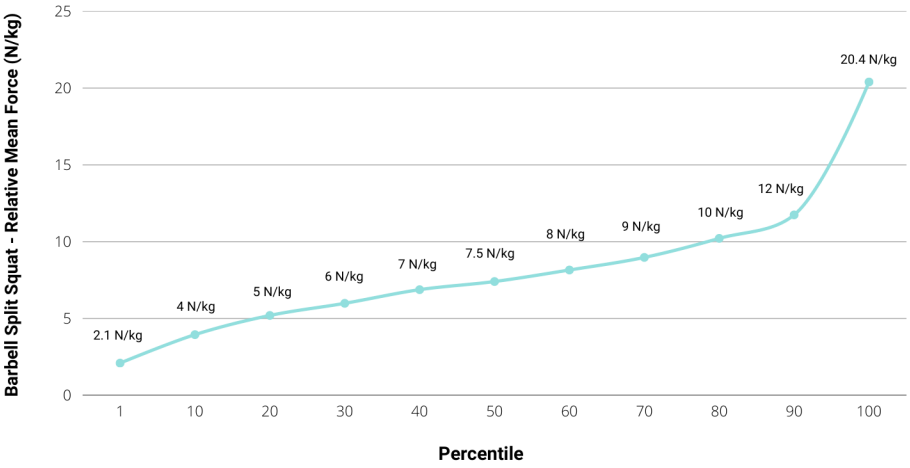
BARBELL SPLIT SQUAT STRENGTH

Relative Mean Force	
1st-10th Percentile	1.84 - 3.6 N/kg
10th-30th Percentile	1.84 - 3.6 N/kg
30th-50th Percentile	5.8 - 7.5 N/kg
50th-70th Percentile	7.5 - 8.8 N/kg
70th-90th Percentile	8.8 - 11.5 N/kg
90th-100th Percentile	11.5 - 20.36 N/kg

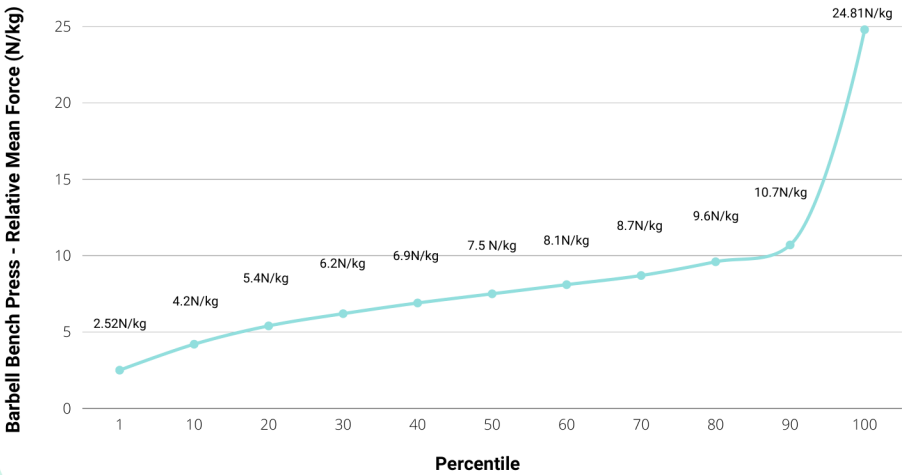
BARBELL BENCH PRESS STRENGTH

Relative Mean Force	
1st-10th Percentile	2.52-4.2 N/kg
10th-30th Percentile	4.2-6.2 N/kg
30th-50th Percentile	6.2-7.5 N/kg
50th-70th Percentile	7.5-8.7 N/kg
70th-90th Percentile	8.7-10.7 N/kg
90th-100th Percentile	10.7-24.81 N/kg

BARBELL SPLIT SQUAT - RELATIVE MEAN FORCE



BARBELL BENCH PRESS - RELATIVE MEAN FORCE



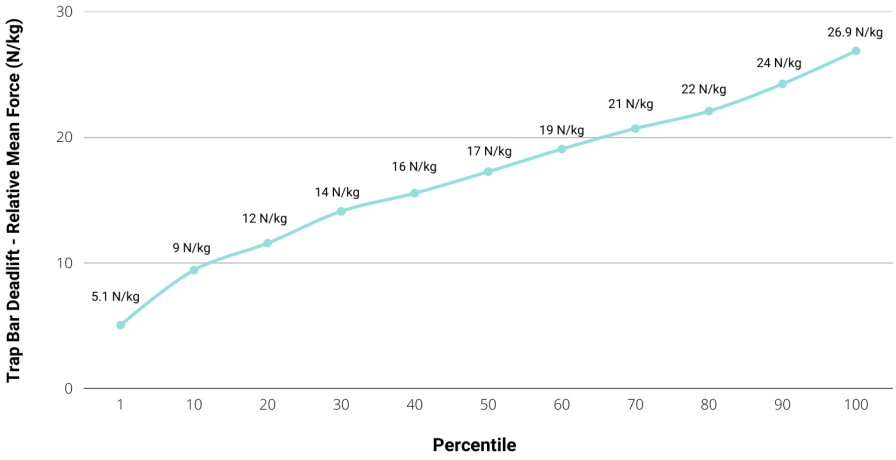
TRAP BAR DEADLIFT STRENGTH

Relative Mean Force (Metric)	
1st-10th Percentile	5 - 9 N/kg
10th-30th Percentile	9 - 14 N/kg
30th-50th Percentile	14 - 17 N/kg
50th-70th Percentile	17 - 21 N/kg
70th-90th Percentile	21 - 24 N/kg
90th-100th Percentile	24 - 27 N/kg

NEWTONS PER KILO AS A STRENGTH METRIC

The metric provided for all strength testing exercises within this eBook is Relative Mean Force (N/kg). This means it is providing the measure of Mean Force (N) for the set, but also taking the athletes bodyweight into account. By providing the metric in relative terms, it allows for more meaningful comparisons of interperson scores. In other words, it allows for fairer and more standardized comparisons of strength levels between individuals. This is particularly pertinent to these data sets, as the normative data is taken from thousands of Output users, representing a broad spectrum of individuals in terms of age, sports disciplines, geographic locations, and athletic abilities.

TRAP BAR DEADLIFT - RELATIVE MEAN FORCE



POWER TESTING

When we think of "power" we often think of explosive dynamic movements. In this context, what we are often actually referring to is the rate of force development in reference to our bodyweight, or our body weight relative to some external load. During absolute strength testing, we can in fact estimate power (in Watts). The most common method for measuring lower body power though (particularly in the published literature) is jump performance. Other test metrics such as flight time, ground contact time (in hop or multiple jump tests) or reactive strength index can give us useful data that can also be used to understand an athlete's power production strategy and potential.

The countermovement jump (CMJ) is the most widely used test in the literature and is one of the more standardized protocol movements to test power output. It has a much greater ability to predict power output across different studies (assuming the method for actually measuring jump height is accurate).

COUNTERMOVEMENT JUMP HEIGHT

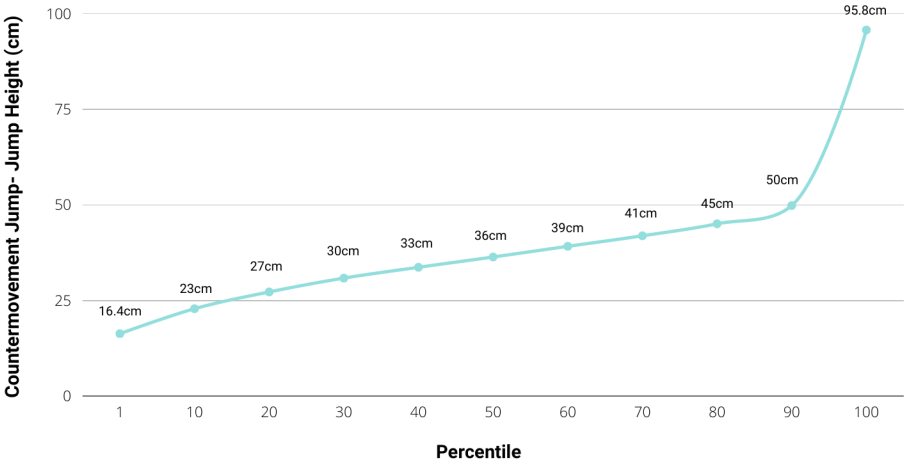
Jump Height (Metric)	
1st-10th Percentile	16 - 23cm
10th-30th Percentile	23 - 30cm
30th-50th Percentile	30 - 36cm
50th-70th Percentile	36 - 41cm
70th-90th Percentile	41- 50cm
90th-100th Percentile	50 - 96cm

COUNTERMOVEMENT JUMP HEIGHT

Jump Height (Imperial)	
1st-10th Percentile	6.4 - 9 in
10th-30th Percentile	9 - 12 in
30th-50th Percentile	12 - 14 in
50th-70th Percentile	14 - 17 in
70th-90th Percentile	17 - 20 in
90th-100th Percentile	20 - 37.7 in

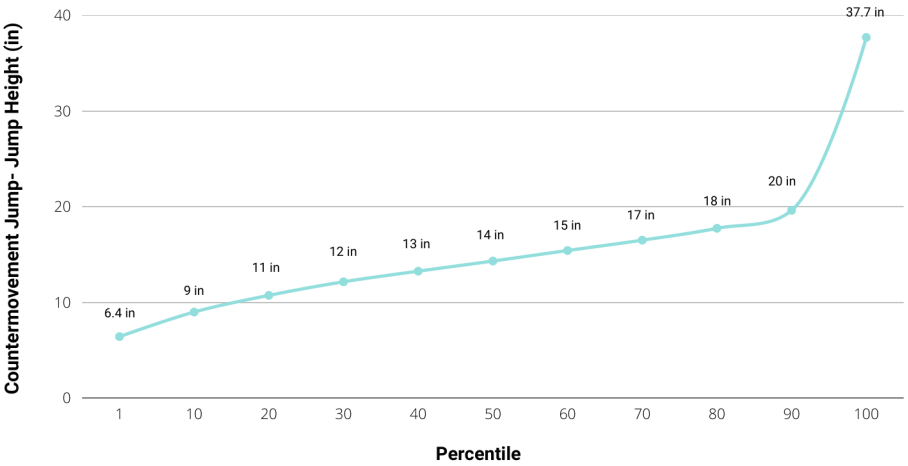
METRIC (CM)

COUNTERMOVEMENT JUMP- JUMP HEIGHT



IMPERIAL (IN)

COUNTERMOVEMENT JUMP- JUMP HEIGHT



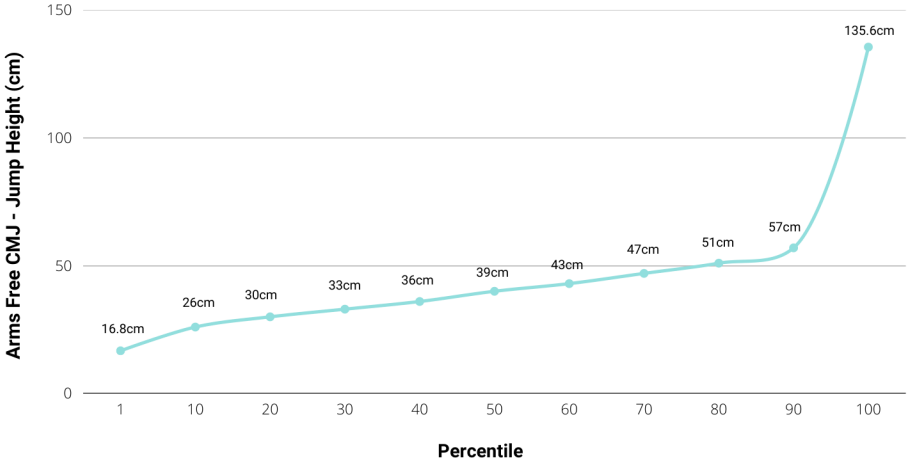
ARMS FREE COUNTERMOVEMENT JUMP HEIGHT

Jump Height (Metric)	
1st-10th Percentile	17 - 26cm
11th-30th Percentile	26 - 33cm
30th-50th Percentile	33 - 40cm
50th-70th Percentile	40 - 47cm
70th-90th Percentile	47 - 57cm
90th-100th Percentile	57 - 136cm

Jump Height (Imperial)	
1st-10th Percentile	6.6 - 10 in
10th-30th Percentile	10 - 13 in
30th-50th Percentile	13 - 16 in
50th-70th Percentile	16 - 19 in
70th-90th Percentile	19 - 22 in
90th-100th Percentile	22 - 53.4 in

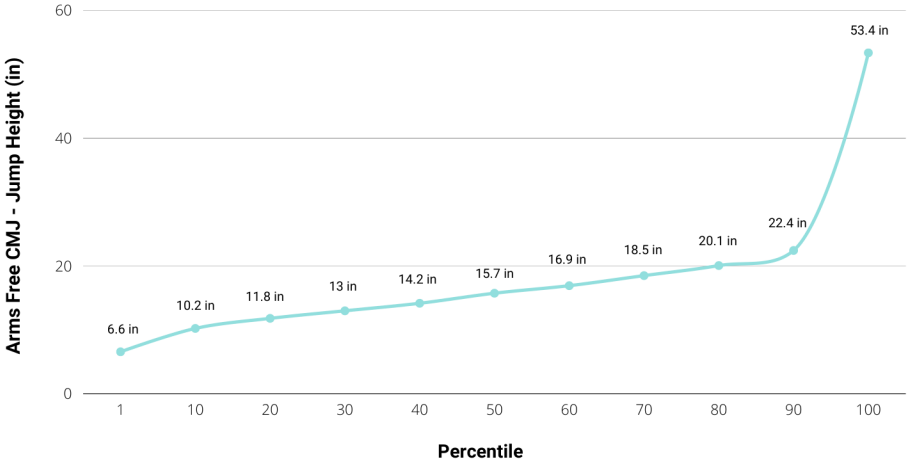
METRIC (CM)

ARMS FREE CMJ - JUMP HEIGHT



IMPERIAL (IN)

ARMS FREE CMJ - JUMP HEIGHT



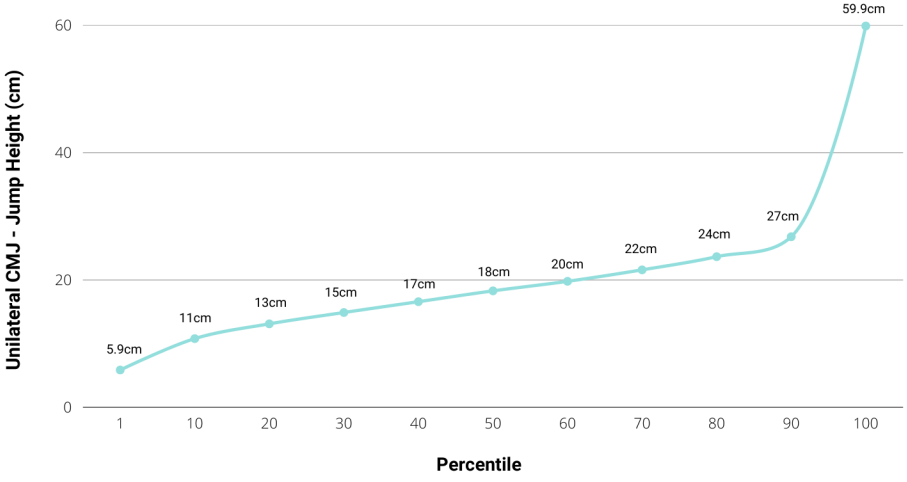
UNILATERAL COUNTERMOVEMENT JUMP HEIGHT

Jump Height (Metric)	
1st-10th Percentile	6 - 11cm
11th-30th Percentile	11 - 15cm
30th-50th Percentile	15 - 18cm
50th-70th Percentile	19 - 22cm
70th-90th Percentile	22 - 27cm
90th-100th Percentile	27 - 60cm

Jump Height (Imperial)	
1st-10th Percentile	2.3 - 4 in
10th-30th Percentile	4 - 6 in
30th-50th Percentile	6 - 7 in
50th-70th Percentile	7 - 9 in
70th-90th Percentile	9 - 11 in
90th-100th Percentile	11 - 23.6 in

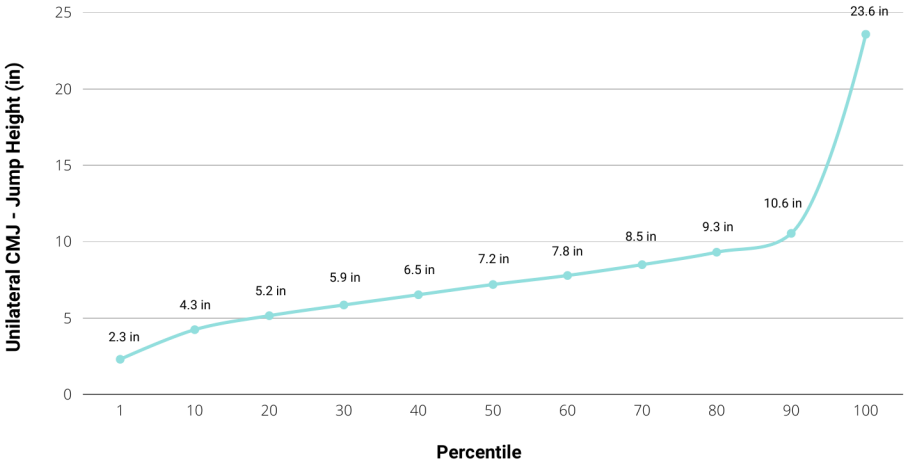
METRIC (CM)

UNILATERAL CMJ - JUMP HEIGHT



IMPERIAL (IN)

UNILATERAL CMJ - JUMP HEIGHT



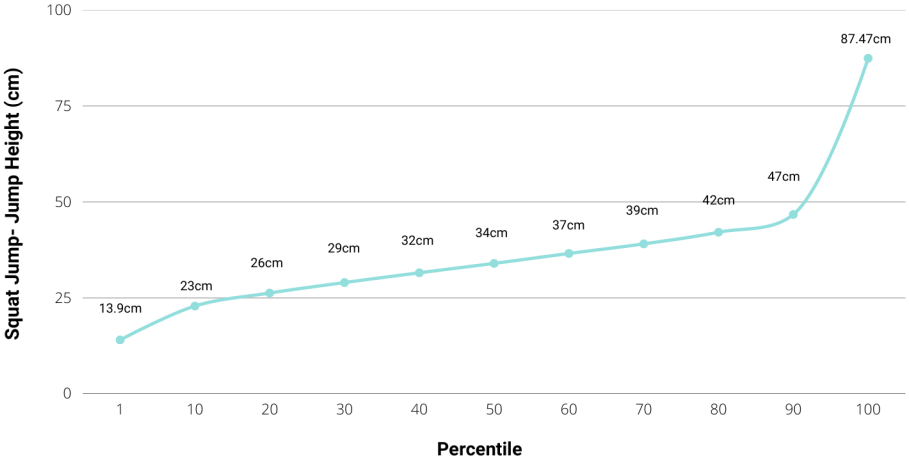
SQUAT JUMP HEIGHT

Jump Height (Metric)	
1st-10th Percentile	13.9 - 23cm
11th-30th Percentile	23 - 29cm
30th-50th Percentile	29 - 34cm
50th-70th Percentile	34 - 39cm
70th-90th Percentile	39- 47cm
90th-100th Percentile	47 - 87.5cm

Jump Height (Imperial)	
1st-10th Percentile	5.5-9 in
10th-30th Percentile	9 - 11.4 in
30th-50th Percentile	11.4 - 13.4 in
50th-70th Percentile	13.4 - 15.3 in
70th-90th Percentile	15.3 - 18.5 in
90th-100th Percentile	18.5 - 34.4 in

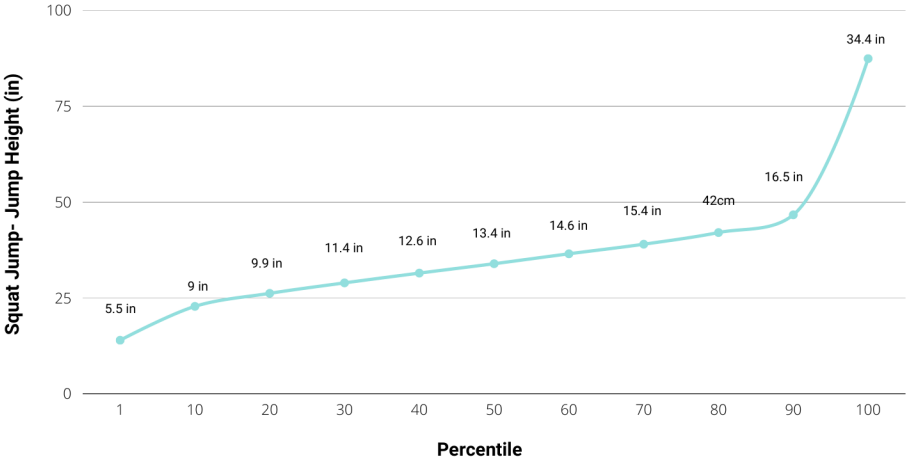
METRIC (CM)

SQUAT JUMP - JUMP HEIGHT



IMPERIAL (IN)

SQUAT JUMP - JUMP HEIGHT



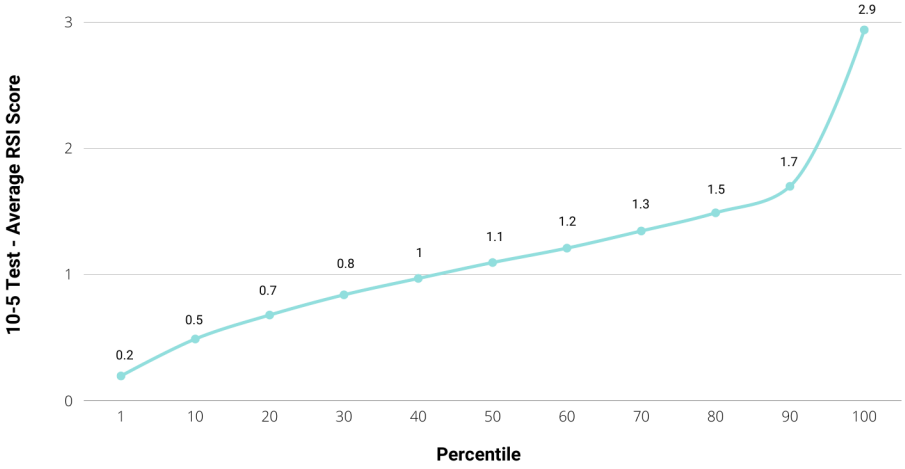
RSI TESTING

RSI, or reactive strength index, is a valuable tool in quantifying an athlete's fast stretch-shortening cycle, which is critical for explosive movements such as jumping and sprinting. By measuring an athlete's RSI, coaches and trainers can identify if the athlete has enough general fitness to perform specific fitness activities, such as high-intensity plyometric training. Additionally, RSI can be used to rank athletes in a particular sport by traits that may determine sporting success, such as the ability to generate maximal force and power. Repeated jump variations, such as the 10-5 Test, can also be used to measure the determinants of performance and target specific areas for improvement, while drop-jump variations can be used to monitor an athlete's progress over time as a response to interventions aimed at improving their reactive strength. Overall, the use of normative data in conjunction with these tests can provide valuable insights into the make-up of elite athletes and the determinants of their success.

10-5 TEST

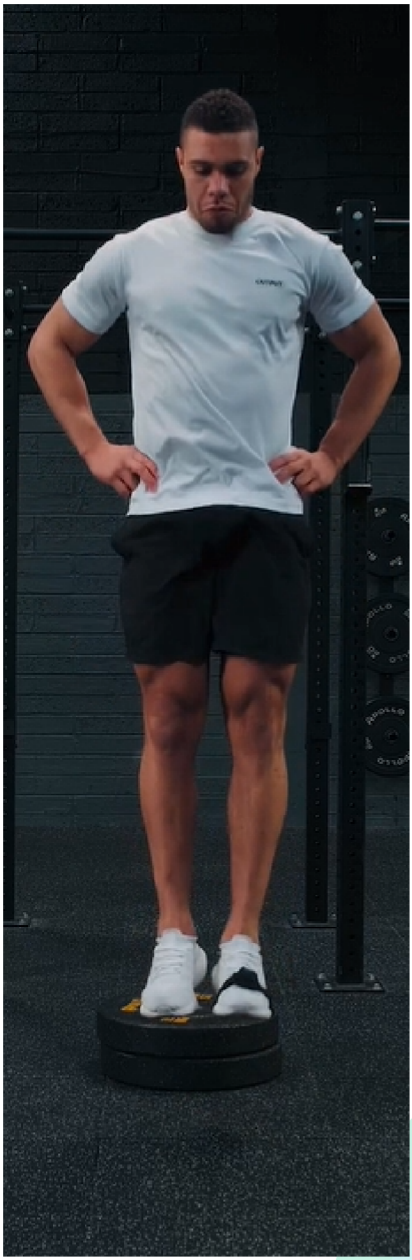
RSI Score	
1st-10th Percentile	0.2 - 0.5
11th-30th Percentile	0.5 - 0.8
30th-50th Percentile	0.8 - 1.1
50th-70th Percentile	1.1 - 1.3
70th-90th Percentile	1.3 - 1.7
90th-100th Percentile	1.7 - 2.9

10-5 TEST - AVERAGE RSI SCORE

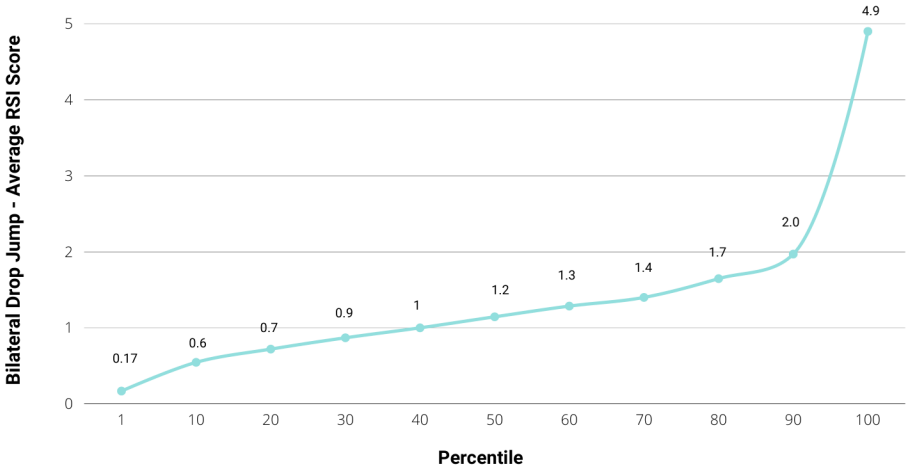


BILATERAL DROP JUMP

RSI Score	
1st-10th Percentile	0.17 - 0.6
10th-30th Percentile	0.6 - 0.9
30th-50th Percentile	0.9 - 1.2
50th-70th Percentile	1.2 - 1.4
70th-90th Percentile	1.4 - 2.0
90th-100th Percentile	2.0 - 4.9



BILATERAL DROP JUMP - AVERAGE RSI SCORE



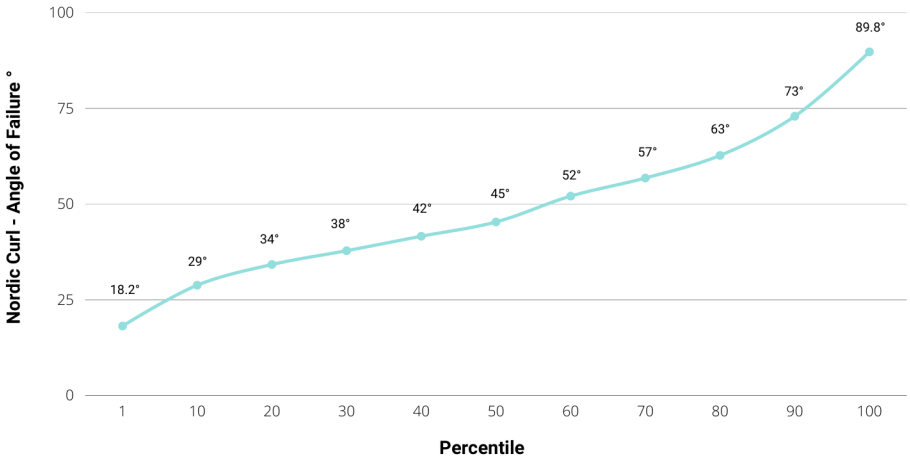
NORDICS TESTING

Nordic hamstring curls are a popular exercise used to strengthen the hamstring muscles, which are important for sprinting and jumping activities. In addition to their effectiveness in improving performance, Nordic hamstring curls are also valuable for assessing an athlete's hamstring strength and endurance. By measuring the kinematics of the exercise, including the angle of failure and rep duration, coaches and trainers can identify areas of weakness and develop targeted interventions to improve performance. For example, an athlete who experiences early fatigue or fails to maintain proper form during the exercise may benefit from additional strength training exercises or modifications to their training program. Additionally, tracking the angle of failure and rep duration over time can provide valuable information on an athlete's progress and help to identify when modifications to their training program may be necessary.

NORDIC HAMSTRING CURL

Angle of Failure	
1st-10th Percentile	18° - 29°
11th-30th Percentile	29° - 38°
30th-50th Percentile	38° - 45°
50th-70th Percentile	45° - 57°
70th-90th Percentile	57° - 73°
90th-100th Percentile	73° - 90°

NORDIC CURL - ANGLE OF FAILURE



CHOOSING THE MOST APPROPRIATE TEST

Generally speaking, the higher the level of the athlete, the more specific the testing protocol needs to be. For example, in some situations, a simple shuttle run 'bleep test' might be a useful measure of improved aerobic fitness. But at the elite level, an understanding of the mechanisms under which this improvement has taken place needs to be determined to guide future adaptation specific programming. Has the improvement come from improved aerobic fitness, or is it a learning effect, change in body mass or some other variables that have changed which has led to a change in score?

GOAL OUTCOME

To put it simply, does the test actually measure what we want to measure and does this information direct our decision making with an athlete. If not, then why are we doing it?

ACCURACY

If we are going to make training decisions based on scores from the fitness test, we should understand how well informed those decisions are likely to be. This doesn't mean that all of our fitness tests have to be incredibly accurate, but the measurements we obtain should at least give us enough confidence that the decisions we are making are sufficiently supported. This might mean that we have to combine several less accurate tests in order to make effective decisions. This is likely to be governed largely by the other "considerations", especially time and resources when working with large groups of athletes.

SPORTING DEMANDS

Working with an individual is going to give you more time to test than in a team setting (although this might not always be the case depending on the level of support, budget and importance a coach, manager or performance director places on fitness tests). Therefore, we need to understand how long a test takes to perform, and if it is a viable option for multiple athletes. There might be a trade off between time and accuracy in some situations that as coaches we have to 'absorb' into our thinking.

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