Reliability and Accuracy

A range of beep tests are available, and these negate the need for athletes to self-pace. Although the 20-m shuttle run test is arguably the most renowned beep test aimed at predicting aerobic capacity, a soccer-specific 20-m shuttle run test, the Yo-Yo intermittent test, is often advised for soccer and other ball games.
This test also consists of a 20-m shuttle run, but after 2 lengths (out and back), the subjects have a recovery period. There are 2 versions of the Yo-Yo intermittent test. The Yo-Yo intermittent endurance (YYIE) test allows a recovery period of 5 seconds and the Yo-Yo intermittent recovery (YYIR) test allows 10 seconds.
Two difficulty levels for each test have been developed. The Yo-Yo tests are designed to assess the athletes' capacity to exercise intensely and intermittently over a long period. The tests stress the phosphagen and glycolytic energy systems, thus providing an appropriate representation of most ball games.

YYIE tests are more aerobic related, whereas YYIR tests are aerobic-anaerobic related, and thus, the latter is most appropriate. Furthermore, younger athletes and those with a lower training age would be recommended to undergo the YYIE level 1 test and progress through to level 2. Elite athletes, with a high training age, are recommended to be tested with the YYIR level 2 (*Turner et al., 2011*)

Validity

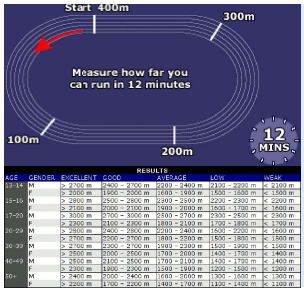
Sport scientists and fitness professionals should consider whether the quality that a test measures is related to performance in this sport the athlete or client participates and whether the test is sufficiently sensitive to change (i.e. can it detect changes due to training, fatigue or development (adaptation).

⇒ The test should have a known, sport-relevant outcome measure, and a low enough typical error so that test will detect changes attributed to training and other factors.

For example a testing concept may largely satisfy **ecological validity**, in that the test greatly resembles and reflects the demands of the sport (e.g. soccer-specific test). However, the test may have a very high variation (i.e. low reliability), making it difficult for this test to detect changes.

Conversely, a test protocol may not be directly relate to performance outcome (in predicting a particular performance outcome in a sport), but does measure the intended quality, is relevant to the sport and is sensitive to change in training.

Reliability and Accuracy



RESULTS

AGE	GENDER	EXCELLENT	GOOD	AVERAGE	LOW	WEAK
13-14	M	> 2700 m	2400 – 2700 m	2200 – 2400 m	2100 – 2200 m	< 2100 m
	F	> 2500 m	1900 – 2500 m	1600 – 1900 m	1500 – 1600 m	< 1500 m
15-16	M	> 2800 m	2500 – 2800 m	2300 – 2500 m	2200 – 2300 m	< 2200 m
	F	> 2700 m	2500 – 2700 m	1900 – 2500 m	1600 – 1700 m	< 1600 m
17-20	M	> 3000 m	2700 – 3000 m	2500 – 2700 m	2300 – 2500 m	< 2300 m
	F	> 2700 m	2500 – 2700 m	1900 – 2500 m	1700 – 1800 m	< 1700 m
21-29	M	> 2800 m	2400 – 2800 m	2200 – 2400 m	1600 – 2200 m	< 1600 m
	F	> 2700 m	2500 – 2700 m	1800 – 2500 m	1600 – 1800 m	< 1600 m
30-39	M	> 2700 m	2200 – 2700 m	1900 – 2200 m	1500 – 1900 m	< 1500 m
	F	> 2500 m	2000 – 2500 m	1700 – 2000 m	1400 – 1700 m	< 1400 m
40-49	M	> 2500 m	2100 – 2500 m	1700 – 2100 m	1400 – 1700 m	< 1400 m
	F	> 2200 m	1900 – 2200 m	1500 – 1900 m	1200 – 1500 m	< 1200 m
50+	M	> 2400 m	2000 – 2400 m	1600 – 2000 m	1300 – 1500 m	< 1300 m
	F	> 2200 m	1700 – 2200 m	1400 – 1700 m	1100 – 1400 m	< 1100 m

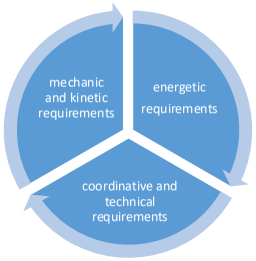
Several field tests for aerobic capacity have been developed that require the subject to either cover a maximal distance in a set time or a set distance in the fastest time possible.
These tests are maximal from the beginning and require **a high degree of motivation and knowledge of pacing to achieve a reliable result.**
Due to the significance of pacing skills, tests depending on this ability, such as the 2000m run and the 12-minute run, may not be the most appropriate tests for unexperienced athletes because these possibly require lengthy **familiarization** periods due to an inherent **learning effect**.

Psychological factors, such as lack of motivation or anxiety can contribute to low exercise performance.

Specificity

Needs analysis – triangulation of sport requirements

Assessment should be preceded by a full needs analysis,
which in turn should be based on a triangulation of the requirements
(structure, requirement profile of the type or discipline of sport)



Specificity
Assessment should mimic the form of exercise under scrutiny.

- Muscle groups, muscular activity, types of activity, range of motion
- Intensity and duration of activity
- Energy systems recruited
- Resistive forces encountered

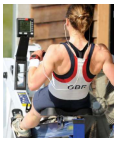
To be effective, assessments should be specific and valid and the resulting measure should be reproducible and sensitive to changes in performance

Validity and Releability

Both age and sex can affect the validity and reliability of a test.
A 2400 meters run may be a valid and reliable field test
for collage-aged women and men but may not be appropriate for preadolescents
because of their lack of experience and interest in sustained running.

Specificity

Activity-specific ergometers might have to be designed to satisfy specificity requirements.



Field-based as opposed to laboratory-based procedures might provide improved characterisation of patterns of motion.

Anthropometry

Anthropometry is the measurement of human body dimension such as lengths, breadths, girths, and skinfolds using surface landmarks for reference. Like other areas of science the procedures and processes depend upon adherence to the particular rules of measurement as determined by national and international standards bodies.
In sport science standards from the International Society for the Advancement of Kinanthropometry (ISAK) are applied. *It should be recognized, however, that other groups exist that also have their own standards. These include the World Health Organization, International Organization for Standardization (ISO), and those used in very large surveys such as the National Health Examination surveys (NHANES)*

ISAK – Accreditation a useful additional qualification for Sport Scientists.

The International Society for the Advancement of Kinanthropometry (ISAK) embraces and regulates the practice of anthropometryat the international level establishirg the International Anthropometric Accreditation Scheme (IAAS). The accreditation scheme is based on the concept of a four-level hierarchy.
A key element in it is the objective maintenance of quality assurance by requiring that all levels have to meet initial technical error of measurement (TEM).

https://www.isak.global/

http://www.goldstandardsystems.com/courses/

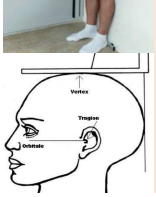
Measuring body mass correctly

- Body weight and mass represent different kinetic variables.
- In anthropometrics body mass is the amount of matter!
- Body mass is expressed in kilograms (kg).
- Weight on the other hand is a force measurement – that is the product of mass and acceleration due to gravity ($9.81\ m \cdot s^{-2}$) depending on the effects of gravity.
- Body weight is expressed in Newtons (N).

- Ask the subject to step on the scale with minimal clothing.
- Body mass changes at various times of the day as a result of meal and beverage consumption, urination, defecation, and dehydration, or water loss. Therefore a standard time (early in the morning) is recommended.
- Ask the subject to stand on the centre of the scales without support, with their arms loosely by their sides and with their weight distributed evenly on both feet.
- The numbers will change, and then stop. Once the numbers have stopped, take the reading to the nearest 0.1 kg.

Every scale has an allowable tolerance of error. If you're looking for a new scale and accuracy is extremely important to you, then be sure to research the allowable tolerance of error for the brand you chose.
However, the most dominant variable in skewing the results of obtaining a proper scale reading is not the make, model, or the internal mechanics of the device, but how the subject steps on the device. If he or she tends to lean, placing more weight one foot over the other for example, you'll have more variance in your scale readings.
It also has to be ensured that the scale is placed on a flat and hard surface to minimize measurement error.

Measuring height correctly (adapted from the ISAK manual)



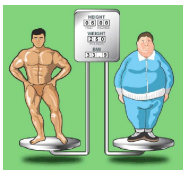
Height should be measured with a stadiometer (a vertical ruler mounted on the wall, with a wide horizontal head board). Although many commercial scales have an attached vertical ruler, these devices are frequently less reliable. It should be noted that height can change throughout the day (based on spinal loading and vertebral disc volume). Subjects are tallest in the morning and be as much as one centimeter shorter by the day's end.

Method:
- Ask subjects to remove shoes (should be clear but experience tells this is not always the case).
- The subject stands as straight as possible with heels together touching the wall or stadiometer.
- Their buttocks and upper part of their back should also be touching the wall or stadiometer upright.
- The respondent's head should be in the Frankfort plane. This is achieved when the lower edge of the eye socket (the Orbitale) is horizontal with the Tragion looking straight ahead (see figure).
- The vertical ruler (vertex) will be the highest point on their head. If their head is not aligned properly, (and for most respondents it probably won't be), ask them to raise or lower their chin until it is in the Frankfort Plane.
- When you are happy that the respondent is in the correct position, ask them to take a deep breath and hold it.
- Lower the vertex until it is in contact with the head. Compress the hair if needed. Make sure you don't bend the headboard from the horizontal, nor move the respondent's head.
- Hold the headboard firmly at its final position and take the reading to the nearest 0.1 cm.
- Each subject should be measured twice but this measures should not differ by more than 0.4 cm – if they do a third measurement should be taken, and the median of all three measurements calculated.

Note: If the respondent is as tall as you, or taller, you will need to stand on a box to judge when the head is in the right position and to take the reading, as both these actions need your eyes to be in the same horizontal plane as the object you are looking at.

Body Composition Measurement

There are no truly direct methods for measuring body composition.
⇒ Most body composition measurements involve indirect assessment, or estimation



Body Mass Index (BMI): Is used to assess body mass relative to height

BMI (kg / m^{-2}) = body mass (kg) / height squared (m^2)

Reference values for adults

Weight Classificatcn	BMI (kg /m^{-2})
Underweight	< 18.5
Normal Weight	18.5-24.9
Overweight	25.0-29.9
Obese Class 1	30.0-34.9
Obese Class 2	35.0-39.9
Obese Class 3	> 40.0

The body mass index (BMI), a weight-for–height ratio is widely used in epidemiological studies. Obesity standards based on BMI have been developed and a high BMI is associated with increased risk of chronic disease.
Ironically, BMI is a poor predictor of percent body fat and often misclassifies individuals as obese if they have above average muscularity and skeletal mass rather than excess fat.
In children and the elderly, for whom the ratio of muscle and bone to height is changing, BMI is especially misleading.
Although BMI may be useful if no other method is available, the results must be interpreted cautiously and a follow-up examination a more accurate method should be sought for persons for whom interventions are considered.

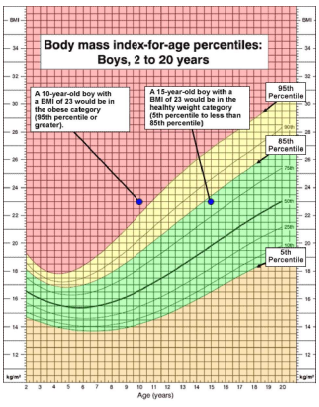
A study that examined body composition NFL players showed that based on BMI all players were classified overweight, obese or very obese despite having body fat percentages of 6.3-18.5% (Kreamer et al., 2005).

Measuring sitting height (Protocol by Simmons, 2000)

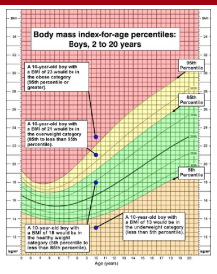
- Subjects sits on the base of the stadiometer (wall-mounted system preferable) with knees slightly bent. hands rest on knees.
- The buttocks and shoulders rest lightly against the stadiometer, which is positioned vertically behind the subject.
- Ensure that there is no gab between buttocks and the stadiometer.
- The tester applies gentle upward traction to the skull behind the ears (see figure) to ensure the trunk is fully stretched.
- The subject's head should be in the Frankfort plane (see previous figure).
- When you are happy that the respondent is in the correct position, ask them to take a deep breath and hold it.
- Lower the vertex until it is in contact with the head. Compress the hair if needed.
- Make sure you don't bend the headboard from the horizontal, nor move the respondent's head.
- Hold the headboard firmly at its final position and take the reading to the nearest 0.1 cm.
- Each subject should be measured twice but this measures should not differ by more than 0.4 cm – if they do a third measurement should be taken, and the median of all three measurements calculated.
- Once sitting height is assessed, it can be subtracted from the stature score, in order to derive leg length height.

The usual method of judging body proportions of children is to calculate the ratio between sitting height and height (SH/H) or sitting height and leg length (SH/LL) and compare this with age references (legs and trunk have different growth rates – long bones of the leg expierence peak growth before the short bones of the trunk) (Mirwald et al., 2002).

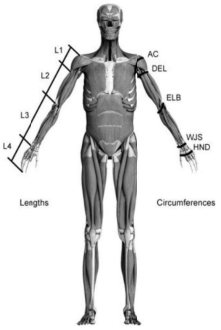
Body mass index (BMI) provide sufficient information to enable classification of overweight or obesity in children and adolescent only when growth centile charts and ratios are employed



Weight status category for the calculated BMI-for-age percentile in childhood and adolescence	
Weight Status Category	**Percentile Range**
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile



Anthropometric circumference measurements



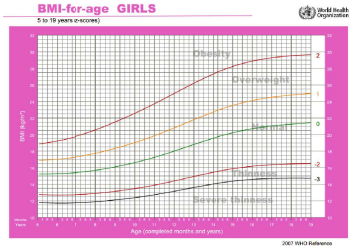
Girths are circumference measures at standard anatomical sites around the body, measured with a tape measure. Girth measurements can be used in determining body size and composition, and to monitor changes in these parameters.
Equipment required: flexible metal tape measure and pen for marking the skin. If a plastic or cloth tape is used, it should be checked regularly against a metal tape as others may stretch over time.
Procedure: First mark the sites to be measured. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal.
validity: Girth measurements are sometimes used as a measure of body fat, but is not a valid predictor of this. They are however a good measure of proportionality.
advantages: low costs involved in the testing procedure, and for many sites the measurement can be self administered.
other comments: Girth measurements combined with skinfold measurements can give a clearer picture of changes in muscle and fat compositions and distribution. A common girth measure is the waist measure, used in determining waist to hip ratio (WHR).

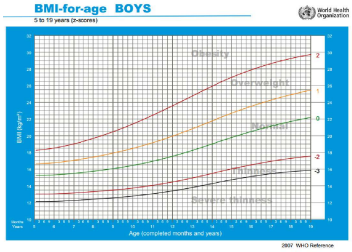
Monitoring the growth of adolescents and identifying those at risk of over-fatness or under-fatness, respectively

BMI-for-age (5-19 years)

Interpretation of cut-offs

Overweight: >+1SD (equivalent to BMI 25 kg/m² at 19 years)
Obesity: >+2SD (equivalent to BMI 30 kg/m² at 19 years)
Thinness: <-2sd>
Severe thinness: <>





Waist – to – Hip Ratio (WHR):

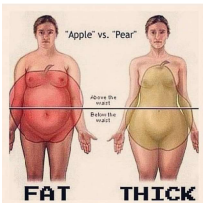
Compares the circumferences of the waist to that of the hip.

WHR = waist circumference (cm) / hip circumference (cm)

Indicator of body fat distribution (apple vs. pear) and a indicator of general health.

A high WHR has been identified as a risk factor for disease.

A better predictor for mortality than BMI.



Waist circumference measured around the smallest area of the waist 2.5 cm above the navel.

Hip circumference measured around the largest area of the buttocks.

Monitoring the growth of children identifying those at risk of over-fatness or under-fatness, respectively

For children under 5 years of age:

•Overweight is weight-for-height greater than 2 standard deviations above WHO Child Growth Standards median; and
•Obesity is weight-for-height greater than 3 standard deviations above the WHO Child Growth Standards median.