

Muscle Performance

What is it?

Muscle performance consists of muscular strength, muscular endurance, muscular power, and anaerobic power, and is an integral portion of both health- and sport-related fitness. Muscular strength is defined as the maximal force that can be generated by a muscle group. Muscular endurance is the ability of a muscle group to repeatedly perform muscle contractions over a period of time that is sufficient to cause muscular fatigue. The ability to produce maximal force at a rapid velocity of movement underlies both muscular and anaerobic power.



Why is it important?

Enhanced muscular strength, endurance and power can lead to improvements in the areas of sport and exercise performance, injury prevention, body composition, quality of life, self-image, lifetime muscle and bone health, and metabolic and heart health. More importantly, according to a growing body of evidence, greater muscular strength and muscle mass is associated with lower rates of death from all causes (up to 1.5 times lower), including cancer and cardiovascular disease. In fact, the link between strength and death rate is independent of age, physical activity, smoking, alcohol intake, body composition, and family history of cardiovascular disease. Indeed, muscular strength and endurance add to the protective effect of cardiorespiratory fitness against the risk of premature death in both men and women, young and old.

How is it assessed?

Because of the specificity of muscle performance, there is no single test for total body muscle performance but instead individual measures as described below:

1. Upper and lower body muscular strength (1-RM) and endurance (85% of 1-RM to fatigue)

Muscular strength is assessed by measuring the maximum amount of weight a person can lift one time.

This single maximum effort is called the one-repetition maximum (1-RM). Upper body strength is measured via the seated chest press machine and lower body strength via the seated leg press machine.

Muscular endurance of these two tests is assessed as a percent of 1-RM (85%) to fatigue; that is, the maximum number of repetitions successfully completed through its full range-of-motion. The greater the endurance, the greater the amount of repetitions performed.

2. Hand grip dynamometer strength

Hand grip strength can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer. The simple method of handgrip dynamometry has been found to reveal more than an individual's handgrip strength – it is related to and predictive of other health conditions. For example: (i) normal hand grip strength is positively related to normal bone mineral density in postmenopausal women, (ii) longitudinal studies suggest that poor grip strength is predictive of increased mortality from cardiovascular disease and cancer in men, even when factors of muscle mass and body mass index are adjusted for, and (iii) grip strength is negatively associated with physical frailty even when the effects of body mass index and arm muscle circumference are removed.

3. Lower-body power (vertical jump test via an electronic jump mat)

The vertical jump test is an objective functional field measurement used to estimate explosive power and anaerobic power and capacity in the extensor muscles of the lower extremities. The ability to perform a maximal vertical jump is considered to be an integral component of an athlete's successful performance. The test measures the highest distance jumped from a semi-crouched position based on flight time using a validated electronic jump mat. From here one's inferred "explosive" peak anaerobic power output can be calculated through vertical jump height and body mass.

4. Anaerobic power and capacity (Wingate Anaerobic Test (WAnT))

One of the most predominant and definitive lab-based tests to determine anaerobic power and capacity is the WAnT. The test consists of a subject initially pedaling the electronically braked cycle ergometer at a fixed speed against no resistance. The resistance (determined using 7.5% of the subject's body mass) is then applied and the subject pedals at a maximal level ("all out") for a period of 30 seconds. The following parameters can be determined: (i) Peak power output: the highest power output, observed during the first

5- second exercise interval , which indicates the energy-generating capacity of the immediate energy systems, (ii) Anaerobic capacity: Total work accomplished over 30 seconds, (iii) Anaerobic fatigue: Percentage decline in power output during the test.

What to expect during the assessment:

1. You will be instructed in the appropriate technique and allowed several 'practice' trials beforehand; however, there is always a small risk of injury when attempting maximal lifts, jumps and cycle sprint tests.
2. For all tests you will be asked to give a full-out effort.

Participant preparation:

Test validity and data accuracy are greatly improved by adhering to the following guidelines prior to your assessment. Your test(s) will be given on the assumption that you have followed these recommendations:

1. Refrain from ingesting heavy meals, alcohol, caffeine and tobacco products within 5 hours of testing
2. You should be well rested for the test: avoid significant exertion or exercise 24 hours prior to testing and get a good night's sleep
3. Drink ample fluids over the 24-hour period preceding the assessment to ensure normal hydration
4. Clothing should permit freedom of movement and be appropriate for exercise