

Important Concepts of Physical Activity and Physical Fitness

Chapter objectives:

- To introduce important concepts and terms regarding physical activity and physical fitness.
- To describe different methods for assessing intensity of physical activity.
- To describe the four most important components of physical activity for young people.
- To describe the difference between health-related and athletic performance physical fitness.

1. Definitions

Physical activity : is defined as body movement produced by muscle action that increases energy expenditure. It is an encompassing term that includes physical “exercise”.

Physical exercise: is a more specific term and implies planned, structured, repetitive and purposeful physical activity, often with the goal of improving or maintaining one’s physical fitness. For example, gardening or walking up stairs in one’s home may not be classed as structured “exercise”, but it is certainly physical activity.

Physical fitness: is a physiological state of well-being that provides the foundation for the tasks of daily living, a degree of protection against chronic disease and a basis for participation in sport. In essence, physical fitness describes a set of attributes relating to how well one performs physical activity.

Health: is a reflection of one’s overall physical, mental and social well-being. It is much more than simply an absence of disease. Health, as we all know, is a characteristic that is not stable in time and can vary along a continuum from near death (ill health) to optimal physiologic functioning (high level wellness) (see Figure 1).

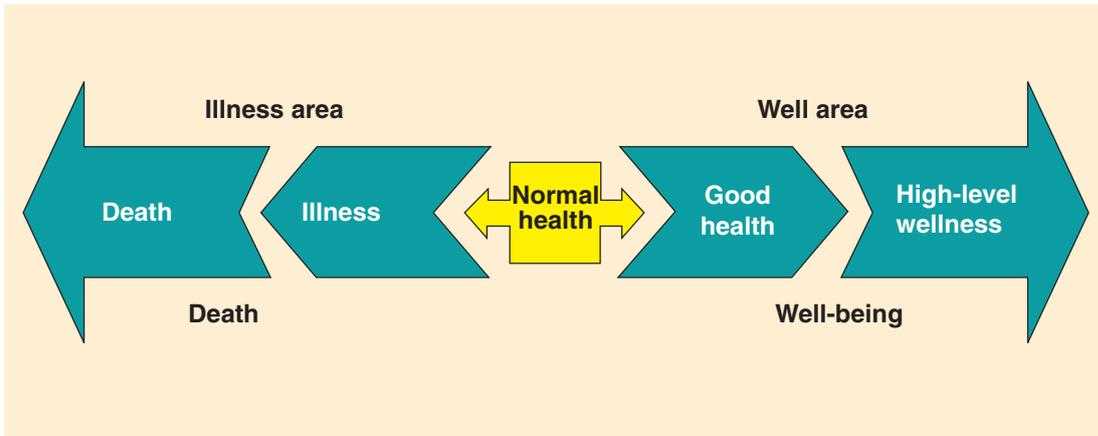


Figure 1. The health and wellness continuum.

2. Important descriptors of physical activity and exercise

The “dose” of physical activity that a person receives is dependent upon the factors contained within the “*F.I.T.T.*” principle:

Frequency (*how often*): the amount of times that one engages in physical activity (often expressed as number of times per week).

Intensity (*how hard*): how strenuous is the physical activity (often described as light, moderate or vigorous).

Time (*how long*) : the duration of the physical activity session.

Type: the specific mode of exercise in which one engages (eg. running, swimming, etc.).

These factors can be manipulated to vary the “dose” of physical activity. Often this dose is expressed in terms of energy expenditure (calories expended). One can appreciate that if physical activity is more intense, one can expend calories at a greater rate which may reduce the amount of time needed to burn a set amount of calories.

Other important training principles are:

Overload: refers to the load or amount of resistance for each exercise, providing a greater stress, or load, on the body than it is normally accustomed to in order to increase fitness.

Progression: is the way in which an individual should increase overload in order to stimulate continuous increases in fitness (often called progressive overload). It is a gradual increase in either frequency, intensity or time, or a combination of all three

components. Progression must be gradual to be safe. Progressing too quickly can lead to injury or unnecessary fatigue, both of which can be discouraging or prevent an individual from continuing to participate.

3. Clarification of moderate intensity physical activity

Of all the factors contained within the FITT principle, intensity is probably the most difficult to measure. The physical activity guidelines for both adults and young people (the latter are detailed later) make reference to the importance of exercise at least of moderate intensity. A person who is doing moderate intensity activity will usually feel:

- an increase in breathing rate, but conversation is still possible
- an increase in heart rate, to the point where it should be easily felt at the wrist, neck or chest,
- a feeling of increased warmth, possibly accompanied by sweating on hot or humid days

A bout of moderate intensity activity can be continued for many minutes and does not cause exhaustion or extreme fatigue in healthy individuals when continued for an extended period.

It is important to understand that moderate intensity is relative to each individual's fitness level. For example, a fitter individual would need to perform activity at a higher absolute intensity than an unfit individual in order to feel the similar sensations of increased breathing, heart rate and temperature that are characteristic of moderate intensity activity.

Below, various methods for assessing exercise intensity are discussed in further detail.

4. Further methods for gauging intensity of physical activity

There are numerous other ways of monitoring the intensity of physical activity. The most widely used are outlined below:

4.1. The talk test:

The talk test method of measuring intensity is simple:

- **Light intensity:** a person who is active at a *light* intensity level should be able to sing or carry on a normal conversation while doing the activity. An example of light activity would be easy walking or cleaning.

- **Moderate intensity:** one who is active at a *moderate* intensity level should be able to carry on a conversation but with some difficulty while engaging in the activity. An example would be brisk walking, biking, or dancing.
- **Vigorous intensity:** If a person becomes winded or too out of breath to carry on a conversation easily, the activity can be considered vigorous. Examples of *vigorous* activity would include jogging or running and strenuous sports such as basketball, swimming, handball, etc.)

4.2. Heart rate:

Heart rate can be measured easily either at the wrist (the radial pulse) or the neck (the carotid pulse) and should be converted into the number of beats per minute (bpm). One can measure heart rate for a full minute or one can measure for a shorter period of time (eg. 15, 20 or 30 seconds) and multiply by the relevant factor (4, 3 or 2 respectively) to convert to bpm.



Knowledge of one’s resting heart rate and maximal heart rate is needed to be able to gauge exercise intensity most effectively. Resting heart rate is best measured while an individual is truly resting, such as on awakening in the morning or after being seated quietly for a few minutes. Maximal heart rate is often roughly estimated using the simple equation “220 – age”. For example, if a child was 15 years old, their estimated maximal heart rate would be 220 – 15 = 205 bpm.

The best method to determine target heart rate ranges for monitoring intensity of physical activity is to use the technique known as the heart rate reserve (HRR) method, also known as the Karvonen method [8]. In this method, resting heart rate (RHR) is first subtracted from the maximal heart rate (MHR) to obtain HRR. For example, let us assume that the 15 year old child above had a resting heart rate of 80 bpm. The HRR of this individual is MHR (205) – RHR (80) = 125 bpm.

To calculate a heart rate range for practical purposes, one must first consult table 1 below to determine the relevant % values of HRR:

Table 1
Classification of physical activity intensity using % heart rate reserve and rating of perceived exertion.

Intensity descriptor	RELATIVE INTENSITY	
	% Heart rate reserve (%HRR)	Rating of perceived exertion (RPE)*
Very light	< 20	< 10
Light	20-39	10-11
Moderate	40-59	12-13
Vigorous	60-84	14-16
Very vigorous	>85	17-19

Adapted from [9].

* see section 4.3 below for an explanation of rating of perceived exertion.

We can see that moderate intensity corresponds to 40-59% of heart rate reserve = $50 (0.40 \times 125) - 74 (0.59 \times 125)$. We must now add the resting heart rate back onto each number to determine the final target heart rate range. Therefore, the corresponding heart rate range for our child for moderate intensity activity is **130** ($50 + 80$) to **154** ($74 + 80$) bpm.

For vigorous intensity exercise, the heart rate range for this child would be **155** to **185** using exactly the same procedure as above.

4.3. Rating of perceived exertion using a Borg scale:

Perceived exertion is how hard you feel that you are working based on the physical sensations you experience during exercise. An example of a Borg scale is shown below in Figure 2.

6	No exertion at all
7	
	Extremely light (7,5)
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Figure 2. The Borg Scale of Rating of Perceived Exertion.

While exercising, you should look at the rating scale expressions, appraise your feelings of exertion as honestly as possible and provide the appropriate number. This is your “rating of perceived exertion” or RPE.

As can be seen in Table 1 above, moderate intensity physical activity is represented by a RPE of between 12 to 13 on the Borg scale (around the description “somewhat hard”). Light and vigorous activities fall into the ranges of 10-11 and 14-16 respectively.

4.4. Metabolic equivalent (MET) level:

1 metabolic equivalent (1 MET) is the amount of energy (oxygen) your body uses as you sit quietly, for example while reading a book. Intensity may be described as a multiple of this value. The harder your body works during a physical activity, the higher the MET level at which you are working.

- Any activity that burns 3-6 METs is considered moderate intensity
- Any activity that burns >6 METs is considered vigorous intensity

One can consult standard tables that define physical activities and their MET levels to ascertain roughly the intensity of the activity concerned, such as table 2 below:

Table 2
Intensities and energy expenditure for common types of physical activity

Activity	Intensity	Intensity (METS)	Energy expenditure (kcal equivalent, for a person of 30kg doing the activity for 30 mins)
Ironing	Light	2.3	35
Cleaning & dusting	Light	2.5	37
Walking – strolling, 3-4 km/h	Light	2.5	37
Painting/decorating	Moderate	3.0	45
Walking – 4-6 km/h	Moderate	3.3	50
Hoovering	Moderate	3.5	53
Golf – walking, pulling clubs	Moderate	4.3	65
Badminton – social	Moderate	4.5	68
Tennis – doubles	Moderate	5.0	75
Walking – brisk, >6 km/h	Moderate	5.0	75
Mowing lawn – walking, using power mower	Moderate	5.5	83
Cycling – 16-19 km/h	Moderate	6.0	90
Aerobic dancing	Vigorous	6.5	93
Cycling – 19-22 km/h	Vigorous	8.0	120
Swimming – slow crawl, 45m per minute	Vigorous	8.0	120
Tennis – singles	Vigorous	8.0	120
Running – 9-10 km/h	Vigorous	10.0	150
Running – 10-12 km/h	Vigorous	11.5	173
Running – 12-14 km/h	Vigorous	13.5	203

Source: based on data from Ainsworth *et al.* [10].

5. Different components of physical activity

There are obviously many different types of physical activity that develop different aspects of physical fitness. The most important types of physical activity for health in children and adolescents are:

1. Activities involving cardiovascular (aerobic) work,
2. Activities involving strength and/or muscular endurance,
3. Activities involving flexibility, and
4. Activities involving coordination.

5.1. Cardiovascular (aerobic) activities:

Cardiovascular activities are also often called “cardio-respiratory” or “aerobic” activities because they require the body to transport oxygen using the heart and lungs. Cardiovascular endurance is the capacity of our body to perform tasks that require the

use of large muscle groups usually for relatively prolonged periods of time (several minutes or more). With repeated endurance exercise our hearts and lungs adapt to become more efficient at providing the working muscles with the oxygenated blood that they need to perform the task.

One can improve one's cardiovascular endurance using continuous activities such as walking, running, swimming, bicycling, paddling, dancing, *etc.*

When one performs these kinds of activities it is important to remember:

- That one must progress sensibly – if you have not done much of these kinds of activities before you must start gradually with relatively low intensity and duration and gradually build these up as you gain fitness.
- That the activity chosen should be fun and easily accessible – this will improve the likelihood that you will stay with the activity and practice it regularly. If you do not enjoy the activity, it requires a lot of expensive equipment or you must travel a long way to do it, you will be less likely to stick with it
- Safety issues – these include issues such as wearing the relevant safety equipment (*eg.* helmet when riding a bike). In addition, one must be wary of high (vigorous) intensity activities where it may be necessary for the child or adolescent concerned (if they have a medical condition) to consult a doctor or exercise specialist prior to participation.

5.2. Muscular strength and endurance activities:

Muscular strength is the capacity of muscle to generate tension and to overcome an opposing force. Muscle endurance is the capacity of a muscle to maintain its tension or its contractions for a prolonged period of time. These activities build and strengthen bones and muscles. We call upon muscle strength and endurance when we push, pull, lift or carry things like heavy shopping bags.

Muscular strength and endurance activities can be practiced:

- with one's own weight (rope skipping, climbing, push-ups, *etc.*)
- with the weight of a partner (wheelbarrow races, tug-of-war, wrestling with a friend, *etc.*)
- or with activities like throwing a ball, paddling, rowing, weight lifting in a gymnasium, carrying things, *etc.*

When one does muscular strength and endurance activities, one must bear in mind the following:

- That one must progress sensibly – if one is new to these kinds of activities one must start slowly and with lighter resistance to avoid excessive muscle soreness and injuries
- For strength activities it is not necessary to lift weights – there are plenty of activities that tax muscle strength without using weights. Examples include body weight activities such as push-ups, climbing, handstands, *etc.* Other very sim-

ple objects can also train muscle strength very well such as elastic tubing and bands, *etc.*

- Strength activities with excessive weight or resistance can be harmful during childhood as the body is developing and it is possible to damage growing cartilage and bones
- If one has any doubts, it is always a good idea to consult an expert such as a PE teacher, physical trainer, doctor, *etc.*

5.3. Flexibility activities:

Flexibility is the ability of joints to move through a full range of motion. Flexibility is specific to specific body parts and is a function of the type of joint(s) involved and the elasticity of the muscles and connective tissue (*eg.* tendons, ligaments) surrounding the joint(s). Flexibility is beneficial for all activities that involve bending, lunging, twisting, reaching and stretching.

Some activities that improve flexibility are: gentle stretching of muscles, sports such as gymnastics and karate, yoga, Pilates, and any muscle strength or endurance activities that work a muscle through a full range of motion.

When you do flexibility activities it is important to remember that:

- One must be patient. It takes time to see significant improvements in flexibility, often several weeks or sometimes months.
- One must never stretch to the point where you feel pain and movements should always be performed in a controlled manner without bouncing or jerkiness. You should NEVER push yourself to imitate someone else who is more flexible than yourself. This is asking for injury!
- You should stretch regularly (preferably several times a week or even daily). Reasons for this include the facts that you lose flexibility easily if you do not continue to work it, it assists in avoiding injury and also it tends to decrease as we get older.
- It is a good idea to start flexibility exercises at a young age (as that is when we are most flexible) and to continue them for one's lifetime
- It is best to perform stretching when muscles and joints are warm and more pliable. Therefore, good times to stretch include after a warm-up at the start of physical activity or after the physical activity is over as part of a cool-down

It is also important to know that flexibility is different between boys and girls (often superior in the latter) and also during the major growth phases of life it is common to see large decreases in flexibility as the bones often are growing faster than muscles and tendons.

5.4. Coordination activities:

Motor coordination is the capacity to use the brain and nervous system together with the locomotor system to develop smooth and precise movements.

Coordination activities include:

- Balancing activities involving the body, such as walking on a beam or balancing on one leg
- Rhythm activities, such as dancing to music
- Activities involving kinesthetic awareness and spatial coordination, such as learning how to perform a somersault or learning a new dance move
- Activities involving foot-eye coordination, eg. kicking or dribbling a ball as in football
- Activities involving hand-eye, eg. racquet sports, throwing or catching a ball

Bear in mind the following points regarding coordination activities:

- Be careful to avoid falls and other accidents as kids are often so engrossed in these activities that they lose awareness of their surroundings and other people in the vicinity
- Coordination activities are excellent for motor development, especially in young children. And most children love them!
- The learning curve for these skills is different for each child – some learn much faster than others

6. Health-related vs. athletic performance physical fitness

It is important to make the distinction between **health-related physical fitness** and **athletic performance physical fitness**. Health-related physical fitness refers specifically to those components of physical fitness associated with some aspect of good health and/or disease and not necessarily sports performance. For example, good aerobic fitness and a relatively low amount of body fat are important components of health related physical fitness. In this situation, the individual may not have a high level of athletic performance physical fitness but their favourable aerobic fitness and body fat confer a large amount of health-related fitness and protection against disease.

Athletic performance physical fitness is that portion of physical fitness directed towards optimizing performance in a certain sport - each sport will require a balance of different facets of fitness for optimal performance. For example, gymnastics requires a high degree of agility and flexibility whereas competitive long distance swimming requires a high degree of aerobic fitness. The adaptations within the body as a result of training for specific sports will almost always confer significant health benefits also on the athletes concerned.

Figures 3 and 4 below outlines some facets of health-related physical fitness and athletic performance physical fitness.

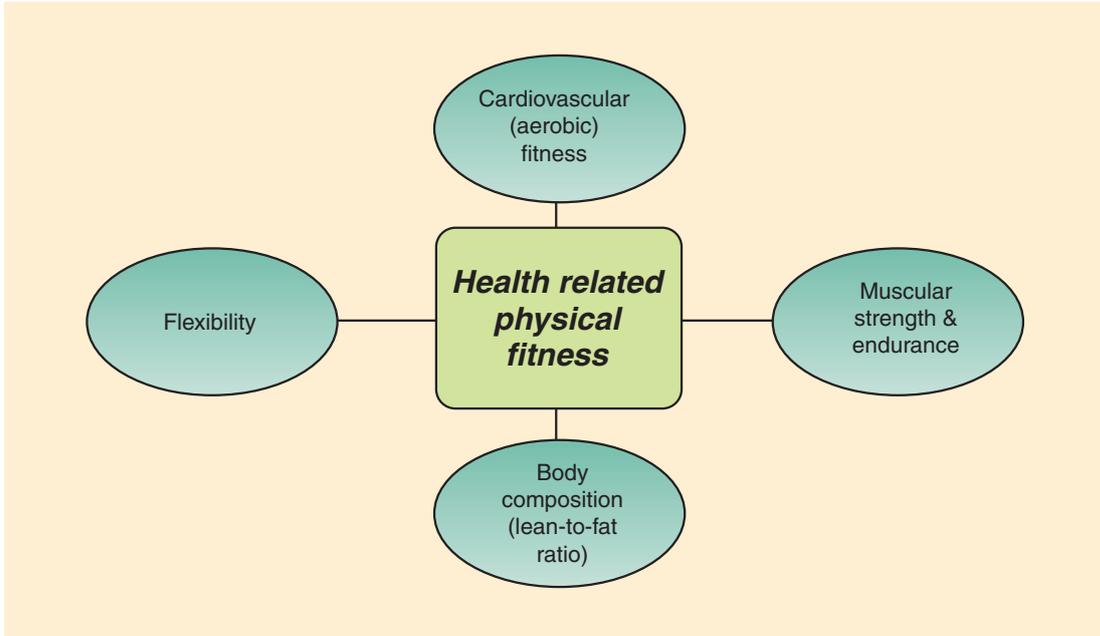


Figure 3. Aspects of health-related physical fitness.

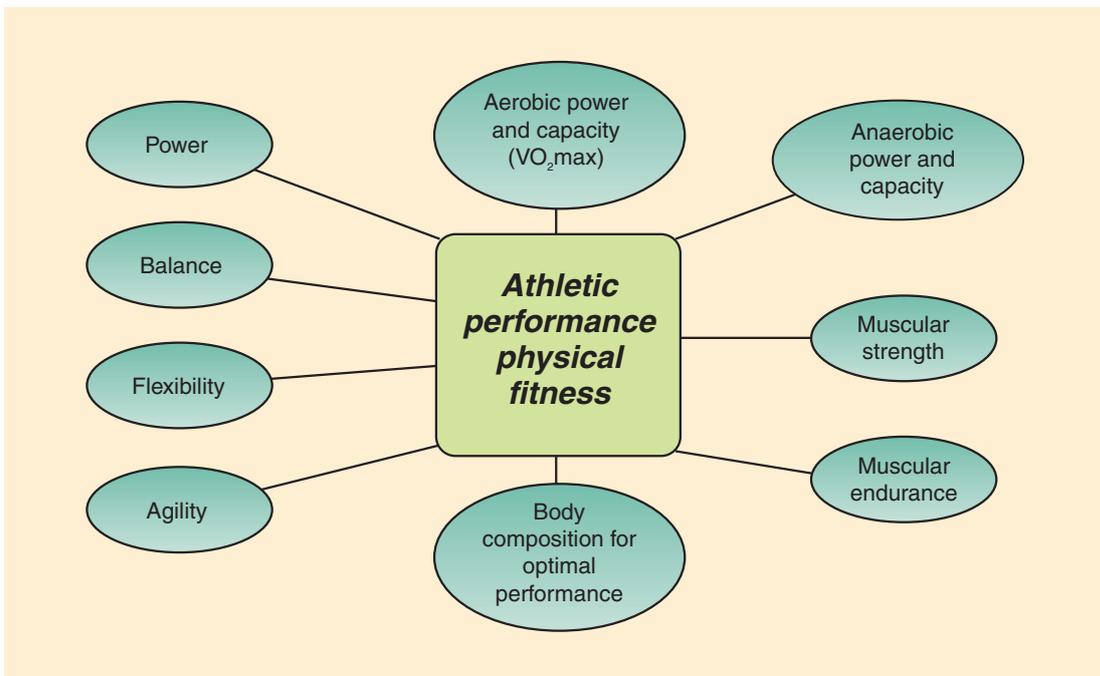


Figure 4. Aspects of athletic performance physical fitness

Key points:

- Physical activity is body movement produced by skeletal muscle contraction that results in energy expenditure.
- The dose (or amount) of physical activity is a combination of frequency, intensity, time and type of activity.
- For an individual to continually improve their physical fitness, there must be gradual progressive overload in the amount of physical activity.
- Intensity of physical activity can be monitored through the talk test, heart rates, rating of perceived exertion and metabolic equivalents (METs).
- The most important types of physical activity for health-related fitness in young people are cardiovascular, muscular strength/endurance, flexibility and co-ordination activities.
- Health-related physical fitness refers to those components of physical fitness associated with some aspect of good health whereas athletic performance physical fitness refers to those aspects of physical fitness required for optimal performance in sports.