

UNIT

7

Test, Measurement and Evaluation

INTRODUCTION

Test and measurement are very important in games and sports. Testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions are made. They provide information about the fitness, performance, and progress of the athlete. Time to time tests and measurements are must to know about the progress of the athlete. On the basis of test and measurement, person can be selected and training programmes can be designed. The results from tests can be used to predict future performance, indicate weaknesses, measure improvement, enable the coach to assess the success of his training programme, place the athlete in appropriate training group and motivate the athlete.

LEARNING OBJECTIVES

- 7.1 Define Test, Measurement and Evaluation
- 7.2 Importance of Test, Measurement and Evaluation in Sports
- 7.3 Calculation of BMI and Waist-Hip Ratio
- 7.4 Somato Types (Endomorphy, Mesomorphy and Ectomorphy)
- 7.5 Measurement of Health Related Fitness

7.1 DEFINE TEST, MEASUREMENT AND EVALUATION

TEST

Testing is an important element in the field of games and sports. It is an attempt to assess the needs and capacities of the athlete or player, with a view to help and improve the performance. With the help of test, teaching can be determined and



progress can be known. But for accurate results from a test, a teacher, coach or trainer must know the present abilities of the athlete or player. A test should be valid, meaning it measures what it is supposed to measure and it should be reliable, meaning it is repeatable.

According to **Webster's Dictionary**, "A test is a tool to evaluate the skill, knowledge, capacities or aptitudes of an individual or a group."

According to **H.M. Barrow and Megee**, "Test refers to any specific instrument, procedure or technique used by an administrator to elicit a response from the test taker."

According to **Barry L Johnson and Jack Nelson**, "Test is the form of questioning or measuring used to assess retention of knowledge, capacity or ability of some endeavour."

Thus, a test is a tool which is used to evaluate the skills, performance and reliability of the task completed by a sportsperson.

MEASUREMENT

Measurement is the use of tests and techniques to get the information about a particular skill or fitness level of an athlete or player. In other words, measurement is a process with the help of various types of tests through which the fitness level, knowledge, ability, behaviour, interest and personality traits etc. of an athlete or player can be measured. Measurements generally result in quantitative data.

According to **H.M. Barrow**, "Measurement refers to the process of administering a test to obtain quantitative data."

According to **Johnson and Nelson**, "Measurement aids evaluation process in which various tools and techniques are used in the collection of data."

Thus, we can say that measurement is about the collection of data about performance or task completed by a sportsperson by using a test.

EVALUATION

An evaluation is an appraisal or examination of something to determine its worth or fitness. For example, before you start an exercise programme, get a medical evaluation, to make sure you're able to handle the activity.

According to **Tuckman**, "Evaluation is a process where in the parts, processes or outcomes of a programme are examined to see whether they are satisfactory, particularly with reference to the programmes stated objectives our own expectations or our own standards of excellence."



Evaluations should help to draw conclusions about five main aspects of the intervention: Relevance, effectiveness, efficiency, impact and sustainability.

7.2

IMPORTANCE OF TEST, MEASUREMENT AND EVALUATION IN SPORTS

Test, Measurement and Evaluation is an important aspect for all training programmes and other activities of sports. They help coaches to know the real position of their trainee and how much more they have to work. The effectiveness of the training can be confirmed from tests and measurements. It gives information about whether the work load should be increased or decreased or to continue with the same load. The following points clearly show the importance of test and measurement in sports :

- 1. Talent Identification :** Test, Measurement and Evaluation are primarily used for providing an individual with an idea of his basic strengths and weaknesses, and from this he may find the sport for which he would be better suited and where he can make better use of his strengths.
- 2. Selection of athletes :** There is a large variations in the physical demands required to compete in different categories of a sport. To classify the athletes into various categories and groups, the expert must test, measure and evaluate the performance and capacity of the athletes. Only then the athletes can be selected for suitable categories.
- 3. Identify Weaknesses and Strengths :** Of the many benefits of testing, measuring, and evaluating the major use is to establish the strengths and weaknesses of the athlete. This is done by comparing test results to other athletes in the same training group, the same sport, or a similar population group. By comparing results to successful athletes in your sport, you can see the areas which need improvement, and the training programme can be modified accordingly. This way valuable training time can be used more efficiently.
- 4. Monitor Progress :** Test, measurement and evaluation can give the athlete an idea of his performance at the start of a programme, so that future testing can be compared to this and any changes can be noted. By repeating tests at regular intervals, athlete can get an idea of the effectiveness of the training programme. The time-frame between tests can depend on the availability of time or costs involved, or the phase of training the athlete is in.
- 5. Goal Setting :** Setting specific and measurable goals is a fundamental part of the modern-day athlete's approach to sport. It's not enough to say "I want to be fitter". It's not even enough to say "I want to be faster over 40 yards". A more appropriate target would be to "reduce my 40 yard sprint time by 0.5 second by the end of the pre-season". Of course this can only be done if one knows from he is starting from. Thus, test, measurement and evaluation help an athlete in setting his goal.
- 6. Motivation :** Tests, Measurements and Evaluations act as a tool for motivating the individual to improve his physical fitness. It is very important to motivate the individual to achieve best results. Motivation helps in further improvement.



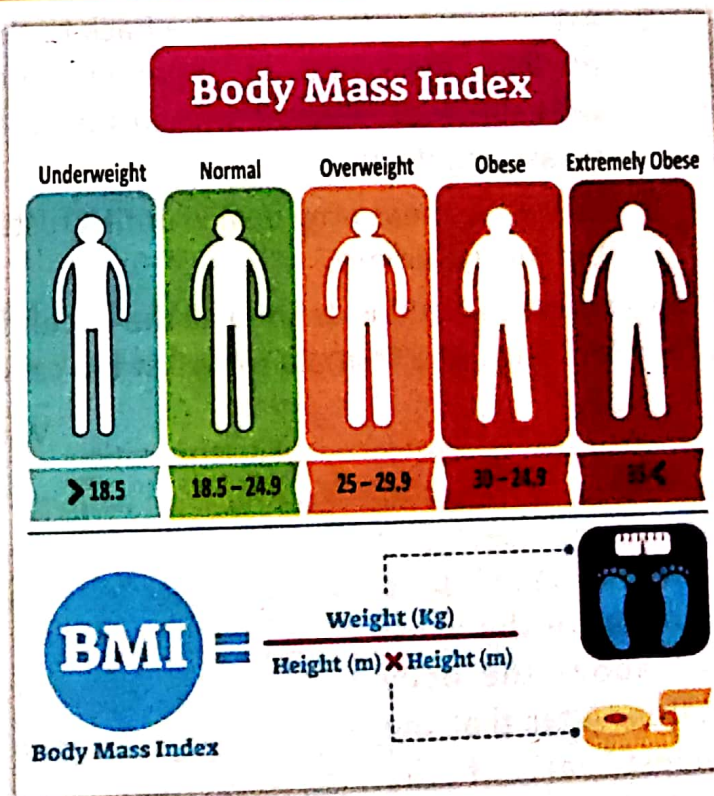
7. **Effective Planning** : Test, Measurement and Evaluation play an important role in preparing effective plans. Teaching or coaching methods can be changed on the basis of test and measurement. Participants can be guided in a proper way with the help of measurement.
8. **Identifying Potential** : With the help of test, measurement and evaluation, teachers and coaches can come to know about the potential of the participants which ultimately help in the preparation of a programme of physical education and sports for the individual according to the need.
9. **Training Methods** : Test, Measurement and Evaluation enable the teachers and coaches of physical education to compare different training methods suitable for different groups or categories.
10. **Research and Experimentation** : Test, Measurement and Evaluation are important tools for research and development in the field of physical education. Test and measurement help to find missing points in existing knowledge and help in new discoveries.

7.3 CALCULATION OF BMI AND WAIST-HIP RATIO

Body Mass Index (BMI) is a measure of body fat which is calculated on the basis of weight and height. This method applies to both adult men and women. BMI helps a person to know whether he is under weight, over weight or normal weight. Accordingly, he can think about gaining or losing weight.

Belgian Polymath Adolphe Quetelet (1796-1874) developed the formula of BMI (Body Mass Index). It was known as the Quetelet Index. BMI, is calculated by taking weight in kilograms and divide it by squaring height taken in metres.

Once the BMI number is determined the following table is used :



BMI	Below 18.5	18.5 - 24.9	25.0 - 29.9	30.0 and Above
Weight Status	Underweight	Normal	Overweight	Obese

e.g. BMI is calculated by using the body mass index formula = $\frac{\text{Weight (in kgs)}}{[\text{Height (in metres)}]^2}$

Height = 1.80 m, Weight = 80 kg

$$\text{BMI Calculation} = 80 \div (1.80)^2 = 24.69$$

From the following table, the score 24.69 shows normal weight status.

Precautions while taking BMI:

To ensure you take reliable measurements using body weight scales you must:

1. Zero the scales before the person steps onto them.
2. Ask the person to remove any 'heavy' items from their pockets (key's, wallets etc) and remove any heavy items of clothing or apparel (big jackets, shoes, woollen jerseys etc).
3. Ensure you note the person's state and time of day for testing to ensure any subsequent tests can be taken under identical conditions (check state of hydration, food consumed recently etc).
4. When measuring weight – ask person to look straight ahead and stay still on the scales. Wait for the needle/digital screen to settle before recording the measurement.

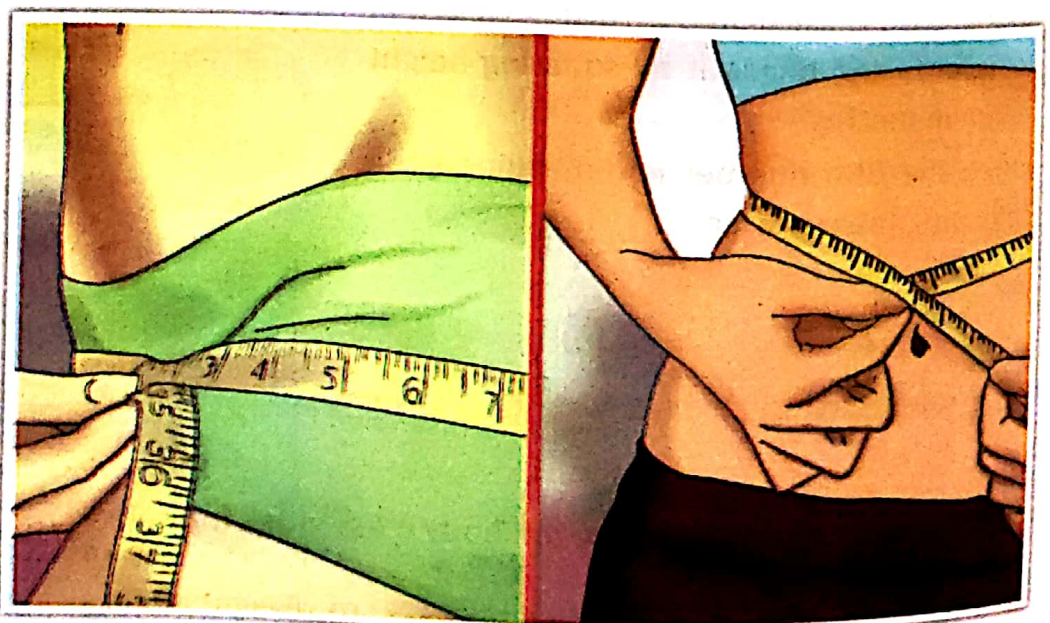
When taking measurements of height you must:

1. Ask person to remove the shoes prior to taking the measurement.
2. Ask person to stand with the back to the wall and look directly forward. The back of the feet, calves, bottom, upper back and the back of the head should all be in contact with the wall. Person should be positioned directly underneath the drop down measuring device.
3. Lower the measuring device until it rests gently on the top of person's head and record the measurement.

Waist-hip ratio (WHR) is defined as the circumference of the waist divided by circumference of the hip. Thus, the formula for waist hip ratio is :

$$\text{Waist hip ratio} = \frac{\text{Waist Circumference}}{\text{Hip Circumference}}$$

For this test, a measuring tape is used to measure the waist just above the belly button. After that the widest part of the buttocks is measured. The measurements can be taken in inches or centimetres. This test is used as an assessment tool for heart diseases, diabetes and hypertension. The waist hip ratio



of 0.7 is considered healthy for women whereas the waist hip ratio of 0.9 is considered healthy for males. The higher the waist hip ratio, the more chances are of getting problems like diabetes, hypertension and cardio vascular diseases. The health risk can be understood in a better way by using BMI along with waist hip ratio. The following table shows the degree of health risk.

BMI	Waist-Hip Ratio (Males)			Waist-Hip Ratio (Females)		
	< 0.85	0.85-1.0	≥1.0	≤0.70	0.70-0.85	>0.85
20 to < 25	Very low	Low	Moderate	Very low	Low	Moderate
25 to < 30	Low	Moderate	High	Low	Moderate	High
30 to < 35	Moderate	High	Very high	Moderate	High	Very high
35 to < 40	High	Very high	Very high	High	Very high	Very high
≥40	Very high	Very high	Very high	Very high	Very high	Very high

7.4 SOMATO TYPES (ENDOMORPHY, MESOMORPHY & ECTOMORPHY)

TYPES OF PERSONALITY

Various psychologists have given different classification of personality. These types are as follows :

1. Types of personality on the Basis of Physical Traits :

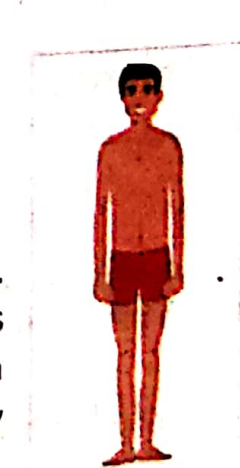
According to **William Herbert Sheldon**, there are three types of personalities on the basis of physical traits are given below :

- (i) **Endomorph** : The Endomorph is physically quite 'round', have short arms and legs and is typified as the 'barrel of fun' person. General characteristics of endomorphs are : (a) Wide hips and narrow shoulders, which makes them rather pear-shaped. (b) Quite a lot of fat spread across the body, including upper arms and thighs. (c) They have quite slim ankles and wrists, which only serves to accentuate the fatter other parts.

Psychologically, the endomorph is:

- Sociable
- Fun-loving
- Love of food
- Tolerant
- Even-tempered
- Good humored
- Relaxed
- With a love of comfort
- And has a need for affection

- (ii) **Ectomorph** : The Ectomorph is a form of opposite of the Endomorph. General characteristics of ectomorphs are : (a) Narrow shoulders and hips (b) A thin and narrow face, with a high forehead (c) A thin and narrow chest and abdomen (d) Thin legs and arms (e) Very little body fat



Even though they may eat as much as the endomorph, they never seem to put on weight. Psychologically they are:

- Self-conscious
- Inhibited
- Intense
- Private
- Socially anxious
- Emotionally restrained
- Introverted
- Artistic
- Thoughtful

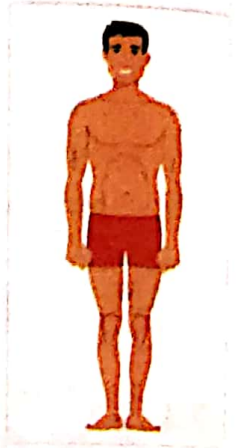
(iii) **Mesomorph** : The mesomorph is somewhere between the round endomorph and the thin ectomorph. General characteristics of mesomorphs are :

- (a) Large head, broad shoulders and narrow waist (wedge-shaped).
- (b) Muscular body, with strong forearms and and thighs
- (c) Very little body fat

They are generally considered as 'well-proportioned'.

Psychologically, they are:

- Adventurous
- Indifferent to what others think or want
- Zest for physical activity
- With a desire for power/dominance
- Courageous
- Assertive/bold
- Competitive
- And a love of risk/chance



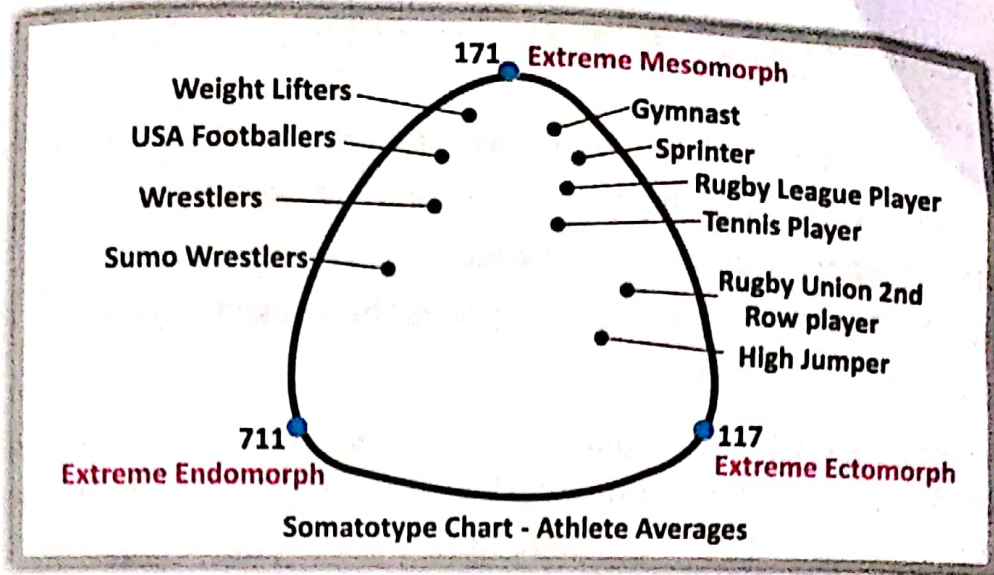
Difference between Endomorph, Ectomorph and Mesomorph types of personalities

Endomorph	Ectomorph	Mesomorph
1. Individuals have short arms and legs.	1. Individuals have thin legs and arms.	1. Individuals have balanced body composition.
2. Individuals have rounded physique.	2. Individuals have thin physique.	2. Individuals have athletic physique.
3. Individuals have undeveloped muscles.	3. Individuals have little or less muscles.	3. Individuals have strong muscles.
4. Individuals have high fat storage.	4. Individuals have very little fat storage.	4. Individuals have fat evenly stored all over the body.
5. Individuals have pear shaped body.	5. Individuals have rectangular shaped body.	5. Individuals have V-shaped body.
6. Individuals have less ability to compete in sports.	6. Individuals are best suited for events where height is helpful.	6. Individuals can excel in sports.

MEASURING SOMATO TYPE

Somatotype is most commonly measured using the Heath-Carter measurement system, in which ratings for endomorphy, mesomorphy and ectomorphy are calculated using various anthropometrical measurements and also sometimes in conjunction with standardized photos (photoscopic method).





In each of the three categories someone is generally classified on a scale from 1 to 7 (though higher ratings are possible), though you cannot score highly on all three. The three numbers together give a somatotype number, with the endomorphy score first, then mesomorphy and finally ectomorphy (e.g. 1-5-2). The scores may also be plotted in a shield diagram or somatograph, representing the somatotype on a two dimensional scale. Ratings on each component of ½ to 2½ are considered low, 3 to 5 are moderate, 5½ to 7 are high, and 7½ and above are very high (Carter & Heath, 1990).

7.5 MEASUREMENT OF HEALTH RELATED FITNESS

Physical fitness is defined as “a set of attributes that people have or achieve that relates to the ability to perform physical activity.” In other words, it is more than being able to run a long distance or lift a lot of weight at the gym. Being fit is not defined only by what kind of activity you do, how long you do it, or at what level of intensity. While these are important measures of fitness, they only address single areas. Overall fitness is made up of five main components :

1. **CARDIO-RESPIRATORY ENDURANCE**

According to Corbin & Lindsey, cardio-respiratory endurance is the ability of the body's circulatory and respiratory systems to supply fuel during sustained physical activity. It requires a strong heart, healthy lungs, and clear blood vessels to supply the body with oxygen. To improve your cardio-respiratory endurance, try activities that keep your heart rate elevated at a safe level for a sustained length of time such as walking, swimming, or bicycling. The activity you choose does not have to be strenuous to improve your cardio-respiratory endurance. Start slowly with an activity you enjoy, and gradually work up to a more intense pace.

Measurement of Cardio-Respiratory Endurance:

THREE MINUTE STEP TEST

Purpose : To measure cardio-respiratory endurance.



Equipment : Stopwatch, Bench (12 inches or 30 cm height).

Procedure :

1. The individual to be tested steps up and down the bench for continuously for 3 minutes.
2. After completion of test, the subject sits down and remains still.
3. The heart rate is then measured and recorded.

Scoring : The heart rate one minute post-exercise is the subject's score for the test.

2. MUSCULAR STRENGTH

According to Wilmore & Costill, Muscular strength is the ability of the muscle to exert force during an activity. The key to making your muscles stronger is working them against resistance, whether that be from weights or gravity. Good muscular strength is important for maintaining correct posture and avoiding injuries. If you want to gain muscle strength, try exercises such as lifting weights or rapidly taking the stairs.

Measurement of Muscular Strength:

a) PARTIAL CURL UP

Purpose : To measure abdominal strength and endurance.

Equipment : Flat surface, Mat.

Procedure :

1. Start by lying on the back with knees bent and the feet at about 12 inches from the buttocks.
2. The arms are extended and kept at side.
3. The subject slowly lifts the shoulder and trunk upwards to around 30 degrees and touches his/her knees with the hands.

Scoring : Record the number of correctly performed curl-ups within the given time limit.

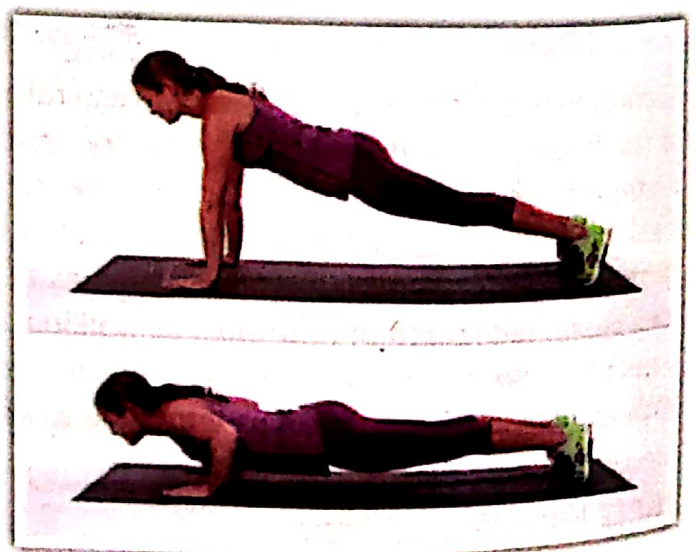
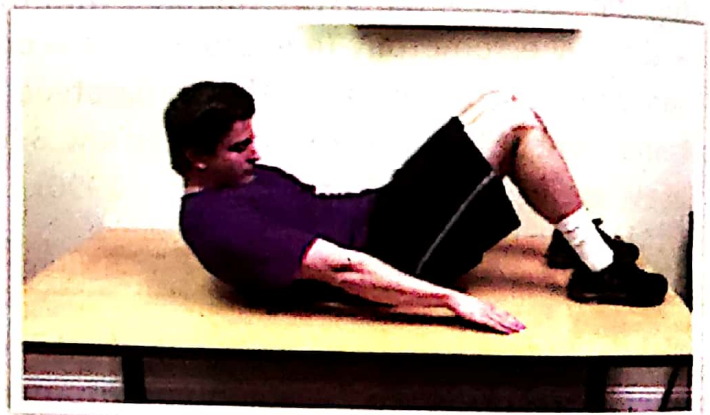
b) PUSH UP

Purpose : To measure upper chest and shoulder strength.

Equipment : Stop watch

Procedure :

1. The subject should begin in a position on hands and toes with hands kept shoulder width apart and elbows fully extended.
2. Now drop the hips until the shoulders, hips and knees are in a straight line.
3. While maintaining this position the upper body is lowered so that the elbows bend to 90 degrees.



4. Push back up to the starting position. This completes one push-up.

Scoring : One point is given each time when the subject completes a push-up.

3. MUSCULAR ENDURANCE

According to Wilmore & Costill, Muscular endurance is the ability of the muscle to continue to perform without fatigue. To improve your muscle endurance, try cardio-respiratory activities such as walking, jogging, bicycling, or dancing.

Measurement of Muscular Endurance:

600 M RUN/WALK

Purpose : To measure endurance and aerobic fitness.

Equipment : Stop watch, Track or area marked 600 M.

Procedure : The subject should run 600 M.

Scoring : The time is recorded in minutes and seconds and taken as a score.

Rules : Walking is permitted but the object is to cover the distance in shortest possible time.

4. BODY COMPOSITION

According to Corbin & Lindsey, Body composition refers to the relative amount of muscle, fat, bone, and other vital parts of the body. People who have a high percentage of fat are more likely to be ill than lean people. Exercise and eating the right foods in the proper amounts can improve body composition. A person's total body weight may not change over time, but body composition changes i.e. how much of that body weight is fat and how much is lean mass (muscle, bone, tendons, and ligaments).

Body composition is an important component to be considered for health and managing your weight.

Measuring body composition (estimating per cent body fat)

SKINFOLD MEASUREMENT

Purpose : To measure the triceps and calf skinfold thicknesses (on the right sides of the body) for calculating per cent body fat.

Equipment : Calipers

Procedure :



1. **Skinfold measurement :** Skinfold measurement involves measuring a double thickness of skin and subcutaneous fat with a caliper.



2. **Triceps Skinfold :** The triceps site is located midway between the shoulder (acromion process) and the elbow. The pinch should be made slightly above the midway point so that the skinfold calipers can be placed directly on the proper location. The skinfold site should be vertical.



3. **Calf Skinfold** : For the calf skinfold, students place their right foot on a stool so that the knee is at a 90 degree angle. The calf skinfold site is located medially at the largest calf girth (on the right calf). The vertical skinfold should be grasped firmly with the thumb and forefinger. The skinfold should be lifted away from the body tissue. The calf pinch is made slightly above the largest girth so the skinfold caliper will be placed on the correct site.



Scoring :

The skinfold measure is registered on the caliper. Each measurement should be taken three times. The recorded score is the median (middle) value of the three scores. To illustrate, if the readings were 7.0, 9.0 and 8.0, the score would be recorded as 8.0 millimeters. Each reading should be recorded to the nearest 0.5 millimeters.

5. FLEXIBILITY

According to Wilmore & Costill, Flexibility is the range of motion around a joint. Flexibility is the ability to use your joints fully. You are flexible when the muscles are long enough and the joints are free enough to allow movement. Good flexibility in the joints can help prevent injuries through all stages of life. If you want to improve your flexibility, try activities that lengthen the muscles such as swimming or a basic stretching programme. Yoga asanas are also helpful to improve flexibility.

Measurement of Flexibility:

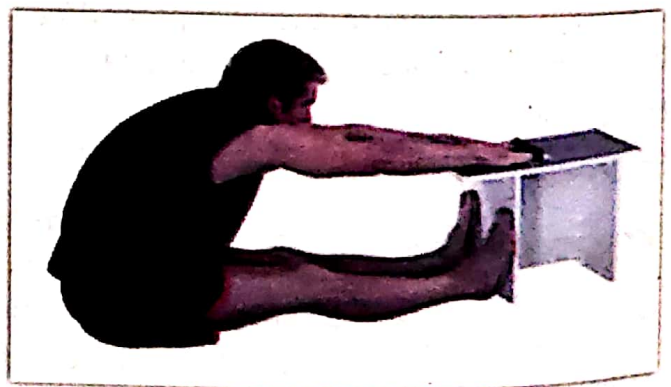
SIT AND REACH TEST

Purpose : To measure flexibility of lower back and hamstrings.

Equipment : Flat surface, Mat, Sit and reach box

Procedure :

1. The individual to be tested first removes his/her shoes and sits on floor with knees fully extended, feet shoulder-width apart, and soles of the feet held flat against the end of the box.
2. With hands on top of each other, palms down, and legs held flat, the student reaches along the measuring line as far as possible.
3. After three practice reaches, the fourth reach is held while the distance is recorded.
4. The purpose is to reach as forward as possible.



Scoring : The distance is recorded in centimeters.



Important Questions

Multiple Choice Questions

1. What point-scale did Sheldon used to classify individuals in his somato-typing system ?
 - (a) 1-5
 - (b) 1-7
 - (c) 1-9
 - (d) None of these
2. Sheldon's body types classification is—
 - (a) Endomorph
 - (b) Mesomorph
 - (c) Ectomorph
 - (d) All of the above
3. From the viewpoint of body-build, an ectomorphic individual has a
 - (a) thin and slender frame.
 - (b) bulky and stocky body.
 - (c) muscular and athletic frame.
 - (d) body-beautiful image.
4. "Mesomorphy" is characterized by—
 - (a) Well defined muscles
 - (b) Soft and round body
 - (c) Slow metabolism
 - (d) Thin
5. "Endomorph" is characterized by—
 - (a) husky and muscular
 - (b) soft and fat
 - (c) thin and bony
 - (d) None of the above
6. Which measure is used to assess the needs and capacities of an athlete or player to improve the performance?
 - (a) Measurement
 - (b) Assessment
 - (c) Test
 - (d) Evaluation
7. A test should be:
 - (a) Valid
 - (b) Reliable
 - (c) Repeatable
 - (d) All of the above
8. What is the process of administrating a test to obtain quantitative data known as?
 - (a) Measurement
 - (b) Evaluation
 - (c) Assessment
 - (d) None of the above
9. What is the term used for an appraisal or examination to determine worth or fitness?
 - (a) Assessment
 - (b) Evaluation
 - (c) Test
 - (d) Measurement



- 10.** Which parameters are required for calculation of BMI?
 (a) Weight and Height (b) Age and Gender
 (c) Weight and Age (d) Height and Age
- 11.** What is the formula for BMI?
 (a) Weight/height (b) Weight/(height)²
 (c) Height/Weight (d) (Weight/Height)²
- 12.** What is the formula for waist-hip ratio?
 (a) Hip circumference/Waist circumference
 (b) Waist circumference* Hip circumference
 (c) Waist circumference/Hip circumference (d) None of the above
- 13.** Higher waist hip ratio means:
 (a) Higher chances of Cardiovascular diseases (b) Higher chances of hypertension
 (c) Higher chances of Diabetes (d) All of the above
- 14.** The ability of body's circulatory and respiratory systems to supply fuel during sustained physical activity is known as:
 (a) Endurance (b) Agility
 (c) Cardio-respiratory endurance (d) Flexibility
- 15.** Three minute step test is used to measure:
 (a) Muscular Strength (b) Cardio-respiratory endurance
 (c) Muscular endurance (d) Agility
- 16.** Skinfold measurement is used to measure:
 (a) Muscle Bulk (b) Muscle strength
 (c) Percent body fat (d) Body composition
- 17.** Sit and Reach test is used to measure:
 (a) Agility (b) Flexibility
 (c) Strength (d) All of the above
- 18.** The range of motion around a joint is known as:
 (a) Flexibility (b) Endurance
 (c) Agility (d) Strength
- 19.** What is the degree of health risk of a person with BMI more than 40 and Waist hip ratio more than 0.85?
 (a) Moderate (b) Very high
 (c) High (d) Low
- 20.** If BMI is less than 18.5, the person is in the:
 (a) Underweight category (b) recommended weight category
 (c) overweight category (d) obese category



Very Short Answer Type Questions

1. What do you mean by test ?
2. Define the term measurement.
3. What do you mean by evaluation ?
4. What is Somatotype ?
5. What is the formula for calculating BMI ?
6. What is the formula for calculating waist-hip ratio ?
7. State the uses of Anthropometric measurements.
8. What are Endomorphs ?
9. What are Ectomorphs ?
10. What are Mesomorphs ?
11. Define Body Composition.
12. Which test is used to measure Muscular strength?

Short Answer Type Questions

1. What is the difference between endomorphs and ectomorphs ?
2. What is BMI ? How will you calculate it ?
3. What is waist-hip ratio ? How is it calculated ?
4. Explain the test used to measure Body Composition?
5. What is the importance of test and measurement ?
6. What is the importance of evaluation ?
7. Calculate the BMI of a male person whose weight is 80 kg and height is 1.6 m. Also state the category in which he falls.
8. Explain the test used to measure flexibility.

Long Answer Type Questions

1. Explain in detail the Somatotypes. How can we measure Somatotype?
2. What is measurement ? Explain the importance of test and measurement in the field of sports.
3. What are the components of Health Related Fitness? Explain in detail how they can be measured?

