<u>Unit B</u>

<u>Physical working capacity and physical fitness methodology: Evaluation of response and adaption of the body to stress exercise</u>

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Introduction - Among the measurements of nutritional status and health the evaluation of physical fitness and functional capacity have an important place. They belong to the most important characteristics of the human organism: its level of development, growth, and maturation. Their reduction and deterioration are often the first signs of a certain degree of malnutrition, illness and! or any other pathological state. By functional capacity we understand first of all the ability to perform physical work, which depends mostly on the efficiency of the cardiovascular, respiratory, and neuromuscular systems as related to the function of all other systems of the human organism. In the type of work that engages large muscle groups (especially when one's body weight is transferred along a distance) the limiting factor is the individual's ability to transport oxygen to the working tissues. From the measurements of functional capacity we can characterize not only so-called 'normality', but also 'positive health' according to the World Health Organization definition. An adequate level of functional capacity and physical fitness are important not only from the point of view of well-being, but also of economic productivity, which especially applies to the developing countries. As often stated, it is more important to be healthy and fit, than to achieve certain bodily dimensions. Adequate nutrition is necessary for optimal development of physical fitness and functional capacity . Malnutrition, both in a positive and negative sense of energy intake, has a negative impact on the functional characteristics. Obese as well as excessively underweight persons have a low level of physical fitness. However, this deterioration is differentiated according to the character of physical activity and work-load. A very lean person can have very good results as regards dynamic performance (e.g. running), but his gross work output demanding muscle strength may be reduced. On the other hand an obese person has very bad results in dynamic performance, but is frequently strong. Intake and nutritional status is related to the changes of body weight and body composition. Special deficiences, e.g. that of iron (causing anaemia), or vitamin C (resulting in increased fatiguability, more frequent common colds, etc.), even if slight, may cause a considerable reduction in the level of physical fitness and physical performance. The same applies to a number of other micronutrients, trace elements, and so forth. Studies concerning the relationship between physical fitness and intake of the above-mentioned food components have only been initiated recently. The impact of malnutrition of specific character manifests both in developing as well as industrially developed countries. As regards the latter, the impact of overeating, usually together with hypokinesia, results in deterioration of cardiorespiratory efficiency that may predispose the subject to diseases of the cardiovascular system. On the other hand the impact oflow intakes of energy on gross work output in developing countries is well known. Similarly, as with other physical traits in humans, there exists a wide variability in physical fitness and functional capacity, which depends both on genetic and/or environmental factors. Adaptation processes can significantly modify the capacity for performing physical work at all ages. The impact of a systematic work-load of a sufficient intensity, but within the adaptation limits of the organism, can markedly increase the work performance. This applies especially during the growing period, when an appropriate stimulation helps to develop an optimal level of all bodily systems, and especially those involved in physical work. This is particularly applicable to the cardiorespiratory system. However, if the growing organism is overburdened, it can significantly interfere not only with normal development but also with the desirable functional capacity currently as well as in later periods. The evaluation of functional capacity and physical fitness have become an integral part of research, not only in nutritional sciences but also in research in physiology (theoretical and clinical), epidemiology, human biology, and so forth. The level of functional capacity and physical fitness can be evaluated by a number of methodological approaches that concern cardiovascular, respiratory and neuromuscular systems.

There are broadly four method for assessing physical working capacity and physical fitness:

1. **Body composition**

a. Dual energy X-ray absorptiometry

b. Underwater weighing (Densitometry)

c. Bioelectrical impedance Analysis (BIA)

d. Anthropometry

2. **Cardio-respiratory fitness Maximal versus sub-maximal exercise test**

a. Open circuit spirometry

b. Graded exercise testing

i. Treadmill test

ii. Balke treadmill test

iii. Bruce treadmill test

iv. Cycle ergometer

c. Field test

i. Harvard step test

***3.* Muscular Fitness**

a. Muscular strength

i. Static strength Grip strength Leg strength Back strength

ii. Dynamic strength One-repetition maximum (1-RM)

b. Muscular endurance One-repetition maximum (1-RM) Bench Press

3. Musculoskeletal Flexibility

i. Sit-and-reach test

ii. Behind-the-back reach test

1. Body composition is the relative proportion of fat and fat-free tissue in the body. An understanding of body composition is important because of the influence it has on both exercise performance ad general health. Reduced body fat level correspond to reduced body mass that has to be accelerate during exercise or any sports activity. It provides the force required to change direction or speed, project into air during jump, perform activity against gravity etc. An athlete with more body fat would produce more heat due to increased metabolic rate but shield dissipation of heat from body to environment. Considering general population, increased body fat termed as obesity has emerged as global epidemic. It is associated with elevated risk for range of chronic diseases including cardiovascular, diabetes, blood pressure and some cancers (Schwellnus 2009; Percia et al. 2010). Obesity results from imbalance between calorie intake and caloric expenditure regulated by complex interaction between genetic and environmental factors (Rippe 2013). There are a variety of technique to measure body composition in both field and the laboratory, and each approach has different levels of accuracy.

a) Dual energy X-ray absorptiometry (DEXA) has been accepted as “gold standard’. But it requires expensive equipment and convenient place, as well as an individual is exposed to radiations. Thus, more practical alternative to estimate body composition at whole body level using indirect methods have also been developed. These include underwater weighing, bioelectrical impedance and anthropometric measurements (skinfold thickness, girths and weight-height ratios). a. Dual energy X-ray absorptiometry The dual energy X-ray absorptiometry method requires the low level X- ray radiation exposure in the form of two photon beams, the one with low energy and other with high energy. It is based on differential transmission of energy beam which related to the thickness, density, and chemical composition of bone, lean tissue, and fat as it passes through the body. The amount of each photon beam absorbed by the atoms of bone minerals and soft tissues of the body are recorded during the scan and used to estimate bone mineral, fat-free soft tissue and fat tissue content of the total body using algorithms (**Heymsfield 2005; Schwellnus 2009).**

b) **Underwater weighing** (Densitometry) Underwater or hydrostatic weighing estimates fat mass in relation to fat free mass by measuring the density of the body. Density = body mass /body volume Body volume is estimated on the basis of Archimedes Principle which states that the weight an object loses in water is equivalent to the weight of the water displaced during immersion. When a subject is submerged in water, body volume (BV) is equal to the loss of weight in water, corrected for density of water corresponding to the temperature at the time of the submersion (Heymsfield et al 2005; Schwellnus 2009; Rippe 2013). BV = (Wa - Ww)/Dw Where, Wa - subject's weight in air Ww - subject's weight in water The body density (D) is then converted to percent body fat using the Siri equation (1961): Percent body fat = [(4.95/D) − 4.50] × 100.

c) **Bioelectrical impedance Analysis** (BIA) In this technique, estimates of body composition are based on the difference in electrical conductive properties of various tissues- non-conducting materials offers resistance to the flow of electric current. Water due to dissolved electrolytes is the good conductor whereas body fat has a relatively poor conductance property. Hence, lean tissue which is rich in water and electrolytes, has minimal impedance and increases to a maximum when all lean tissue is replaced by fat tissue. Here, impedance signifies the opposition of a conductor to the flow of an alternating electric current. Hence, fat free mass (FFM) and fat mass (FM) can be calculated from the difference in conductivity. BIA measurement assumes body as a cylindrical-shaped ionic conductor with homogeneous composition, a fixed cross-sectional area and a uniform distribution of current density (Kyle et al. 2004). The conductive volume (V) which represents FFM relates directly to the square length of conductor (S) and inversely correlated to resistance of the cross-section area (R), while p is the specific receptivity of the conductor, yielding the equation (Dehghan and Merchant 2008). $V = p \times S2 / R$

d) **Anthropometry** -Anthropometry quantifies body composition by measuring body size, circumference and skinfold thickness. These techniques being portable, non-invasive and inexpensive are useful in field based large epidemiological studies.

i. **Body mass index**- Body mass index (BMI) is one of the most established anthropometric indicators used as a clinical indicator of body adiposity. BMI is calculated as weight (kg) divided by height (m) squared (kg/m2).It correlates with total body fat and relates to cardiovascular and all-cause mortality (Rippe 2013). However, ability of BMI to identify an overweight/obese individual has challenged as it does not distinguish excess fat mass or due to excess lean mass in among them. Also, Asian Indians tend to have higher body fat percentage for a given BMI and develop chronic diseases at a lower BMI compared to white populations (Wang et al. 1994; Tuan et al. 2009).

ii. **Body circumference and indices** Epidemiological evidences suggest that increased accumulation of adiposity in the abdomen is independently associated with a higher risk for morbidity and mortality than peripheral distribution of body fat (Okosun et al 2000; Ho et al. 2001). BMI limits the assessment of body fat distribution pattern and hence waist circumference provides a non-invasive field based method to identify mortality or morbidity risk associated with central adiposity (Rippe 2013; Dhall et al. 2011). There are several anthropometric indices which can be computed using waist circumference to assess central adiposity that is waist hip ratio, waist height ratio and conicity index.

iii. **Skinfold thickness** Estimation of body composition using skinfold measurement is based on the premise that approximately one-third of total body fat is subcutaneous fat and rest is visceral fat (Rippe 2013). It involves measurement of thickness of skinfold by grasping a fold of skin and fat, holding away from underlying muscle at various sites (bicep, tricep, subscapular, suprailiac, abdomen, calf etc). The assessment with skinfold caliper correlate well with hydrostatic weighing but reliability of skinfold measurement depends on precision in measuring the exact anatomical locations indicated and practice of the technique (Acevedo and Starks 2003). Sum of skinfold thickness known as grand mean thickness can be to rate individuals according to the fatness as well as evaluate changes in body fat following dietary restriction, exercise conditioning or both (Acevedo and Starks 2003). Sensitivity of different skinfold sites toward accumulation of fat can be estimated as relative percentage of each skinfold thickness to grand mean thickness (Tyagi et al. 2005; Sinha et al. 2012). Several populationspecific regression equations utilizing skinfold thickness have been derived to predict body density, which is used to estimate percent body fat using Siri's equation (Acevedo and Starks 2003). Furthermore, as more fat is deposited viscerally with ageing, age-adjusted equation should be used. Accuracy is also compromised with extremely obese or lean individuals (Rippe 2013).

1. **Cardio-respiratory fitness-** Cardio-respiratory fitness of an individual can be defined as the ability to perform moderate- to highintensity exercise involving large-muscle groups, for prolonged periods of time (American College of Sports Medicine, ACSM 2000). It is primarily limited by the oxygen transport capacity of the cardiovascular and pulmonary system (Mitchell and Blomqvist 1971). Thus, maximal oxygen consumption (VO2max), that is, maximum amount of oxygen that an individual can utilize during maximal or exhaustive exercise represents the gold standard measure for cardio-respiratory fitness (Haskell and Kiernan 2000). It is typically expressed in litres of oxygen (O2) consumed per minute ($L \cdot min^{-1}$) or millilitres of O2 consumed per kilogram of body mass per minute ($mL \cdot kg^{-1} \cdot min^{-1}$).Traditionally, a plateau in oxygen consumption despite an increase in workload determines the attainment of VO2max (Heyward and Gibson 2014). There are other criteria also which may be used to indicate the attainment of VO2max (Gonzalez and Williams 2015):

- Failure of heart rate to increase with increase in exercise intensity
- Venous lactate concentration exceeding 8 mmol.L-1
- Respiratory exchange ratio (RER) greater than 1.15

- Rating of perceived exertion (RPE) greater that 17 using Borg Scale.

However, in comparison to these parameters, a heart rate technique is more practical and easy to use. It is applicable for elite athletes, general population as well as persons with chronic disease or disability. The blood lactate threshold method is more difficult to perform and is mainly used with elite athletes and the study of training intensity or degree of stress placed on the metabolic systems within skeletal muscle. Another technique that is rating of perceived exhaustion (Borg scale), is highly applicable to persons with chronic disease or disability. Among these individuals medication, such as beta blockers, render pulse taking less accurate (Cheevers and Petterson 2007).

Maximal versus sub-maximal exercise test Maximal exercise testing has been considered the gold standard for assessing cardio-respiratory fitness. During such exercises individuals are suppose to work out to the limit of intense physical exercise, bringing the individual to their maximal aerobic output. Under these circumstances among many individuals especially with chronic disease or disability, the assessment is limited due to pain or fatigue rather than exertion (supply of oxygen). It carries a substantial burden for both the subject and examiner in terms of time, effort and risk. To reduce this burden, various submaximal exercise protocols have been developed (Noonan and Dean 2000; Haskell and Kiernan 2000). These protocols estimate the cardiovascular fitness based on the response of the heart rate to a set work rate or workloads. These values are then extrapolated using standardi ed equation to predict O2max (Haskell and Kiernan 2000). In this module we would discuss the submaximal exercise test to assess cardiorespiratory fitness. Underlying assumptions for sub-maximal exercise test are: a. The existence of linear relation between heart rate and oxygen uptake within the range of 110- 115 beats per minute.

a. **Open circuit spirometry** In clinical and research settings, open circuit spirometry- a lab based technique represents the most widely used direct method of estimating VO2max. In this setup, an individual performs an ergometric test with progressive loads and the air inhaled – exhaled is measured for volume and composition. Individual inhales the atmospheric air and then exhales it through a low-resistance valve into either large canvas bag or rubber meteorologic balloons or directly into a gas meter, which continually measure the volume of air. A sample of expired air is analysed for fraction of oxygen and carbon dioxide using biochemical or electronic analyser. Since during exercise body utilises oxygen, the exhaled air will contain less oxygen and more carbon dioxide than inhaled air. Thus, the difference in the O2 content of inhaled and exhaled air determines the oxygen uptake (Shavers 1981; Rippe 2013).

This measurement performed in laboratory environment provides a more reliable estimation of VO2max than indirect methods, but is costly in relation to the indirect measurement. It requires sophisticated equipments and expert individual to conduct the tests. It also demands time and cooperation from the subjects. These conditions make the procedure difficult for large-scale studies (Diaz et al. 2000; Haskell and Kiernan 2000).

b. **Graded exercise testing** Indirect estimation of cardio-respiratory fitness includes graded exercise test that is, individual exercises at gradually increasing workloads (ACSM 2001; Heyward and Gibson 2014). Estimating fitness level of an individual is based on the similar principle as in direct assessment with exception that oxygen consumption is not measured directly. The values are rather estimated on the basis of equation derived from direct assessment of VO2max (Basset et al. 2000). Exercise begins at low workload and maximal workload is determined by the speed and elevation of the treadmill or resistance if a cycle ergometer is used. Heart rate and blood pressure is monitored during the entire test (Rippe 2013). Most of the common exercise test protocols advocate that each workload should be performed for 3 min (Heyward and Gibson 2014). The suitable protocol should include a low intensity warm-up phase followed by progressive, continous exercise in which the demands is elevated to maximum level within a duration of 8-12 min and slow-down period during which exercise intensity is similar to initial phase (Rippe 2015).

Target heart rate

To ensure that the test is being performed at appropriate level of intensity, target heart rate using Karvonen method or heart rate reserve method is calculated (Karvonen and Vuorimaa 1988). Target heart rate = (heart rate reserve) x desired intensity + resting HR where, heart rate reserve signify the difference between maximum heart rate and your resting heart rate. So, Target heart rate = [maxHR (220-age) – restHR] x desired intensity + resting HR Here is an example for a 25year old individual with a resting heart rate of

65bpm who wants to know his target heart rate at the intensity level of 70% Maximum heart rate = 220 - 25 = 195 Then, heart rate reserve = 195 - 65 = 130 Target heart rate = 130 (Heart Rate Reserve) x 0.70 (Min. Intensity) + 65 (Resting HR) = 143 bpm However, substantial inter-individual variation results into considerable error (±10-15%) in estimating VO2max. Tanaka et al. (2001) observed that the above mentioned equation overestimated the measured HRmax of younger individuals and underestimated the actual HRmax of individuals older than 40 years. Using data from 351 studies, they derived the following equation to predict HRmax from age HRmax = 208 – (0.7*age)

i. **Treadmill test** The exercise is performed on a motor-driven treadmill with variable speed and incline. The workload on treadmill is raised with the increase in speed or incline or both, expressed as miles per hour and percent grade. The speed varies upto 25 mph (40 km.h-1) and incline is measured in units of elevation per 100 horizonatal units and is expressed as a percentage. Population –specific and generalized equations mentioned in Table 1.1 have been developed to estimate VO2max from exercise time (Heyward and Gibson 2014). Balke and Bruce treadmill protocols are most widely used exercise test.

ii. **Balke Treadmill Protocol** (Balke and Ware 1959) Initially set the speed of treadmill at 3.4 mph and grade at 0% during first minute of exercise. Constant speed is maintained throughout the exercise test, but at the start of second minute of exercise, the grade is increased to 2%. Subsequently, after each additional minute, increase the grade by only 1% until the individual achieves target heart rate or is exhausted. The grade is reduced to 0% and individual is allowed to walk comfortably for 4 minutes. VO2max can now be estimated using prediction equation (Table 1.1) or monogram (Heyward and Gibson 2014) To use monogram, locate the time corresponding to last complete minute of exercise along with vertical axis labelled “Balke time” and note the oxygen uptake by drawing a hori ontal line from time axis to oxygen uptake axis (Heyward and Gibson 2014).

iii. **Bruce Treadmill Protocol** (Bruce et al. 1972) It is a multistage treadmill protocol in which workload is raised by changing the treadmill speed as well as grade. During first stage (1-3 min), an individual walks at a 1.7mph pace at 10%

grade. At second stage (4-6 min), grade is increased by 2% and speed to 2.5 mph. In subsequent stages, grade is raised by 2% and speed either by 0.8 or 0.9 mph until until the individual achieves maximum heart rate or is exhausted. The duration of exercise till an individual performed, is used in the equation to estimate VO2max. Modified Bruce test, which is suitable for high risk and elderly individual include two more steps at initiation while rest of the protocol is similar to standard Bruce Protocol. Stage 1 begins at 0% and 1.7 mph pace. For stage 2, the grade is increased to 5%.

iv. **Cycle Ergometer Cycle** ergometer is preferred modality when exercise test is to be conducted on individuals with conditions affecting their ability to walk safely on treadmill such as balance instability, severe obesity, or orthopedic limitations (Balady et al. 2010). The workload is raised by increasing resistance on the flywheel. Also, it requires subject cooperation in maintaining pedal speed at constant pressure, usually ≈50-60 rpm. However, in modern electric ergometers, an electromagnetic braking force adjusts the resistance for slower or faster pedalling rates (Baladay et al. 2010; Heyward and Gibson 2014). Thereby, it avoids maintaining constant pedalling rate. The oxygen consumption at target heart rate can be calculated using the following equation (Franklin et al. 2000):

Field test Another approach to assess cardio-respiratory fitness include field testing in which the performance of subjects while walking, jogging, or running for a specified time or distance is converted to an estimate of O2max or aerobic power. These tests require maximal or near-maximal effort by the subject and thus have not been used for older persons or those at increased risk for cardiovascular disease (Cooper 1968; Haskell and Kiernan 2000).

i. **Harvard step test** The Harvard step test of aerobic or cardiovascular fitness was developed by Brohua et al. (1943) Harvard Fatigue Laboratories. It is based on heart rate recovery following a given work load of 5 minutes or until exhaustion. A subject is instructed to step up and down on a box or step measuring approximately 46 cm in height for 5 minutes or until exhaustion, with stepping rate set at 30 steps per minute (www.topendsprots.com). Exhaustion is considered when the subject cannot maintain the stepping rate for 15 seconds. Following the stepping session, the subject is allowed to immediately sit down. After 1 minute that is recovery period, the total numbers of pulse beats are counted. Now, the fitness index can be estimated using the following equation: Fitness Index = 100 X test duration in seconds 5.5 X pulse count Using long method, heart rate is measured after each minute following the stepping phase that is 1 min, 2 min and 3 min. Fitness index can be calculated as Fitness index = 100 X test duration in seconds______ (2 X sum of heart beats during recovery period)

3. Muscular Fitness Muscular fitness refers to the ability of muscle to perform task which includes two componentsstrength and endurance. a. Muscular strength Muscular strength is the ability of the muscle (s) to exert force during voluntary contraction (Casperson et al. 1985). It can be assessed for static and dynamic muscular contractions. If the resistance is immovable, the muscle contraction is static or isometric and there is no visible movement of the joint. Dynamic contractions, in which there is visible joint movement, are either concentric, eccentric, or isokinetic (Heyward and Gibson 2014). For dynamic test, increasing the speed of movement significantly influence the ability of muscles to generate force. In other words, the faster the velocity of muscle shortening the less force can be generated (Newton et al. 2009)

. *i. Static strength Static strength* is measured as the maximum force exerted in a single contraction against an immovable resistance. The test utilizes spring loaded dynamometer for hand grip muscle as well as leg and back muscles. Grip strength The individual stands erect with elbow flexed at 90° and squeezes the dynamometer as hard as possible using one brief maximal contraction and no extraneous body movement. After administering the three trials for each hand, allowing a 1 min rest between trials, the best score is recorded as individual's static strength. The handgrip dynamometer measures forces between 0 and 100 kg in 1 kg increments (Heyward and Gibson 2014). Leg strength Using the back and leg dynamometer, the individual stands on the platform with trunk erect and the knees flexed to an angle of 130° to 140°. The client holds the hand bar using a pronated grip and slowly exerts as much force as possible. Leg strength is assessed by exerting as much force as possible to pull the bar while extending the knees without using back muscle.

Back strength To assess the back strength, the individual stands on the platform of back and leg dynamometer with knees fully extended and trunk erect. The individual pulls the bar straight upward using the back muscles. The maximum score (in pounds) as indicated by the needle is divided by2.2 to convert it into kilogram. The maximum score (in pounds) as indicated by the needle is divided by2.2 to convert it into kilogram for both leg and back muscle. The back and leg dynamometer scale measures forces ranging from 0– 1134 kg in 4.5 kg increments (Heyward and Ginson 2014).

Dynamic strength One-repetition maximum (1-RM) The most common exercise test to assess the maximum force a muscle or group of muscle require maximum effort an individual can exert against the resistance to move the weight through a specified range of motion (Jones et al.2005). This test is referred as one-repetition maximum (1-RM) that is the maximum weight that can be lifted for one complete repetition of the movement (Heyward and Gibson 2014). The procedure is as followed (ACSM 2010):

- Initially during warm-up phase individual is supposed to complete 5 to 10 repetitions of the exercise at 40% to 60% of the estimated 1-RM.
- After a period of rest for 1 min, the individual perform 3 to 5 repetitions of the exercise at 60% to 80% of the estimated 1-RM

. • Increase the weight conservatively, and have the client attempt the 1-RM lift. If the lift is successful, the client should rest 3 to 5 min before attempting the next weight increment.

B) Muscular Endurance Muscular endurance can be defined as ability of muscle (s) to perform repetitive contractions over a period of time against resistance (ACSM 2010). Some of the exercise test to asses muscular endurance includes: One-repetition maximum (1-RM) In this test an individual is supposed to perform as many repetitions as possible using a weight that is a set percentage of their body weight or maximum strength. Pollock et al. (1978) recommend using a weight that is 70% of the 1-RM value for each exercise. An average individual should be able to complete 12 to 15 repetitions (Heyward and Gibson 2014).

4. Musculoskeletal Flexibility Flexibility refers to the degree to which a joint moves through normal, pain-free range of motion. Its evaluations focus on the joints and associated structures, ligaments, and muscles that cross the joints. A reduction in tissue elasticity and deterioration of joint anatomy with age has been shown to decrease flexibility. This may lower the performance in Activities of Daily Living (ADLs), which consequently decrease the quality of life. As flexibility varies joint to joint, there is no single test for overall flexibility (Percia et al. 2010). Field assessment of flexibility has been frequently limited to the sit-and-reach test and behind-the-back reach test. Sit-and-reach test has been considered a measure of lower back and hamstring flexibility while behind-the-back reach test assess should flexibility (Haskell and Kiernan 2000).

i. **Sit-and-reach test** In this test, an individual sits on the floor with hip, back and head against the wall. Legs are fully extended and feet pressed against the sit-and-reach box. Hands should be placed on top of other. Another person then slide the reach indicator on the yardstick until the end of the indicator touches the tips of your fingers. The indicator is then held firmly in place throughout the rest of the test. Now the individual gradually bend forward as far as possible on the yardstick three times. The final number of inches reached is records to categorised individual into fitness category (Hoeger and Hoeger 2014).

ii. **Behind-the-back reach test** The individual stand straight, place right hand at back crossing over the right shoulder and left hand behind the lower back. The fingers are extended and points towards each other. Now, the hands are stretched to bring the fingers close or overlap as much as possible, holding the final reached position for 2 seconds. measure to the nearest half inch the distance between the tips of the fingers or the amount of overlap between the fingers. If the individual is unable to touch or overlap the fingers, the distance between the fingers is recorded as a negative score. If fingers touch but do not overlap, the score is equals to zero (0). If the fingers overlap, the amount of overlap is measured using tape and report as a positive score. Similarly repeat the test on the left side and record the score.