Chapter - I
CHAPTER-I
INTRODUCTION

"Sound Mind in a Sound Body"  "Health is Wealth"

The importance of the health is undoubtedly agreed by everyone in a normal walk of life. If one loses his wealth, it can be recovered in due course of time unless in case of health which can be deemed as a primary wealth of the human being. Without good health, a person cannot enjoy the whole benefits of physical fitness. Specifically the researcher was aiming to know and adopt suitable requirements for maintaining the minimum level of health related fitness for the undergraduate software engineering male students and trying to suggest appropriate regimens of exercise programmes to improve their fitness level. In the present scenario, the physical fitness has become a forgotten component by professional students. They were sitting in front of a computer for a very long time completely neglecting the importance of maintaining the minimum fitness level inviting all the health problems and other ailments.

The components of health related fitness are a basis from which to measure our general wellbeing. It is the aim of exercise to improve our capabilities in each of these areas. Different sports will be more demanding in some, and less demanding in others, but athletes usually strive to achieve a reasonable level of health fitness in each area. There are four health related components of fitness. These are Body Composition, Flexibility, Cardio Respiratory Endurance and Muscular Strength Endurance. To perfect the body performance for a particularly demanding sport one has to focus to fix a goal for a balanced level of achievement in each of these fitness components. The
fitness program selected by the researcher included activities and exercises that promote each of these health related fitness components.

1.1 Physical Fitness

Physical fitness is a state of well-being with low risk of premature health problems and energy to participate in a variety of physical activities - President’s Council on Physical Fitness and Sports (1997). Physical fitness is defined as "a set of attributes that people have or achieve that relates to the ability to perform physical activity" United States Department of Health and Human Services, 1996. Overall fitness is made up of the following four main components: 1. Body composition, 2. Flexibility, 3. Cardio Respiratory Endurance and 4. Muscular Strength Endurance.

As every major health, medical and exercise professional organization in the USA claims a link between improved fitness and health, there must be a universally accepted definition of fitness in support of this assertion, one that is time tested and precise. Most professionals would agree that this is true, but when pressed to define, in absolute terms, what fitness is, 100 professionals would likely provide 100 different definitions. As it turns out, "fitness" is a poorly defined term in the fitness and allied health professions. In the early days of the fitness boom a simple operational definition of “physical fitness” was commonly cited: “The ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure time pursuits and meet unforeseen emergencies” by Clarke, H.H. (ed) (1971). The United States Department of Health and Human Services and the American College of Sports Medicine in their standards of practice doctrine trimmed the 1970’s definition to an even more cursory version: “A set of attributes that people have or achieve relating to their ability to perform physical activity”
Physical fitness had gone from being "ability" in 1971 to a "set of attributes" in 1996. This marks a move away from a functional definition to the enumeration of specific characteristics. The specific "attributes" to which The United States Department of Health and Human Services and the American College of Sports Medicine referred in 1996 were not specifically included in a definition for another 10 years: "A multidimensional concept that has been defined as a set of attributes that people possess or achieve that relates to the ability to perform physical activity and is comprised of skill-related, health related, and physiologic components. Skill related components of physical fitness includes agility, balance, coordination, speed, power, and reaction time, and are mostly associated with sport and motor skills performance. Health related physical fitness is associated with the ability to perform daily activities with vigor, and the possession of traits and capacities that are associated with a low risk of premature development of hypokinetic diseases. Health related components of fitness include cardiovascular endurance, muscular strength endurance, flexibility, and body composition. Physiologic fitness differs from health-related fitness in that includes nonperformance components that relate to biological systems influenced by habitual activity. Physiologic fitness includes – (a) Metabolic Fitness: The status of metabolic systems and variables predictive of the risk for diabetes and cardiovascular disease. (b) Morphologic fitness: The status of body compositional factors such as body circumference, body fat content, and regional body fat distribution. (c) Bone integrity; The status of bone mineral density."

Scientists have always been interested in what makes an organism fit. Major scientific and philosophical theories deal specifically with fitness and its role in adaptation. Darwin, C.R. (1859) provided a crucial insight into the adaptive mechanism, and a better understanding of the organism's relationship to its
environment over time. Claude Bernard (1865) the father of scientific method, was quoted to say "It is the fixity of the ilieu interieur (internal environment) which is the condition of free and independent life, all the vital mechanisms, however varied they may be, have only one object, that of preserving constant the conditions of life in the internal environment". "Possession of adequate levels of strength, endurance, and mobility to provide for successful participation in occupational effort, recreational pursuits, familial obligations, and that is consistent with a functional phenotypic expression of the human genotype" (Dr. Lon Kilgore and Mark Rippetoe). This definition applies to the general population, but can be extended to sporting populations, as sport has goals and specializations that merely emphasize or deemphasize to varying degrees specific components of physical fitness.

A set of attributes that people have or achieve relating to their ability to perform physical activity (U.S. Department of Health & Human Services, 1996). The above definition from Physical Activity and Health: A Report of the Surgeon General is the most common currently used definition of physical fitness. It was originally used by Caspersen, et al. (1985) and has been used extensively by Pate et al (1995) and Howley and Franks (1997). An alternative definition that provides additional descriptive information is also included here. Physical fitness is a state of well-being with low risk of premature health problems and energy to participate in a variety of physical activities (Howley & Franks, 1997) While either is a good definition, most experts agree that physical fitness is both multidimensional and hierarchical (Corbin, 1991 Bouchard, Shephard, and Stephens (1994) presented a comprehensive model for physical fitness that includes morphological fitness, bone strength, muscular fitness, flexibility, motor fitness, cardiovascular fitness, and metabolic fitness. In this paper the researcher defined each of these fitness components that are consistent with recent

1.1.1 Benefits of Physical Fitness

1. The exercises are conditioning the heart and lungs muscle by increasing the oxygen available to the body therefore enabling the heart to use oxygen more efficiently. 2. The physical fitness helps to develop the physical fitness components such as strength, endurance, agility, flexibility, etc and to achieve the improvement of muscle tone. 3. It fosters correct posture, figure, body image, and physical appearance. 4. It helps in the quick recovery after injury, illness and decrease the risk of cardiovascular disease. 5. It reduces and controls body fat, exercise combined with a proper diet will reduce body fat and also fulfill proper nutritional requirement. 6. It increases the energy level of a person and helps to maintain ideal body weight. 7. Through participation in physical fitness program, leisure (free) time is properly utilized. 8. It help to improve mood and reduce depression and anxiety. 9. It postpones fatigue and reduces recovery time after vigorous activity. 10. It also helps people to meet challenges of life, make them self confident and postpones ageing process.

1.2 Health Related Physical Fitness

Health related physical fitness consists of those components of physical fitness that have a relationship with good health. These components are Body Composition, Cardiovascular Endurance, Flexibility and Muscular Strength Endurance. Prior to the last 40 years, the distinction between health related physical fitness and skill related physical fitness was not typically made. When tests of physical fitness are administered in school, medical and other settings it is typically health related fitness components that are measured. Typically lab and field tests of health related fitness
involve some type of performance such as running, stretching, or doing a specific muscle exercise. Because body composition (also referred to as relative leanness) is not a performance measure, some question its inclusion as a component of health related physical fitness. Possessing good health-related fitness is related to lower risk of illness and improved quality of life.

1.3 Skill Related Physical Fitness

Skill Related Physical Fitness consists of those components of physical fitness that have a relationship with enhanced performance in sports and motor skills. The components are commonly defined as agility, balance, coordination, power, speed and reaction time. With the changing focus to health related physical fitness those components of fitness previously included in fitness tests that are not directly related to improved health were designated as skill related physical fitness components. Possession of skill related fitness abilities enhances ability to perform in sports and games but only has an indirect connection with health. The skill related components of fitness are considered to be agility, balance, coordination, power, speed, and reaction time though some experts feel that other abilities such as visual tracking should be included. It is assumed that people who possess skill-related fitness will be more likely to engage in regular activity and for this reason will have enhanced health related fitness and a lower risk of hypokinetic diseases and condition (see later) definition. Skill related fitness components are assessed with performance measures. Such components as reaction time and speed are considered by some to be more related to heredity than healthy lifestyles, especially in children.
1.4 **Physiological Fitness**

Physiological fitness includes non-performance components of physical fitness that relate to biological systems that are influenced by one's level of habitual physical activity. (adapted from Bouchard, et al., 1990). The concept of physiological fitness was introduced in a publication of the first international consensus statement of current knowledge of physical activity (Bouchard, et al., 1990). It differentiated health-related (primarily performance measures) from non-performance measures. Some of the sub-components of physiological fitness that have gained acceptance are metabolic fitness, morphological fitness, and bone integrity.

1.5 **Metabolic Fitness**

The state of metabolic systems and variables predictive of the risk for diabetes and cardiovascular disease which can be favorably altered by increased physical activity or regular endurance exercise without the requirement of a training-related increase in VO$_2$max. (Adapted from the American College of Sports Medicine, 1998). Though Despress, et al. (1991) are first credited with using the term metabolic fitness which was first used widely after it was described in the proceedings of the second International Consensus Conference on Physical Activity, Fitness and Health (Bouchard, et al., 1994). The use of the term metabolic fitness in the recent position statement describing the quality and quantity of physical activity needed to attain health related benefits. American College of Sports Medicine (1998) establishes it as a major fitness component. The International Consensus statement noted that metabolic fitness included such sub-components as blood sugar levels, blood lipid levels, and blood hormone levels. The reason for the identification of metabolic fitness as a separate component of fitness is because "It is now clear that lower levels of physical activity (particularly intensity) than recommended (by this position stand) may reduce
the risk for certain chronic degenerative diseases and improve metabolic fitness and yet may not be of sufficient quantity or quality to improve VO₂max” (American College of Sports Medicine (1998)).

1.6 **Morphological Fitness**

A non-performance component of fitness related to body composition factors such as body circumferences, body fat content, and regional body fat distribution were adapted from Bouchard et al., (1994). Morphological fitness measures are often related to metabolic fitness components. As noted earlier body composition is often included as a component of health related fitness but is also appropriately considered a component of morphological fitness. Those measures used to assess body composition are also used to assess morphological fitness as are measures such as body mass index, waist circumference, and waist to hip ratio.

1.7 **Bone Integrity (Bone Strength)**

A non-performance component of fitness related to bone mineral density. Bone strength was identified as a component of physical fitness in the first International Consensus Statement (Bouchard, 1990). Because measurement is expensive and requires special instrumentation and a high degree of expertise, there are no currently used field measures that are used extensively. There is general consensus, however, that bone integrity is related to habitual physical activity.

1.8 **Levels of Health Related Physical Fitness**

Fitness Level means the human body’s ability to withstand a physical workload (how much) and to recover in a timely manner. There have been numerous studies (mostly for men) about fitness in relation to health over the years showing positive effects of exercise on health. A new one in 2005 included nearly 6,000 Chicago-area
women who underwent exercise stress tests as part of the St. James Women Take Heart Project. Rush University researcher Martha Gulati, MD, led the team that analyzed the data. The researchers designed a simple chart that lets you see how your personal fitness level matches up with the fitness of other people your age. To use the chart, you have to know how much exercise you’re able to do. This can be learned in a gym, using a treadmill or the Fitness Test from Health Reviser, which is a computer test that uses our own physiological data to analyze our fitness level.

Dr. Gulati noted that ‘having a good fitness level for one’s age predicts better survival. If you are below the fitness level for your age, you are more likely to die.’ Gulati found that women double their risk of death if they can’t exercise at 85% of the level normal for their age. (Gulati’s study appears in the Aug. 4, 2005 issue of The New England Journal of Medicine.)

1.9 Fitness Level

Sportsmen/women and professional athletes would benefit greatly from knowing their current fitness level. They are pretty much in training all the time and it would help them to get the most efficient use of their exercise sessions (i.e. the need to exercise with more or less intensity on any given day, or take a day of rest to prevent strain or injury). Also, knowing their fitness level would help them plan their exercise strategy with the goal of a championship meet, match, run, etc. The same benefits would apply to a regular person planning their daily/weekly exercise routine. Avoiding overtraining, under training and injuries is important to everyone.

Pamela S. Douglas, MD, a Duke University researcher said that the doctors usually look at electrocardiograms [EKGs] and other tests to see heart trouble - but it turns out how long one could exercise was almost as important. If one was well, how
long he could exercise was more important than any other variable in determining how
long he lived. Douglas warned that many people who thought of themselves as active
were getting much less exercise than they need. That's why she said that pedometers
were a great idea. The devices measure how many steps one really took in a day.

According to the research done by Kramer et al. (1999), Chodozko-Zaijko
(1991), Van Boxtel et al. (1997) and Etnier et al. (1997), physical fitness has a positive
impact on cognitive performance. So not only does our physical health benefit from
exercise, our brain does also. In this study the researcher has categorized the intensity
level of selected into the following categories: The Intensity Level of exercises was
measured in terms the amount of oxygen consumed by the body as an activity is
performed. This method is expressed in studies as the percentage of maximum oxygen
consumption, or %-VO2 max. The oxygen consumption method is used most often in a
research setting.

Another method of measurement works with the increased heart rate that
occurs with exercise. The greater the intensity of the activity being performed, the
higher the heart rate. This method is expressed as a percentage of maximum heart rate
or %-MHR. Measuring heart rate is the method most often used to evaluate intensity in
everyday life or to set the level of exercise in physical training. Low, moderate and
high levels of exercise intensity, as measured by heart rate, are defined as follows:

- Low (or Light) is about 40-54% MHR.
- Moderate is 55-69% MHR.
- High (or Vigorous) is equal to or greater than 70% MHR.

An individual's maximum heart rate can be estimated by using the formula:

\[
220 - \text{Age in years} = \text{MHR}
\]

Pulse rate can then be monitored while an exercise is being
done and the % MHR calculated to assess intensity. So, for example, the estimated MHR for a 20-year-old individual would be 220-20, or 200. Let's say that an individual's heart rate measured 120 beats per minute performing a certain activity. Since 120 is 60% of the MHR (200), that would be considered a moderate level of exercise. The overall levels of intensity for a 20-year-old would be as follows:

- **Low Intensity**: heart rate is 80-to-108 beats per minute.
- **Moderate Intensity**: heart rate is 109-to-138 beats per minute.
- **High Intensity**: heart rate is more than 139 beats per minute.

The researcher selected 80 subjects of the low level fitness category based on the pilot study conducted for them. The researcher selected the appropriate subjects for the study based on the initial test administered for them. Out of the four groups formed, the researcher has given three different kinds of trainings for each group except the control group who followed their normal activities. The level of fitness took a major role to fix an appropriate load, intensity, duration, and frequency for the training.

### 1.10 Components of Health Related Physical Fitness

Recently all the media constantly projects the image of ideal weight. The principals of the components of physical fitness should be turned towards fat loss for good health rather than the obsession over total weight. Fat control can be efficiently done with a commitment to regular structured exercise that will develop the 4 components of physical fitness.

The health related physical skills each contribute to a healthy quality of life. Optimal fitness is reflected in the a person's ability to cope well with daily life as
actively fit individuals will develop a resistance to hypo kinetic diseases such as obesity, heart failure and diabetes which are physical conditions associated to inactivity and idle lifestyles. Optimal physical fitness is a combination of lifestyle, nutrition, habits, but it cannot be reached without an appropriate level of physical activity.

1.10.1 Body Composition

A health related component of physical fitness that relates to the relative amounts of muscle, fat, bone and other vital parts of the body. (From Surgeon General's Report on Physical Activity and Health, 1996 as adapted from Corbin and Lindsey, 1994). This component of physical fitness is measured in the laboratory using such measures as underwater weighing and in the field using skinfold calipers. There are a variety of other methods of assessing body composition; also referred to as relative leanness (Howley and Franks, 1997). As noted previously body composition is the only non-performance measure among the health related physical fitness components.

The body composition looks at the ratio of fat in the body compared to the overall levels of lean body mass. When the body fat mass ratio is high you are considered over weight or even obese. This high fat content ratio is a sign of a higher propensity to develop coronary heart disease, diabetes, joint and back pains, arthritis and higher risk of tendon-muscular accidents and injuries due to inactivity. There is a direct link in the speed of adding pounds of fat to the lack of physical exercise and reducing the fat ratio both by diet changes, nutrition quality and regular physical exercise are the key.
Body composition represents the amount of fat mass versus fat-free mass in the body. Often we focus on body weight as a method of determining our health. Weight alone may not be the best measure of fitness, especially since muscle weighs more than fat. Therefore, we might conclude that a person weighing 200 pounds may be overweight, but if we look at his/her body composition we may discover that in fact they have a healthy percent body fat, and perhaps they seem "heavy" because muscle weighs more than fat. It is important to realize that weight alone is not the best measure to determine if we are healthy; looking at body composition may give us a more accurate health assessment based on percent body fat.

We know that some fat in the body is essential to our health; for men this level of essential fat is 3-5% and for women it is 8-12%. Without fat in the body, normal functions such as hormone production and regulation may not be possible. In addition, fat serves as an insulator and a cushion, and is it a valuable source of energy. It is possible to be above the essential levels of body fat (many people are) and still be healthy (the average male 15-18% and females 22-25%). However, as mentioned earlier, many people are not just slightly overfat, many people are now being classified as extremely overfat and obese (>30%bodyfat or >30BMI). The resulting diseases and illnesses associated with obesity are diabetes and cardiovascular disease. So as our population becomes fatter, we are at greater risk for health problems.

1.10.2 Percent Body Fat

Body fat scales use the BIA (Bioelectrical Impedance Analysis) technique. This method measures body composition by sending a low, safe electrical current through the body. The current passes freely through the fluids contained in muscle tissue, but encounters difficulty/resistance when it passes through fat tissue. This resistance of the
fat tissue to the current is termed 'bioelectrical impedance', and is accurately measured by body fat scales. When set against a person's height, gender and weight, the scales can then compute their person body fat.

1.10.3 Body Fat Percentage Fluctuations

Our eating habits, life-style and the amount of exercise we perform all affect our weight and levels of hydration. Since BIA relies on the fluid levels of 'fat free mass', such as muscle tissue, certain factors can alter an individual's body fat reading. For example:

- The reading may be lower than normal if you measure your body fat just after a bath or exercising.

- The reading may be higher than normal if you have just woken up or eaten a meal.

In general, there is less fluctuation in a person's body weight and hydration levels between the late afternoon and the early evening (two hours after eating lunch) and before the evening meal. However, as everyone's daily routine and eating habits are different, one should determine the most suitable time to measure their own body fat.

1.10.4 Importance of Monitoring Body Fat

Body fat is vital to daily body functions; it cushions the joints and protects the organs, helps regulate body temperature, stores vitamins and helps the body sustain itself when food is scarce. Everyone needs some body fat to be active and healthy. Most people think that body weight, and not body fat, is a direct indication of fitness. Yet during a diet and exercise regime, whilst someone's absolute weight may fluctuate,
their body fat will decline in a slow but steady rate to the desired level. Using body fat scales to measure changes in both body fat and weight gives a more dependable picture of fitness.

1.10.5 Cardio Respiratory Endurance

A health related component of physical fitness that relates to ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity. (From Surgeon General's Report on Physical Activity and Health, 1996 as adapted from Corbin and Lindsey, 1994).

Cardio Respiratory Endurance is occasionally called as the ability of heart, lungs, and blood vessels to deliver oxygen to muscles during prolonged physical activity. Cardio Respiratory Endurance is also referred to as cardiovascular endurance, aerobic fitness and cardio respiratory fitness. A VO\textsubscript{2}max test in the laboratory setting is considered to be the best measure of Cardio Respiratory Endurance. Commonly administered field tests include the mile run, the 12 minute run, the 1 mile run, the mile walk, the PACER run for children and various bicycle, step, and treadmill tests.

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.

Cardio respiratory endurance represents the body's ability to do physical activity. One's level of fitness is determined by the body's ability to take up, distribute, and use oxygen during physical activity, which is known as Cardio respiratory
endurance. Cardio respiratory endurance is usually measured in terms of maximal oxygen uptake or VO$_2$max—this is the amount of oxygen the body uses when a person reaches their maximum ability to supply oxygen (O$_2$) to the working muscles during physical activity. (VO$_2$max is measured in millimeters of oxygen used per minute for each kilogram of body weight.)

The value of Cardio respiratory endurance is that it can be used to measure present fitness levels and also be used as a tool to measure fitness progress. Higher levels of cardio respiratory endurance represent greater levels of fitness. The higher level indicates that the person’s body is better able to handle the demands (oxygen, nutrients) placed on it during physical activity. This can also be interpreted as an indication that the stronger the heart, the less challenging the task, which means that a person may be able to do an activity longer and/or harder due to their level of fitness. This is important with regards to heart disease because higher cardio respiratory endurance is associated with a lower risk of cardiovascular disease and obesity, and a higher quality of life.

One indirect measure of VO$_2$max is the 1-mile walk run. Using tests such as this can allow us to assess our own cardio respiratory endurance level, and then we can repeat this test to monitor our fitness progress. Often setting cardio respiratory goals enables us to improve our cardio respiratory endurance, which in most cases leads to improvement in the other health related fitness components.

1.10.6 Flexibility

A health-related component of physical fitness that relates to the range of motion available at a joint. (From Surgeon General's Report on Physical Activity and Health, 1996 as adapted from Wilmore and Costill, 1994).
Some experts specify that flexibility requires range of motion without discomfort or pain (Howley and Franks, 1997). Flexibility is specific to each joint of the body, thus there is no general measurement of flexibility as there is for cardiorespiratory fitness. Flexibility is typically measured in the lab using measurement devices such as a goniometer, flexometer and in the field with tests such as the sit and reach and the zipper. 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 program.

The objective of flexibility exercises is to improve the range of stretch of the antagonistic muscles. Flexibility plays an important part in the preparation of athletes by developing a range of movement to allow technical development and assisting in the prevention of injury. When you perform a stretch correctly you will feel mild discomfort in the antagonistic muscles. If you feel pain or a stabbing sensation you must STOP. The body responds best to a stretching program when it is warm and the muscles and joints have been exercised through their current range of movement.

**Types of Flexibility Exercises**

The various techniques of stretching may be grouped as Static, Ballistic, Dynamic, Active, Passive, Isometric and Assisted Stretching. Static methods produce far fewer instances of muscle soreness, injury and damage to connective tissues than dynamic or ballistic methods. Static methods are simple to carry out and may be conducted virtually anywhere. For maximum gains in flexibility in the shortest possible time PNF technique is the most appropriate. Dynamic - slowed controlled movements through the full range of the motion will reduce muscle stiffness. Where the technique requires ballistic movement then ballistic stretches should be employed.
When conducting flexibility exercises it is recommended to perform them in the following order - Static, Assisted and then Dynamic.

Flexibility exercises could be part of the warm up or warm down program and a stand alone unit of work. It is considered beneficial to conduct flexibility exercises as part of the warm down program but should not include ballistic or dynamic exercises as the muscles are fatigued and more prone to injury. Static exercises are recommended as they relax the muscles and increase their range of movement.

The following factors limiting flexibility as internal influences were the type of joint, the internal resistance within a joint, body structures which limit movement, the temperature of the joint and associated tissues, the elasticity of muscle tissue, tendons, ligaments and skin and the ability of a muscle to relax and contract to achieve the greatest range of movement.

Factors limiting external influences were the temperature of the place where one is training (a warmer temperature is more conducive to increased flexibility), the time of day (most people are more flexible in the afternoon than in the morning), the stage in the recovery process of a joint (or muscle) after age (pre-adolescents are generally more flexible than adults), gender (females are generally more flexible than males), the restrictions of any clothing or equipment, one's ability to perform a particular exercise and one's commitment to achieving flexibility.

1.10.7 Muscular Strength Endurance

A health related component of physical fitness that relates to the muscle's ability to continue to perform without fatigue. (From Surgeon General's Report on Physical Activity and Health, 1996 as adapted from Wilmore and Costill, 1994).
Like flexibility, muscular endurance is specific in nature. For true assessment of muscular endurance it would be necessary to test each major muscle group of the body. Lab and field tests of muscular endurance are similar and are based on the number of repetitions that can be performed by the specific muscle group being tested (example: repetitions of push-ups or abdominal curls. Muscular endurance can be measured isometrically (static contractions) or isotonically (dynamic contractions). To improve your muscle endurance, try cardiorespiratory activities such as walking, jogging, bicycling, or dancing.

A health-related component of physical fitness that relates to the ability of the muscle to exert force. (From Surgeon General’s Report on Physical Activity and Health, 1996 as adapted from Wilmore and Costill, 1994).

Like flexibility and muscular endurance, strength is specific in nature. For true assessment it would be necessary to test each major muscle group of the body. Lab and field tests are similar and involve the assessment of one repetition maximum (the maximum amount of resistance you can overcome one time). 1RM tests are typically conducted on resistance machines. Strength can also be assessed using dynamometers. Strength can be measured isometrically (static contractions) or isotonically (dynamic contractions).

The key to making your muscles stronger is working them against resistance, whether that be from weights or gravity. If you want to gain muscle strength, try exercises such as lifting weights or rapidly taking the stairs.

In addition to cardiorespiratory endurance, muscular strength endurance is also an important aspect of our health-related fitness. Muscular strength represents the
maximal amount we can lift/move one time and muscular endurance represents the ability of a muscle to do multiple repetitions and/or hold a contraction over time. The value of maintaining muscular strength endurance is that this enables us to enjoy a higher quality of life because we are able to do our daily tasks more easily. For example, we are able to lift our children, open doors, walk up stairs and carry groceries. Greater muscular strength and endurance are also associated with greater levels of self-confidence. Maintaining muscle mass also assists us with our metabolism because muscle requires energy at rest while fat does not.

So if you are more muscular, you have the potential to burn more calories even when at rest. Therefore, if you are trying to lose weight, incorporating muscular strength and endurance activities into your daily life would potentially allow you to burn more calories. Muscular strength endurance training may also aid with the development and maintenance of strong bones and reduce the onset of osteoporosis, and potentially reduce one's injury risk. Lifting weights or doing other muscular strength and endurance activities has many benefits. Our loss of strength as we age does not have to be very noticeable if we maintain these two components of health-related fitness.

The mention of muscle mass in the strength and endurance paragraph is also important to the health related component of body composition. In general, the more physically active we are, the more likely we are to have a healthier body composition. Physical activity results in the use of energy to complete the activity, and the greater the muscle mass the more calories that will be burned before, during and after the activity. As mentioned this may be important to someone trying to manage their weight.
1.11 Physiological Variables

Physiological fitness includes non-performance components of physical fitness that relate to biological systems that are influenced by one's level of habitual physical activity. (adapted from Bouchard, et al., 1990).

1.11.1 Resting Heart Rate

Resting heart rate (Resting HR) is the number of beats in one minute when you are at complete rest. Your resting heart rate indicates your basic fitness level. The more well-conditioned your body, the less effort and fewer beats per minute it takes your heart to pump blood to your body at rest. The best time to find out your resting heart rate is in the morning, after a good night's sleep, and before you get out of bed.

The heart beats about 60 to 80 times a minute when we're at rest. Resting heart rate usually rises with age, and it's generally lower in physically fit people. Resting heart rate is used to determine one's training target heart rate. Athletes sometimes measure their resting heart rate as one way to find out if they're over trained. The heart rate adapts to changes in the body's need for oxygen, such as during exercise or sleep.

1.11.2 Maximum Oxygen Consumption (VO₂max)

VO₂max is the maximum volume (V) of oxygen (O₂) in milliliters that you can use in one minute, per kilogram of body weight, while breathing air at sea level. Oxygen consumption happens to be linearly related to energy expenditure; therefore, when we measure oxygen consumption, we are indirectly measuring an individual's maximal capacity to do work aerobically. Keep in mind that this is one of many components of "fitness" and happens to be a particularly important characteristic for great endurance performances in running, cycling, rowing, cross-country skiing, or even high-altitude alpine climbing. Those individuals who are in better cardiovascular
condition will have higher VO₂ max values and can exercise more intensely than those
who are not as fit. Don't despair if your VO₂ Max is fairly low when you first start a
training program -- studies show that you can significantly increase your VO₂ max by
regular training and by gradually increasing your activity level until you can work at
an intensity that raises your heart rate to between 65 and 85% of its maximum for at
least 20 minutes 3-5 times a week.

Maximal oxygen consumption (often abbreviated to VO₂ max) is the maximum
volume of oxygen consumed per minute. The fitter a person is, the more oxygen he or
she can draw from the blood. Oxygen is extracted from air in the lungs, transported in
the blood, and then utilized by respiring tissues to release energy from food. The
energy that is released is used to synthesize ATP, a high energy compound which is
the only direct source of energy for the body's activities. Maximal oxygen
consumption is therefore a measure of a person's ability to use aerobic respiration as a
source of energy. As such, it also reflects a persons aerobic work capacity, endurance
capacity, and maximal aerobic power.

Maximal oxygen consumption is usually expressed in units of millilitres of
oxygen consumed per kilogram body mass per minute. It is determined during a large
muscle group activity (e.g. cycling or running). The intensity of the activity is
progressively increased until exhaustion. Sometimes maximal oxygen consumption is
expressed as litres of oxygen consumed per minute, to indicate total work capacity.
The average value for a 20-year-old female is between 32-38 ml/kg/min; for a 20-year-
old male it is 36-44 ml/kg/min.

Maximal aerobic capacity can improve with training. The amount of
improvement is highly individualized and inversely related to the initial level of
fitness. A sedentary person may experience as much as a 25 per cent increase in VO₂ max after only 8 weeks training; someone used to aerobic exercise may experience 5 per cent improvement or less in the same time. There is an upper limit of oxygen consumption beyond which training has no effect. This limit seems to be genetically determined and may be reached after 18-24 months of intensive endurance training.

1.11.3 Systolic Blood Pressure

The pressure exerted on the vessel walls during ventricular contraction, measured in millimeters of mercury. The systolic number is the top of the fraction. 120/80 is an average value for normal blood pressure (120 is the systolic number). Mild high blood pressure is considered to be between 140/90 and 160/95. High blood pressure is defined by a value greater than 160/95.

Blood pressure is a measurement of the force applied to the walls of the arteries as the heart pumps blood through the body. The pressure is determined by the force and amount of blood pumped, and the size and flexibility of the arteries. Blood pressure is continually changing depending on activity, temperature, diet, emotional state, posture, physical state, and medication use.

Blood pressure is usually measured while you are seated with your arm resting on a table. Your arm should be slightly bent so that it is at the same level as your heart. The upper arm should be bare, with your sleeve comfortably rolled up.

Blood pressure readings are measured in millimeters of mercury (mmHg) and usually given as 2 numbers. For example, 110 over 70 (written as 110/70).

- The top number is the systolic blood pressure reading. It represents the maximum pressure exerted when the heart contracts.
• The bottom number is the diastolic blood pressure reading. It represents the minimum pressure in the arteries when the heart is at rest.

To obtain your blood pressure measurement, your health care provider will wrap the blood pressure cuff snugly around your upper arm, positioning it so that the lower edge of the cuff is 1 inch above the bend of the elbow. The health care provider will locate the large artery on the inside of the elbow by feeling for the pulse and will place the head of the stethoscope over this artery, below the cuff. It should not rub the cuff or any clothing because these noises may block out the pulse sounds. Correct positioning of the stethoscope is important to get an accurate recording. Your health care provider will close the valve on the rubber inflating bulb and then will squeeze it rapidly to inflate the cuff until the dial or column of mercury reads 30 mmHg higher than the usual systolic pressure. If the usual systolic pressure is unknown, the cuff is inflated to about 210 mmHg.

1.11.4 Diastolic Blood Pressure

Diastolic blood pressure refers to the pressure that is exerted on the walls of the various arteries around the body in between heart beats when the heart is relaxed. Statistics suggest that high diastolic readings can be directly linked to heart disease, strokes and early death. BP readings are represented as one figure over another. The bottom value in the representation is the diastolic, whilst the upper value is the systolic pressure reading. A blood pressure reading would be written as 140/90, with 140 being the systolic measurement, and 90 being the diastolic measurement. Both readings in the example above would be indicative of a higher than normal blood pressure level.

When diastolic blood pressure readings are above 80, a person is said to be either prehypertensive or hypertensive. Prehypertensive individuals will have a
diastolic blood pressure reading of between 80 and 89 mmHg. The moment that diastolic blood pressure levels reach 90 mmHg it is an indication that the patient concerned is suffering from hypertension, or high blood pressure. Diastolic readings may also be used to determine precisely which type of hypertension a person is suffering from. A diastolic blood pressure reading above 120 mmHg is a clear indication that a person is at serious risk of succumbing to a stroke or heart attack. This type of hypertension is termed accelerated malignant hypertension and requires urgent medical attention.

1.12 Calisthenics Exercises

Calisthenics exercises are a natural form of exercise with a variety of simple movements using only your body weight for resistance. Isometrics are a form of static calisthenics exercise (when done without weights) which improves muscle strength around the joint at which the exercise is performed. For example, by standing, you are engaging muscles around your ankles and legs to keep you balanced. Although isometrics can be done with or without weights, results can be achieved without the use of weights – thus making isometrics fundamentally a calisthenics exercise.

In fact, body weight exercises may be too much for some people, but with proper techniques calisthenics exercises can be modified to increase or decrease resistance allowing the practitioner complete control of the intensity of the workout.

Calisthenics exercises intend to increase body strength and flexibility using only one’s body weight with movements such as bending, jumping, swinging, twisting, kicking, and many other various activities engaging the arms, legs, torso, neck, back – basically every muscle group in your body. In the end, calisthenic exercises are great for natural strength building – easy or hard.
Calisthenic Exercise, if performed vigorously and with variety, can benefit both muscular and cardiovascular fitness. Calisthenic exercises are usually repetitious natural movements that can also improve psycho-motor skills such as balance and coordination when done with consistency.

1.12.1 Benefits of Calisthenics Exercises

1. Calisthenics Exercises are completely free, and relatively easy to perform. You don't necessarily need a gym membership unless you feel like it's a better environment than your home for exercising.

2. By adding calisthenics to your exercise regime and going on a good diet, tremendous improvements to your health and level of fitness will result.

3. Does not require you to buy or use expensive equipment. Your body-weight is the only thing you need!

4. Can be done anywhere and anytime.

5. Calisthenics can be done by people in all age groups and genders and without risk of injury when done properly.

6. Improves overall stamina, strength, energy, agility, coordination, balance, and promotes overall fitness for your health.

7. Can improve mental health just as it does psycho-motor skills like balance and coordination. Can help treat mental problems such as stress, anxiety, depression, etc. and can boost your self-esteem.

8. You can have a partner to help increase or decrease the resistance level of the exercises making calisthenics more fun and enjoyable.
9. Helps burn fat! Calisthenics improves the ability of muscles to use fats during exercise – everyone wants to get rid of unwanted fat which can potentially result in a lean and fit physique.

10. Calisthenics helps strengthen the muscles around your joints allowing them to become more stable and can help you avoid injuries in your everyday life.

11. Simple exercises such as the squat and push up can help you workout the entire body due to all the various synergies.

12. When done consistently, calisthenics can provide relief from various body and muscle aches and pains.

13. You can achieve greater vigor, flexibility, and agility from your muscles by performing calisthenics.

14. Performing some various calisthenics exercises may speed up your heart rate which becomes a cardio workout – thus making it good for heart health.

15. Calisthenics Exercises are more natural for your body than weight-lifting! It also sculpts your body naturally which, in the eyes of most people, results in a more attractive looking physique.

This study mainly focused own body weight for doing the calisthenics exercises. Based on the FITT Principles, the Frequency, Intensity, Training Schedule and Type of Exercises have been selected to suit the purpose of the study.

1.13 Calisthenics Exercises in the Water

Water Exercise have been a popular way of keeping fit for years, particularly for people with certain health problems or those recovering from injury. There is also a growing trend to extend its appeal to younger fitness enthusiasts, with pools and gyms
offering an increasing number of classes with topics such as Water Boxing, Aqua Step, as well as using specialized equipment to extend the normal range of exercises. As a result, it has the potential to appeal to a wider range of people than ever, and regardless of your fitness level there's a good chance you'll find a water exercise class that you'll enjoy.

Water Exercises is an excellent way for people of all ages and fitness levels to exercise in an injury free environment. Water Exercises is recommended because of the natural scientific properties of water; buoyancy, gravity, pressure and warming and cooling properties. Water exercise can increase flexibility, strength, heart health, coordination, and overall well being.

Exercising in the Water requires one to support only 50% of one’s body weight, making exercises easier to perform. You don’t need any special equipment, although there is a variety of equipment available for increasing variety, fitness and helping with floatation if required. Water’s buoyancy lowers the risk of stress related injuries that some land exercises have the water’s resistance against your movements results in a higher workout intensity compared to land exercises. A massaging effect is created when your muscles are surrounded by water. With indoor pools, it’s a great year-round activity; although in the hotter months it is one of the best ways to get a total body workout without overheating. You will come out of the water looking fresher and smelling nicer than many other exercise classes: no sweat, and no wet hair!

Most people exercise for at least one of the following reasons:

- **Fitness:** Cardiovascular Endurance, Muscular Strength and Endurance, Flexibility, Coordination, Agility Power and Balance are fitness components achievable for your improving and maintaining your fitness level.
• **Therapeutic**: Exercise in the Water safely enables and assists you in the recovery of injuries, surgeries and illnesses and helps combat the aging process.

• **Stress Release**: Exercising in a soothing water environment gives you a chance to forget about the stresses of work, problems and other concerns and helps you relax.

• **Social**: Aquatic exercise allows you to meet and be with other people...since your face is out of the water, you have the opportunity to communicate and make new friends.

• **Comfort**: The cooling and massaging effects of exercising in the water make it a great place to workout without feeling fatigued.

• **Fun**: The pool environment and facility atmosphere make water a great place to laugh and have fun while doing something great for your body.

1.13.1 **Benefits of Water Exercises**

Water exercises can be done both in the shallow or deep water. Selecting the amount of water depends on the goal of your exercise. As you go deeper more pressure would be exerted on your body, making your workout even tough. Here are some core benefits of the water exercises:

Water exercises helps to strengthen the back muscles. It helps to develop your abs and even your hip muscles, this is because the water movement hinders and resists the movement of your lower body hence making your muscles even stronger. When you carry out the water exercises with your body immersed in the Water, it helps you to pull the pleasure out of your training session and urges you to spend more time on your workout session. Buoyancy of the water, that you are exercising in helps to
reduce the load on your knees and your joints. It helps to create weightlessness which would help you workout your training session more efficiently. Water exercises are best meant for the lower back. Water exercises that basically works on your hips help to strengthen your lower back, these exercises principally includes bicycling and water walking. Water Exercises helps you to relax your body along with the workout session. Exercising in the Water is purely fun and pleasure. This helps you to carry out the workouts as frequent as needed. Water exercises are mainly aerobic and they help to keep your lungs and heart even more fit. They keep your heart pumping as your body acquires more energy to overcome the water resistance. People with arthritis can have a better workout in the water. Water exercises are suitable for them because it helps to minimize the pressure on the joints. The above points regarding the benefits of water exercises clearly reflects how working out in the Water is better working out on the Land. These exercises just need a bit more attention and care but its results are healthier than the ones carried out on the Land.

Research has proven that, as the physical improves, so does the mental, emotional, and spiritual. Some of these benefits are:

- Water Exercises help to reduce the stress, blood pressure, tension, weight, pain, body fat, impact on joints, risk of injury, and prescription drug requirements.

- Water Exercises also help to an increase in the Strength, flexibility, energy, range of motion, muscle tone, oxygen/circulation, endurance, balance, coordination, fun, self esteem, safety, and enjoyment of life.

- Water Exercises also help to enhance the feelings of well-being, sleeping patterns, recovery from injuries, social pleasures, and the reversing or slowing of ageing, both mentally and physically.
1.14 Yogic Practices

1.14.1 Definition of Yoga

Yoga is an ancient physical and spiritual discipline and branch of philosophy that originated in India reportedly more than 5,000 years ago. The word yoga comes from the Sanskrit word yuj, which means to yoke, join, or unite. The Iyengar School of yoga defines yuj as the "joining or integrating of all aspects of the individual—body with mind and mind with soul—to achieve a happy, balanced and useful life." The ultimate aim of yoga, they claim, is to reach kaivalya (emancipation or ultimate freedom).

The word "yoga" comes from the Sanskrit root yuj, which means "to join" or "to yoke". Yoga is a practical aid, not a religion. Yoga is an ancient art based on a harmonizing system of development for the body, mind, and spirit. The continued practice of yoga will lead you to a sense of peace and well-being, and also a feeling of being at one with their environment. This is a simple definition.

The practice of yoga makes the body strong and flexible; it also improves the functioning of the respiratory, circulatory, digestive, and hormonal systems. Yoga brings about emotional stability and clarity of mind. In the practice of Yoga the ultimate aim is one of self-development and self-realization.

1.14.2 History of Yoga

Yoga is an ancient art with its early roots in India. Some images of yogi from Indus Valley Civilization found are considered as 6 to 7 thousand years old. The earliest written mention of yoga appears in the Rig Veda, which belongs to an era between 1500 BC and 1200 BC. It is not easy to establish exact date when yoga as an art established itself for the first time, because Rig Veda was orally transmitted for...
many centuries. Patanjali mentioned the first yoga dates in the 2nd century BC. Upanisads, which are thought to have been composed between the eighth and fourth centuries BC, provides the first quasi-rational full description of the principles and goals of yoga. The more detailed descriptions of Yoga are found in Bhagavad Gita and Yoga Sutra.

1.14.3 Types of Yoga

Yoga can be classified into different types with each type having its own unique virtues. Some yoga styles are useful for physical strength and some are useful for increasing mental powers. The good thing about Yoga is that it is available for a wide range of physical and mental fitness requirements and can meet the diverse goals of the individuals. Therefore, it is important to choose a form of yoga that is appropriate for each individual's level of fitness, goals, and medical condition. Over the long history of yoga, different schools have emerged, and there are numerous examples of subdivisions and synthesis.

The focus and goals of each yoga type are different. While Bhakti Yoga emphasizes love and devotion, Hatha Yoga is an easy Yoga style. Jnana Yoga highlights the use of the mind, Karma Yoga emphasizes on action and service, Kundalini Yoga emphasizes to enlightenment and knowledge. In the Mantra Yoga one has to chant a word or mantra until he/she transcends mind and emotions. Raja Yoga lays more emphasis on the importance of Karma in daily life. Purna Yoga provides solution for complete and holistic healing. Thus, all the different yoga types have their unique virtues and paths. It is a method of all round personality development: Physical - mental - intellectual - emotional as well as spiritual components of the Man.
1.14.4 Physiological Benefits of Yoga

It decreases Pulse rate, Respiratory rate, Blood Pressure, EMG activity and Pain. There is an Increase in Galvanic Skin Response (GSR), EEG - alpha waves, Cardiovascular efficiency, Respiratory efficiency, Musculoskeletal flexibility and joint range of motion, Breath-holding time, Joint range of motion, Grip strength, Strength and resiliency, Endurance, Energy level and Immunity. It improves Eye-hand coordination, Dexterity skills, Reaction time, Posture, Excretory functions, Sleep, Steadiness, Depth perception, Balance and integrated functioning of body parts.

It Normalizes Gastrointestinal function, Endocrine function and weight. It Stables autonomic nervous system equilibrium.

1.14.5 Psychological Benefits of Yoga

It improves Concentration, Memory, Attention, Learning efficiency, Mood, Attention, Concentration, Symbol coding, Depth perception and Flicker fusion frequency. It increases Somatic and kinesthetic awareness, Mood improves and subjective well-being, Self-acceptance and self-actualization, Social adjustment, Social skills, Somatic and kinesthetic awareness. Yoga decreases Anxiety, Depression and Hostility.

Each asana helps to become more aware of body, mind, and environment. While beginning yoga exercises, experiment with the poses, moving in and out as everyone feels comfortable. If the approach of the poses with playful curiosity, feeling of frustration and competitiveness will not enter in to the mind. While practicing yoga exercises, make sure that no one feels any discomfort or pain.
In Yoga and sports, everyone may think that they are very different from each other. Yoga equals to practice while sports equals to training. But the one thing that connects these two together is the aim one wants to achieve. As a matter of fact, Yoga can be a very helpful training for sports. More and more athletes nowadays are turning to Yoga to help improve their performance. Whatever type of sports you are into, you can be sure that Yoga can help you up your game.

1.15 Statement of the Problem

The main purpose of this exploratory study was to find out the effect of varied regimen of exercise programmes on selected Health Related Physical Fitness Components and Physiological Variables of Low Fitness Level Software Engineering Students.

1.16 Need for the Study

Advancement in the field of science and technology are happening day by day. Many number of technical Institutes and Engineering colleges are blossoming everywhere to meet out the demands of the market. The students those who are under technical study, are giving much importance only for their studies rather than maintaining minimum fitness. Doing physical exercises are rare occasions to them. The purpose of this study is to find out the effect of varied regimen of exercise programmes on Health Related Physical Fitness Components and Physiological Variables of low fitness level software engineering students and make them to feel that physical fitness exercises are very important to everyone in their normal walks of life.
1.17 Objectives of the Study

1. To find out the effects of regimen of Yogic Exercises programme on Health Related Fitness Components and selected Physiological Variables of low fitness level undergraduate software Engineering Male students.

2. To find out the effects of regimen of Calisthenics Exercises programme on the land on Health Related Fitness Components and selected Physiological Variables of low fitness level undergraduate software Engineering Male students.

3. To find out the effects of regimen of Calisthenics Exercises programme in the water on Health Related Fitness Components and selected Physiological Variables of low fitness level undergraduate software Engineering Male students.

4. To compare the effects of regimen of Calisthenics Exercises programme on the land, Calisthenics Exercises programme in the water, Yogic Practices and Control Group on Health Related Fitness Components and selected Physiological Variables of low fitness level undergraduate software Engineering Male students.

1.18 Hypothesis

1. It was hypothesized that practice of regimen of Yogic Practices would not significantly develop the Health Related Physical Fitness Components and selected Physiological Variables of low fitness level software engineering male students.

2. It was hypothesized that practice of regimen of Calisthenics Exercises programme on the land would not significantly develop the Health Related Physical Fitness Components and selected Physiological Variables of low fitness level software engineering male students.
3. It was hypothesized that practice of regimen of Calisthenics Exercises programme in the water would not significantly develop the Health Related Physical Fitness Components and selected Physiological Variables of low fitness level software engineering male students.

4. It was hypothesized that there would not be any significant difference among Calisthenics Exercises programme on the land, Calisthenics Exercises programme in the water, Yogic Practices and Control Group on the development of Health Related Physical Fitness Components and selected Physiological Variables of low fitness level software engineering male students.

1.19 Delimitations

The study was delimited to the following aspects.

1. The study was delimited to 80 male Undergraduate Engineering students of Amrita School of Engineering, Coimbatore.

2. The age of the selected subjects ranged from 18-25 years.

3. The selected variables were delimited to Health Related Physical Fitness Components and Physiological Variables only.

4. The training period was delimited to 12 weeks.

5. The data was collected prior and after 12 weeks of the training programme.

1.20 Limitations

The study was limited to the following aspects

1. Certain factors like Life style, daily routine work, diet and other regular habits which may have an effect on the results of the study were not taken into consideration.
2. The difference in Socio economic status of the subjects was not taken into consideration.

3. The heredity of the subject and its influence on the selected criterion variables were not taken into consideration.

1.21 Significance of the study

1 This study will be helpful to know the status of engineering college male students’ Health Related Physical Fitness Components and Physiological Variables.

2 This investigation may be helpful for the Engineering College Male students to maintain their different variables by doing such selected training programmes.

3 The findings of this study may help to programme suitable programme schedule for the Engineering College Undergraduate Male students to develop fitness and health.

1.22 Operational Definition of Terms

1.22.1 Cardiovascular Endurance: The ability of the circulatory system (heart and blood vessels) to supply oxygen to working muscles during exercise.

1.22.2 Body Composition: The relative percentage of body fat compared to lean body mass (muscle, bone, water, etc)

1.22.3 Flexibility: The ability to flex and extend the body’s joints through their full range of motion.
1.22.4 **Muscular Endurance**: The ability of a muscle group to continue muscle movement over a length of time.

1.22.5 **Resting HR**: The number of heart beats in one minute (bpm) when a person is at complete rest.

1.22.6 **VO₂max**: The maximum capacity of oxygen consumption by the body during maximum exercise. Maximum amount of O₂ that can be transported to and used by muscles during 1 min of exercise.

1.22.7 **Systolic Blood Pressure**: Blood pressure on the artery wall during heart contraction.

1.22.8 **Diastolic Blood Pressure**: The pressure exerted by the blood on the blood vessel walls when the heart relaxes between contractions.

1.22.9 **Percent Body Fat**: Fat mass as a percentage of Body Weight.

1.22.10 **Lean Body Mass**: Everything in the body except for fat, including bone, organs, skin, nails and all body tissue including muscle. Approximately 50-60% of lean body mass is water.

1.22.11 **Body Mass Index**: A number calculated using a person’s height and mass, which gives a indication of total body fat content.