CHAPTER - I

INTRODUCTION

General Introduction

From the beginning of their existence in the world, Man has having the curiosity to know about themselves and the surrounding world. Among the many things under their consideration, human body is the most studied object from ancient time when the people with strong physique with great ability to fight, hunt and organize that achieved the distinction in forming many concepts and applications.

For at least two thousand years people have believed that a man’s character and his/her innermost workings can’t be revealed unless their body-frame and bodily functions are known. After the invention of microscope nearly 400 years ago, people have studied the body’s billions of thin building blocks, known as cell. In 2005 we have learnt about the sequence of gene in the cells of homo Sapience.

It is a matter of fact and elementary observation that no two individuals, even though they belong to the same species, are not exactly similar and/or equal. In humans, a great deal of variation is observed in their physique and other biopsychosocial components.

As early as the fifth century BC, the Greek Physician Hippocrates classified man into two physical types, ‘phthisic habitus’ (long and thin) and ‘apoplectic habitus’ (short and thick). Though less systematic in his observations than Hippocrates, Shakespeare’s more memorable descriptions of the characters: Cassius as ‘lean and hungry’ and Falstaff as ‘indolent and gluttonous’ are meant to disclose something more profound about their caloric intake. (Raymond Montemayor, 1978)
Several of typologies have been proposed to classify human physique; however, the most notable and widely researched one is Sheldon (1940, 1942, 1949 and 1954).

1.1 Physique

The variation in human physique has been a subject of interest to physical anthropologists and human biologists. The form, size and development of person’s body physique can be characterized by the interactive sum of its parts: body structure, body size and its constituent compositions. Those characteristics are known as following.

(i) Body structure – the distributive component parts of the body

(ii) Body size- the body mass, volume, length and surface area of the body

(iii) Body composition – the constituent components of the body in various terms. (Abernathy, B. et al., 2005; Bloomfield, J. et al., 1994; Bioleau, R.A. et al., 1977; Houthkooper, L.B. et al., 1994)

In relation to measure and assessment, three major interrelated but somewhat dichotomous classification systems of human physique study in its history. These physique rating patterns include those of are body type, somatotype and anthropometric somatotype. These classification forms of study have highlighted on the measure of structure, shape and form through arthroscopic and anthropometric evaluation methods. The body builds index rating system evaluated by those of factor type, body type, dysplasia type, and proportionality assessments. These rating system are index oriented and apply anthropometric length, breadth and circumference methods of assessment to identity and relate body measures to one another in the form of ratios. Through the use of statistical calculation, body build assessments and classification have been made in relation to size, proportionality and disproportionality. The last, but probably the most recently utilized system of study, have been those in the field of body composition by Thomas Battinelli (2007).
1.1.1 Somatotype

The human physique is a continuously distributed characteristic which was appreciated by Sheldon, et al., (1940) who successfully devised a method to analyze and quantify human body form called ‘somatotyping’. According to Sheldon et al., (1940 & 1954) somatotypes are morpho-phenotypic ranges along continue of variation which process constantly recognizable characteristics and are the functional end products of the whole genetic and developmental complex. Sheldom recognized three basic characteristics of physique: endomorphy, mesomorphy and ectomorphy. Each individual has varying degrees of developmental of these three characteristics.

Endomorphy is having the features of roundness and softness of the body. Antero-posterior diameters and the lateral diameters tend towards the equality in the head, neck, truck and limbs. Characters of this type are predominance of abdomen over thorax, high square shoulders and short neck. There is smoothness to shape throughout, with no muscle relief. The breasts are always bulging usually as a result of fatty deposit. The buttocks have a round fullness and no noticeable dimpling. The skin is soft end smooth and rarely is there a great deal of chest hair (Mathews et al., 1976).

Mesomorphy is with the characters of a square body with hard, rugged and prominent muscles. Large bones are covered with thick muscles. Legs, trunk and arms are usually substantial in bone and heavily muscled throughout. Prominent characteristics of this type are forearm thickness and heavy wrist, hand and fingers. There is large thorax and the waist is relatively slender. Their having broad shoulders, the trunk are usually upright, and the trapezius and deltoid muscle are quite substantial (Mathews et al., 1976).

Ectomorphy represents as predominant characteristics linearity, fragility and delicacy of body. There are small bones, thin muscles and droop shoulders are seen consistently among the ectomorphs. The abdomen and the lumbar curve are flat while the thoracic curve is relatively sharp and elevated. The body contains relatively long limbs and short trunk; however, this doesn’t necessarily seem that
the individual is tall. The shoulders are mostly narrow and deficiency in muscles relief. Muscles are not seen to be developed on the physique (Mathews et al., 1976).

After Sheldon’s method of somatotyping, there have been many attempts to make it simpler, easily executable and more objective and to measure in a wide age range of males and females. Several endeavors were later made in this focus to somatotype on the ground works of anthropometric measurements by Bullenand Hardy (1946), Cureton (1947), Hooton (1951), Parnell (1958), Damon el al., (1962), Peterson (1967), Clarke (1971). However, these methods remained relatively unused because of certain shortcomings and discrepancies. The Carter-Heath (1990) method of somatotyping is one such attempt which satisfies to a major extent of the requirements and is widely in use throughout the world during the last two decades. Its application is vast in the fields of sports science, anthropology, human biology, child growth etc. The Heath-Carter somatotype method is a modification of the system developed by Sheldon and his colleagues. It uses much of the original vocabulary and employs those criteria of his basis approach with objective approach. This method is having fundamental modifications with the characteristics of (1) The pheno-typing rating, which allows for the changes over time, (2) The rating scales for the components are open and applicable for both sexes at all ages and (3) The anthropometric dimensions help somatotype ratings objectively (Heath and Carter, 1967)

1.1.1(i) Influencing Factors

There are many factors influence on the variation like age, sex, ethnicity, occupation etc.

Age:

Age is a variable to appreciate the effect fat distribution and also changes in BMI. Changes in body weight and BMI are strongly related to changes in fat-free mass as well, and those having 54% of variance in those changes (Forbes, 1999). While the associations between BMI and %BF are linear, the association
with percentage body fat and age is curvilinear, with the slope steeper at lower BMIs than at higher BMIs (Welch & Sowers, 2000). Percent body fat may remain constant or increase with age but aging is associated with substantial redistribution of fat tissue among the sites of fat deposition (Cartwright et al., 2007). Waist circumference increase with age and is larger in older than in younger adults of both sexes up to the age of 70 years (Ford et al., 2003). The Baltimore longitudinal study of Aging also examined the effects of weight change on change in fat distribution (Shimokata et al., 1989).

**Sex:**

Sex difference is a natural phenomenon and in deposition of body fat it is evident even at the foetal stage, but it becomes much more pronounced during puberty (Wells, 2007). Sex differences in body composition are primarily attributable to the effect of sex steroid hormones, which drive the dimorphisms during pubertal development. In men, a reduction in free testosterone levels is associated with an increase in fat mass and reduction in muscle mass, and both total and free testosterone levels are inversely associated with obesity (Derby et al., 2006).

**Ethnicity:**

Ethnicity has some importance in causing individual difference.

Chinese and South Asian men and women display a greater amount of visceral adipose tissue for a given waist circumference then Europeans (Lear et al., 2007b). Similarly, a higher %BF across a range of waist circumference values has been documented in East Asia (Kagawa et al., 2007). In the United States, the indigenous people and Caucasians have had no difference in the relation to physique components like (i) visceral adipose tissue and BMI (Gauiter et al.,1999), (ii) total body fat (Lear et al., 2007b) and (iii) waist circumference (Lear et al., 2007a). Australian aboriginals, living in a remote area, are observed to having higher WHRs with lower BMIs than the Urban Australians of European origin (Piers et al., 2003).
1.1.1(ii) Measurement Method

The Carter- Heath (1990) somatotype method is a semi-quantitative description of the existing relative shape and composition of human body. It is expressed as three numerals of somatotype components, for example, 3-6-4, in which 3 represents the edomorphyquantity - the first component; 6 represents the mesomorphy quantity – the second component and 4 represents the ectomorphy quantity – the third component. Thus a somatotype rating gives a quantified expression of individual variations in morphology and of what a body looks like (ISAK, 2001).

Heath-Carter somatotype incorporates three things: photoscopic somatotype, anthropometric somatotype and anthropometric plus photoscopic somatotype. The photoscopic somatotyperequires a photograph, taken according to standardized instructions with measurements of height and weight, and a table of somatotype according to height-weight-ratio. The anthropometric somatotype can be estimated from 10 anthropometric dimensions (viz., height, weight, four skinfolds - triceps, sub-scapular, supra-spinale and medical calf), two girths (flexed upper arm and calf) and two breadths (bipicondylarhumerus and femur). The anthropometric plus photoscopic somatotype is based upon reference to a standard somatotype photograph and the rating criteria to the anthropometric somatotype and to the table of distribution of somatotype according to height-weight-ratio (ISAK, 2001).

1.1.2 Body Composition

Body composition is the body’s relative amount of fat to fat free mass. Our body is composed of water, protein, minerals, fat and many other constituent components. There are major two components the body consists of two chemically distinct components, i.e., fat and fat free (Brozek, 1963). Body fat is the most important constituent of body composition. The total amount of body fat is the sum of – (i) essential fat and (ii) storage fat. Fat in the marrow of bones, in the heart, lung, liver, spleen, kidneys, intestines, muscles and lipid-rich tissues throughout the central nervous system is called essential fact, whereas fat that
accumulates in adipose tissue is called storage fat. Essential fat is necessary for normal bodily functioning (Heyward, 1991).

The National Institute for Health (1998) suggests that for men 12-18% is considered a healthy amount of fat. For women the range is 16-25% and it is somewhat higher than that of men thus it includes sex-specific fat for child bearing. Storage fat is located around internal organs (internal storage fat) and directly beneath the skin (sub-cutaneous storage fat). It provides bodily protection and serves as an insulator to conserve body heat. The relation between subcutaneous fat and internal fat is having intra-individual and inter-individual differences during the life cycle. Lean body mass (LBM) represents the weight of human body muscles, bones, ligaments, tendons and internal organs. LBM differs from fat free mass. Since there is some essential fat in the marrow of bones and internal organs, LBM includes a small percentage of essential fat. However, with the two components model of body composition, these sources of essential fact are estimated and subtracted from total body weight to obtain the fat free mass (Heyward, 1991).

There are three considerable methods for assessing body composition: (i) Body Mass Index, (ii) Waist-to-Hip Ratio and (iii) Body Fat Percentage (%BF). Body Mass Index (BMI) is a relationship between an individual’s height and weight, on the other hand Waist-to-Hip Ratio (WHR) is calculated through dividing the waist circumference by the hip circumference. There are several methods for determining body fat percentage, like -Duel-energy X-ray Absorptiometry (DXA), Air Displacement (Bodpod), Hydro-densito-metry weighing (under water weighing), Bioelectrical Impedence (BIA) and Field methods with the Skinfold Calipers and/or Measuring Tape (Brodie, 1988).

1.2 Motor Ability

Movement is the basis of life and it can be executed by the physique only. By the way of evolution of human body, physique has been providing a particular type of musculo-skeleton system and nervous system. It has been developed
through movement or locomotion from biological and/or instinctive urges. Walking, running, jumping, throwing and other daily physical/ loco-motor activities includes the category of motor activities that requires the ‘motor ability’ of a person. It is the capacity of an individual to move efficiently with strength and force over a reasonable length of time.Fleisman (1964) on investigating the nature had the opinion that ‘motor ability’ is specific rather than general in its nature. The factors most often cited by the investigator included muscular strength, agility, balance, endurance and flexibility – all are basic abilities. Fleshman (1964) distinguished between skill and abilities. Abilities are more general and innate in nature than skills, however, skills are learned traits based on the abilities a person possesses.

Motor ability, for a given moment, is the ability acquired and innate ability of an individual to perform motor skills of a general or fundamental in nature, exclusively from the highly specialized sport (Barrow & McGee, 1971).

1.2.1 Influence on Motor Ability

There are some factors that influence motor ability of an individual. Payne & Isaac (1987), Carlin, c., et al., (2000)

i) Personal - The most common influencing factors are personal factor that are self-efficacy, perceived competence, enjoyment and parental influence (Welk, 1999).

ii) Biological - Genetics and ethnicity has effect on the motor ability. Differences in body weight, size and strength influence on motor ability. The physical characteristics also account for the initial difference in gross motor ability for males and females.

iii) Environment:

Social: Parental expectations of their children in view of gender. This is particularly so with regards of boys. As boys mature they are traditionally expected to be involved in organized sports to a greater extent than girls.
**Physical**: Proper physical environment help to enhance the motor ability but lack of adequate facilities for boys and girls restrict its development.

There is a ‘critical period’ of time when a child is especially sensitive to environmental stimuli. If the child is appropriately stimulated during this period the associated behavior is most likely to emerge or be facilitated (Payne and Isaac 1987).

1.2.2 Measurement of Motor Ability

Motor ability is measured by motor performance and this performance is based on composition of many components. The most common components are power, speed, agility, strength, endurance, balance and flexibility. Some of these are more dominant than others (eg. Strength is more dominant than agility) and thus have relation with motor fitness (Barrow and Rose Mary, 1979). The factors/components are described as:

(i) Muscular Strength – is the ability of the muscle to exert maximum force during an activity (Wilmore & Costill, 1994), (ii) Flexibility – is the range of motion around one/many joints (Wilmore and Costill, 1994), (iii) Agility – is the ability of the body or part of the body to change direction rapidly and accurately (Barrows and McGee, 1979), (iv) Muscular Endurance – is the ability of the muscle to continue to perform without fatigue (Wilmore & Costill, 1994), (v) Speed – is the capacity of an individual to perform successive movement of the same pattern at a faster rate (Barrow and McGee, 1979) and (f) Endurance – is the ability of the circulatory and respiratory system to supply oxygen during sustained physical activity (Corbin and Lindsey, 1994).

1.3 Cardio-Respiratory Capacity

For efficient and graceful movement(s), fundamental in nature, one must have proper back-up system. Cardio-respiratory capacity acts as one that back-up system. Cardio-respiratory capacity is the ability of the circulatory and respiratory systems to supply oxygen to the muscles during sustained physical activity.
Cardio-respiratory capacity is responsible for cardio-respiratory fitness that also known as cardio-vascular fitness, cardiovascular-endurance or aerobic fitness.

The body’s main parts, like the brain, heart, lung and stomach are called organs. Different groups of organs work together as systems. Each system has a vital job to keep the whole body alive and healthy. The body needs as substantial amount of movement of its part and as a whole, a wide range of nutrients to remain healthy. All the muscles and tissues, that make-up the body, must be continually supplied with food and oxygen. This job is carried out by the cardio-respiratory system.

There are several factors that have effect on individual’s maximal oxygen uptake (VO₂max). These factors are heredity, age, sex, body size and composition, training status, type of muscles fibers used during exercise, attitude and temperature. (Noakes, Tim, 2003)

1.3.1 Mechanism

Cardio-respiratory endurance (CRE) – the functional aspect of cardio-respiratory capacity - depends upon a multitude of functions. Limitations of any single function in the chain of events reduce the capacity and the function as well. (Jensen,C.R.,1977).

The underlying mechanisms of CRE are the following.

- External respiration provides for exchange of oxygen (O₂) and carbon-dioxide (CO₂) between the circulatory system and the external environment through lung.

- Blood acts as the medium through which essential materials transports to and from the cells.

- The heart, along with its forceful muscular contraction, generates the force to circulate the blood.
- The blood vessels contain the blood and aid in its selective distribution because of their ability to constrict and dilate.

- The blood pressure ensures the adequacy of delivery of blood to meet the demands of cells.

- Aerobic processes are dependent upon the presence of O₂ and consequently upon the fitness of the cardio-respiratory system.

- If the work intensity exceeds the threshold level of the ability of the cardio-respiratory capacity, oxygen debt starts.

**1.3.2 Measurement**

A maximal oxygen uptake test is the measure of the cardio-respiratory capacity. Maximal oxygen uptake (VO₂ max) is individual’s maximum volume of oxygen consuming capacity per minute. VO₂ max depends on the three main bodily systems. (Fox, 1973; Koley, 2007)

Those are:

(i) **Pulmonary system:** Pulmonary function tests are a broad range of tests that measure how well the lungs take in and exhale air and how efficiently they transfer oxygen into the blood.

(ii) **Cardiovascular system:** Cardiac output, stroke volume, heart rate, peripheral resistance, muscle blood flow, Hemoglobin content by red blood cells.

(iii) **Muscular system:** Muscles mass, muscle fiber type, oxygen extraction through mitochondrial density and oxidative enzymes.
Fig. 1: Influencing Factors of Genotype-Phenotype Characteristics
1.4 Rationale of the Study

This study was a status study in its form in three dimensions: physique, motor ability and cardio-respiratory capacity of young adult males (20-24 years) of a segment of the Bengali population. The study findings were aimed at to predict the status of the young adults in the three dimensions (parameters) of the study with reference to the available relevant norms. Relationships between the variables in inter- and intra-parameter were also been observed to find the particular status of the subjects from different angles. There was no such study after searching literature, till date, so far the knowledge of the researcher. Hence, the study was a sincere effort from the part of the researcher to reach to the end according to the objectives of the study.

1.5 Statement of the Problem

Although there was many difference among the young male college students of our population, the researcher endeavor to know any influence or relationship among the physique, motor ability and cardio respiratory capacity of the young adults. Hence, the study was titled as “A Study on Physique, Motor Ability and Cardio-Respiratory Capacity of Young Adults.”

1.6 Purpose of the Study

The purpose of the study was to reveal the different aspects of physique, motor ability and cardio-respiratory capacity of young adults. The following purposes were relevant to reach the end. The purposes were:

1. To assess body composition and somato-type of the young adults as the physique component.

2. To assess the level(s) of motor ability of the young adults.

3. To assess the level(s) of cardio-respiratory capacity of the young adults.
4. To observe the influence of body composition, if any, on motor ability and cardio-respiratory capacity of the young adults.

5. To observe the influence of somato-type, if any, on motor ability and cardio-respiratory capacity of the young adults.

6. To assess the relationship among physique, motor ability and cardio-respiratory capacity among young adults.

7. To predict the relationship among the physique variables.

8. To observe the relationship among the motor ability variables.

9. To observe the relationship among the cardio-respiratory capacity variables.

1.7 Significance of the Study

This study might prove significant in many ways. Those are as following:

1. The study may throw new light on the aspect of physique, motor ability and cardio-respiratory capacity of young adults.

2. It may reveal the influence of body composition on motor ability and cardio-respiratory capacity.

3. It may help to reveal the relationship among body composition, motor ability and cardio respiratory capacity in the young adult age group.

4. The study may enlighten the physical educators, coaches and conscious guardians who might feel interested in development of the young ones in a healthy way.

5. This study may act as a frame of reference for formulating sport training programme and sport achievements in young adult age group.
1.8 Delimitation of the Study

This study was delimited to the following ways.

1. The study was confined only on males.

2. The age group of the subjects was 18-25 years as young adults.

3. The study was restricted to certain selected variables under the three major areas of the study, viz., Physique, Motor Ability and Cardio-Respiratory Capacity.

4. The subjects were selected from the three colleges where the students enrolled from three Districts of West Bengal viz., Nadia, Hooghly and North 24 Pargana.

1.9 Limitations of the Study

1. The researcher could no cover more areas of West Bengal because of paucity of time and money.

2. It was not possible from the part of researcher to conduct all the tests for all the subjects on the same day in the similar time and environmental condition.

3. The environmental conditions of different test days, more of less was the same, effect of environmental condition, if any were beyond the control of the researcher.

4. More sophisticated instrument and modern test could have given more accurate results on the variables of this study.

5. Other than the three parameters: physique, motor ability and cardio-respiratory capacity the socio-economic condition, psychological characteristics were not considered in this study.

6. In spite of creating a positive and conducive environment all the individual factors, like motivation, assertiveness etc, were beyond the control of the researcher.
1.10 Definition and Explanation of Important Terms

**Body Composition**: Body composition is the combination of relative amount of Fat Mass and Fat Free Mass (bone, water, connective tissues, organ & teeth).

**Body Mass Index (BMI)**: The Body Mass Index (BMI) is a measure for human body shape based on an individual’s mass and height. The value categorizes the person as underweight, normal weight, overweight or obese.

**Percentage of Body Fat (%BF)**: Percentage of Body fat is the portion of fat to the total body weight of individual.

**Fat Mass**: It is actual weight of fat in the body of individual.

**Lean Body Mass (LBM)**: The fat free body weight of the subject is considered as lean body mass. So LBM refers to the body weight minus total body fat.

**Somatotype**: Somatotype is the classification of human physique based on body shape and size.

**Waist-to-Hip Ratio (WHR)**: Waist-to-hip ratio is the ratio of the circumference of the waist to that of the hips. This is calculated as waist measurement divided by hip measurement (W/H).

**Physique**: The form, size and development of a person’s body.

**Cardio-respiratory Capacity**: The ultimate level of development in the ability of the lungs and heart to take in and transport adequate amount of oxygen to the working muscles, allowing activities that involve large muscle masses to be performed over long period of time.

**Heart Rate**: The blood is pumped by the heart to the circulatory system produced one round called ‘beat’. Number of beats in one minute period is called heart rate.

**Resting Heart Rate**: The rate of heart beat per minute at rest.
Exercise Heart Rate: The rate of heart beat per minute during exercise.

Blood Pressure: The driving force that moves blood through when blood is ejected into the arteries; diastolic pressure is obtained when the blood drains from the arteries.

Vo2 max: Vo2 max is the individual maximum volume of O2 consume capacity per minute. It is expressed as ml/kg/min.

Cardiac Index: Cardiac index is a haemo-dynamic parameter that related the cardiac out-put (CO) from left ventricle in one minute to body surface area (BSA) thus relating heart performance to the size of the individual. It is expressed as liters per minute per square meter (L/min/m^2).

Motor Ability: An ability that is specifically related to the performance of a motor skill.

Flexibility: Flexibility is the range of motion.

Muscular Strength: Muscular strength is the ability of the muscle to generate force during a short period of time.

Muscular Endurance: Muscular endurance is the ability to use a muscle or muscle group for an extended period of time.

Co-ordination: Co-ordination may be defined as the ability to perform a skilled movement pattern. Several factors are involved in co-ordination likely agility, balance, kinesthetic sense, power, movement and speed for instance.

Agility: Agility is the ability to change and control the direction and position of the body while maintaining a constant rapid motion.

Speed: Speed may be defined as the capacity of the individual to perform successive movements of the same pattern at a fast rate.

Endurance: Ability to resist fatigue and recovery quickly after fatigue.
**Physical fitness:** Physical fitness is the development and maintenance of a sound physique and a sound functioning of the organs to the end that the individual realizes in an optimum measure his capacity for physical activity as well as for mental accomplishment unhampered by physical drains or by a body lacking in physical strength and strength and vitality.

### 1.11 ABBREVIATIONS USED

- **BC** = Body Composition
- **BMI** = Body Mass Index
- **BP** = Blood Pressure
- **bpm** = Beats per minute
- **%BF** = Percent Body Fat
- **CI** = Cardiac Index
- **Cir.** = Circumference
- **Cm** = centimeter/centimeters
- **CRC** = Cardio Respiratory Capacity
- **DBP** = Diastolic Blood Pressure
- **df** = Degree of Freedom
- **Dig.** = Diagram
- **Ecto.** = Ectomorph
- **EHR** = Exercise Heart Rate
- **Endo.** = Endomorph
- **Fig** = Figure
- **Flex** = Flexibility
- **FM** = Fat Mass
- **Gr** = Group
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<tr>
<td>HC</td>
<td>Hip Circumference</td>
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<tr>
<td>ISAK</td>
<td>International Society for the Advancement of Kinanthropometry</td>
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<td>kg</td>
<td>Kilogram</td>
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<td>Liter</td>
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<td>LBM</td>
<td>Lean body Mass</td>
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<td>LSD</td>
<td>Least Significant Difference</td>
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<td>Meter</td>
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<td>Meso.</td>
<td>Mesomorph</td>
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<td>MS</td>
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<td>PF</td>
<td>Physical Fitness</td>
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<td>SBP</td>
<td>Systolic Blood Pressure</td>
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<tr>
<td>SD</td>
<td>Standard deviation</td>
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<td>SE&lt;sub&gt;M&lt;/sub&gt;</td>
<td>Standard Error of Mean</td>
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<td>WC</td>
<td>Waist Circumference</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>WHR</td>
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