Chapter I

INTRODUCTION

Ever since the first modern Olympic games, human performance has captured the attention of a wide segment of the population. In addition to the athlete, there is a growing scientific awareness among coaches and investigators. Athletic records are followed by more and more people, and data are meticulously kept by officials of various sports and by the media as well. For an athlete, achieving peak performance is one of the factors that make competition so self-sustaining. The growth in size, complexity and number of research laboratories has provided an impetus for the study of the athletic performer. Data are now available in nearly every sport, and the elite athlete has been described in a variety of scientific journals. Ultimately it will benefit the performer to have information on which to base future performance and training methods, as well as to help explain the achievement of certain competitive standards.¹

Whether there can be an end to human efficiency relating to his performance in sports, is an extremely difficult question to answer though every day records in athletics are being shattered. To the casual observer, it would seem that we must indeed be reaching the point where further improvement in performance is almost impossible. But this is not to be, for the existing trends clearly show that improvement is without doubt, possible. May be that the more precise ways of measuring performance are used. Knowledge obtained from the progress of past records over the years should permit one to speculate on the future changes likely to occur.

The human physique across the centuries has been the subject of discussion with the scientist, artist and even layman. However, it has not been possible for any of these to say clearly as to what physical characteristics are more suited to what type of performance task. Subjective judgement and hypothetical views have been expressed, but there has been lack of empirical data to substantiate various theoretical viewpoints. Perhaps no serious attempt has been made through either systematic or experimental study to relate performance with certain physical characteristics. It would be a million dollar question if one could point out very precisely as to what contributed by way of physical characteristics to the elite performance in a game or sport. All most all the game and sports are based upon such fundamental
skills that do require typical characteristics of physique so thickly associated with performance. With reference to the olympic levels of performance, \textsuperscript{2}Tanner observed that lack of proper physique may make it almost impossible for an athlete to reach that degree of success. In general, the most productive studies have been of high level performers at national and international levels. Theoretically we would expect those who are most successful to have the appropriate structures commensurate with their performance task; therefore, examination of differences between these structures and tasks will increase our understanding of the importance of aspects of physique.

Morphology is the science of structure and form without regard to function. It is a biological dictum that structure defines function and function defines structure. So there is a relationship between the two. Further morphology is not only a study of material things, but has its dynamical aspect, under which we deal with the interpretation, in term of force, of the operation of energy. It is pointed out that matter as such produces nothing, changes nothing and

does nothing, yet cells can never act as matter alone, but only as seats of energy and as centres of force. Thus morphology, or physique, is related to the physiology and bio-mechanics of the human body in motion, levers, and forces are the corner stones of human movements and their quantification is the foundation for building a more complete knowledge of human performance.  

Measurement of the morphology of athletes has largely developed during the past century. Since then the most studies have focused on descriptions of athletes, comparisons of athletes between and within sports, relationships of physique to physiology and bio-mechanics and selection of young athletes for training. Absolute and relative size, somatotypes, composition and maturation are morphological factors that may limit human performance. It is inferred that athletes who already have or acquire the optimal physique for an event are more likely to succeed than those who lack these characteristics. Quantification of physique through kinesanthropometry can provide a better basis for understanding the limits related to bio-mechanics, physiology and psychology of performance. Classification of human physique into

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various types based on certain prominent body characteristics has always been an interesting phenomenon.

The knowledge of body types as described by Sheldon and others has significance in the field of physical education, health education and recreation. The uses which may be made of this information are diagnostic and prognostic in nature. In physical diagnosis the causes of psychological differences may have a partial cause in body morphology. The limits of athletic performance are influenced by body structure, psychological characteristics and in some instances, health levels also have their bases in body structure. Those individuals interested in the "why" of various performances cannot omit body type information.⁴

The biological and social significance of the tests of posture, strength, flexibility, endurance or circulatory-respiratory functions are understood more clearly when constitutional potentialities and limitations are considered.⁵


Sheldon et al\(^6\) observe that many young people could be saved from frustration and anxiety if they were not encouraged to attempt skills in certain physical performances which they may never attain in their life and these youngsters should be encouraged to direct their thinking towards those values which may be fulfilled within the scope of their own constitutional potentialities.

Athletic ambitious are often frustrated because of the unsuitability of body types. It has been said that we need to dispose the influence to which children are exposed in such a manner that youngster set their hearts upon values which represent the fulfilments of their own constitutional potentialities. Cureton\(^7\) recommends somatotyping as a fundamental procedure for work in body mechanics and physical fitness testing. He emphasises that every test must eventually be normed in terms of constitutional type.

As teachers it would be beneficial to know if those who have common physique behave similarly, whether a particular


temperament accompanies any somatotype component or physique type or whether one can predict a man's interest by measuring his body.\textsuperscript{8}

The more means the individual teacher has for observing and appraising behaviour, the more likely he is to reach specific educational goals. A study of constitutional psychology would be helpful to teachers interested in the optimum development of each student. The analysis of body types would be of use for the teachers of physical education to more fully meet the needs of corrective, required and elective phases of their program.

Classifying students into homogenous or heterogenous groups while keeping the requirement of each physical activity in view, is one of the most crucial problems in physical education. Grade, fitness level, skill level, height, weight, academic achievement etc. are some of the criterion commonly used by physical educators for classifying students on various situations. However, each criterion does not seem to be suitable on all occasions. Miller and Elbel\textsuperscript{9} contend that general

\textsuperscript{8}Sheldon, Stevens and Tucker, \textit{Varieties}, p.1.

\textsuperscript{9}Waldo, A. Miller and Edwin R. Elbel, "The Effect Upon Pulse Rate of Various Cadences in the Step up Test" \textit{Research Quarterly} 17 (December 1949):416.
physical performance such as height and weight are unsatisfactory elements upon which to base a classification of students in physical education, where objective is to achieve peak level performance. Cureton\textsuperscript{10} also believes that 'such grouping may be utilised for specific events only but evidence reveals that total physique description such as somatotyping would be of greater use if one is to understand human beings and their attributes and to be able to intelligently communicate this knowledge. Combination of age, height and weight are not satisfactory basis for norm athletic performances for subjects above seventeen years of age.'

A programme of physical education which consists of appropriate activities and provides for suitable grouping, when implemented, will facilitate the attainment of specifically desired outcomes, besides enhancing all round development of the participant. A scientific physical education, which is in process of information, will have to take cognizance of the possibilities and limitations for physical development conditioned by the type of physique of an individual.\textsuperscript{11}

\textsuperscript{10}Cureton, "Body Build" Research Quarterly, p.314.

\textsuperscript{11}Peter V. Karpovich, Physiology of Muscular Activity (London: W.B. Saunders Company, 1971), p.293.
Whether the classification of students based on any of the criteria mentioned above is absolute, is a debatable point. Similarly whether the body type of an individual is pre-determined is also ticklish question to answer. Sheldon upheld that to find out whether somatotype can be modified during life-time of an individual requires genetic research. Individuals would have to be tested and retested over a long period of time in order to obtain this information. Over a period of twelve years, found no instance in which a marked change of somatotype had occurred. Actually somatotype changes result from skeletal changes at places, where fat does not accumulate. Fatty deposits therefore donot change the somatotype significantly. Sheldon accepted that somatotype can be accurately measured at 6 years of age and be predicted almost from birth.

Prediction of an individual's weight should be made in reference to the somatotype rating. The accurate prediction of future weight may save great frustration because the age-height-weight tables which do not recognise differences in body types lead to questionable results.

Sheldon\textsuperscript{12} also reported that little was known concerning the influence of heredity upon somatotypes, and that

body-build might be a direct result of heredity or an indirect result of influence of heredity on body physiology. It is possible that dietary habits or early environmental factors play a part in the final determination of somatotype. Endocrinal conditions may be the cause of variation in physical type or may be elements in general constitutional pattern.

Sheldon proposed a thick relationship between body type and certain temperamental traits. For him personality emerged from the interaction between the potentialities - the heredity and the environment. He argued "That personality, is broadly conceived, as the product of the play of a complex pattern of environmental pressures upon the organism that carries on innately determined constitutional patterning," He found clear understanding between physique and behaviour and between organic constitution and the mental outlook and it seems almost fatuous to attempt to draw a line between what is organic and what is functional in the human personality.

The concept of somatotyping is appealing because it is a classification of total body form that can be expressed as a simple rating. It provides a gestalt impression of human physique but it is not limited by placing individuals into discrete categories. Somatotyping is a genetic term embracing several different methods, all based on Sheldon's concept of three component rating. It is a quantitative description
of the present morphological conformation and composition of
the body. It is expressed in three rating as per Heath and
Carter method of somatotype that describes the body as a
whole and is a rating of what the body look like.\textsuperscript{13}

The earliest attempts to study human physique were
made from the stand point of health and behavioural aspects
and were based on the premise that man behaves as he does
because of what he is.

The main obstacle to the study of the relations
between body type and physiological functions at various age
periods has been the lack of a practical classification of
body types. Hippocrates, 430 B.C. described two antithetical
types of body build which he called the habitus apoplecticus
(short, thick) and habitus phthisicus (long, thin ). Halle,
in 1797, talked of four types: abdominal, muscular, thoracic
(long chest, slender) and nervous (cephalic). Rostan, in
1828, recognized four types: digestive, muscular, respiratory
and cerebral.\textsuperscript{14}

\textsuperscript{13}Michel Ostyn; Gaston Bennen; Jan Simons; Richard C.
Nelson and Channey A. Murehouse; ed. \textit{Kinaanthropometry II}

\textsuperscript{14}H.J. Eysenck, \textit{The Structure of Human Personality}
Walker\textsuperscript{15} in 1852 recognised three types: nutritive, locomotive and mental. Carus and Beneke in 1852, described three body types: phlegmatic, athletic and cerebral-asthenic. According to Wells, vital, motive and mental are the three categories. According to Huter body types are of three types: Food type, strength type and sensation type.

Kretschmer\textsuperscript{16} classified human body into Pyknic, Athletic, Asthenic and Dysplastic. Sheldon's treatise on the body classification is in fact a great landmark in the history of somatotyping. He scientifically tried to prove that the entire human population could be classified into Endomorph, Mesomorph and Ectomorph. In due course of time, Heath and Carter added to this Omomorph "The triangular torsotype."

A shortcoming common to these attempts was the use of a single scale with rather gross and subjective differentiations which did not permit refined classification of physique.\textsuperscript{17}

Sheldon's methods of body classification is perhaps, considered to be the first earnestly scientific attempts

\textsuperscript{15} Ibid., p.319.

\textsuperscript{16} Ibid., p.320.

\textsuperscript{17} Karpovich and Sinning, \textit{Physiology of Muscular Activity}, p.295.
in this direction. Sheldon's\(^{18}\) seven point rating scale applicable to each of the three categories, is based on sound scientific reasoning. According to him by using the intermediary half points, the entire population of the world could be classified into 342 sub-classifications. The identification of physique, or somatotype, in this scheme was done on the basis of the relative amounts of fatty tissue, muscular and bony tissue, and nervous tissue present in the body.

However, the apparent difficulties involved in this procedure seem to indicate that it is somewhat esoteric and has limited use in schools and colleges.\(^{19}\) Beside this the method is expensive, time consuming and involves high technical training for accurately evaluating physique on the basis of photographic plates. That is perhaps why Sheldon's technique has receded into the background.

Notwithstanding these shortcomings, Heath and Carter\(^{20}\) developed a simplified method for somatotyping with

\(^{18}\) Sheldon, Steven and Tucker, The Varieties of Human Physique, cited by Karpovich and Sinning, Physiology of Muscular Activity, pp.295-96.

\(^{19}\) Karpovich and Sinning, Physiology of Muscular Activity, p.295.

the use of selected anthropometric measurements. In addition to its simplicity, feasibility in terms of time and cost this method also provides for changes in somatotype during a person's life time.

Using Sheldon's as well as Heath and Carter's method, numerous attempts have been made to study the relationship of somatotype to health and physical/motor fitness of individuals. A perusal of the related literature would seem to indicate that somatotype on one hand and health, behaviour and fitness on the other, are interrelated processes and interact to serve as important factors in determining the health and fitness needs as well as the interests and abilities of individuals and may be used for classification purposes.

However, such findings have largely been made on individuals belonging to extreme categories of somatotype or of performance. The few studies done on the average population have used test batteries comprising of items for the various components of fitness like speed, strength, endurance etc. In spite of their obvious value, such test batteries result in scores that do not point clearly as to the area in which an individual is poor or proficient.²¹

²¹ Tanner, The Physique of the Olympic Athletes, pp.21-45.
To understand the relationship of somatotype to physical fitness and personality traits and do well upon the implications of such relationship, study of isolated variables of motor components and personality traits as they are influenced by somatotype would seem to be well justified and hopefully, may assist in the development of a formula relating these aspects of individual.  

In the light of the facts discussed above, it was considered worth while to investigate the relationship of somatotype component to personality traits, self concept, reaction to frustration and selected motor ability variables. Somatotype components were determined by using Heath and Carter method which determines the relationship of form to function. The idea was to examine morphological factors that were related to, and that might affect human physical performance.

**Statement of the Problem**

The main purpose of the study was to assess the relationship of somatotype components to personality traits, self concept, reaction to frustration and selected motor ability variables among secondary school boys.

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22Ibid., p. 25.
Sub Problem

The subordinate purpose of the study was to develop a Multiple Regression Equation for the prediction of somatotype components based on personality traits, self concept, reaction to frustration and selected motor ability variables.

Delimitations

1. The present study was delimited to the assessment of somatotype components by Heath and Carter Anthropometric Somatotyping Method.23

2. The study was further delimited to the assessment of personality traits through Higher Secondary Personality Questionnaire (HSPQ) prepared by Kapoor and Mehrotra.24

3. The study was delimited to the assessment of self concept dimensions by self concept Questionnaire (SCQ) prepared by Saraswat.25


4. The study was delimited to the assessment of reaction to Frustration by Frustration Test prepared by Chauhan and Tiwari.26

5. The study was delimited to the assessment of selected motor ability variables i.e. speed by 50 yard dash, strength of arm and shoulder, abdominal muscles and explosive power of legs, by pull-ups, bent knee sit-ups and vertical jump respectively, cardio-respiratory endurance by Coopers 9 minute run/walk test; agility by shuttle run; dynamic balance by Johnson modified bass test; flexibility by Wells and Dillion, i.e. sit and reach and bridge-up test; kinesthetic perception by distance perception test; reaction time by Electronic Reaction Time apparatus; speed of movement by Nelson speed of movement test and two hand coordination by Two Hand Coordination apparatus with Electronic Chronoscope.27

6. As per the subjects, the study was delimited to secondary school boys of Grade IX and X of Kendriya Vidyalaya No.1, Gwalior.


Limitations

1. Since the subjects for the study were day scholars of the secondary section of the Kendriya Vidyalaya, no controls were imposed on factors such as their daily routine, attitudes, habits, life style etc. which might have an effect on the results of the study.

2. No motivational device was used during the testing of different variables and the differences that might have occurred in performance due to lack of motivation was recognised as one of the limitation of the study.

3. Non-availability of some of the sophisticated instruments for measuring reaction time, speed of movement, flexibility and two hand coordination might deemed to be a limitation of the study.

Hypothesis

On the basis of extensive as well as intensive review of related literature, the following hypotheses were formulated:

1- There would be significant relationship between somatotype components and personality traits.

2- There would be no significant relationship of somatotype components to different dimensions of self concept
and different modes of reaction to frustration.

3- There would be significant relationship between selected motor ability variables namely, speed, strength, endurance, agility, flexibility, dynamic balance, kinesthetic perception, coordination, reaction time movement time and somatotype components.

4- The prediction of somatotype components would be possible on the basis of personality traits and selected motor ability variables.

**Definition and Explanation of Terms**

The following terms are defined as they are used in this study.

**Somatotype**

A quantification of three primary components determining the morphological structure of an individual, expressed as series of three numerals, the first referring to endomorphy, the second to mesomorphy and the third to ectomorphy.28

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Endomorphy

Endomorphy is characterized by roundness and softness of the body. Anteroposterior as well as lateral diameters tend toward equality in the head, neck, trunk and limbs. Features of this type are predominance of abdomen over thorax, high, square shoulders, and short neck. There is a smoothness of contours throughout, with no muscle relief. The breasts are always developed, usually as a result of fatty deposit.  

Mesomorphy

Mesomorphy is characterized by square body with hard, rugged and prominent musculature. The bones are large and covered with thick muscle. Outstanding characteristics of this type are forearm thickness and heavy wrist, hand and fingers. The thorax is large and the waist is relatively slender. Shoulders are broad, the trunk is usually upright and the trapezius and deltoid muscles are quite massive.

Ectomorphy

Ectomorphy includes, as predominant characteristics, linearity, fragility, and delicacy of the body. The bones

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30 Ibid.
are small and thin. The limbs are relatively long and the trunk short, however this does not necessarily mean that the individual is tall. The abdomen and the lumbar curve are flat, while the thoracic curve is relatively sharp and elevated.\textsuperscript{31}

For the purpose of this study, endomorphy, mesomorphy and ectomorphy will be represented by the ratings according to the anthropometric method suggested by Heath and Carter.\textsuperscript{32}

Personality

According to Allport\textsuperscript{33}, "personality is that which permits a prediction of what a person will do in a given situation and it also concerned with all the behaviour of the situation both over and under the skin."

Self Concept

Self concept denotes the totality of attitudes, beliefs, perceptions, and feeling which the individual views as a part

\textsuperscript{31}Ibid.


of the characteristics of himself. It is one's own conception of himself with regards to health and physique, intellectual abilities, mental health, emotional stability and socioeconomic status.  

Reaction to Frustration

It is defined as "Intense catharsisty and conative-ness get expressed in various modes, such as aggression, fixation, regression and resignation." It may be taken as a hypothetical construct produced either by some type of inhibitory condition, or by a competitive excitatory tendency aroused simultaneously with an already enjoying excitatory tendency to strength.  

Aggression

Aggression is "an act whose goal response is injury to an organism." Children who are highly frustrated are more aggressive and it is result of where punishment is inflicted. Aggression may be operationally defined in terms of rude

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34 Sarawat, Manual for Self Concept Questionnaire, p.4.

answering to elders, irritation, feeling of unfairness, carrying grudges, frequent quarreling, broken engagement impulses to take revenge and reactionary attitudes to tradition and belief.\textsuperscript{36}

**Fixation**

It is a defense against anxiety by stopping the process of development. In fixation it is noted that behaviour appears that tends to be repeated over and over again without variations and shows a degree of resistance to change.\textsuperscript{37}

**Regression**

Regression in Freudian terms means a return to an earlier mode of adjustment.

**Resignation**

It is an emotionally tinged attitude shown by cessation of active response to a situation which we have previously been making efforts to alter.\textsuperscript{38}


\textsuperscript{38} Ibid.
Motor Ability

This ability may be defined as present acquired and innate ability to perform motor skills of a fundamental nature, exclusive of highly specialized sports or gymnastics. The following motor ability variables were selected for the purpose of this study.

Speed

It is the ability to perform energetic movements at maximum speed over a short distance.

Strength

It is a force that a muscle or group of muscles can exert against resistance in one maximum effort.

Agility

Parts of the body to change directions rapidly and accurately. It is defined as the physical ability which


41 Mathews, Measurement in Physical Education, p.3.

enables an individual to rapidly change body position and
direction in a precise manner. 43

Cardio-respiratory Endurance

Cardio-respiratory endurance is the ability to conti-
nue or persist in strenuous task involving, large muscle
groups for long periods of time. 44

According to Mathew and Fox 45 it is the ability of the
lungs and heart to take in and transport adequate amounts of
oxygen to the working muscles, allowing activities that
involve large muscle masses to perform over long periods
of time.

Flexibility

Flexibility is defined as the range of possible move-
ments about a joint or a sequence of joints. 46

43 Johnson and Nelson, Practical Measurements for Eval-
uation in Physical Education, p. 200.

44 Robert V. Houch, Physical Fitness: The Pathway to
Healthful Living (St. Louis: The C.V. Mosby Company, 1973),
pp. 93-94.

45 Donald K. Mathews and Edward L. Fox, The Physiolo-
gical Basis of Physical Education and Athletics (Philadelphia:

46 Harrison H. Clarke, Application of Measurement to
Health and Physical Education 5th ed. (Englewood Cliffs, N.J.:
Prentice Hall Inc., 1976), p. 120.
In other words, it is the ability of an individual to move the body and its parts through as wide a range of motion as possible without undue strain to the articulations and muscle attachments.\textsuperscript{47}

\textbf{Co-ordination}

Co-ordination is the ability of the individual to integrate movements of different kinds into one single pattern.\textsuperscript{48}

\textbf{Dynamic Balance}

The ability of an individual to maintain balance during vigorous movements.\textsuperscript{49}

\textbf{Reaction Time}

Reaction time is the interval of time between the presentation of stimulus and initiation of a volitional response.\textsuperscript{50}

\textsuperscript{47}Johnson and Nelson, \textit{Practical Measurements for Evaluation in Physical Education}, p. 76.

\textsuperscript{48}Ibid.

\textsuperscript{49}Ibid., p. 227.

\textsuperscript{50}Johnson and Nelson, \textit{Practical Measurements for Evaluation in Physical Education}, p. 245.
Speed of Movement

Speed of movement has been defined as the rate at which a person can propel his body or parts of his body through space.\(^{51}\)

It refers to the time taken from the presentation of stimulus to the completion of a small movement and is given by the sum of reaction time and movement time.

Kinesthetic Perception

Kinesthetic perception is the ability to perceive the position, effort and movement of parts of the body or the entire body during muscular action.\(^{52}\)

It is the sense that gives us an awareness of the body and its parts in space so that we can cause desired movements without using our five basic senses of smell, taste, touch, sight and hearing, hence it is some times referred to as the sixth sense of the muscle sense.\(^{53}\)

\(^{51}\)Ibid.

\(^{52}\)Ibid., p. 339

Significance of the Study

Sport scientists and physical educators in many countries are experimenting on ways and means to find out the best, easiest and most economical methods of selecting and training their sportsmen in terms of time spent in order to get maximum benefit from them. In some of the advanced countries, like USA, GDR, FRG, USSR and Australia a very scientific and refined method of selection is used in selecting sportsmen for different games and sports as per their requirement and potentialities possessed by sportsmen. The most accurate and scientific method followed is known as muscle biopsy. The muscle biopsy method can be used to identify the potentials even in India but it has certain limitations in our country. The first limitation is in terms of cost and secondly our sportsmen are not educated and conscious about these latest methods and it is difficult to get their cooperation. Keeping above limitations in mind a feasible method should be investigated to select sportsmen for different games and sports, so that optimal level of performance can be attained.

Absolute and relative size, somatotype, composition and maturation are morphological factors that may limit human performance. It is inferred that athletes who have, or acquire, the optimal physique for an event are more likely to
succeed than those who lack these characteristics. Quantification of physique through kinanthropometry can provide a better basis for understanding the limits related to biomechanics and physiology of performance.

The present study will be of significance in the following ways:

1. The findings of the study are likely to provide guidelines for selection of sportsmen for different games and sports on the basis of their body types.

2. The results of the study may educate physical education teachers, coaches and teachers in general, regarding the role played by somatotype components in achieving high performance in different motor ability variables on the basis of their psychological make up.

3. The study will help the physical education teachers and coaches in developing and in implementing systematic and scientific training programmes for each body types.

4. The study may help the coaches and physical education teachers to understand the psychological make up of each body types.

5. The study may help physical education teachers and coaches to understand the self concept and mode of reaction
to frustration associated with each somatotype component.

6. The study may motivate other sports scientists to take up similar studies on physique so that quantification of physique through kinanthropometry can provide a better basis for understanding the limits related to bio-mechanics psychology and physiology of performance.