Chapter I

INTRODUCTION

"In every item of sport, human achievement has been improving and old world records which once were regarded as the ultimate in that particular sport and humanly impossible to be broken have toppled one by one in the succeeding competition. The cause of this seemingly super human performances in the introduction of scientific approach to human psychology and physiology and the application of the fruits of intensive and extensive research in these fields of physical training."

Change is perhaps the only unchanged thing in the world. Today we live in space age and technological giganticism and the impact of advanced scientific technology is seen on every set up. These prodigious societal changes have a definite impact on various programmes which have opened new vistas undreamed by human beings a few years ago. Competition is natural activity which is inevitable in human life and every educational set up should permit and assist

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with the preparation of individuals for "battle of life". 
Competition provide the right opportunity and in aculate 
means by which one can easily demonstrate one's worth by 
competing successfully.

Physical education seems to have taken a new turn in 
the form of sport sciences. The sport sciences inturn have 
taken their substance and methodology from various basic 
sciences. For many years the research in sport was being 
undertaken within these basic sciences but with the 
advancement of knowledge the new specialisations and micro-
specialisations have taken a respectable position. As a 
matter of fact the research now-a-days embraces knowledge 
from various disciplines of human sciences. The human 
bioscientist is interested in studying morphology and motor 
learning in sports, the physiologist, the functioning of 
various parts of the human body, the kinesiologist; the 
movement and skill; the medical doctor, the traumatology and 
rehabilitation, the nutritionist, the food intake; the 
psychologists, the personality traits and the sociologists, 
the social and cultural dimension of sports participation. 
In India too in the recent years some research work has been 
going on in the basic disciplines pertaining to sport.
Physical education and sport, being an integral part of education, have also experienced the impact of scientific advancement. Now the sportsmen have been able to give outstanding performance because of involvement of new scientifically substantiated training methods and means of execution of sport exercises such as sports techniques and tactics, improvement of sports gear and equipments, as well as other components and conditions of the system of sports training.

By definition, a sportsman is one who challenges himself to show superior ability intasks which do not bestow any benefit other than the spiritual satisfaction of achieving something which was not achievable till then by the individual concerned.

As practiced by man, swimming is an art. Fish, amphibia, water-fowl, and practically all quadrupeds born with the ability to swim; have instincts which enables them to acquire swimming ability very rapidly, or employ a form of

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locomotion on land. If man possessed any one of these characteristics or even if he had six inches more of neck and six inches less of thigh, there would have been no art of swimming. No swimming methods would have had to be devised; no one would have to be taught how to swim; nothing would have to be written or said about it. Everyone could, as the need or desire arose, simply enter the water and swim away just as most animals can do. But in so doing man would have foregone an experience which has enriched him not only physically but mentally as well. Furthermore, he would have missed completely the amazingly versatile of all creatures, in the water. 4

It is literally true that with his acquired art of swimming man is one of the most, if not the most, versatile of all living creatures in the water. He is limited, of course, in the distance he can swim, the depth to which he can descend, the speed he can make, and even the length of time he can be immersed. In these things, fish, amphibia, even some mammals can far exceed him. Man excels in the water rather in the great variety of positions, swimming movements, maneuvers and directions he can assume, employ, or

take. He can swim on the front, on the side, on the back, at at the surface or beneath it. He can swim forward, backward, even sidewise with ease. He has the ability to somer sault either forward or backward, or to rotate on his long axis like a rolling log. But above all, he has and can use many varied and different movements of his limbs to sustain and propel himself in the water.5

The performance of the swimmers have been all time matter of great concerned for the coaching and sports scientists and continuous efforts have been made in this direction. Tanner6, Sodhi and Sidhu7 have stressed that the physique and body composition, including the size, shape and form play a significant role in the performance. The performance of a sportsman in any game or event is also dependent on his suppleness, skill, training motivation and, on various other factors of physiological and biochemical nature.

5Ibid. p.3


Body composition plays an important role in athletic performance. A substantial amount of evidence is available to indicate that the relative degree of fat free body weight is an important factor contributing to higher levels of physical performance in activities where the total body weight must be moved. In addition studies have shown that high percentage of body fat not only serves as dead weight but also lessens the relative ability to support oxygen to the working muscles than cutting down on one’s Cardio-Vascular endurance.⁸

The assessment and prediction of body composition has gained widespread application in various exercise science discipline. There are applications to physiology of exercise, biomechanics, exercise biochemistry, anatomy, motor integration, and other allied medical field, that consider such topics as nutritional and dietary assessment, the man-machine interface, as well as various environmental concerns. Whatever the applications, one major area of interest is the predictive accuracy of body composition assessment, particularly percentage body fat and lean body weight.⁹

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Body Composition in certain sports indicated that the athletes who were very lean but heavy because of a well-developed musculatures were superior in performance in certain competitive sports activities, such as football, weight lifting and the shotput. On the other hand, the degree of excess fat may play an advantageous role, if the performances are carried out under conditions of cold stress. It was observed that the middle distance runners and channel swimmers were endowed with a substantial amount of subcutaneous tissue and often were obese. Their ability to tolerate cold water for long periods was largely attributed to the insulation provided by the fat and to a reduced rate of heat loss.\textsuperscript{10}

Body fat generally has been considered to be a liability in the performance of motor activities. However, very few objectives studies have been made which establish the direct relationship between body fat and the performance of various motor activities. Direct evidence of this nature would be very useful in demonstration to both athletes and

nonathletes that excess of body fact effects deleteriously on
motor performance.  

Anthropometry is the oldest type of body measurement
used, dealing back to the beginning of recorded history. The
concept of the ideal proportion varied over period of time.
For example, polycletus Fashioned Doryphones, the Spear
Thrower, a fighter and an athlete, broad shouldered, thick
set, and square chested-the perfect man.  

The concept that an individual's body type is related
to his health, immunity from diseases, physical performances,
and personality characteristics has developed from ancient
times. Hippocrates designated two fundamental physical
types, the phthisic habitus and the apoplectic habitus. The
phthisic had a long, thin body which was considered
particularly subject to tuberculosis. The apoplectic was a
short thick individual with a predisposition towards diseases
of the vascular system leading to apoplexy. Rostan defined
three essentially different types: the type digestif,
typemausculaire and typecerebral. Krestchmer's three types.

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pyknic, athletic, and aesthetic, received considerable attention. The concept of body types, as shown in the numerous studies, proved inadequate in many respects. However, there remained considerable evidence that the physique pattern is significant and is related to an understanding of the individual, physically, mentally, emotionally and socially\textsuperscript{13}.

Anthropometric measurements consist of objective measurements of structures and functions of the body. The measurements of structures include such items as weight, total height, and the width, the depth and the circumference of the chest. The measurements of function include such items as pulse rate, arterial and venous blood pressure, muscular strength, basal metabolic rate, estimate from cardiovascular variables, posture, and breathing capacity\textsuperscript{14}.

The anthropometric examination is a supplement to and not a substitute for, the medical examination. It may, however, and frequently does, indicate incipient physical disorder, that are not sufficiently advanced to be detected.

\textsuperscript{13}Ibid p. 101.

as specific pathologics by the physician. The anthropometric measurement can be administered by trained persons, who are not physicians. Anthropometric measurements have contributed to physical and health education in relation to body build and physical growth.\textsuperscript{15}

Early standard for body weight were in most cases based upon averages of measurements taken as persons of all types of body builds, with race, sex, age and perhaps the nationality held constant. The same standard can not be validly used for both the slender and stocky type of body build, a race horse and a drasy horse may be of same height and the same length, but they do not weigh the same and possess same amount of strength.\textsuperscript{16}

Anthropologists and physicians have from early time suggested categories of body build with every tall and slender person representing one extreme of body build, and with a some what shorter but very stocky person representing the other extreme of build. In this system a category of normality in body build was usually placed between the two extremes of body build and in a few cases variations were

\textsuperscript{15}Ibid.

\textsuperscript{16}Ibid.
proposed within these categories. Later the question arouse concerning whether there were several distinct body builds or simply a distinction of body builds extending between the two most different body builders.17

The body build of swimmers has been assessed by somatotype, skinfold and body density techniques. In 1948, Cureton18 somatotyped olympic swimming champion concluded that swimming of top ability "represent the mesomorphic ideal of body build". Pugh19 and others evaluated the body build of 12 channel swimmers by somatotyping. With few exceptions, the channel swimmers were extremely high in endomorphy. Even among world class swimmers, sprint swimmers were higher on mesomorphy, and the 400 and 1,500 metre men were higher on endomorphy. The distance swimmers were also more buoyant floated closer to the horizontal than the printers.

17Ibid.


Compared to age-matched college students, swimmers are taller, heavier, less fat, and have greater body density. Channel swimmers are shorter, heavier, fatter, and have a lower body density — than adult man of corresponding age. The winners and runners up in channel swim tend to be less than the slower channel swimmers.

Female swimmers have extremely low skinfold measurements and high body density at all ages. Although girl swimmers tend to be taller than other girls of the same age, there is no significant change in the weight/height ratio.20

According to Harry21 height is an advantage smaller a disadvantage. Because he did not see any male swimmers under five feet eleven inches in height, or any female under five feet seven inches, winning an olympic sprint. Most men have been over six feet.


There is a weight for height ratio that must be within certain limits for the sprinter to perform at maximum. Taking National Insurance Company Standards as our guide five percent under weight or 10 per cent over weight puts the sprinters into the danger zone.

There appears to be three main categories of body types of successful sprinting.

(a) Tall and lean (Thin Hontgomery)
(Six feet, five inches & 193 lbs)

(b) Medium and muscular (Like klenders)
(Six feet, one inch & 168 lbs)

(c) Medium and lithe (more spintz)
(six feet, one inch & 160 lbs)

In women's sprinters tall and medium seems to be the universal standard kornelia Ender, Shirle Babashoff, Shane Gould, Down Fraser, all being between 126 and 140 lbs when at their top form. Kathey Heddy five feet five inches is the shortest world class sprinters at present, she weigh 130 lbs.

A light bouyant, swimmer floate higher and created less resistance than a heavier, less bouyant swimmer of the same size, swimmers vary in body build, bone, size, muscle development, weight distribution, relative amounts of adipose fat tissue, lung capacity and so on. All these factors effect the individual's buoyancy and floating position. A
large boned boy with a heavy frame floats lower in the water than does a lighter swimmer, but probably has more imasele to move him through the water.

Two world record holders who were examples of the experiences in buoyancy. Iom Stock, world record holder in the back stroke was so buoyant that he could float on his back in a horizontal position, while chest Jastremskik, record holder in the breast stroke, could not float in any position.22

During the last decade world record times for the crawl stroke have been recorded by a number of swimmers whose only kicking action was to prevent their trailing legs from sinking below their horizontal body position in the water. In essence, the kick was used mainly to balance the stabilise swimming speed which was attained by the stroke action of the arms.

As swimming speed is normally improved when the kick is coordinated with the arm stroke, as compared to the propulsive speed of the arm stroke alone, Councilman23 in

22 James E. Counsilman, The Science of Swimming" (Great Britain; Pelham Book Co. Ltd., 1967)

his discussion concerning the function of the kick in the
crawl and back crawl strokes relative to swimming speed,
posed the following questions. "Is this because of the kick,
(1) increases propulsion (2) decreases resistance of (3) does
both of these?"

He reported that the results of his studies, which
involved swimmers being dragged by a towing apparatus,
demonstrated that there was a ceiling speed of 1.5 meter per
second above which the legs did not contribute and in turn
retarded swim speed.

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the arm stroke has been more to swimming speed than does
the propulsion derived from the kicking action of the legs.
There is little agreement among swimming specialists and researchers concerning the relative contribution of arms and legs speed that is associated with optimum swimming speed. In reference to this problem, Karpovich\textsuperscript{24} concluded that for the superior swimmers the arms provided the main force responsible for crawl swim speed, namely 70\% as compared to 30\% which is contributed by the legs.

The teachers and coaches required excessive kicking practice relative to the time and effort which swimmers could more profitably expend on arms and swim practice? Is there point of no productive return in that the intensity and duration of kicking will be physically and physiologically detrimental to the swimmer's speed? What is the relative influence and relationships of the speed of the arms and legs upon the overall swim speed of the crawl stroke? Does the kick significantly contribute to swim speed or is its main purpose to stabilise and position the body so as the arms are in the most effective position in the water to apply maximal propulsive force?

\textsuperscript{24}P.V. Karpovich, "Analysis of the Propelling Force in the Crawl Stroke," \textit{Research Quarterly} 6 (May, 1935): 49.
Another current problem revolves around the question of whether an individual's anthropometrical characteristics, such as body weight, height and arm and leg length influence arm, leg and swim speed?

Is the tall, long limbed individual a faster swimmer than the shorter, light weight and short limbed person? Because of the possible influence of different anthropometrical characteristics of swimmers, measurements of arm and leg length, body weight, and height were included in the study in an endeavour to ascertain if they had a differential effect upon arm legs and swim speed. Are there differences between males and females relative to their arm, leg and swim speed? As a review of the research literature revealed that there have been no studies which involved the comparison of the ratios of leg and arm speed for males, as compared to female, it was proposed to investigate these relationships, and in addition the intra and inter individual differences in performance between the two sexes.

As the controversial problems surrounding the importance of legs propulsion as contrasted to arms propulsion, relative to their contribution to swim speed, have not been resolved, it was decided to investigate these problems with the swimmers performing under natural
conditions of locomotions namely swimming unattached to a tether, harness of other restrictive equipment.

Statement of the Problem

The purpose of this study is to explore the possibility to what degree anthropology and individual differences in arm and leg speed are valid predictors of swim speed.

Delimitations

1. The study was delimited to the male swimmers of different parts of India, who participated at National Competition.

2. The study was further confirmed to the anthropometric and physiological variables.

Limitation

1. Certain factors like diet, daily routine, lifestyle, habits etc. were the limitations of the study. Which might have had effect on the results of the study, could not be controlled.

2. Non-availability of some of sophisticated instruments for measuring different variables was considered as a limitation of the study.
3. No special motivational techniques was used during the test, therefore, the differences that might have occurred in performance due to lack of motivation was recorded as the limitation of the study.

Hypothesis

On the basis of the available literature and observation of different scholars, it was hypothesised that:

1. There will be significant relationship between physiological variables and swim speed.

2. There will be significant relationship between Anthropometric variables and swim speed.

3. Arm and leg speed will have significant relationship to swim speed.

Definitions and Explanations of Terms

Front Crawl Stroke

1. The Front crawl is the stroke referred to as "free style" in competitive swimming and is presently the fastest stroke man swims.25

2. In Front crawl swimming the person appears to be crawling like a baby, reacting out with one hand at a time. The swimmer lies flat on the water face down, the arms are pulled alternately from front to back down the imaginary centre line of the body upto the thigh and are recovered out of the water to produce another pull. Both legs move up and down alternately. The number of leg beats to one arm cycle—left and right, varies from 2 to 6 as per the build of the swimmers and the distance to swims.26

Anthropology

1. The study of body and mind and their inter-relationships.

2. The study combining human anatomy and physiology.27

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Anthropometric Measurement

Anthropometric variables are dimensions of the structure of the human body taken at specific sites to give measures of length, girth and width.  

Body Composition

Body composition is determined by two factors, fast tissue and lean body weight or mass. The body fat or skinfold thickness can be measured with the help of skinfold calipers. Lean body weight can be calculated from the total body weight minus the weight of the body's fat, lean body weight or mass is relatively constant in man, while fat may exhibit considerable variation.  

Speed

Speed is fitness with which one is able to move his body from one point to another. 


For the purpose of this study speed is considered as the time taken by a swimmer to swim a distance of 50 meters as fast as possible.

**Vital capacity**

Vital capacity is defined as the largest volume of air that can be exhaled after deepest possible inhalation.\(^{31}\)

The maximal volumes of gas that can be expelled from the lungs following a maximal inspiration is called vital capacity.\(^{32}\)

**Blood Pressure**

Blood pressure is the pressure exerted on the walls of the arteries as the heart pumps blood through the body. Systolic pressure is obtained when blood is ejected into the arteries. Diastolic pressure is obtained when the blood drains out from the arteries.\(^{33}\)

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Blood pressure has been defined as the force which the blood exerts on the walls of the blood vessels in which it is obtained. When the left ventricle contracts and pushes the blood in the aorta, the pressure produced is known as systolic blood pressure. When complete cardiac diastole occurs and the heart is resting with no-ejection of blood, the pressure with in the blood vessels is termed as the diastolic blood pressure.\textsuperscript{34}

Resting Pulse Rate

The distention of the arterial walls at the beginning of the systolic ejection of blood is not confined to aorta but travels down the arteries as a wave followed by a wave of recoil. In arteries that lie close to the surface of the body such the radial artery at the wrist, the arrival of the wave of distention and subsequent recoil may be felt as a distinct throb, the pulse, which affords a convenient method to counting the heart-rate.\textsuperscript{35}

\textsuperscript{34}J.S. Ross and K.S. Wilson, \textit{Foundation of Anatomy and Physiology} (The English Book Society, Churchihill living Store, 1973) : 150

Significance of the study

Numerous researchers have been carried out to ascertain the best, the easiest and the most profitable and economical methods of selecting and training athletes in order to get the best performance from them.

The days have gone when good skills were enough to win competitions. In present era because of explosive scientific advancements Swimming also has become very systematic. The question of "Promising Swimmers" or "model Swimmers" and the qualities which afford him his success have been receiving the attention of physical education and coaches for quite some time.

The study may contribute towards promotion of swim speed in following ways:

1. The findings of the study may provide criteria for selecting potential beginners in swimming who are likely to benefit from coaching in order to achieve competitive success.

2. It is likely that the results of this study may be used as a screening tool in assessing and classifying swimmers.
3. The study may help physical education teachers and coaches by way of informing them about the specific Anthropometric, physiological qualities which the swimmers require.

4. It may help physical educators and coaches to develop sound training programme besides devising remedial training programme.

5. The results of the study will help in determining the extent of relationship of Physiological and Anthropometric characteristic of swim speed.