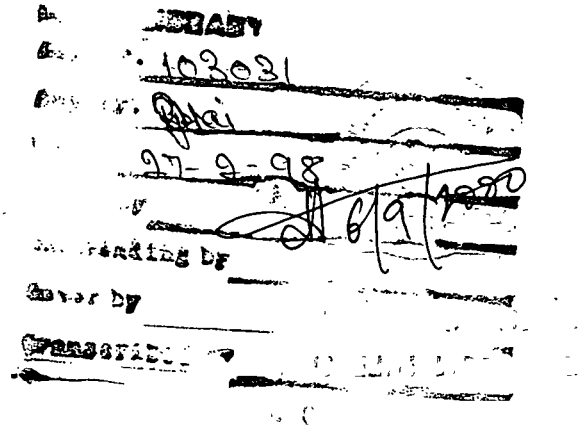
AN ANTHROPOLOGICAL STUDY OF BASKETBALL PLAYERS AMONG KHASI WOMEN OF SHILLONG

By
ILINDA BLAH

DISSERTATION
SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
OF THE AWARD FOR THE DEGREE OF
MASTER OF PHILOSOPHY IN ANTHROPOLOGY

To

DEPARTMENT OF ANTHROPOLOGY
NORTH-EASTERN HILL UNIVERSITY
SHILLONG - 793 014
1993



PHONE :
GRAMS : NEHU

North-Eastern Hill University

Mayurbhanj Complex, Nongthymmai, Shillong-793014

Department of Anthropology

Dr. R. K. Pathak
Reader

CERTIFICATE

Certified that the subject matter of the dissertation is the record of work done by ILINDA BLAH, that the contents of her dissertation entitled "AN ANTHROPOLOGICAL STUDY OF BASKETBALL PLAYERS AMONG KHASI WOMEN OF SHILLONG" did not form a basis of any previous degree to ner or to the best of my knowledge to anybody else, and the dissertation had not been submitted by ner for research degree in any other University.

R.K. Pathak

(R. K. PATHAK)
Supervisor

SHILLONG

THE 30th Nov. 1993

CONTENTS

ACKNOWLEDGEMENTS

I am deeply indebted to express my sincere thanks and gratitude to Dr. R. K. Pathak, Reader, Department of Anthropology, North-Eastern Hill University, Shillong, for his inspiring and invaluable guidance rendered to me in carrying out this research work.

I also wish to place on record my sincere gratefulness to Prof. A.K. Ghosh, Head, Department of Anthropology, and to all other teachers of the Department, who provided me with facilities to successfully carry out this work.

My gratitude to the Principal of Synod College, Lady Keane College, St. Mary's College, Shillong College, Christian Academy, K.J.P. High School, Synod High School, Laitumkhrah Presbyterian High School, Seng Khasi High School and to the Sports Secretary of different localities for facilitating the conduct of the present study.

My sincere thanks go to all the subjects of the present study, who were very cooperative with my research work. Without them, this study could not have been completed.

I am equally grateful to my friends, Clara Lyngwal, Graceterwell Lyngdoh, Architect War, who assisted me in the compilation of the data.

Words cannot express my deep gratitude to my parents for their moral and financial encouragement throughout my academic career.

Lastly, I would sincerely wish to thank Mr. Joseph F. Khongbuh for his help in giving a beautiful final shape to the manuscript.

J. Blah
(ILINDA BLAH)

SHILLONG

THE 30TH NOV 1993

CHAPTER I

INTRODUCTION

INTRODUCTION

WOMEN AND SPORTS

Sports and games historically were designed for men; adaptations were made later on for women. Sex roles in most societies are specific and well defined. However, the cultural prescription associated with gender varies from group to group and from time to time. In Western society, the attitudes and ideals regarding the women's role in the family and other social institutions, including sports, that emerged during the Victorian era in the late 1800s were consistent and distinctive.

For girls and women to participate in sports was contrary to the Victorian ideal. Sports would take a woman out of home to engage in vigorous activity. It would place a woman in a situation where modesty might be compromised, where emotional control might be jeopardized, and where overall propriety could be endangered. It was also feared that attracting a mate and child bearing could be hindered or prevented by injuries to the face and reproductive organs resulting from sport accidents (Sneider, 1983).

Although women were kept away from competing, under

the influence of Hippodamus the Mereca games were organised to provide competition for women. These games were held secretly every four year, midway between the Olympics. Although the status of women improved somewhat after the birth and ministry of Jesus Christ, it was not until the end of the 19th century that women could compete seriously in sports. Yet social definitions still prescribe and limit the range of athletic participation for girls and women. The 'appropriateness' of the type of sport continues to reflect the tenets of the Victorian ideal of femininity. Metheny (1965) has provided an analysis of how the appropriateness of a sport for women continues to reflect those historical ideals.

Even the first modern Olympic games did not include events for women. In 1900, equestrian events and tennis were for the first time introduced as events for women at the Paris games. Although one of the most interesting developments in sport during the decades of the sixties and seventies has been the tremendous growth in number of women taking part in competitive athletic, performance has not been studied as intensively as in the case of men.

Women nowadays are taking active participation in competitive sports. Women for a long time took part in gymnastics, tennis, badminton, but nowadays they are

taking part in more tough games like Football, Basketball, Volleyball, Hockey, Marathon, Swimming, Running, Skiing, Skating etc. and even in power lifting and endurance games. Thus the technique of physical culture and exercise have been adopted by women.

According to Thakur (1984), the girls of pre-school age must be encouraged to participate in games requiring physical activity like boys and this will enhance the self confidence among the girls which will naturally provide them to attain perfection in their later life. Anderson (1984) opines that women must be given the same encouragement and opportunity to participate in the same vigorous activities as young men with possible exception of collision sports activities.

IMPORTANCE OF SPORTS

Sports activities bring people of different regions and different cultures together and the importance of sports specially for the younger generations cannot be over-emphasized. Sports and games provide a very healthy form of recreation and help in building up character and attitudes which can prove helpful in meeting the challenges of life more effectively. Sports in recent times are mainly of competitive nature though their recreative values cannot be under-estimated or denied. Sports nowadays have changed

a lot and are more scientific and mass oriented, well organised, elevate mental and physical stamina of participants, help to acquire sound health and courage to fight against difficult situations, cater to basic needs of players and elevate their economic status, bring honour and social dignity to successful participants, teams and countries, and forge national integration and international peace and brotherhood amongst the people of the whole world.

"A sound ming in a sound body," so goes the saying. Physical culture and sports play an important role in the harmonious development of the individual. A weak body is the mother of all unhealthy planes. In the animal kingdom one finds that the young ones take to play and physical exercise with enthusiasm. In the human kingdom it ought to be much more so. Indigenous games of the past tended to develop and bring to display individual excellence, while western games have been organised to inculcate team spirit of the best type (Blah, 1988).

Physical activities provided an exciting outlet for human expression – often creative in nature. Physical activities have throughout the ages been acclaimed for health and recreation. It provided fun and enjoyment, youthful exuberance and elderly care. But the natural urge, power, and the natural surface that groomed the participants

through the centuries from primitive to modern days are gradually being replaced by technology in the name of betterment, variety, improvement and excellence. No longer it is fun and enjoyment or youthful exurberance or elderly care, sports are being used for the purpose of diplomacy, the purpose of humanitarian work extending warm hands of the friendly humanity, and for the purpose of cultural awareness and health consciousness. The Goodwill Games emerged when boycotts after boycotts started crippling the Olympic Games. So Games are being used as a political force. The Goodwill Games have extended the hand of goodwill, cordiality, and fraternity amongst the nations of the world. Recently, we saw a unique event - the Earth run. In this Sport-Aid programme, sportsmen, musicians, artists, intellectuals and people from all walks of life over the world joined hands, participated in the run on the streets of the world to express an unique sporting sympathy, fellow feeling, and solidarity with Africa's hungry millions. The 'Health-Run' at New Delhi in early January 1988, was organised for promoting health consciousness among the masses (Bhattacharya, 1988).

A nation cannot thrive well without the advancement of sports. Sports have got tremendous national value. These have immense importance and influence over people of all

ages. A country or a state may be poor in its economical or educational aspects, but if it can produce great players and athletes then that country can enjoy a high position and respect throughout the world. The motto of sports especially in the international meets is "to bring and preach peace and unity among the nations," and the prestige of a country depend on the behaviour, culture, and dignity of its sporstmen (Chu, 1982).

FACTORS AFFECTING PERFORMANCE IN SPORTS

Not all the factors that affect human performance are susceptible to easy measurement. In addition to the psychological, there are anthropometric, physiological, environmental, technical, and social factors. To these may also be added the elements of chance or coincidence which at some point allows some of all the factors to exert maximum influence at the same time to produce a second breaking performance. Fortune favours the well-prepared, however, and it is seldom that lucky circumstances produce a record performance by some one who had not already manifested the potential to achieve it. It almost goes without saying that it is all but impossible to produce performance that cannot be measured in numbers, either in time or distance or repetitions.

The social factors that are to some extent for

extending human peformance to the establishment of new world records have been pointed out by Graig (1968) and Biskirk and Tait (1965). These include a larger population from which to draw a greater number of persons included in sports, greater prestige attached to sports participation, development of keener competitive attitude, improved economic conditions and the availability of better medical care. It seems likely that some of these factors may continue to bring about improvements for an extended period of time into the future, barring major changes in man's social organisation.

Although sports are a universal phenomena, even in the most primitive societies, the spread of European culture around the world in the last centuries has been chiefly responsible for developing the type of sports and the attitude toward sports which has led to extending the apparent limits of human performance. Track and field sports and swimming have given us types of activities where achievements are measured in times and distances which can be compared from year to year and from generation to generation (Ryan, 1974).

Perhaps the greatest single factor in the increase in sports participations has been the inclusion of physical education and sports programme in the programmes of general education at all levels.

The sportsman today, whether amateur or professional, does not have to apologize to any one for spending a good part or indeed all of his/her time playing games. His exploits are recorded endlessly in newspapers, magazines, on radio and television, and in motion pictures. The successful athlete today is a cultural hero who is received by Presidents and Kings and honoured with Parades and Medals. Professional athletes command some of the highest annual salaries paid in the United States today.

Improvement in average income levels and work conditions for many part of the world today mean that more time can be taken from the day for pursuit of leisure to pay for these. As far as countries and communities are concerned it means more and better facilities for sport participation and more professional instruction and supervision available. It also means greater income from spectators for both amateur and professional sports which help to make more and better sports programme possible.

The limit of human performance have been extended in the past and will be further extended in the future, by technical factors which aid the athlete in his efforts. These include the development of improved apparatus and equipments, provision of better facilities, refinements of measurement techniques, and improvement in coaching techniques and systems.

The improved design of faster track surfaces, resistance to the unfavourable effects of weather, such as the Tartan Track have helped to make for better running times indoor and outdoor meets. Improved design of indoor running tracks with wider surfaces, more scientifically banked curves, and fewer laps to the mile have also played a role. One of the most important, useful and practical aspects of elevating the efficiency of the athletes activities is the proper and scientific coaching and training of the athletes. It has been accepted by all that if the coaching and training are imposed or directed by all that if the coaching and training are improved or directed by experience trainers and coaches and if the athletes submit themselves whole heartedly and fully to such coaching methods than they must attain perfection in their technique.

Success in competition is not gauranteed but correct training makes success possible. If techniques, strength and fitness are improved, then the chance of being successful are increased. Cratty (1968) suggested that factors at three levels contribute to a person's final motor or athletic performance: (i) the basic behavioural support underlying all performance, (ii) the person's physical ability traits, and (iii) the specific skills required in the relevant task.

Due to a growing change in the competitive philosophy of sports, a rapport has developed among sport scientists, team physicians, athletic trainers, coaches and athletes to discover modern scientific techniques in terms of selection of athletics best suited to the activity and to derive new tactics and training methods (Ryan, 1974).

Nutrients obtained from injested food provide the building blocks for the athlete's growth, development and maturation, plus the fuel elements for routine energy expenditure and for initiation and maintenance of high level performance. Contracting muscle requires a continuing supply and replacement of the substrates of fuel used to support contraction. It has been said that an athlete is no better than the adequacy of his nutrition (Buskirk, 1974).

Fortunately, with many sources of good foods currently available there is no reason for the athlete to be inadequately nourished. The key for the athlete is nutrition as for every one else's is a balance diet, balance in all the essential nutrients so that the body is provided the necessary fuels and building materials. In selecting a diet the athlete can exercise considerable individuality. There is no best balanced diet, for one balance diet is likely to be as good as another. Neither can a balance diet alone compensate for poor skill development and training.

Diet conditioning and training should be regarded as complementary. Similarly, a proper diet is no substitute for the will to win, but a nutrient may indirectly aid that will.

Established nutritional practices fortified by knowledge gleamed from current nutritional research should provide the basis for dietary planning. The athletic team physicians and the local dieticians, i.e., hospitals, schools, etc. are the persons usually most knowledgeable in nutritional planning and who can provide sound nutritional advice. In addition, trainers who are well read and/or who have been associated with college programmes are likely to have been exposed to discussions about good nutrition and should be able to provide nutritional counsel. Team physicians and trainers should be well aware of current dietary foods. Efforts should be made to clarify misrepresentation of nutritional facts in order to forestall initiation of costly and perhaps useless food habits.

ANTHROPOLOGY AND SPORTS

The morphological characteristics of sportsmen and athletes are of interest to the anthropologists, for competitive sports demand the utmost from the body and it is therefore reasonable to expect in athletes demonstration of the rationship of structure and function. Athletic

events are amenable to study, for the represent well defined tasks with objective measures of success, winning, placing, time, distance, points etc. These tasks usually reflect one or more of the basic elements of physical performance, namely, speed, strength, stamina, suppleness and skill. The study of champion athletes therefore may provide information on the structural requirements for success in the specific tasks as well as measures of the differences between tasks. Moreover, the superior athletes of different specialities are of interest because of the information they provide about extremes of performance in a population (Carter, 1970).

It has been demonstrated by Anthropologists that different body shapes and sizes tend to make the owner more or less suitable for certain type of physical activity. The person with a relative light body and long legs (ectomorphic type) has the potentiality of becoming a good weight lifter. The individual who is generally well proportioned and of medium to all height (mesomorph) may excell in a variety of sports. In term of functional capacity three types of represented by individuals may exhibit a general state of fitness but each one is more fit for certain specific performance than others.

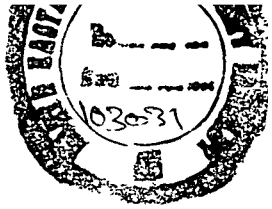
Size is a factor in all types of physical sports

performance that involve the athletics accelerating his body, moving it over a distance lifting it, turning it, exerting force and throwing. The relationship between body size and performance have summarized very clearly and concisely by Astrand and Rodahl (1970). Taller persons have greater strength in proportion to their size and also have an advantage in jumping events, due to their higher centre of gravity, and in throwing events, since they can launched their missile from a greater height. They are slower in accelerating their bodies than shorter persons, and are at the disadvantage in lifting them if their weight is greater, which usually is.

Anthropometric body composition and maturity characteristic of the selected athletes should be determined to assess their performance ability. One has to know whether the athletes differ in height, physique and body composition. Indications of individual's physical readiness for sports may be found in many factors, including size, body build, flexibility, strength, cardiovascular and respiratory fitness etc. Accurate evaluation of the body build may yield important facts relating to his physical readiness for sports participation.

Increase in height among the world's population are observed to have occurred sporadically, but with

increasing consistency during the past two centuries (Shapiro, 1963). This process had accelerated greatly in the last 50 years. This increase in height has quite naturally been reflected in increase in average height among athletes in athletics in many sports, especially those sports where records of time and distance can be established. There is no questions that the average increas in height of athletes in recent years has contributed to the establishment of new world records. Scientists who have studied this problem (recent growth spurt) are not in agreement as to the causes. Better nutrition, lower mobility and mortality rates in the early years due to control of infectious diseases, more vigorously exercise in early years of life, earlier sexual maturity, and hetorosis have all been implicated (Hathaway and Foard, 1960; Tanner, 1960; Aschroft et al., 1966; Bakwin and McLaughlin, 1964). Although all these factors may have some part in increasing the average height, the most significant role has probably been played by meterosis, the mixing of diverse population. It has been demonstrated in other forms of life that the mixture of genes will produce increases in size in subsequent generations within the same species. There is certainly a tremendous variety of sub-species among Homo Sapiens, and the improvements in travels, communications, trade, wars, etc. have produced a satisfactory mixture



in the past 300 years, particularly. It has also been noted that groups that have remained isolated during their period of time have not apparently shared the same growth (Shapiro, 1963).

Success of a player depends upon the physique and the training he gets. According to Hirata (1979), the best factors to be used as screening tests may be his age and physique, because when the training methods are equivalent to all, the suitable physique will be most important, i.e., if a person who has a suitable physique and takes the best training may become a champion. To produce peak performance from the biological viewpoint, one would expect to find the sportsman at various levels the expression of the effects of nature and nurture (Sodhi et al., 1988). Analysis of this characteristics of the athletes can help the scientists understand best performance by providing useful information in formulating strategies for training and for the explanation and prediction of performance. Such information about the sportsmen can helpfully contribute to healthy sport practice at regional, national as well as international levels.

KINANTHROPOMETRY

The emergence of a relatively new scientific specialization called Kinanthropometry provides a convenient

framework for the study of athletes. Kinanthropometry is a synthesis of the Greek words ('kineein' means to move, 'anthropos' means man, and 'metreein' means to measure) is defined as "the study of human size, shape proportion, composition, maturation and gross function in order to help growth, exercise, performance and nutrition." (Ross et al., 1980).

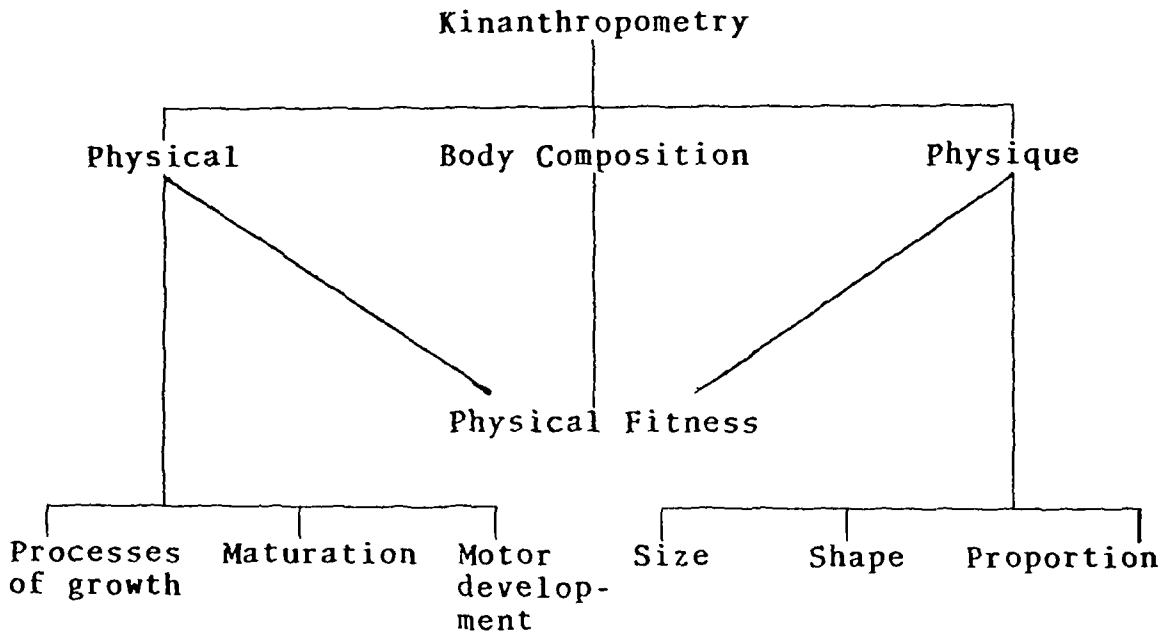
According to Carter (1985), a relatively new and comprehensive approach to assessment of physique is through kinanthropometry which evaluates the physical structure of individuals in relation to gross motor performance. The term kinanthropometry is derived from morphometry which is the measurement of shape, and form of man. It is the quantitative study of size, shape, proportion, composition and maturation in relation to gross function (Carter, 1985).

The constitution of International Society for the Advancement of Kinanthropometry (ISAK) also elaborates explanation of the science. Accordingly,

> "Kinanthropometry is a scientific specialization dealing with the measurement of man in a variety of morphological perspectives, its application to movement and those factors which influence movement, including, components of body build, body measurements, proportions, compositions, shape and maturation, motor abilities and cardiorespiratory capacities, physical activity including recreational activity as well as highly specialized sports performance."

Defined as such, kinanthropometry is a scientific specialization closely allied to physical education, sports science, sports medicine, human biology, auxology, physical anthropology, gerontology, ergometry and several medical disciplines. (Sodhi, 1991)

Kinanthropometric investigations have been conducted on the olympic athletes during the recent Olympic Games. The different kinanthropometric characteristics examined include investigations of their size and shape, using large numbeı of variables according to sports and events (Carter, 1982, 1984). The term kinanthropometry in its present connotation was probably first used in 1972 by Ross et al. (1980). However, a more common term, used especially in Europe, was Sports Anthropometry (Tittel, 1978; Tittel and Wutscherk, 1972). Of course, the use of the term was incorporated in a Symposium of Kinanthropometry and Ergometry at the International Congress of Physical Activity Sciences held in Quebec city in 1976. In his keynote address about its scope, Ross (1978) referred to kinanthropometry both as "an emerging scientific technology" and as "an emerging scientific discipline." Sodhi and his associates (1988) gave an account of the main organs of Kinanthropometry as follows:



Now-a-days it is apparently clear that the term 'Kinanthropometry' has been gaining popularity since its use in many international and national conferences. With the advancement of the science of Kinanthropometry has taken a strong footing at the international level. Even in India special scientific sessions on Kinanthropometry were arranged in the First (1985) and Second (1986) National Conferences of Indian Association of Sports Scientists and Physical Educationists (IASSPE).

So, it is essential to examine a sportsman from every possible aspect. This is in order that he wins in any sport event at the local, state, national or international level. To achieve success in objective one has

to examine the best sportsmen at each level. Estimation of the Kinanthropometry characteristics of these sportsmen provides a valuable reference point in relating human structure and function. In order to develop science of Kinanthropometry (NWGK) was established at Lakshmi Bai National College of Physical Education, Gwalior, in 1985.

SOMATOTYPING

Physique is measured by different procedures. Surface dimensions, body height and weight, and dimensions of body segments are measured by anthropometry. The study of body composition involves a variety of methods: X-rays, densitometry, hydrometry, and skinfold thickness among others. While many of these procedures are precise, they necessarily given values for only a single parameter; they do not evaluate total body form. A technique attempting the latter was described by Sheldon et al. (1940, 1954) who called it 'Somatotyping'. Somatotyping can best be thought as a numerical shorthand method of describing human physique. The technique is used as a means of assessing body shape and composition independent of size. It has been applied in its original and modified forms in a variety of ways for measuring the effects of nutritional insult on physique (Lasker, 1947) to the description of many different groups and individuals including children, athletes etc. (Parnell, 1958; Heath and Carter, 1966).

Somatotyping is a valuable technique to quantify the overall morphological conformation of human body for which many characteristics can be summarised. It is also a generic term that means the quantitative description of the morphological conformation and composition of the body. It is an appealing concept since a simple rating can be given for any particular body form.

HEATH AND CARTER SOMATOTYPING METHOD

Heath and Carter (1967) further objectified Heath's system by incorporating anthropometric measurements and redefining somatotype and the component scales. These definition are as follows:

1. A somatotype is a description of present morphological conformation. It is expressed in a three numeral rating, consisting of three sequential numerals, always recorded in the same order. Each numeral represents evaluation of one of the three primary components of physique which describe individual variations in human morphology and composition.

2. First component (or endomorphy) refers to relative fatness in individual physique; it also refers to relative leanness. That is, first component ratings are evaluations of degrees of fatness which lie on a continuum from the lowest recorded values to the highest recorded values.

3. Second component (or mesomorphy) refers to relative musculo-skeletal development per unit of height. Second component ratings are evaluations of musculo-skeletal development which lie on a continuum from lowest to highest degrees recorded. The second component can be thought of as Lean Body Mass relative to height.

4. Third component (or ectomorphy) refers to relative linearity of individual physique. Third component rating are based largely, but not entirely, on height/$\sqrt[3]{\text{weight}}$ ratios. These ratios and third component ratings are closely related, so that at the low ends of their distributions both connote relative shortness of the several body segments, and the high ends connote elongation or linearity of the several body segments. Ratings evaluate the form and degree of longitudinal distribution of the first and second components.

The definitions and concepts of the three somatotype components are derived in part from interpretation studies of body composition. Extremes in each component are found at both ends of continua. That is, low first component ratings signify physiques with little non-essential fat, while high ratings signify high degrees of non-essential fat. Low second component ratings signify light skeletal frames and little muscle relief, while high ratings

signify marked musculo-skeletal development, as in many athletes. Low third component ratings signify short extremities and low height/3/$\overline{\text{weight}}$ ratios, while high ratings signify linearity of body segments and of the body as a whole, together with high height/3/$\overline{\text{weight}}$ ratios. Extremes at both ends of all three somatotype component ranges connote rarity of occurrence. In the majority of cases ratings of all three components tend to be nearer to the mid-range than to the extremes.

Several authors, Cureton (1947, 1951), Parnell (1954, 1958), and Damon et al. (1962), have demonstrated the feasibility and validity of applying anthropometric measurements to the estimate of a somatotype using Sheldon's method. Recently Heath and Carter have developed an anthropometric estimate for their method of somatotyping. The utilization of anthropometry in obtaining a somatotype rating has certain inherent advantages.

(a) It provides an objectives method of somatotyping.

(b) In the absence of a photograph, it is best estimate of a criterion somatotype rating.

(c) When a somatotype photograph is available, it provides an objective starting point for a combined anthropometric plus photoscopic rating by different observers.

(d) An estimate of the subject's somatotype can be obtained in the field quickly and accurately without having to wait for development of photographs and rating by a criterion rater.

(e) The subject does not have to undress completely for the measurements, or for a somatotype photograph.

(f) Partly as a consequence of the previous advantage, subjects can be somatotyped who would not otherwise be available because of the objection to being photographed, either nude or partially nude.

(g) The anthropometric measurements in addition to height and weight can be utilized for other types of analysis and evaluation of body structure.

(h) The anthropometric measurements provide a more precise measure of change in the somatotype components than a subjective rating.

CONRAD'S METHOD OF SOMATOTYPING

Conrad (1963) described a modified method for somatotyping. He classified the human body considering the body growth and muscular mass. His method for studying the body type involves six anthropometric measurements.

Conrad's Method for studying body type has been very popular in German Democratic Republic where it is frequently used to study the somatotype of athletes and sportsmen. The method has been used for both sexes.

According to Conrad's Method, the constitutional types are not seen as polar extreme basic types but they are rather valued as deviations in a normally distributed totality in which not extreme forms, but the means represent the normal, and according to the laws of normal distribution, the most frequent.

Any normal distribution shows two poles excluding one another influenced by growth tendencies respectively. According to Conrad, these are leptomorphic and pycnomorphic types. The leptomorph physique deviates from the mean by an emphatic upward growth and a limited depth growth. The pycnomorph physique deviates from the means by an emphatic depth growth and limited upward growth.

However, the athletic body build result mainly from a functional adaptation defined by a specific character of the physique. It is possible that both growth tendencies excluding each other (lepto and pycno) and the forms in between them, can adopt within the limits of the individual reaction capacity. Accordingly, both body types are athleti-

cally shaped joining characteristics in an opposite trend and may be formed non-athletically.

Conrad calls these forms 'hyperplasia' and 'hypoplasia' respectively. In which the degree of leptomorph and pycnomorph are based on the basis of metric index. Whereas the degree of hyperplasia and hypoplasia are based on the plastic index. The metric index is estimated from the body height, chest depth and chest breadth. The value of plastic index is estimated from biacromial breadth, forearm circumference and hand circumference.

PRESENT STUDY

The present study proposes to report the body size and shape (somatotype) and the influence of various factors on the performance of Khasi women basketball players participating at the school, college, local, ex-state and state level. Many such studies have been conducted on players of different games in UK, USA, USSR, Germany, etc. While there are only a few somatotype investigations on Indian players of various games in some parts of the country (other than North-East India). Dkhar (1991) has conducted similar study on football players of Meghalaya but no one has attempted similar study on Khasi sports women for any sport, let alone basketball – the most favourable sport of the present times. Further data on athletes generally support

the hypothesis that athletes are somatotypically different from the general populations. In many studies, athletes in reference populations were not separated from samples in their entirely before comparisons were made.

Experts in the fields of sports science and administration have realized that identification of talents to be based on scientific methods (Sports Authority of India, 1990). In a study of somatotype of players or athletes, one needs to ask, "who are to be considered champions?" A champion by definition is unique within his group. He is found at the local, state, national and international levels. At any of these levels he becomes a champion by his ability to defeat others, by his individual performances in competition or by being a member of a champion team (Carter, 1970).

In view of the above, the following objectives are identified for the proposed study.

i) To report the body size and shape (somatotypes) of basketball players.

ii) To examine the differences in the body size and shape of basketball players and the general population.

iii) To compare the present data with that reported in the literature.

iv) To evaluate the influence of various factors on the performance of basketball players, and

v) To make suggestions in the light of the above.

CHAPTER II

SURVEY OF LITERATURE

SURVEY OF LITERATURE

Physique and body composition play an important role in different categories of sports. Cureton (1941, 1947) opined that body composition is a key to human physique. During adolescence children of the same age show variation in their growth status. Regular physical activity during childhood result in a favourable influence on the individual performance during growth. Among various workers who had contributed to the understanding of physical activity among growing children mention may be made of Jolk (1945) and Montagu (1960). According to Tanner (1964) athletes were both born and made, "the basic structure", he stated must be present for the possibility of being an athlete to arise. Hirata (1966) suggested that a nation with people whose general physique was limited to be characteristics of champions in certain events should concentrate on those events. Variation have been reported in physique and body composition of men and women in different categories of sports.

It is common observation that regular physical activity or the lack of activity can alter body composition.

Moody et al. (1969), Pollock et al. (1971) demonstrated that fat free body weight to fat weight ratio increases during periods of physical training. The relationship of body structure and body composition to physical performance in volleyball players has been studied by Cureton et al. (1975), Morrow et al. (1979).

Cureton (1947) measured 11 American female swimming and diving champions and observed that swimmers were taller than average, and they represented a close approximation to 3-4-3 and 4-5-4 somatotypes. Most were meso-endomorphs. Morris (1960) published data on 150 women athletes from the Philadelphia area somatotyped by Sheldon's Laboratory. These athletes from basketball, field hockey, golf, gymnastics, softball, swimming, diving, tennis and track and field were selected because of earned rank, membership on selected teams or opinions of experts in the field. For the college sample, 5-3-3 and 5-3-2 were nodal somatotypes. The mean somatotype for the athletes was 4.5-4-3. Morris concluded that divers, gymnasts, and track women rated higher than other athletes in mesomorphy. Participants in hockey, basketball, swimming, softball, and golf were predominantly re-endomorphs. Tennis players had high representation in the balanced group of somatotypes. Spence et al (1980), Slaughter et al (1980) and Meleski et al (1982)

reported a relationship between lean tissue and subcutaneous tissue and physical performance.

Tappen (1950) took somatotype photographs of 43 to 57 entrants for the 1947 National Amateur Athletic Union Weight Lifting Championships. Outstanding lifters in all weight classes were measured and had a mean somatotype of 3-6.5-1. These competitors were characterised by very high mesomorphic and low ectomorphic ratings. The ranges of these components were also narrow. On endomorphy the range was grater but still low at 3.5 units.

Cureton (1951) studied 24 track and field champions who were contenders for the 1984 U.S. Olympic team or championship performers at the National levels; several were olympic champions. His mean somatotype for these competitors was 2.5-5.5-4.5.

Kroll (1954) studied somatotypes of 36 wrestlers from four universities in the mid western United States. He said that different types of wrestling such as free style or Greco Roman might indicate the kinds of people attracted to it. The mean somatotype of his subjects was 2.7-5.0-3.8.

Parnell (1958) plotted somatocharts of competitors in various track and field events and noted differences

between events even though these athletes reached only moderate standard of performance. The outstanding study to date on track and field competitors is Tanner's (1964) in which 137 Olympic and British Empire and Commonwealth Games competitors were somatotyped. The somatochart distribution was similar to that of (Tappen, 1950) being predominantly endo-mesomorphs and with high mesomorphic ratings. The mean for the British Empire Games Lifter was approximately 3-6-1.5. Both samples were rated by Sheldon's system, in which the highest mesomorphic rating is seven.

Sheldon and his associates (1954) have made many interesting observations regarding the somatotype of College Football players in America. They have brought out the probable nature of the somatotypes which are successful in the case of players playing at various field positions. In the study of junior high school athletes, Shelley (1960) found that those athletes who were outstanding in football were largely mesomorphic or mid-types, and that they were taller and heavier than other athletes. Wiley Carter and Sucec (1966) somatotype the 1964-65 San Diego State cross country championship team, and compared it with 19 of Tanner's 5,000-10,000 metre distance runners, and concluded that groups of outstanding distance runners have a relatively limited somatotype distribution patterns because

they are largely ectomesomorphs or meso-ectomorphs. Olympic runners differed from college champions, being less endomorphic, lighter and older, and having a lower total skinfold values. Track and field competitors were also studied by Westlake (1967).

Lewis (1966) studying that somatotypes of 'A Grade' provincial representatives, and national representatives basketball players in New Zealand and found that the heights and weights of players at different levels of selection did not differ, nor did the somatotype rating, except for a decrease in endomorphy by half a unit at the higher levels of selection. The mean somatotype of players was 3.5-4.5-3.5 and when comparable Heath Carter rating is made the mean somatotype would be 3-5-2.5.

Hirata (1966) studied 186 Tokyo Olympic Basketball players who average 189.4 cm in height and 84.3 kg in weight. Except the shot putter, they were found to be tallest of the players being 218.0 cm. Hirata stated that it was an obviously favourable condition for shooters to be tall, and lean type was particularly suitable for prompt action, so they had the most suitable physique.

Imlay (1966) somatotyped 151 college baseball players from the San Diego country and assigned them M.4

phenotype ratings. Their mean somatotype was 4-5-2.5. The range of physiques was fairly large and included most of the scale on each of the components except there were relatively few somatotypes lower than 4 in the second component. The baseball players differ from the normative population of American males; they had a higher proportion of endomesomorphic physiques and lower proportion of all other physiques. Imlay compared the sub-group of players according to their defensive and offensive positions. Many significant differences were noted, and Imlay concluded that somatotype was a selective factor in achieving success at certain position.

By using Parnell's M.4 deviation chart technique, McLure (1967) somatotyped 26 professional golfers from the United States and 26 amateurs from San Diego country, California. The average rating of professional women golfers was 4.1-3.7-3.6 and that of the amateur women golfers' 4.3-4.0-3.3; the data obtained by McLure were converted to Heath-Carter somatotype ratings, thus facilitating a more valid comparison between the group. In using this method, the mean somatotype for the professionals was 4-4-2.5 and for amateurs 5-4.5-2.

Westlake (1967), using Heath Carter anthropometric somatotype rating form somatotyped 61 female track and

field competitors from San Diego county. Many subjects had achieved success as place getters at local, state and national levels. Thirteen per cent were Negro and the remainder Caucasian. For analysis, these athletes were divided into four groups on the basis of their best event. The mean somatotypes for each group were: sprinters 3-3.5-4; jumper 3-3-4.5; distant runners 3-4-3.5; and throwers 5-4.5-2. Throwers differ most from the other groups, being heavier, more endormorphic, more mesomorphic and less ectomorphic.

Carter (1970) reported data on the University of Iowa, San Diego team and USSR outstanding basketball players who became taller and heavier respectively in accordance with the superiority of the team. They were found to be fairly tall (173.6 cm) and heavy (71.2 kg) for women with a mean somatotype of 4.3-4.5-3.0. The close balance between endomorphy and mesomorphy and the lack of physique dominant in ectomorphy characterized this sample. The Mexico Olympic Basketball players were 189.1 cm tall and 79.7 kg heavy (de Garay et al., 1974) many of their players were ectomorphs or mesoectomorphs. One player had a rating of 1.5-2.5-6.

Singh et al. (1987) studied the somatotypes of 152 sportsmen taking part in various games and sports events

viz., hockey, football, basketball, cycling, shot put, hammer throw, javelin throw and discuss throw. The hockey, basketball players and football players and throwers were those who have at least participated in the inter-university competitions. Somatotypes were estimated from the anthropometric measurements with the help of Heath-Carter (1967) Method, and further calculations were done using Carter et al. (1983) methods. The average somatotypes of hockey football and basketball groups are almost similar to each other and are 3.5-4.0-3.0, 3.0-4.0-3.0 and 3.0-4.0-3.5, respectively. The average somatotype of Air Force cyclists is 4.40-4.77-2.13 as compared to 2.76-3.90-3.21 of the cyclists participating in a national coaching camp. The throwers are highly mesomorphic having an average somatotype of 3.5-5.0-2.5. All the sports categories have shown significantly higher ratings of mesomorphy associated with lower ratings of ectomorphy as compared to the control group. Compared to the Olympic level playrs, those of the present study are much below in the development of musculo-skeletal system.

Sodhi et al. (1987) somatotyped 97 volleyball players and 25 controls. The volleyball players have been categorized into five groups depending upon their level of participation. Group I consists of 12 National Indian Volley-

ballers, Group II includes those State level volleyballers (N=21) followed by 27 University level volleyballers, 25 District level players, 12 School level volleyballers. The average value of somatotype of National, State, University and District level players is 2.4-2.8-4.4; 1.9-3.3-3.9; 2.4-3.1-4.0; 2.9-3.4-3.9, respectively. The rating of endomorphy depicts that the volleyballers in each group are having less fat component than the control. In mesomorphic component, the volleyballers in each group possess lower average value as compared with that of the controls. The ectomorphic component shows non-significant results between different groups of volleyball players. However, the volleyballers on the who are found to be significantly more ectomorphic than the controls.

Mokha and Sidhu (1988) conducted the study on somatotype of seventeen female players of volleyball who were selected to represent India in the games held at Hongkong in September 1979. All the players selected had participated in national level competitions. 81 females formed the control sample. The mean age of volleyball players was 18.83 and that of the control was 19.70, height 162.14 and 156.64, weight 53.21 (volleyballer) and 46.31 (controls). The mean somatotypes of volleyballers were 3.71-3.15-2.97, control 4.25-2.88 and 3.41. The players are more mesomorphic and

less endomorphic and ectomorphic than the controls, however, the differences are non-significant.

Sidhu et al. (1989) somatotyped state level women participants of hockey, basketball, volleyball and athletics using Conrad's Method. The age of athletes ranged from 18 to 22 years. The athletes had represented their respective states in the national games. The number of subjects studied in each specialization is ten. The mean height of hockey is 156.79, basketball is 158.75, volleyball 157.21, athletics 160.00 and control group 153.73. The mean weight of hockey is 52.09, basketball 51.02, volleyball 49.06, athletics 55.06 and control 45.00. The average body type of women hockey team is leptomorph-metroplastic. The average body type of women volleyball team player is leptomorph-metroplastic. The average body type of women basketball players is leptomorph hypoplastic. The average type of women athletes is leptomorph-metroplastic and the average body type of control group is leptomorph hypoplastic.

Singal and Kaur (1993) studied the somatotype of 53 urban and 50 rural Jat Sikhs girls ranging in age from 19-25 years. However, the mean age of the rural Jat Sikh girls is 22.54 years and that of the urban Jat Sikh girls is 22.43 years. Fifteen anthropometric measurements have been taken on each subject by following standard techniques.

The mean height and weight of both the rural and urban Sikh girls have been given. The mean height and weight of urban Jath Sikh girls is 161.28 and 53.79. The mean height and weight of Rural Jat Sikh girls is 159.50 and 50.94 kg. The mean somatotype of urban Jat Sikh girls are 4.98-2.93-2.83 and that of the rural are 5.56-2.54 and 3.05. The overall physique of the two groups is not much different.

CHAPTER III

LAND AND PEOPLE

LAND AND PEOPLE

LAND

Meghalaya, the 21st State of the Indian Union, was delcared a full-fledged State on 21st January 1972, comprising the areas of United Khasi and Jaintia Hils and the Garo Hills, with Shillong as the capital of the State. The State is situated in the North Eastern Region of India and lies between 25°47' and 26°10' North Latitude and 89°45' and 92°47' East Longitude.

The Khasis inhabit the central portion of Meghalaya. In Khasi Hills, the major tribes of the Khasi are War, Bhoi and Lyngngam. The War tribe is concentrated on the southern slopes of the Khasi Hills and the Bhoi tribe on the northern portion. Lyngngams are found on the western part of the Khasi Hills bordering Garo Hills.

The Khasi Hills district is divided into three parts. The first division is the Bhoi region on the north which forms itself a compact plateau with associated flat lands and open valleys, its northern extremity gradually sloping towards the Brahmaputra valley. The next division

is a Rilum, an irregular plateau on higher elevation comprises of metamorphic rocks. Small river basins are seen here and there, among *the blue ranges. The highest table land* extends from near about Mawphlang upland on the west as far as the Rableng hill on the east and culminates at Swer and Lyngkyrdem on the South. The highest peak is Shillong peak (6, 449 feet) situated in the heart of the country. Towards the south of Rilum lie the Mawsynram, Sohra and Syndai platforms renowned for heaviest rainfall in the world. The last division is Ri War forming a narrow belt full of oblong and sturdy ridges, abruptly terminating at the Surma valley, forming a scene of mounted up recipices, occasionally coloured by deep gorges, carved up by magnificient rocks, interspersed by the elevated ravines, and at particular points, the sparkling cascades can clearly be seen.

Metamorphic rocks called ki Mawlong Mawteh are abundant in the upper region, being prominent in the zone which extends from Mawphlang to Pynursla and eastward to Syndai. Towards the west liest the Kyllang peak formed of two solid rocks only. The southern part is composed on gneiss forming an area of sub-metamorphic rocks. Large elements of shales, fossils along with worn out masses of granite called Ki Mawramsong are scattered at different

places. Quartz is also admixed. The rocks yield valuable mineral resources like limestone, iron, coal, sillimanite, granite, mica, some of which have been worked. The Khasi Hills along with the areas in the neighbourhood are believed at one time to have submerged under water and their first appearance is traced to the tertiary age. Sir Joseph Hooker (1856) thinks that the geological features of Khasi resemble those of the Vindhya and Raj Mohal in Bihar.

The upper region has a temperate climate. Border areas on the north and south have a comparatively warmer weather and share the climate of the nearby plains. The hills obstruct the monsoons giving the country a regular supply of rainfall. It is interesting to note that Cherrapunji at the southern extremity of Rilum receives the heaviest rainfall in the world, the average being 500 to 700 inches in a year. But recently, Mawsynram lying west of Cherrapunji has received more rainfall than the latter hitherto the rainiest place. Other regions in the country receive a moderate rainfall.

The vegetation is rich. Sal trees are found more numerous towards the Assam plains and a few on the eastern border of the country. Conical pine trees are widespread in a central table land. A few open tracts in the plateau form pastures and grasslands. On the higher regions are

found chestnuts, black berries, oaks, nut-megs, fir and other wild trees. The southern part forms rich orchards where fruits are grown, some of which are rare in other parts of India.

There have been constant changes in the earth's surface. Old men still remember how streams change their courses deserting old beds from time to time. Denudation and other factors have played a role not only in the disfiguration of the soil but in the stages of settlement. The observation of such things has been corroborated by the views of many geologists (Bareh, 1985).

The Khasi Hills district has a rich collection of flora resources. The species of the richest and finest flora are numerous, more protuse in such a small sphere of the Khasi Hills than anywhere in India. To quote Sir Joseph Hooker, "The flora of the Khasi Hills in number and variety of fine plants is the richest in India and probably in Asia."

In Khasi Hills, there is no rationalised land administration. This is due to the fact that according to the customary land tenure system most of the land belongs to the people and not to the state. Individual landholdings are small and there are no holdings beyond 20 hectares.

The dense jungles are the habitat of various wild life. These are, elephants, tigers, bisons, hoolock, bears, barking deers, sambhars, leopards and slow lorris. Monkeys, reptiles, mammals and birds, fauna are also common. In the higher altitudes, smaller birds like fly catcher, thrush treepie, magpie, miniyet, grey-tit and backed-tit, hoopee and wood pecker are found.

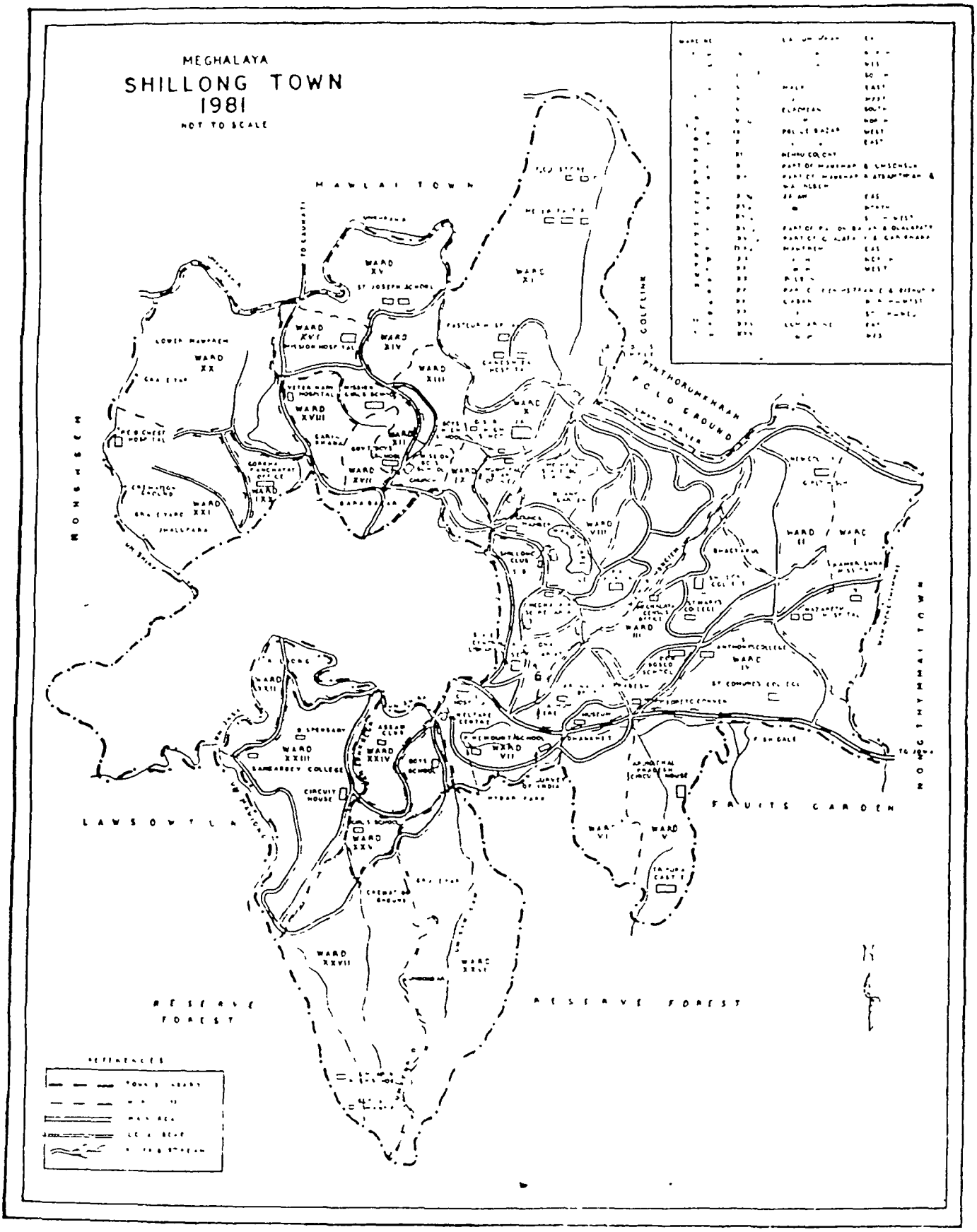
In the lower altitude and in deeper forests, hornbill (Dhanish) including the great hornbill, impeyon pheasant (monal) partridges, wood-cook, florican, barn owl, maina, black drongo, whistling thrush and the Himalayan Great Barbet (Newool) are commonly found.

Both food crops and cash crops are called subsistence crops. The greater proportion of the District's population subsists by cultivating various crops. Crops which are grown mainly for consumption are also sold if they are found to be surplus. Yet there are those crop commodities which are produced mainly on economic consideration and which are termed cash crops. The major food crops are paddy, maize, wheat, millets and pulses. Cash crops are potatoes, jute and mesta, cotton, ginger, turmeric, sugarcane, oilsced, tapioca, black pepper, arecanut and betel vines.

Table 1 - Distribution of population in East Khasi Hills District of Meghalaya.

District/Town	Total/Rural Urban	Total population (in persons)	Area in Sq.Km.
East Khasi Hills District	Total	66,5218	5,196.00
	Rural	4,34,075	5,162.80
	Urban	2,31,143	33.20
Shillong Urban Agglomeration	Urban	2,23,366	25.40
Shillong (Municipality)	Urban	1,31,719	10.36

Shillong, the capital of Meghalaya and also the Headquarters of the District of East Khasi Hills, is popularly known as the "Scotland of the East". But few may knwo how this place 'Shillong' derives its name. According to tradition, Shillong derives its name from a diety and 'Shyllong' whose dwelling is also known as 'Shyllong Peak' from whose niece, the Syiem clans of Khyrim, Mylliem, Maharam, Langrin, Malaisohmat and Bhowal sprang up. The original plan for the site of the Civil Station of the British East India Company was located at the foothills of Shillong Peak, but due to lack of water resources, the site was changed to an area known as Laban and Iewduh but the original name Shillong has been kept intact.



1 Census 83

Fig 1.

Shillong is notably one of the finest hill stations in the country. It is situated at an altitude of about 1,500 metres above sea level. It is any visitor's dream come true. Unlike most hill resorts, it neither snowbound in winter nor hot and overcrowded in summer. The climate is bracing all the year round and is balmy from March to October. The annual average rainfall is 250 cm. The town is criss-crossed with numerous paths and it is the only hill station with motorable roads all round.

PEOPLE

Sociologically, Shillong is a town with a variety of customs and religions, as it boasts of being the abode of many tribes and people of other states. The Khasi, Jaintia and Garo tribes have settled here although the main residue-tribe is the Khasis.

Khasi is a general name given to the sub-tribes viz. Khynriam, Pnar, Bhoi, War and Lyngngam. The term Khasi has a particular significance. Kha means born of and si refers to an ancient mother. Khasi, therefore, means born of a mother. It is relevant to add here that the various names of clans bear their mother's names. This system of ascribing the names of clans after mothers, is, as well, intimately related to a matrilineal system of the people themselves. Khasi indicates, therefore, an original derivation and a legacy bequeathed upon the descendants.

Khasi men, by and large, have discarded their traditional dress/costume and have adopted western dress. The traditional dress of male was 'dhoti' and 'turban'. Khasi male wear sleeveless coat. Khasi women have stuck to their traditional garmen. Women's traditional costume dhara means a jainsem made of pure silkworm on special ceremonies like Christmas or on the ocasion of local festivals. Khasi women are found of decorating themselves with beautiful ornaments made of pure gold.

Khasi believe in one upreme God, the Creator of the Universe. The Khasi believes in one God called U Blei. Almost half of the Khasi population has given up old beliefs and the practice of scrifices. The Khasis called their religion Niam Khasi or Khasi Religion. eng Khasi (named non-Christians), however, continue to worship their own God and practise their own beliefs. Now the main religion of the Khasi is more or less Christianity.

The Khasi trace descent through the mother. Property is transmitted through women. Women amongst the Khasi enjoy a position of unusual dignity and importance. Women have, for generations, been cutodians of property. It is true that the Khasi are matrilineal people, but the authority and control are in the hands of the maternal uncles. The woman is the mistress of the household and custodian of

wealth and not a proprietress. The woman has certain rights over the house and property sanctioned by customs and religious tradition. She does not have any control or rights to sell property without the consent and counsel of her maternal uncles. She is the custodian, the preserver of her clan, her family and her lineage. But the father is the executive head of the house, where his wife and children live with him. On the other hand, he is uncle in his mother's house and having authority and control over his mother's property. The male has double responsibility in his house as father and in his mother's house as uncle.

The staple food of the Khasi is rice, with pork and beef, and fried potatoes, green vegetables are consumed occasionally. Besides this, they consume locally grown seasonal fruits (mostly citrus), nuts and berries. Betel nut chewing (kwai) with betel leaf and a little slaked lime is very common among the Khasi men as well as women. Smoking and drinking, is also quite common among males.

HISTORY OF INDIGENOUS SPORTS OF THE KHASIS

Archery occupies the pride and place, and assumed the character of a National sport amongst the Khasis. Mythology to the beginning of time when their progenitor or the first ancestress of the Khasi race, Ka Meikha, taught this art to her two sons. The Khasi claim to believe that

the Kamakhya hill at Guwahati where now the famous Hindu shrine stands is sacred to them being the seat of their ancestress Ka Meikha. The renowned scholar or Banikanta, Kakati, also agreed that Kamakhya could be sanskritized form of an original Austric formation. The mother of a Khasi race, while giving them the bow and arrows cautioned them that they should never lose their temper over the game. Even now the Nongkhan Khnam, or arbitrator (umpire) directing and regulating the sport, invariably invokes the primenial mother and repeats her warning to the contestants before the commencement of every game of archery.

It appears that Yule among early writers first took notice of Khasi indigenous sports and recreation. For instance, he observed that peg-top spinning locally known as ka pynshad latom was indigenous to the Khasi. They could not have borrowed it from Assam or the Surma Valley Plains where the prevalence of this form of sport was not known. Yule was also suprise to find the presence of another sport among the Khasi, known as 'greasy pole' in England, locally known as kiew dieng btuid. Instead, however, of a leg of mutton or a piece of pork fixed at the top of a pole, the Khasis placed a silver ornaments or some amount of money on top of a bamboo pole well-oiled and made slippery. The successful climber appropriate the

reward. According to J.N. Chowdhury (1978) this sport was adopted from the Khasis amongst whom it was native and popular.

According to Webster Davis Jyrwa (1981) our fore-fathers had already seen the need of sports and games in order to make our children, youth as well as the adults strong and healthy citizens. Some of the sports and games played by the Khasis before and even now are, Randos, Hai-shong syiem, tieddieng khun, ka ialeh point, flying kites and rusni, playing with five pebble stones and with seeds of turmarine.

The most important and exciting indigenous sports among the Khasi are Archery, hunting and fishing. In modern times, football has become very popular with men, while basketball with women. Basketball became popular in Shillong in the 1970s onward. In those times Basketball was played by school girls only in inter-school competition but as years passed this game was also played in different localities and colleges. Now-a-days it has become a popular game not only for girls and women but also for boys and men. Every year the Department of Sports and Youth Affairs hold inter-schools competition/tournaments. Inter-colleges or localities competitions are held by this department and sometimes by clubs, localities or municipality. As for

the participation of the State team in the various tournaments outside the state, the women Basketball Team emerged as a champion of the tournament in the East Zone National Basketball Championship held at Lucknow in 1991.

CHAPTER IV

MATERIAL AND METHODS

MATERIAL AND METHODS

MATERIAL

THE SUBJECTS

The subjects of the present study are Khasi women drawn from different schools (Khasi Jaintia Presbyterian, Seng Khasi, Laitumkhrah Presbyterian, Synod Girls' High School), Colleges (Lady Keane Girls', St. Mary's, Synod College, Shillong College), and localities (Jaiaw Main Raod, Jaiaw Langsning, Laitumkhrah, Mawkhat etc.) of Shillong. Most of the subjects came from middle economic group.

DATA

The data for the present study comprises a total of 200 women, of which 100 women are basketball players, while 100 women form our 'control' samples, that is, these women do not play basketball nor do they participate in any other sports activity. This control sample has been taken in order to examine differences/similarities in physique of players and the general population. Samples for basketball player are divided into five categories on the basis of participation at different levels of competition: State players, Ex-State players, College players, School

players and Local players. The first category is formed by the basketball players of Meghalaya State team 1993. The control samples are drawn from the same areas as for players. The sample distribution is presented in Table 1.

All basketball players range in age from 17 to 83 years with a mean age of 20.562. The control subjects were selected in such a manner that their age range is also the same as for basketball players. The mean age of control subjects is 19.000. Care was taken to inclued only those subjects who were apparently normal and healthy. Basic background information was gathered from each subjects, which includes name, place of birth, domicile, tribe/sub-tribe, education, occupation, total family income.

Table 2 - Sample distribution of basketball players and control according to level of participation.

Group	Sample size	Mean age/years
State players	12	18.760
Ex-State players	16	25.062
College players	11	19.453
School players	27	17.412
Local players	34	19.594
All players combined	100	20.562
Control (non-sports women)	100	19.000
Total number of subjects	200	

In all 10 anthropometric measurements were taken on each subject, for evaluating one's somatotype. Bilateral measurements were taken on the right side of the body. The human body which is subjected to exercise may elicit bilateral differences, the side used more may show greater development. Generally, it is the right side which is of special significance. So, the experts in sports sciences feel that the landmarks depending on the laterality of the body should be different in sportsmen from the other protocols because of the different types of objectives to be achieved, especially to know the maximum development of muscularity, as well as for maintaining uniformity with the techniques employed by sports scientists in the past (Singh & Malhotra, 1989). All measurements were taken according to techniques standardized by the International Biological Programme/Human Adaptability (IBP/HA) Growth Sub-Committee (Weiner and Lourie, 1969).

The basketball players of the present study were also administered a set of questions relating to their training, experience, various facilities enjoyed and difficulties faced by them in the course of pursuing their interest in basketball.

METHODS

ANTHROPOMETRIC MEASUREMENTS

1. Stature – It is the straight distance between horizontal floor (on which the subject stands with his heels together) and vertex, when the head is kept in Frankfurt Horizontal plane. The Anthropometer was used to record this measurement.

2. Weight – It is a three dimensional measurement, and records the total bulk of the body. The subject stands in the centre of the platform of an accurate scale, with minimal clothing. Weight was recorded (using light weight personal weigher) to the nearest 0.5 kg with an allowance deducted for the clothing.

SUBCUTANEOUS FAT

GENERAL INSTRUCTIONS

Instrument – Harpenden skinfold caliper.

Technique – The objective is to measure the thickness of a complete double layer of skin and subcutaneous tissue without including any underlying muscle tissue. A double layer of skin and subcutaneous tissue is grasped with a thumb and forefinger, the fold being large enough to get a complete double layer, but not so large as to get so much skin and fat as may cause excessive amount of tension beyond the finger tips. The fold of skin and

fat is held somewhat loosely while the centres of the caliper faces are 1.0 cm from the edges of the thumb and forefinger.

The reading on the dial of the caliper is taken after applying the full spring pressure of the instrument for all measurements. Time was allowed for the full pressure of the caliper to take effect, but not so long so that the fat is being 'squeezed out' of the skinfold (Firmer pressure of the fingers on the skinfold will normally arrest the movement of the indicator if the movement is excessive). The measurement is recorded to the nearest 0.1 mm.

3. Triceps – The subject stands with the arm by the side and the elbow extended but relaxed (Muscle fibres are excluded, if necessary, by locking the elbow joint momentarily in full extension). The skinfold is raised with the thumb and forefinger of the left hand over the triceps muscle on the back of the right arm, half way between the acromien and the elbow. The skinfold runs parallel to the long axis of the arm.

4. Subscapular – The subject stands with shoulders erect but relaxed and arms by the sides. The skinfold is raised with the thumb and forefinger of the left hand lateral to the inferior angle of the right scapula, the skinfold running downward and outward in the direction of the ribs.

5. Suprailiac – The subject stands in normal erect posture. The subject is instructed to draw in a medium breath and hold it. The skinfold is raised with the thumb and forefinger of the left hand on the medial side of the right calf just above the level of the maximum calf girth so that the fold run vertically.

BONE DIAMETERS

GENERAL INSTRUCTIONS

Instrument – Sliding caliper.

Definition – Bi-epicondylar diameter of the distal extremity of the humerus and femur.

Landmarks – The points on either epicondyle of the distal extremity of the humerus or femur most lateral to the medial plane of the bone.

Technique – The discs on the branches of the caliper are applied against the epicondyles in such a manner as to bisect the angle of the joint and to lie in the same plane as the limb. Firm pressure is applied and the measurement is recorded to the nearest .05 cm.

7. Humerus – The arm of the subject is raised forward to approximately the level of the shoulder and the forearm is flexed upward at a right angle. The cross arms of the caliper are applied to the epicondyles, bisecting

the angle of the elbow, and lying in the same plane as the arm and forearm.

8. **Femur** – The subject sits on a chair with his foot on the floor and the leg vertical.

The observer kneels in front of the subject and applied the cross arms of the caliper to the epicondyles, bisecting the knee angle and keeping the caliper branches in a parallel to the thigh and the leg.

MUSCLE GIRTHS

Instrument – Flexible steel tape.

Definition of measurement – The maximum girth muscle when measured at right angles to its long axis.

Technique - The tape is passed around the limb and the region of the muscle explored with the tape always at right angles to the long axis of the bone, until the largest reading is obtained. The tape is in light contact with the skin (so as to produce deformation of the tissues), and maximum girth is recorded to the nearest 0.1 cm.

9. **Biceps** – The arm of the subject is horizontal, the forearm is separated and elbow fully flexed. The subject is instructed the clench his fist and contract his 'biceps' as strongly as possible.

The tape is passed around the arm approximately midway between the acromion and the elbow, at right angle to the long axis of the arm.

10. Calf – The subject stands on a floor with his feet six to nine inches apart, with his weight equally distributed through both lower limbs.

The tape is passed around the leg near the top of the calf muscle and lowered until the greatest girth is located at right angle to the long axis of the leg.

SOMATOTYPING

According to the method of Heath and Carter (1967) the somatotype is expressed in a 3 numeral, always recorded in the same order. The first component (Endomorphy) refers to the relative fatness and leanness in individual physique. The second component (mesomorphy) refers to the musculo-skeletal development per unit of height and can be treated as the relative lean body mass. The third component (ecto-morphy) refers to the relative linearity of individuals and is based on ponderal index. Before obtaining the soma-totype rating, appropriate data were entered in the appro-priate place at the left side of the rating form.

FIRST COMPONENT RATING

1. Calculate the sum of three skinfolds (triceps)

subscapular and suprailiac) and record it at right side of total skinfolds.

2. Go to the numerical section (right side block) and choose the appropriate value which is very close to the value of total skinfolds. Then encircle that value.

3. Look to the row of 'first component' and observe carefully which value is directly under (vertically) the column which have already encircled. Again encircle that value and now we get the first component.

SECOND COMPONENT RATING

1. Go directly to the numerical section and consider only the horizontal row of height, mark the point of the subject's height by a downward arrow (↓) on the nearest value of height regard the height row as a continuous scale.

2. For each of the measurements of left side (Bone: humerus and femur) go directly to the right side block, consider each horizontal row and encircle the value which is nearest to the value of the left side.

3. Subtract the triceps skinfold thickness value from muscle. biceps (note that triceps skinfold thickness has been measured in mm unit and muslce: Biceps in cm unit, so it would be best to divide skinfold thickness measurement by 10, then substract the value from Muscle: Biceps). In case of calf, again substract the calf skinfold thickness keeping in mind for the transformation of the unit.

4. For each corrected value obtained from 3 (Muscle: Biceps/Calf) go along the row on the right side block and encircle the value which is nearest to the value on the left side.

5. Now do not look at the numberical values. Consider only columns, ignore thc height row and take the other four rows (Humerus, femur, biceps, calf) of the right side block.

6. There will be four encircled figures in the four rows. Out of these four, take the left most encircled column as '0' (zero) or as the base point, then court the column deviations of the other three encircled figures along the row. Add the total deviation of the three encircled figures and divide the total by 4.

7. Take the number obtained by division described in point 6. Still consider the left most encircled column as the base point and count the number (obtained by division) horizontally towards the right side column (count each column as 1). Mark a point (.) to the column position reached after counting; it may be a fraction between the two consecutive columns. Then go vertically up along the column marked with a point to the height row and mark a point with a asterisk (*) on the row.

8. Consider the column only, count horizontally the column deviation from asterisk (*) to mark of height (↓) or vice versa).

9. Remember the column (done in 8), look to the row of 'second component' and consider '4' as the base point. Then move towards left or right horizontally (depending upon the direction of the asterisk from the height marker). Now, count the number of column deviation from 4 and encircle the second component figure. Note if the asterisk is to the right of height then count 4+ figures and if the asterisk is to the left then count 4 figures. Caution: In this row, the unit in consecutive columns has a half-unit increment.

THIRD COMPONENT RATING

1. Calculate the ratio height $\sqrt[3]{\text{weight}}$ (ponderal index, except that here multiplication by 100 is not done; but kg is changed to pound (lb).

2. Look to the right side block and encircle the value very close to the ratio.

3. Look to the row of 'third component' and locate the value directly under (vertically) the column already encircled. Encircled the value. Now, the third component is obtained.

SOMATOCHART (Fig. 2)

Sheldon used a somatotype triangle to represent individual somatotypes in it. The somatotype triangle has all the three sides of equal length and are arc-shaped. The corners of the traingle represent the extremes in each component. The left corner at the base of the triangle represents extreme in endomorphy, the right corner at the base represents extreme in ectomorphy and the top corner represents extreme in mesomorphy. The somatotypes can be plotted on the somatotype triangle as dots whose visual inspection can be very useful in interpreting the somatotypes. Heath-Carter (1967) and Carter (1975) utilised the same concept and triangle to design the somatochart. A

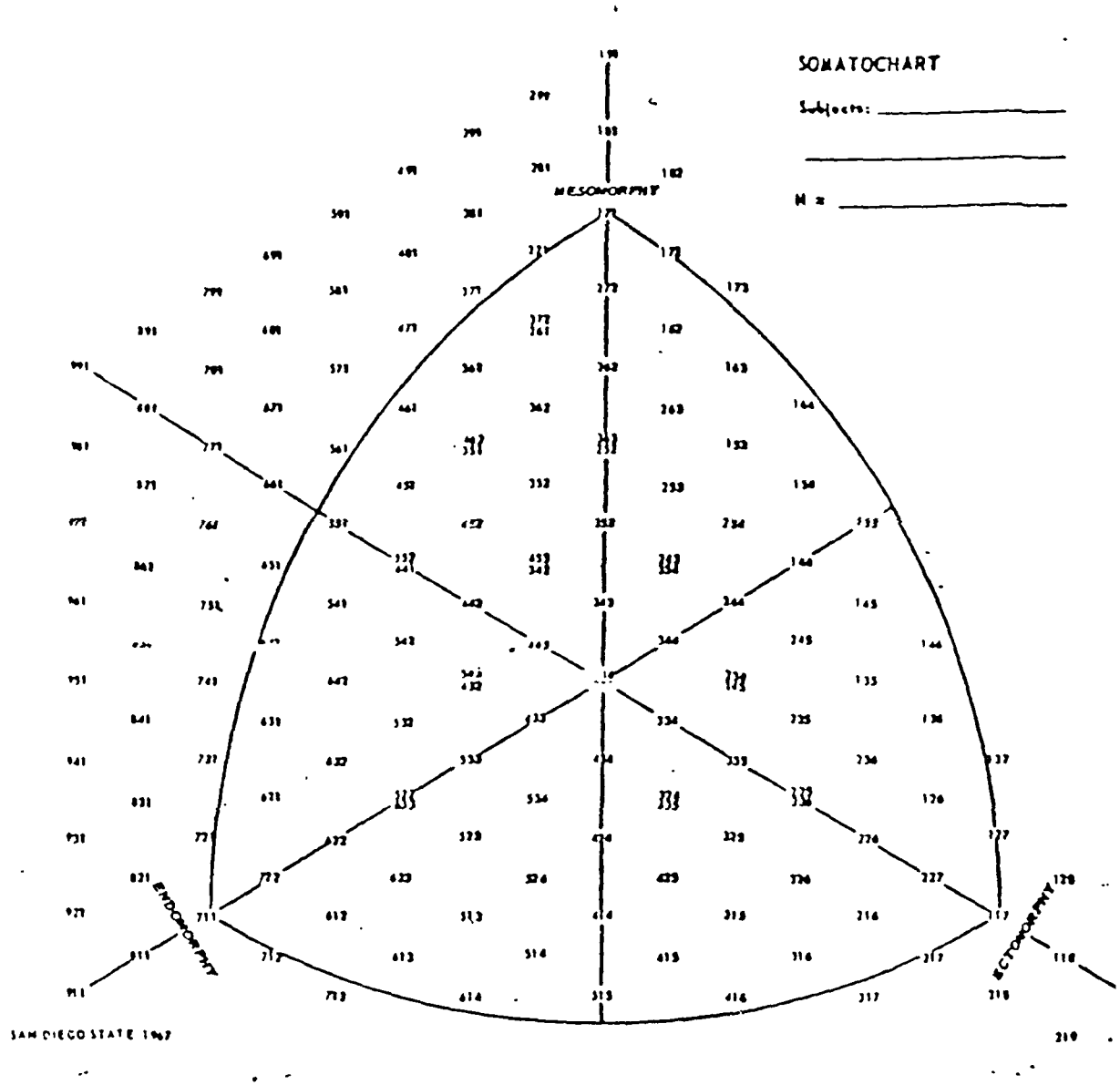


Fig. 2. A somatochart for plotting the distribution of somatotypes.

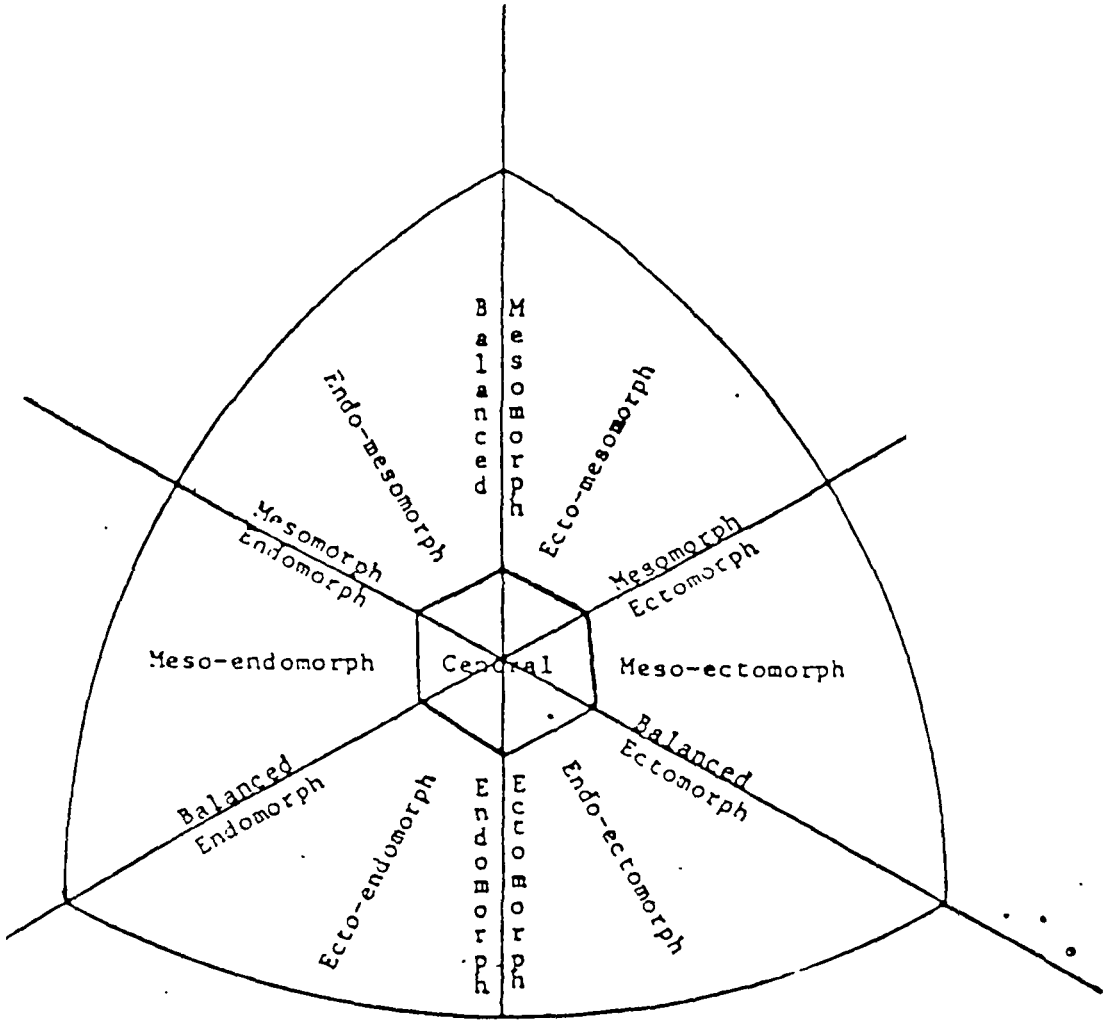


Fig. 3. A diagramatic representation of thirteen somatotype categories based on the axes and sectors of the somatochart.

typical somatochart has been displayed where the individual somatotypes can be plotted which are called somatoplots. the somatotypes can be divided into following categories depending upon the position of the somatotypes on the somatochart (Fig. 3).

i) **Balance endomorph** – The first component dominates over second and third which are either equal or differ no more than 0.5 units (5-3-3, 5-3-2.5, 5-2.5-3).

ii) **Balanced mesomorph** – Second component dominates, the first and third components are either equal or differ no more than 0.5 units (3-5-3, 2-5-5-3, 3-5-2.5).

iii) **Balance ectomorph** – Third component dominates over second and third which are either equal or differ no more than 0.5 units (3-3-5, 3-2.5-5, 2.5-3-5).

iv) **Mesomorph-endomorph** – First and second components either equal or differ no more than 0.5 units and dominates over third component (5-5-3, 4.5-5-3, 5-4.5-3).

v) **Mesomorph-endomorph** – Second and third components either equal or differ no more than 0.5 units and

dominate over the first component (3-5-5, 3-5-4.5, 3-4.5-5).

vi) **Endomorph-ectomorph** – First and third components either equal or differ no more than 0.5 units and dominate over second component (5-3-5, 4.5-3-5, 5-3-4.5).

vii) **Mesomorphic endomorph** – First component greater than second and the third is the smallest (5-3-2, 5-4-2).

viii) **Ectomorphic endomorph** – First component greater than the third and the second is the smallest (5-2-3).

ix) **Endomorphic mesomorph** – Second component greater than first whereas the third is the smallest (3-5-2).

x) **Ectomorphi mesomorph** – Second component greater than third and the first is the smallest (2-5-3).

xi) **Endomorphic ectomorph** – Third component dominates over first and the second is the smallest (3-2-5).

xii) **Mesomorphic ectomorph** – Third component greater han second and the first is the smallest (2-3-5).

xiii) **Central** – All components are either equal or differ no more than one unit from the other two, the ratings of all components should be within and consist of ratings of 2, 3 or 4 (3-3-3, 4-4-4, 3.5-4-4, 4-3.5-4, 4-4-3.5, 3.5-4-3.5).

STATISTICAL CONSIDERATIONS

The data were subjected to the following statistical treatment in order to arrive at suitable interpretations.

1. **Somatotype Distributions** – The distributions of the somatotypes on the somatochart may be described by simply counting the number of somatotypes in the areas of the somatochart. From these frequencies the relative frequency can be calculated, and if two distributions are to be compared, the chi-square test can be applied to determine the significance of the differences between the distributions. Before proceeding to the other analysis of somatotype data, the somatotype distributions were analyzed in the present study.

2. **Mean Somatotypes** – The somatotype ratings were also analyzed one at a time, for which simple descriptive statistics were used – mean, standard deviation, etc. In order to analyze differences/similarities in the mean ratings

of any two samples, student's t-test was applied for statistical significance.

3. **Somatotype Dispersion Distances (SDD)** - Somatotype dispersion distances (SDD) is the distance between the somatoplots which have the coordinates (x_1, y_1) and (x_2, y_2) and is calculated as follows:

$$SDD = \sqrt{3(x_1-x_2)^2 + (y_1-y_2)^2}$$

The 3 under the square root sign is a constant which converts x distances into y distances units. The location of the somatotype in terms of (x, y) coordinates on the somatochart is referred to as its somatoplot.

4. **Somatotype Dispersion Index (SDI)** - A somatotype dispersion index (SDI) is the mean SDD of the somatoplots in a distribution from the $\bar{S}$ somatoplot. This may be obtained by the following formula.

$$SDI = \sum_{i=1}^{n} \frac{SDD_i}{n}$$

Where SDI is the somatotype dispersion index and the SDD_i are the somatotype dispersion distances from the plot of the calculated mean somatotype $\bar{S}$ of the distribution to each somatoplot for any given number of subjects (n) in the distribution.

5. **Simple Descriptive Statistics** – Mean ($\bar{x}$): It is the sum of individual values divided by their total number and is given as,

$$\bar{x} = \frac{\Sigma x}{N}$$

Where, Σx = Total of values.

N = Total number of values.

Standard Deviation (SD): It is defined as the root mean-square deviation, and given as,

$$SD = \sqrt{\frac{\Sigma(\bar{x}-x)^2}{N-1}}$$

Where, $(\bar{x}-x)$ = Deviation from mean.

$\Sigma(x-x)^2$ = Summation of the squares of mean deviations.

N + Number of items.

Chi-Square (x^2): Contingency tables are normally tested for significant departures from independence by means of x^2 test. The most direct method for this is given by the formula,

$$x^2 = \Sigma \frac{(O-E)^2}{E}$$

Where, O = Observed.

E = Expected.

Σ = Summation.

Student's t-test: For comparisons of means of two samples, the statistical significance is tested with student's t-test.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{SEM_1^2 + SEM_2^2}}$$

Where, $\bar{X}_1$, $\bar{X}_2$ = means of first and second sample.

SEM_1^2, SEM_2^2 = Squares of standard errors of means of first and second samples.

All calculations were performed on the 'casio-scientific calculator - fx - 82c'.

CHAPTER V

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

In this chapter, the somatotypes of Khasi women basketball players and control subjects are presented. The individual somatotypes are plotted on Somatocharts I to V for each of the five samples of players, and on Somatochart 6 for the control subject, under study.

SOMATOTYPE DISTRIBUTIONS

Table 3 gives the number and percentage of basketball players distributed in various somatotype categories. Out of the total 13 generalised categories of somatotypes, all basketball players of the present study are distributed among 12 somatotype categories. No players fall under the Ectomorphic-endomorph category. A majority (28%) of the players are classified as 'central type' which means that none of the three components greatly differ from each other. State players reported only 8.33% in this category while Ex-State players 50% and others more than 22% each. 26% of the players fall under 'Mesomorph-endomorph' category meaning that the first and second components are almost equal while the third is smaller. In this category the highest percentage is reported by School (40.74) and local

players (26.47) followed by Ex-State (25.00) and the others less than 20%. While there is no state players who fall within this category but 33.33% of the State players fall under 'Endomorph-mesomorph' meaning that the second component is dominant while the first is greater than the third. 25% of the State players are 'Balanced dendomorphy' which means that in these players endomorphy dominates over mesomorphy and ectomorphy and the second and third components are almost similar.

Among the control subjects the somatotypes are distributed into 10 categories. A maximum of 23% fall under the 'central type', which means that all the components are either equal or differ no more than one unit from the other two, followed by 'balance endomorphy' (20%) meaning the first component dominates over second and third which are either equal or differ no more than 0.5 units, and 'mesomorph-endomorph' (13%). 12% of these subjects are 'Endomorph-ectomorph' – the first and third components are similar and dominates over the second component.

Considering the players at different levels of participation it is seen that the somatotypes of State and Ex-State level players are placed in 6 categories each, the local players in 5 categories, the school level players in 7 categories and the local players in 8 categories.

Whereas the control subjects are distributed among ten types of categories.

On the basis of distribution of players in different somatotype categories the chi-square test was performed, and the results are presented in Table 4. Statistically significant differences are found between State level players on the one hand, and Ex-State (X^2 = 23.38, P > 0.01) College (X^2 = 14.19), School (X^2 = 19.87, p > 0.05), and local (X^2 = 34.99, p > 0.01) on the other. The somatotype category distribution very significantly differentiate (X^2 = 63.41, p > 0.01) from the control subjects of the study.

MEAN SOMATOTYPES

Mean and Standard Deviation of Somatotypes of players at different level of participation and control subjects are given in Table 5. The mean somatotypes of players of different samples are: State 4.33-4.29-3.54, Ex-State 4.15-3.90-3.81, College 4.27-4.18-2.73, School 4.50-4.61-2.83, Local 4.59-4.29-3.47, Combined players 4.42-4.30-3.25, Control subjects 4.90-4.18-4.15. These mean somatotypes indicate that the State players, College players and School players are 'Mesomorph-endomorph' which means that in these players the endomorphy is similar to mesomorphy but ectomorphy is lower than the first and second

components. Ex-State players and control subjects have the same body size and shape, i.e., both are 'Balanced-endomorph' meaning that the first component is dominant and the second and third either equal or differ no more than 0.5 unit. Local players and combined players are 'Mesomorphic-endomorph' which means that the first component is greater than the second and the third is the smallest. The State players have a different body size and shape (Mesomorph-endomorph) from the control subjects (balanced endomorph). However, the somatotypes rating of the three components are somewhat different in players of different samples as well as the control subjects.

Table 6 shows the statistical comparisons (using Student's t-test) based on mean somatotypes which fails to show any significant differences for the three components of physique between the State players and Ex-State players, and between the State players and College level players. Only mean 'ectomorphy' rating of school level players show statistically significant difference ($t = 1.80$, $p > 0.10$). It is interesting to note here that the players belonging to locality sports clubs do not reveals significant differences in their mean somatotypes as compared to the State level players.

The subjects of our control sample show significan-

tly different 'endomorphy' ($t = 2.96$, $p > 0.01$) and ectomorphy ($t = 1.70$, $p > 0.10$) ratings from those of the State players. Similarly, the combined samples of all players show statistically significant differences for mean endomorphy and ectomorphy ratings when compared with the control samples.

The analyses presented previously have certain limitations. When the somatotype is disassembled and the individual components are treated separately, interpretation of the component rating is not without hazard. While it is important to know the absolute value of the component rating, comparison with either individuals or groups, treating the components as independent variables destroys the concept of relative dominance (Carter, 1980). The singular usefulness of the somatotype concept over and above that of single variable description is that the three numeral rating represents the body as a whole by giving relative component dominance. Ross and Wilson (1974) and Ross et al. (1984) have developed several methods of analyses which preserve the integrity of the somatotype rating. Some of these methods have been used to analyse the somatotype data of present study, and the results are presented in Table 6, and discussed below.

By using the formulae for obtaining the X and Y

coordinates, any somatotype given on the somatochart can easily be verificd. Table 7 gives the means for X and Y coordinates in different groups. The positive higher values of 'Y' indicate a greater development of Mesomorphy. Among the groups considered in the present study the State players have the highest value of 'Y' while the Ex-State players have the lowest value.

The location of a somatotype in term of X and Y coordinates in the somatochart is referred to as its somatoplot. A somatotype dispersion index (SDI) is the mean SDD (somatotype dispersion distance) of all somatoplots in a sample from the mean somatoplot ($\bar{S}$). The SDI value listed in Table 7 tells us the average distance of the somatotype from their mean ($\bar{S}$) in different groups.

One of the objectives of this study is to compare the present somatotype data with other data available in literature. But out limitations of such comparisons are: (i) very few studies have been conducted on women basketball players of India or elsewhere, (ii) many such studies do not report 'Standard Deviations' for different component of physique, (iii) most of the studies have avoided giving the values of X and Y coordinates. However, a comparison of present data with whatever studies are available (Table 14) is presented as follows:

Carter (1970) reported a sample of 10 USSR female basketball players with a mean somatotype 4.3-4.5-3.0; whereas the mean somatotype of the State level players of the present study is 4.33-4.29-3.54. Due to non-availability of standard deviation/standard error of mean for Carter's data the 'Student's t-test' could not be applied. However, it can be seen that the mean endomorphy and mesomorphy ratings of Khasi players is slightly more than the USSR players. This difference is ectomorphy rating is obviously due to the great difference in the mean height (Khasi = 157.13 cm, USSR = 173.0 cm) and weight (Khasi = 46.17 kg, USSR = 71.2 kg).

Sidhu et al. (1989) studied Punjab State level women basketball players, using Conrad (1963) method for somatotyping which has different methodology than the Heath-Carter method followed in the present study. However, the the Punjab State players broadly are 'leptomorphic' (which may be similar to Heath-Carter's ectomorphy) while the Khasi players are mesomorph-ectomorph. In both samples of players the endomorphic (or Conrad's 'pycnomorphy') ratings are lower than the other two components. The relative dominance of ectomorphy among women basketball players of Punjab may be attributed to their greater mean height (158.75 cm) and weight (51.02 kg) as compared to the Khasi players.

Morris (1960) published data on 150 women athletes from Philadelphia area somatotyped by Sheldon's laboratory. These athletes from basketball, field hockey, golf, gymnastics, softball, swimming, diving tennis and track and field were selected. The mean somatotype of the athletes was 4.5-4.0-3.0; whereas the mean somatotype of the Khasi women basketball players is 4.33-4.29-3.54. Both the samples are predominantly meso-endomorphs, but the mean ectomorphy and mesomorphy ratings of the Khasi players is more than the Philadelphia athletes. However, Morris found that divers gymnasts and track women rated higher than basketball players, hockey etc., in mesomorphy.

Carter (1970) somatotyped 61 female New Zealand Physical Education Majors. Most somatotypes of golfers, gymnasts and basketball players fall within the physical education distribution. The mean somatotype of New Zealand Physical Education Majors is 3.0-4.4-2.2 while the mean somatotype of the State players of the present study is 4.33-4.29-3.54. The Standard deviation and Standard error of mean for Carter's data is not available, hence the Student's t-test could not be applied. The physical education majors are 'endomorphic-mesomorph' whereas the State players are mesomorph-endomorph. The endomorphy and ectomorphy rating is higher in the present study than the New Zealanders physical education majors.

Westlake (1967), using Heath-Carter anthropometric somatotype rating form somatotyped 61 female tract and field competitions from San Diego County. The athletes were divided into four groups, the sprinters with a mean somatotype of 3.0-3.5-4.0, jumpers 3.0-3.0-4.5; distance runners 3.0-4.0-3.5; and throwers 5.0-4.5-2.0. The total mean somatotype of these athletes is 3.5-3.6-3.6, with an average height of 107.1 cm and weight 56.8 kg. The sprinters are mesomorphic-ectomorph, jumpers balance ecto-morph, distance runners ectomorphic mesomorph and throwers mesomorphic-endomorph. The ratings of these players differ from one group to another and even from the State players of the present study which is mesomorph-endomorph. The mean somatotype of the State players of the present study is more than that of the total mean of the San Diego track and field players especially in endomorphy and mesomorphy ratings, and this is obviously due to the fact that (i) the latter are fatter and their musculo-skeletal dimensions are well developed than the players of the present study, (ii) and also because they are engaged in different events.

McLure (1967) somatotyped 26 professional and 26 amateur golfers from the United States and California. The mean for the professionals was 4.1-4.0-2.7 and for amateurs 4.9-4.6-2.1 whereas the mean somatotypes of the

State players of the present study is 4.33-4.29-3.54. In all the samples the players are mesomorph-endomorph, and the third component is the lowest but the mean ectomorphy rating is higher in the players of the present study than the golfers.

Carter (1970) studied the somatotype of 5 female USSR gymnasts. Although the sample is small, their mean height (157.0 cm) is almost identical to the mean of the State basketball players of the present study (157.13 cm). The USSR Gymnasts are shorter by .13 cm and heavier (53.9 kg) than the State players of the present study with a mean weight of 46.17 kg. The mean somatotype of the gymnast is 3.8-5.2-1.6 whereas the State players have a mean somatotype of 4.33-4.29-3.54. It can be seen that there is a great difference in the means of all the three components of both the samples perhaps because of the differences in masculo-skeletal development and leanness/fatness ratio in the two samples.

Mokha et al. (1988) somatotyped 17 female volleyball players of India. The mean somatotype of the volleyball players (3.71-3.15-2.97) differs greatly from the basketball players of the State of the present study (4.33-4.29-3.54). The volleyball players are mesomorphic-endomorph while the basketball players are mesomorph-endomorph. The basket-

ball players have a higher rating in all the means of the three components.

Now we present an analysis and interpretation of responses received to the Questionnaire administered to the basketball players relating to the influence of various factors on their performance at different level of competition. The responses have been analysed in terms of percentages, and comparisons are made between State, Ex-State, College, School and College level players.

Table 8 lists the percentages of experience in playing the game of basketball, formal training and major difficulties faced by the basketball players at different levels of participation. It is interesting to note here that more than 80% of the State team as well as School level players possess less than 5 years of experience for playing basketball. On the other hand, at least 87% of Ex-State players and 50% of College and Local level players have more than five years of experience in playing this game. 91.67% of the State players and 81.25% of Ex-State players are formally trained. Hoever, only 37% and 54% of School and College team players, have had formal training in basketball. Surprisingly, 100% of players of all categories are not in receipt of any scholarship/financial help from either the government or any other agency. Further

it is shocking to note that 100% of Local players, 81% each of College and School players, 66% of State players followed by 31.25% of Ex-State players reported as not getting any special diet. While none of the players complained of lack of practising time, yet 33% of State players and 13% each of College and School players felt that their performance is affected as they are pursuing their studies also. Though none of the State players reported the lack of basketball court, but at least 41% of them felt the need of a proper Indoor Stadium. Approximately 70% of College as well as School players and 32% of local players expressed the lack of playing courts. At least 18.18% of School, 29% of College and 52% of local players do not have proper sports kit. However, this difficulty is not faced by the State team players, though 8.33% of them felt that their performance would improve if they get proper and thorough coaching. Similarly, 55% and 44% of School and College players, respectively, complained of lack of good coaching.

Table 9 gives the percentages of players engaging in regular practice in a week, before any tournaments, and also the hours spent by the basketball players in practicing the game. 100% of the State players practice daily whether there is any tournament or not. While in other teams, the percentage of players in other teams, the per-

centage of players who practice everyday or once in two days is less than 37%. The highest percentage reporting by players at different level of participation excepting State is once in a week, Ex-State players 93.75% followed by College 63%, Local 47% and School 37%. However, before the tournaments more than 81% of the players at all levels practice daily. 72% of college players spent only 1 hour in practicing, followed by Ex-State 68% , Local 58%, School and State 25% each. 66.67% of School players spent 2 hours in practice while other players spent the same time but their percentage is less than 35%. Before the tournament, 58% of the State players spent 3 hours in practicing followed by Local players 23% and College and School less than 10% each. More than 62% of Ex-State and College level players spent 2 hours for practice followed by School (59%), Local (59%) and State (33.33%).

The percentages of spending more time in practice between the age of 10-15 or now, warm-up exercise and personal habits are listed in Table 10. 75% of the State players and 55% of local players spent more time in practice now than when they were younger (i.e., between the age of 10-15). However, 81% of Ex-State players spent more time in practice between the age of 10-15 followed by College 63% and 55% of School players, while only 25% of State players reported

as spending more time between the age of 10-15 years. 100% of the State players do warm up exercise before play followed by Ex-State players 93.75%, Local players 91%, School 70% and College players 54%. 87% of the Ex-State players spend half an hour in warm up eexercise followed by local 70%, State players 66%, School 40% and College 18%. The percentage of players at different level of participation in spending 15 minutes and 1 hour in warm up exercise is less than 16%, excepting in College players where the percentage of spending 1 hour in warm up exercise is 36.57%. The percentage of those who chew 'chewing gums' is more than those who do not. It is found that about 50% of State players and more than 87% players at all levels of participation are in the habit of using 'chewing-gums'. More than 50% of the players chew 'chewing-gums' before and during the game. In the field of Sports Medicine it is well-known that the practice of chewing gums is not only dangerous but also causes wastage of energy as the act of chewing itself is an exercise (Thakur, 1984).

Table 11 shows the percentage of women basketball players who frequently suffer from spasm (of calf/thigh muscles) ankle sprain, backache and pain in knees and shoulders. A small percentage (ranging between 8.33-31.25) of players of different teams frequently suffer from spasm of calf and thigh muscle, ankle sprain and backache. All the players at different levels of participation who suffer

from spasm reported as having got a problem with calf muscles but not thigh muscle excepting school and local players reported as having problem with thigh muscles. Only State players, Ex-State players and Local players reported as frequently suffering both from ankle sprain and backache while School and local players suffered only from backache. 8.83% of Local players reported as having sufferred from pain in the knees, while none of the players from other sample complained on this.

The medical attention given to players in case of any injury during regular practice or tournaments is tabulated in Table 12. It is pathetic to know that none of the team at any level of participation, even the State team, has any Doctor to attend to any injuries on the players during regular practice or tournaments. In the event of any injury the players are attended either by their respective coaches or incharge on the spot and later on they visit private doctors at their own expense.

Table 13 gives the percentages of the Family members of the baskeball players who were sports person, the different categories of sports activity they are engaged in, and the person who encouraged them to play basketball. 93.75% of Ex-State players followed by State 83.33%, School 74%, College 72.73% and 58.82% of local players reported

that their family members are players of different sports activities. More than 50% of Family members of basketball players of State and Ex-State each were/are playing the same sports as the women of this study, followed by family members of Local (26%) School and College (18% each). The percentage of the family members who are engaged in other sports activities other than basketball is less than 26% at all level of participation excepting in School players who reported the highest percentage (44%). A total of 52% of the women basketball players at all level of participation were encouraged to take to sports by their relatives (State 33%, Ex-State 56%, College 36%, School 55% and Local 58%) while 6% were encouraged by their friends. Approximately 42% of them did not receive any encouragement from anybody (State 66%, Ex-State 37%, College 54%, School 37% and Local 35%) but took to basketball on their own.

Coaching means organised instruction where aim is to increase athletes physical, psychological, intellectual, moral and mechanical performance rapidly. The coach is the person who is expected to put all the sciences into practice. In the present study, 8.33% of the State players, 55% of College and 44% of school, respectively, complained of lack of good coaching and felt that their performance would improve if they get proper and thorough coaching.

Kundu and Mukherji (1988) stated that a coach and a physical educator is expected to pay attention to body composition in order to construct a training schedule for improving one's performance, to select appropriate events or activities and to assess the intensity of a training programme.

Pal and Sharma (1988) reported that sports training is essentially a preparation of the individual so that they can withstand competition stress. Sports training is a process of athletic improvement conducted on the basis of scientific principles. It is always aimed at achieving the highest possible individual performance in a given event or discipline. About 55% of the players of the present study spend 2-3 hours daily in practice before any tournament with a view to achieving top performances in basketball. According to Singh (1987), in order to achieve an optimum level of development of an athlete's physical and psychological performance one should be subjected to maximum training loads. But in order to do so, the athlete should adapt his living habits to the requirement of his sports activities in such a way that they help him to improve his performance in the most effective way. Thus, training becomes an integral part of the athlete's way of life.

'Warm up' means adaptation of athlete of some alterations in physical states as a result of which competitors

become mentally enthusiastic and geared up and prepare themselves for a tough time to follow (Thakur, 1984). A warm up should be undertaken before participation in any type of sports and vigorous activity. The intensity and duration of warm up should be individualized according to the athlete's physical status or capabilities. Too intense of warm up can deteriorate physical performance due to fatigue. Young athletes/sportsmen and students should be taught a short, yet comprehensive warm up in physical education classes, because such exercise help to prevent injuries in growing ages. Warm up has become an accepted way of preferring an athlete's mind, heart, lungs and muscles for athletes so that he becomes quiet and relaxed and can concentrate in games.

The specific injuries sustained by Basketball players are seen in the ankles, knees, shoulder, back and calf muscles. According to Thakur (1984) basketball requires very rapid movements (Zig-Zag course), jumping, side twisting and smashing and so the common injuries encountered are the shoulder and wrist sprains. Knee injuries like sprains of the medial and lateral ligaments, cartilage tears and anterior or posterior cruciate ligament laxity and tears are common in such games. Backache, disc strain, and different muscle sprains like adductor, hamstring and

gastroenemies are commonly found in this game. The thigh, calf and back muscles are frequently sprained as these players have to turn their body quickly, undertake forward bending for smashing, shooting and bouncing the ball and hyper-extension of the back during receiving the ball passed by another player. Calf muscle spasm also becomes at time so painful that the player stops the game and a reasonable period of rest must be advised.* Sometimes sprains and tears cause a serious set back to the normal performances of these players that the injured players cannot continue the game even he is given treatment at the spot. The muscle injury however minor it may be must be dealt with immediately and proper treatment should be instituted for such disabilities. In order to improve the performance either for an individual or for that matter of a team, sports medicine doctors should form an integral part of the entire exercise practice, training and coaching (Banerjee & Ghosh, 1984).

The health of the athlete and his ultimate physical performance depends largely on the state of his nutrition. Maintenance of proper nutrition is a year round project

---

* These spasms are commonly due to improper tacking or incomplete warm up or due to unfair charge to the opponent players.

and is organised depending on the type of physical exertion the athlete is undergoing from time to time and also from season to season. The energy requirement of an athlete depends on the intensity, duration and type of his activities. The quality of a sports diet depends on the correct proportion of carbohydrate, protein, fat, mineral salts and vitamins which constitute the main nutrients of the diet. Pre-competition diet was popularised recently by western sports scientists to meet the extra demand for energy required by the athlete during actual competition. The athlete who is fed on a well balanced sport diet is deprived of carbohydrate in his diet, 7 days prior to the competition. He is fed mainly on protein and fat rich food for the first 4 days. During the remaining 3 days prior to the competition, this carbohydrate starved athlete is fed on an exclusive carbohydrate diet, thereby increasing the glycogen (glucose) storage within the body. This enhanced glycogen reserve is utilised by the athlete to meet his extra demand on energy during actual competition. After the competition he goes back to his normal sports diet (Chandran, 1984). According to the survey reports of the National Institute of Nutrition of Hyderabad, "the protein intake of school children in the low and lower middle income group in urban and rural areas is 35.6 gm as compared to a suggested requirement of 41.0 gm". Thus it is evident

that in sports performing capabilities, we are already handicapped compared to the nutritional advantage of the children of the developed and richer countries, since our basic fitness levels are rather poor in formative years of life.

Minimum facilities viz. playgrounds, pools, tracks, sports equipments and gymnasiums, etc. are not available in our vast country. As regard the facilities at the University/Colleges, School and Localities are concerned, it is true that infrastructure for sports and games is grossly insufficient (Narain, 1987). According to Singh (1987), in the hilly areas, the outdoor playfield facilities would be restricted to the courts of the small area games like volleyball, basketball, wrestling etc. In hilly areas of places of high rainfall, where the weather condition are not favourable for most part of the year, the indoor facilities render greater service and utility. The existing facilities at this level may not stand to any comparison to what is required. The games stadium facilities are very few, the ground facilities are also uncommon, while multipurpose indoor hall facilities are unheard of. Schools, Colleges and Universities should attempt to provide attractive facilities and safe equipments for Physical Education and Sports.

There are number of schemes for providing financial assistance to sportsmen and women. In order to attract them, it is imperative to widely publicise such benefits so as to increase their participation in sports. There are also universities where sports scholarships are awarded to these with exceptional ability in a particular game. This is particularly so in the USA, where the national and international stars hail from high schools or universities. Life for such people is hardly a bed of roses. They have to spend long hours at workouts, supervised by coaches and other experts. Once the training sessions are over, they are rushed through into the lecture rooms for study. So, the athlete who scores those vital points for his team is well taken care of and he does not fall short of the grades at work. At the end of the exercise he comes out a winner with a hard earned degree (Bhatia, 1987).

There ought to be financial and material incentives not only for those who are outstanding performers but those who combine excellence in sports with studies. Universities here are yet to compromise on academics and sports. With a result, students who are good in studies as well as in sports find it difficult to adjust their sports with their academics. Some prefers to leave sports to concentrate on their academic career while others neglect their studies

and pursue their sporting activities. Universities should help those high flying sportsmen who because of tournament commitments, miss work during term time, to be able to attend extra courses during the vacation period. The mere giving of leave from work and providing playing facilities gives only a temporary respite to one who desperately needs that all important university degree. For too many players have faced crisis in later life, because of lack of proper qualification for a suitable career (Singh Deo, 1987). There are no incentives to excel or insurances for safety ;for our aspiring sports person in case they are out of form or injured resulting in dire poverty for the rest of life. The examples of many of our past sportstars languishing in obscurity with economic and social distress are not encouraging sight to our youngsters, majority of whom usually drop out of sports arenas for other secure professions, unlike their western counterparts who are looked after by their countries or states.

Table 3 - Number and percentage (within brackets) of Basketball players and control in various somatotype categories.

Somatotype Categories	State	Ex-State	College	School	Local	Control
Balanced Endomorphy	3(25.00)	1(6.25)	3(27.27)	2(7.41)	1(2.94)	20(20.00)
Mesomorphic endomorph	-	1(6.25)	2(18.18)	3(11.11)	7(20.58)	11(11.00)
Mesomorph-endomorph	-	4(25.00)	2(18.18)	11(40.74)	9(26.47)	13(13.00)
Endomorphic mesomorph	4(33.33)	-	1(9.09)	2(7.41)	-	1(1.00)
Balanced Mesomorph	-	-	-	2(7.41)	-	-
Ectomorphic mesomorph	-	1(6.25)	-	-	2(5.88)	-
Mesomorph-ectomorph	-	-	-	-	1(2.94)	-
Mesomorphic ectomorph	-	1(6.25)	-	-	1(2.94)	3(3.00)
Balanced ectomorph	1(8.33)	-	-	-	3(8.82)	9(9.00)
Endomorphic-ectomorph	1(8.33)	-	-	1(3.70)	-	6(6.00)
Endomorph-ectomorph	2(16.67)	-	-	-	-	12(12.00)
Ectomorphic-endomorph	-	-	-	-	-	2(2.00)
Central	1(8.33)	8(50.00)	3(27.27)	6(22.22)	10(29.41)	23(23.00)

Table 4 - Differences in the distribution of somatotype categories of basketball players and control.

Groups compared	X^2 value	df
State vrs Ex-State	23.38**	9
State vrs College	14.19*	7
State vrs School	19.87*	8
State vrs Local	34.99**	10
State vrs Control	29.51**	9
Combined vrs Control	63.41**	12

* $p > 0.05$

** $p > 0.01$

Table 5 - Mean and Standard Deviation of different components of physique in players and control group.

Group	Number	Endomorphy		Mesomorphy		Ectomorphy	
		Mean	SD	Mean	SD	Mean	SD
State players	12	4.33	0.58	4.29	1.29	3.54	1.99
Ex-State players	16	4.15	0.87	3.90	0.66	3.81	1.05
College players	11	4.27	0.68	4.18	0.68	2.73	0.90
School players	27	4.50	0.83	4.61	0.97	2.83	1.12
Local players	34	4.59	0.90	4.29	0.74	3.47	1.37
Combined players	100	4.42	0.83	4.30	0.89	3.28	1.23
Control	100	4.90	0.92	4.18	0.78	4.15	1.43

Table 6 - Statistical differences (t-values) in Mean Somatotypes of players and control.

Groups	Endomorphy	Mesomorphy	Ectomorphy
State vrs Ex-State players	0.65	0.78	- 0.63
State vrs College players	0.22	0.25	1.64
State vrs School players	-0.73	-0.32	1.80*
State vrs Local	-1.11	0.00	0.18
State vrs Control	-2.96**	0.29	0.17*
Combined players vrs Control	-3.99**	1.05	- 4.72**

* $p > 0.05\%$ level.

** $p > 0.01\%$ level.

Table 7 - Plot coordinates (X, Y) Somatotype Dispersion Index (SDI), Somatotype Dispersion Distance of various groups of players and control.

Group $\bar{X}$	X	Y	SDI	Two Dimension SDD
State players	1.33	3.08	1.99	2.03
Ex-State players	1.40	1.50	1.90	4.09
College players	1.73	1.54	2.05	4.27
School players	1.89	2.44	2.80	3.31
Local players	1.78	1.57	2.47	2.67
Combined players	1.64	1.97	2.26	3.28
Control subjects	1.56	1.95	2.33	-

Table 8 - Experience, training, difficulties as reported by basketball players (Figures are percentage of players).

Group	Formal training	Experience of playing		Difficulties faced by players							
		1-5 yrs	5 yrs & above	Lack of playing court	Lack of coaches	Lack of practicing time	No special diet	Lack of Indoor stadium	Clash with studies	No scholarship	Lack of sports kit
State Team players (N=12)	91.67	83.33	16.67	00.00	8.33	00.00	66.67	41.67	33.33	100.00	00.00
Ex-State players (N=16)	81.25	12.50	87.50	68.75	87.50	18.75	31.25	00.00	00.00	100.00	68.75
College players (N=11)	54.55	45.45	54.55	70.37	44.44	00.00	81.82	00.00	18.18	100.00	29.63
School players (N=27)	37.04	81.58	18.42	70.37	55.56	00.00	81.48	00.00	18.18	100.00	18.18
Local players (N=34)	38.24	50.00	50.00	32.25	26.47	00.00	100.00	00.00	00.00	100.00	52.94

Table 9 - Percentage of girls/women reporting different frequency of practice.

Groups	Practice				Hours				Before the tournament							
									Practice				Hours			
	Once a week	Once in 2 days	Twice a week	Daily	1 hr	2 hrs	3 hrs	More than 3 hrs	Once a week	Once in 2 days	Twice a week	Once a week	1 hr	2 hrs	3 hrs	More than 3 hrs
State players	0.0	0.0	0.0	100	25.00	25.00	50.00	-	-	-	-	100	8.33	33.33	58.34	-
Ex-State players	93.75	-	6.25	-	68.75	31.25	-	-	-	-	-	100	37.50	62.50	-	-
College players	63.64	9.09	18.18	9.09	72.73	27.27	-	-	9.09	-	9.09	81.82	27.27	63.64	9.09	-
School players	37.04	-	25.92	37.04	25.93	66.67	14.81	-	-	14.81	-	85.19	22.22	59.26	7.41	7.41
Local players	47.06	5.88	20.59	26.47	52.94	35.29	11.76	-	-	5.88	5.88	88.24	17.65	55.88	23.54	2.94

Table 10 - Percentage of players engaged in practice, warm up etc. and in the habit of chewing.

Groups	Spending more time in practice		Warm up Exercise		Hours			Personal habits					
								Chew chewing gum		if yes:			
	Between Age 10-15 yrs	Now	Yes	No	15 min.	½hr	1hr	Yes	No	Before play	During	After	Both
State players	25.00	75.00	100.00	-	16.67	66.67	16.67	58.33	41.67	41.67	8.33	8.33	-
Ex-State players	81.25	18.75	93.75	6.25	6.25	87.50	6.25	87.50	12.50	56.25	12.50	-	31.25
College players	63.64	36.36	54.55	45.45	-	18.18	36.37	100.00	00.00	45.45	9.09	-	45.45
School players	55.56	44.44	70.37	29.63	14.81	40.74	14.82	96.30	3.70	37.04	22.22	11.11	29.63
Local players	44.12	55.88	91.18	8.82	8.82	70.59	11.76	94.12	5.88	38.23	26.47	35.30	-

Table 11 - Percentage of players reporting different ailments of the body.

Groups	Thigh (Spasm) muscle	Calf (Spasm) muscle	Ankle sprain	Backache	Knees
State players	-	8.33	8.33	16.67	-
Ex-State players	-	31.25	12.50	31.25	-
College players	-	18.18	-	27.27	-
School players	14.82	11.11	-	7.41	-
Local players	11.76	8.82	2.94	8.83	8.83

Table 12 - Percentage of players reporting the kind of medical attention being received by them.

Groups	Private Doctor	Incharge	Coach	Family Members	Friends	No one
State players	16.67	-	66.67	-	-	16.67
Ex-State Players	25.00	6.25	12.50	-	-	56.25
College players	18.18	18.18	9.09	-	-	54.55
School players	25.93	22.22	3.70	7.41	7.41	33.33
Local players	17.65	14.71	11.76	8.82	8.82	41.18

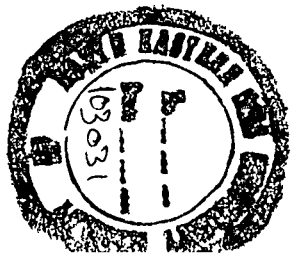
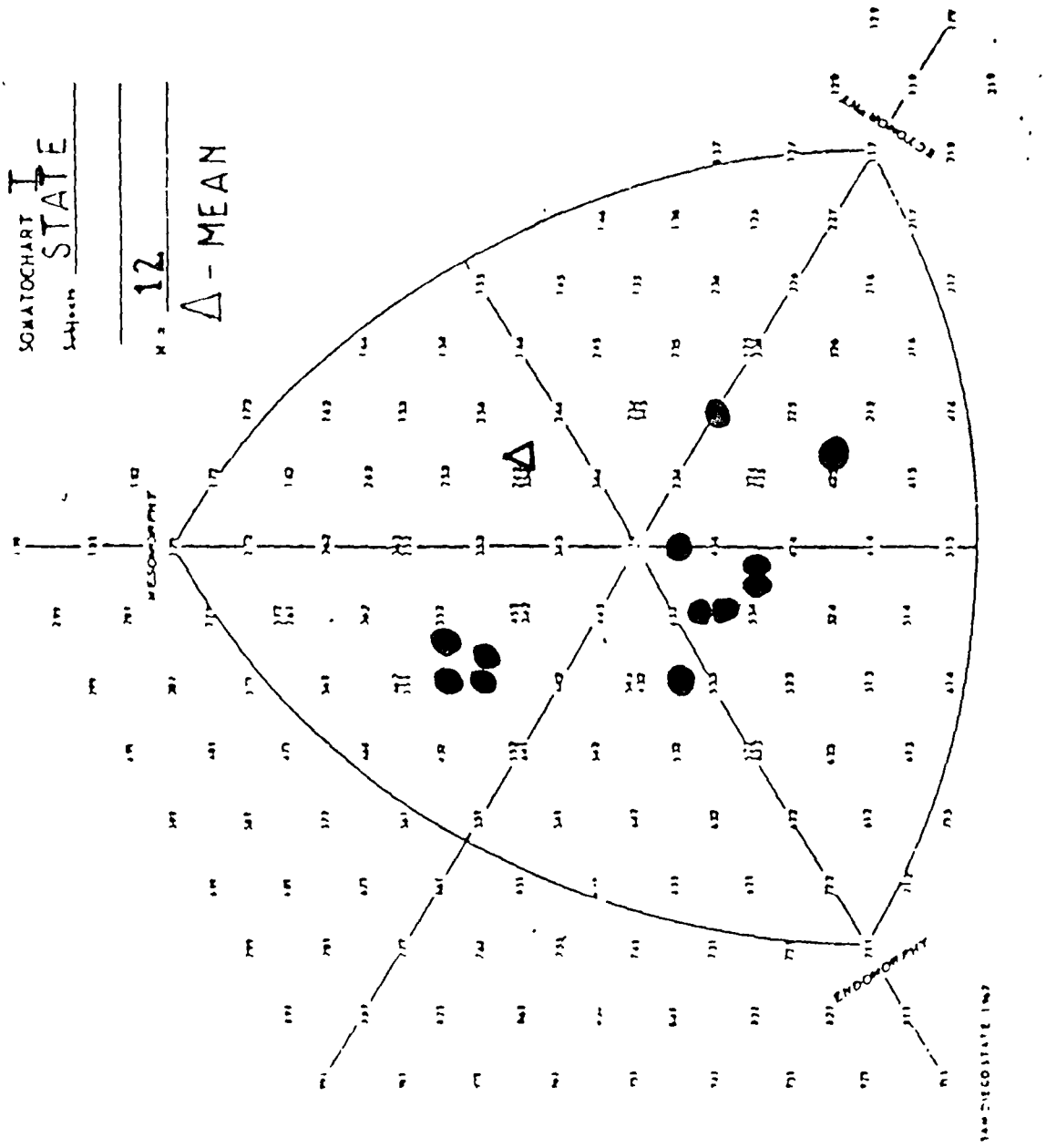


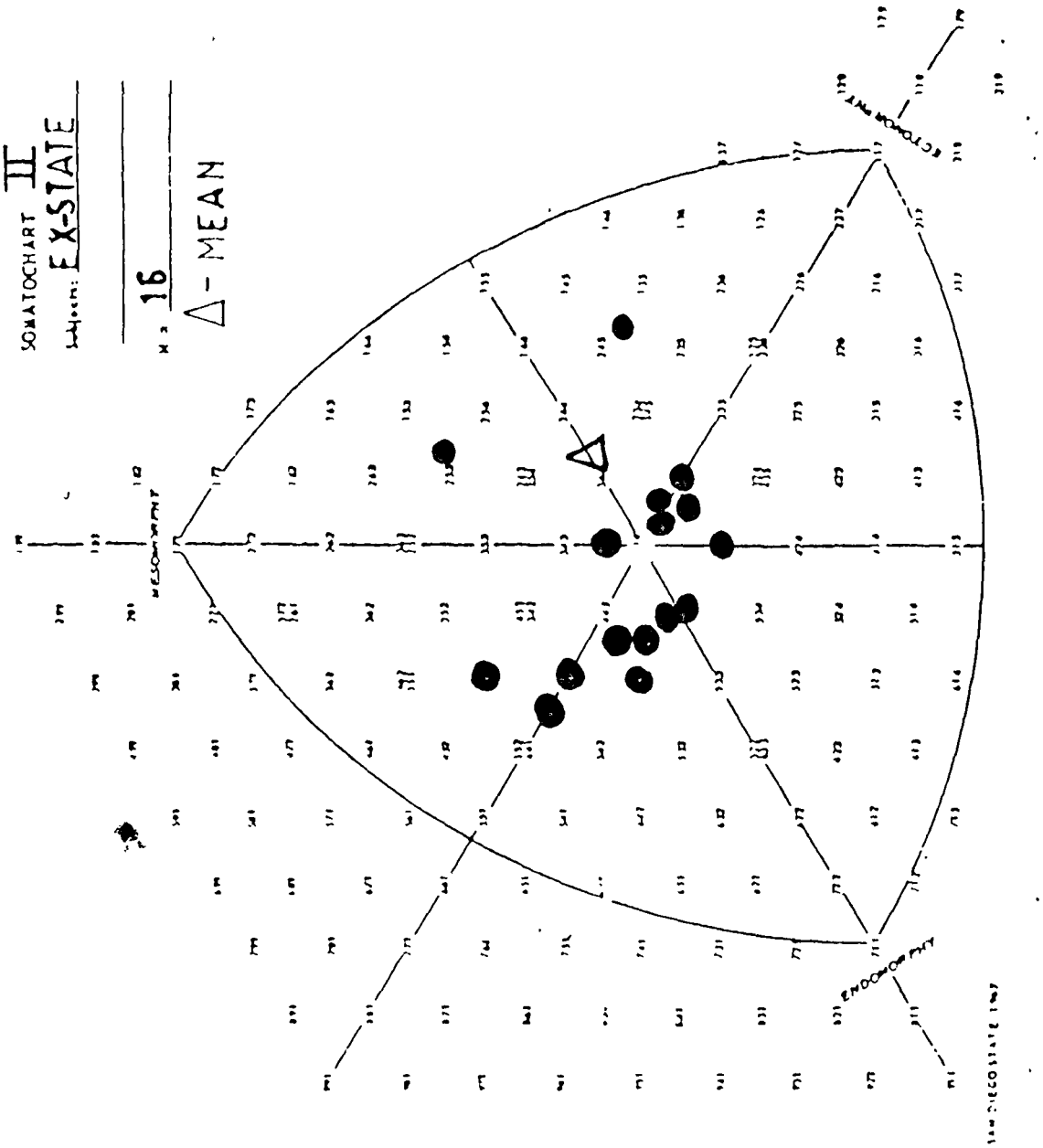
Table 13 - Percentage of basketball players reporting (i) any family member as a sports person, and (ii) persons who encouraged them into sports.

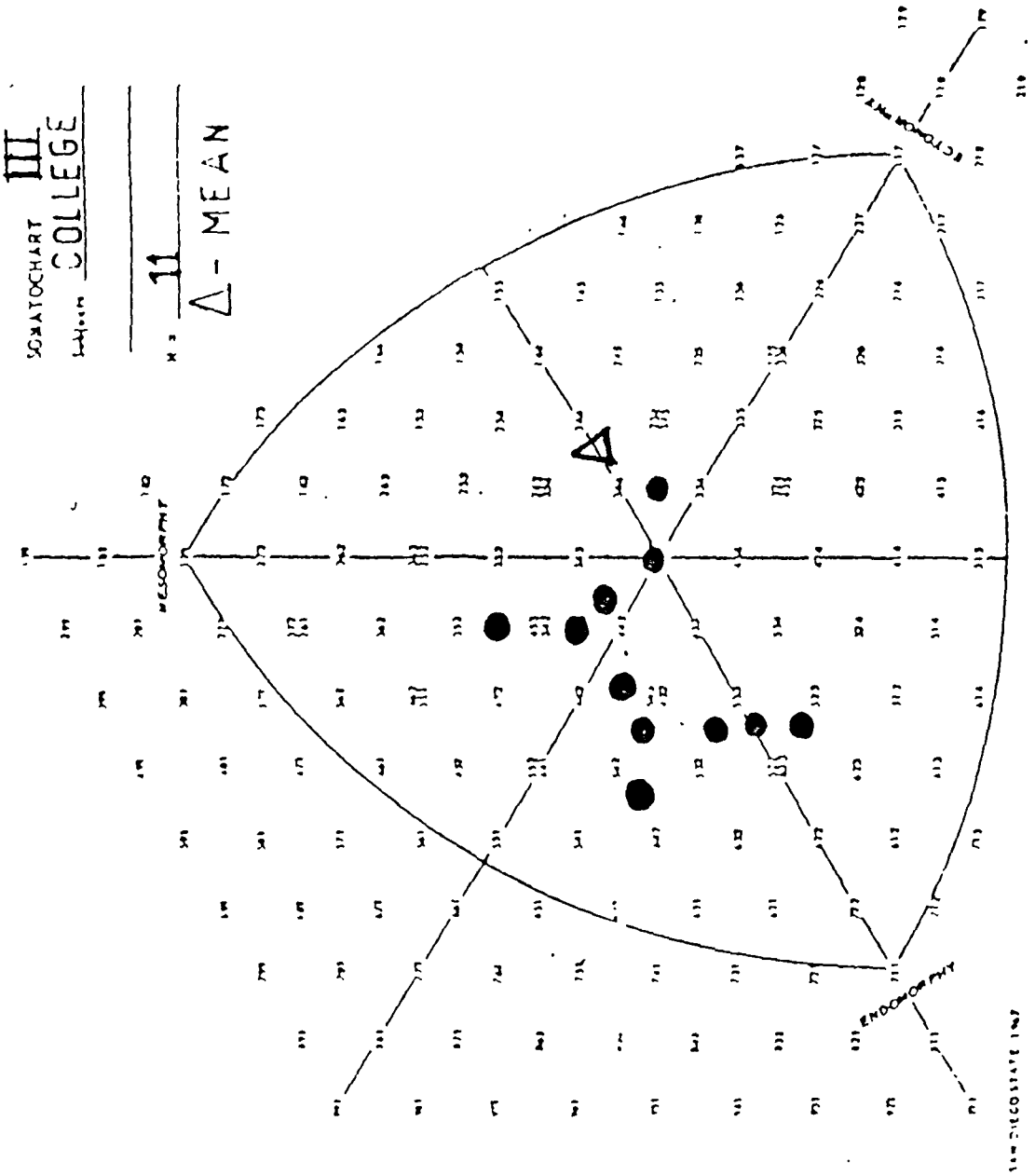
Groups	(i)						(ii)		
	Yes	No	Same game	Foot-ball	Badmin-ton	Others	Family Member	Non-Family Member	No one
State players	83.33	16.67	50.00	16.67	8.33	8.33	33.33	00.00	66.67
Ex-State players	93.75	6.25	56.25	18.75	6.25	6.25	56.25	6.25	37.50
College players	72.73	27.27	18.18	18.18	9.09	27.27	36.36	9.09	54.56
School players	74.07	25.93	18.52	44.44	11.11	00.00	55.56	7.40	37.04
Local players	58.82	41.18	26.47	26.47	0.00	5.88	58.82	5.88	35.30

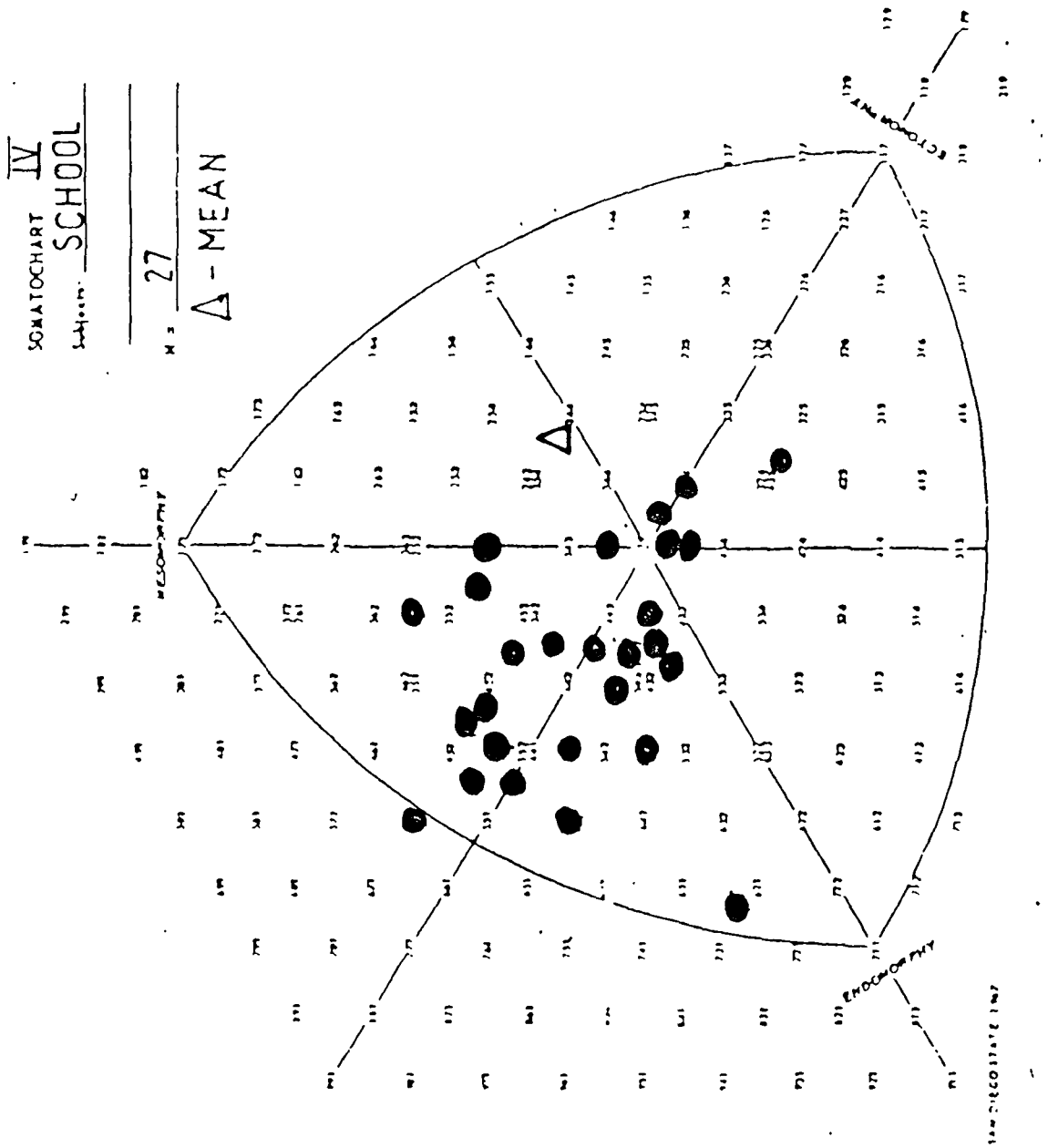
Table 14 - Mean (+SD) Height, Weight, Age and Somatotype ratings for the three components of physique.

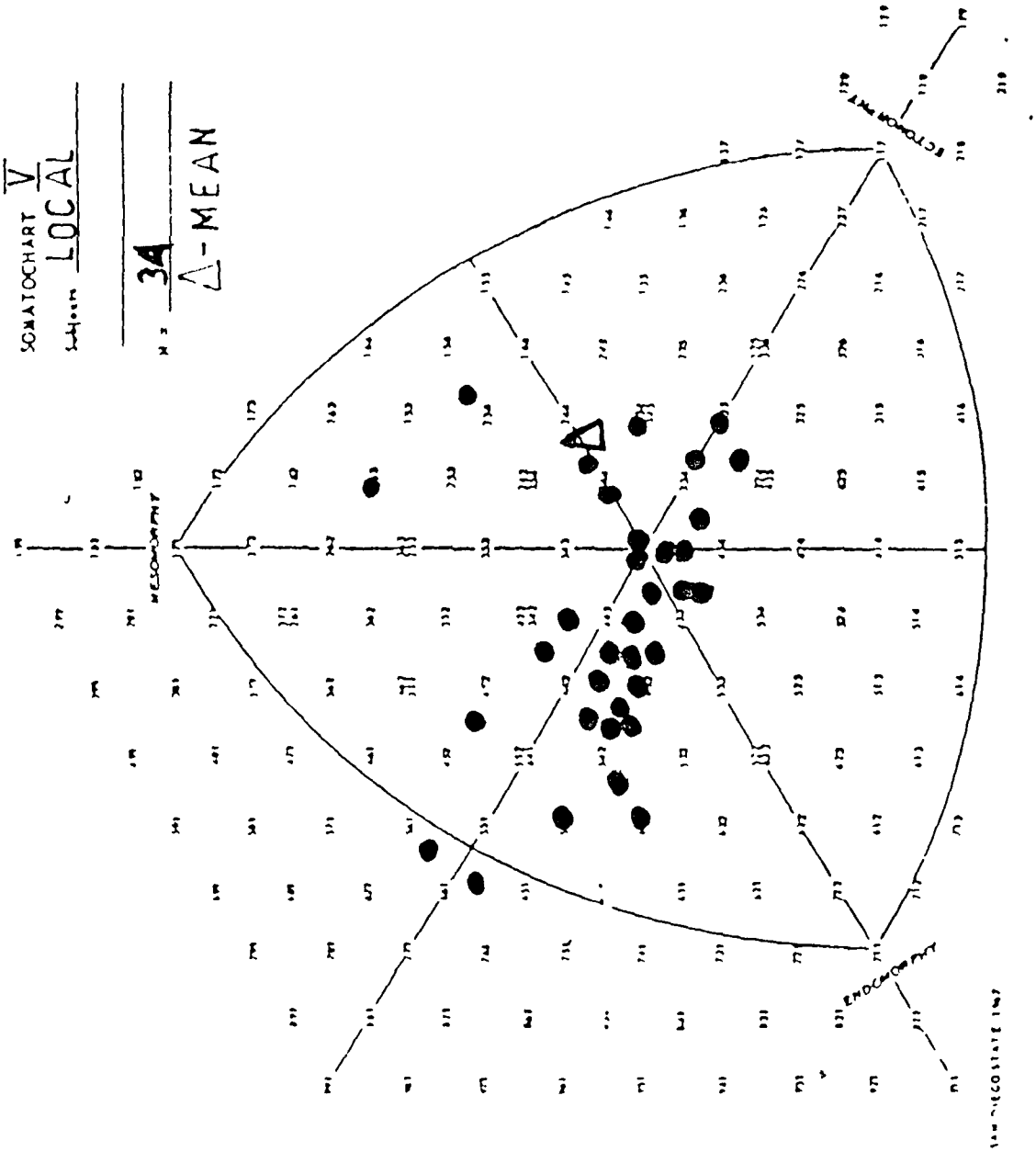
Players	N	Age (Yrs)	Ht (cm)	Wt (kg)	Endomorphy		Mesomorphy		Ectomorphy		Coordinate	
					Mean	SD	Mean	SD	Mean	SD	X	Y
State players (present study)	12	18.76	157.13	46.17	4.33	0.58	4.29	1.29	3.54	1.99	1.33	3.08
USSR Basketball players(Carter, 1970)	10	N.A.	173.00	71.40	4.30	-	4.50	-	3.00	-	-1.17	1.17
Volleyball players (Mokha et al. 1988)	17	18.33	162.14	53.21	3.71	1.08	3.15	0.63	2.97	0.87	-0.74	-0.38
USSR Gymnasts (Carter 1970)	5	N.A.	157.00	53.90	3.80	-	5.20	-	1.60	-	-2.20	5.0
Physical Education Major (Carter, 1970)	61	19.40	164.3	60.00	3.90	-	4.40	-	2.20	-	-1.70	2.7
San Diego Track & Fields (Westlake, 1967)												
Sprinters (Westlake, 1967)	-	17.20	167.1	56.8	3.00	-	3.50	-	4.00	-	1.00	0.00
Jumpers (Westlake, 1967)	-	-	-	-	3.00	-	3.00	-	4.50	-	1.50	-1.50
Distance Runners (Westlake, 1967)	-	-	-	-	3.00	-	4.00	-	3.50	-	0.50	1.50
Thrower (Westlake, 1967)	-	-	-	-	5.00	-	4.50	-	2.00	-	-3.0	2.00
Athletes (Monis, 1960)	-	N.A.	N.A.	N.A.	4.50	-	4.00	-	3.00	-	-1.5	0.50
U.S. Golfers (McLure, 1967)	26	27.80	167.6	62.4	4.10	-	4.00	-	2.70	-	-1.5	1.50
San D. Golfers (McLure, 1967)	26	40.50	164.8	62.9	4.90	-	4.60	-	2.10	-	-3.0	2.0

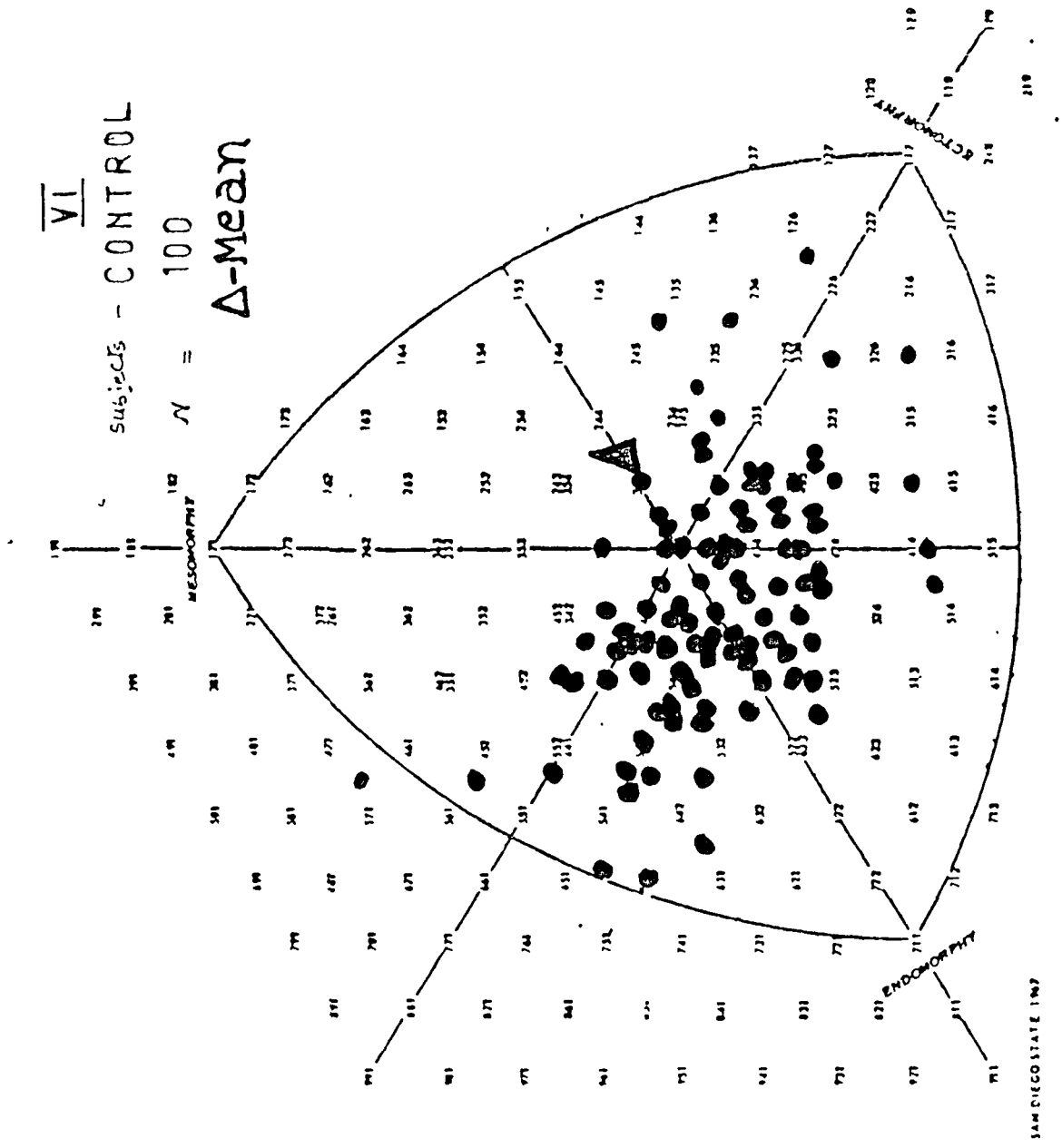

SOMATOCHART I
STATE
N = 12
Δ - MEAN
MESOMORPHY
ECTOMORPHY
ENDOMORPHY


SOMATOCHART II
EX-STATE
N = 16
Δ - MEAN
MESOMORPHY
ECTOMORPHY
ENDOMORPHY


SOMATOCHART III
COLLEGE
11
Δ - MEAN
MESOMORPHY
ECTOMORPHY
ENDOMORPHY


SOMATOCHART IV
SCHOOL
N = 27
Δ - MEAN

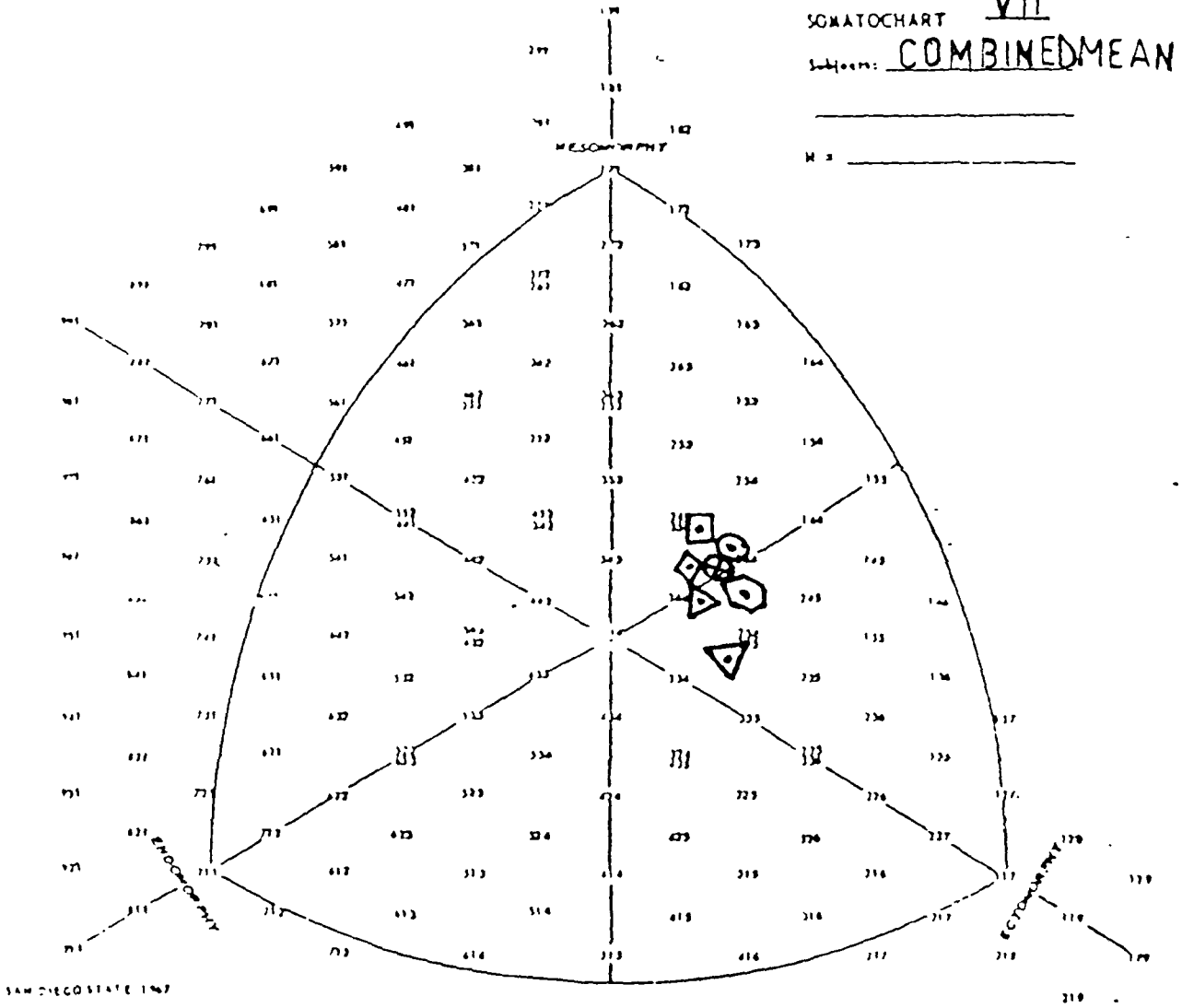

SOMATOCHART V
LOCAL
N = 34
Δ - MEAN
MESOMORPHY
ECTOMORPHY
ENDOMORPHY


VI
Subjects - CONTROL
N = 100
Δ-Mean
MESOMORPHY
ECTOMORPHY
ENDOMORPHY
SAN DIEGO STATE 1967

SOMATOCHART VII

Subject: COMBINED MEAN

N = _____



□ — STATE

△ — EXSTATE

⬡ — COLLEGE

⊙ — SCHOOL

▽ — LOCAL

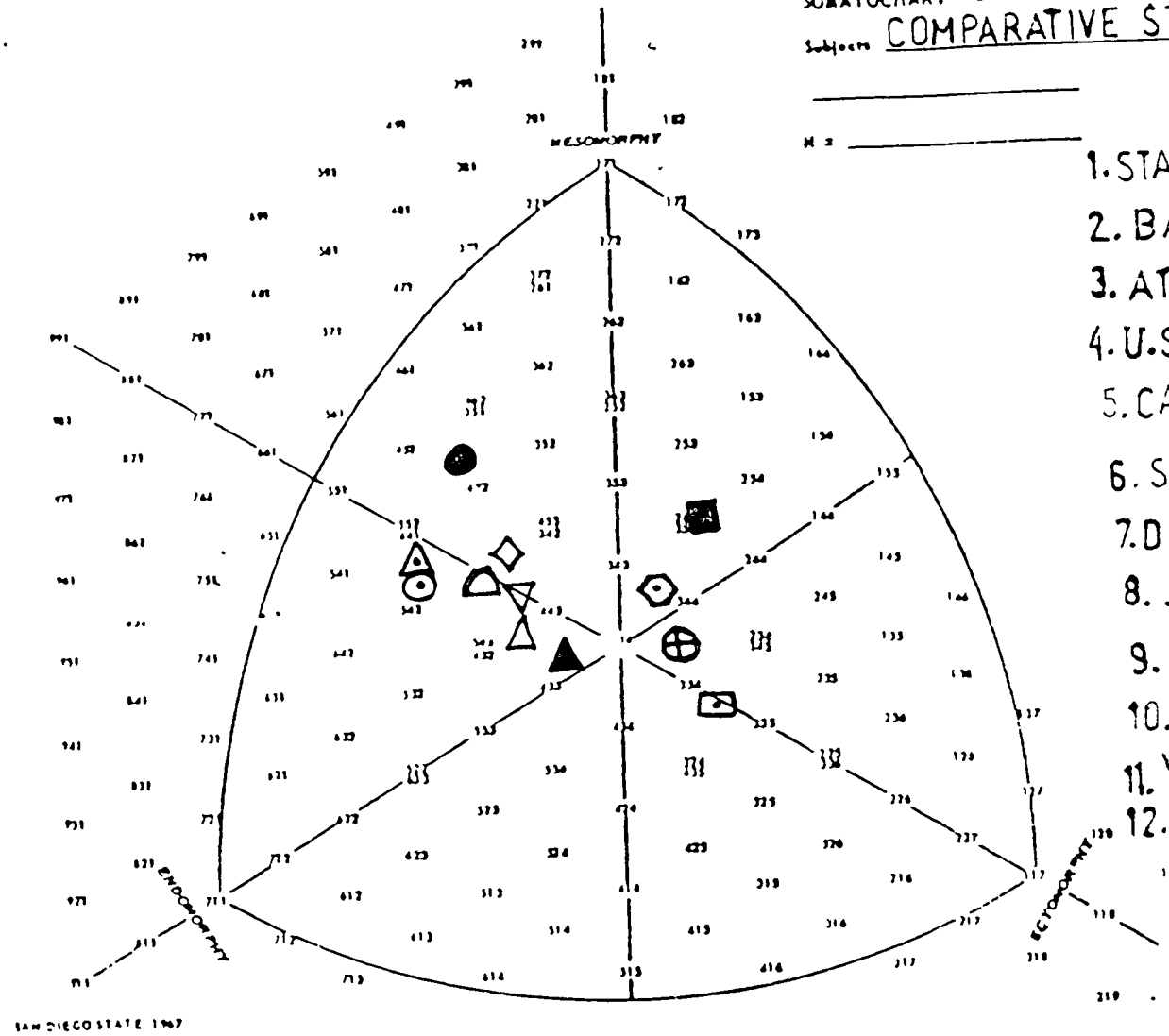
◇ — CONTROL

⊕ — COMBINED PLAYERS

SOMATOCHART VIII

Subject: COMPARATIVE STUDY

N = _____



1. STATE PLAYERS (PRESENT).
2. BASKETBALL (USSR).
3. ATHLETES,
4. U.S. GOLFERS.
5. CARLIFORNIA GOLFERS.
6. SPRINTERS.
7. DISTANCE RUNNERS
8. JUMPERS.
9. THROWERS.
10. GYMNASTS.
11. VOLLEY BALL
12. PHYSICAL EDU. MAJOR.

CHAPTER VI

SUMMARY AND SUGGESTIONS

SUMMARY AND SUGGESTIONS

A somatotype of basketball players of Khasi women is made with the following objectives:

i) To report the body size and shape of basketball players;

ii) to examine the differences in the body size and shape of basketball players and the general population;

iii) to compare the present data with that reported in the literature;

iv) to evaluate the influence of various factors on the performance of basketball players; and

v) to make suggestions in the light of the above.

In the present study a total of 200 Khasi women (basketball players and control) ranging in age from 17 to 33 years were investigated. A total of 100 basketball players participating at State, Ex-State, College, School and Local levels were investigated. The data were collected from different schools, colleges and localities of Shillong

Municipal town. Heath and Carter (1967) Anthropometric somatotype was used. Somatotype categories and mean somatotypes have been calculated and plotted on Somatocharts. Other statistics applied include, Somatotype Dispersion Index, Somatotype Dispersion Distance, percentage frequencies, mean, standard deviation, chi-square, and Student's t-test. The important findings of the present study are as follows:

i) Khasi women basketball players are predominantly Mesomorph-Endomorph.

ii) Out of the 13 generalised categories of somatotypes they are distributed among 12 categories. On the basis of somatotype categories significant differences are observed at all levels of participation and even between combined players and control.

iii) Statistically significant differences are observed only on two components of physique between State and Control on the basis of mean somatotype ratings. The mean ratings of State level players is 4.33-4.29-3.54, while that of the control sample is 4.90-4.18-4.15.

iv) The body size and shape of all Khasi women basketball players is not similar i.e., in different

players different components of physique are found to be dominant. For example, in some players relative fatness is more and in some relative musculoskeletal development is more, while among others the relative linearity is dominant. In fact, in the sport of basketball since there are no specific positions of players, all players of a team are expected to possess almost similar type of physique that is suited to basketball. However, the average body size and shape of players at different levels of competition does not differ greatly.

v) Further, the hypothesis that athletes are somatotypically different from the general population is also proved in the present study. The body size and shape of players is found to be significantly different than the control subjects. Specially, the general Khasi population (women) are relatively shorter and heavier than the players.

vi) The basketball players of the present study do not have sufficient experience and complained of improper playgrounds, lack of indoor stadium, sports kit, inadequate coaching, lack of financial assistance, special diet and medical care and clashes with studies. Most of the players are in the habit

of chew 'chewing gum' which is not only dangerous but also causes wastage of energy as the act of chewing itself is an exercise. Broadly speaking, the basketball players of the present study do not enjoy adequate infrastructural facilities and incentives, in order to produce their best performance in the game.

vii) The players of the present study are on the average shorter and lighter when compared with female basketball players of Punjab State team and USSR team.

viii) In comparison to the somatotype of Olympic athletes the body size and shape of the present study differs greatly especially in the average height and weight.

ix) The average body size and shape of Khasi women basketball players is quite different from that of the women volleyball players at National level.

In the light of the present study following suggestions may be made:

One of the major applications of somatotyping is to explore changes in individual physique i.e., how the physique of a child is transformed into that of an adult? In order to search talent specific to any sport or athletics,

it is suggested that extensive somatotype surveys should be conducted among Khasi girls as well as boys. This would help in spotting and training such children, who later on grown as adults would possess the type of physique which is best suited for a kind of sport at national or international level.

To bring out players at par with other States, National and International players, and improve their performance arrangements should be made for imparting formal training, adequate and best coaching, proper courts, complete sports kit for each player, regular scholarships and counselling etc. Games like Football and Basketball which are popular in this area, and where the cost of construction of infrastructure of sports facilities, equipments etc. is comparatively much less should be identified and the facilities required for these games should be created and developed on priority basis.

In future while granting recognition to the University/Colleges by the UGC/AIU availability of sports facilities as in the case of academic facilities should be taken into account. Universities and colleges already recognised and not having the minimum sports facilities should be impressed upon the need to acquire and develop such facilities. Students should be involved in organisation of intra-

mural sports programmes in the school and colleges. Arrangement of extra coaching and wherever necessary for holding special examinations may be made for sports persons excelling at different level of participation.

Finally, it is suggested that a scientific research cell on modest scale be created, at least at the university level to begin with, which should carry research in respect of spotting the sports talent for different sports disciplines. the Department of Sports and Youth Affairs, Union/ State Government may be requested to allocate funds for this purpose.

BIBLIOGRAPHY

BIBLIOGRAPHY

Anderson, J.L. (1984). Children and Women in Sports. Sports and Sports Medicine. Published by Mrs. Thakur, Bagmari Road, Calcutta.

Ashcroft, M.T., Ling, J., Lovell, H.G. and Maill, W.E. (1966). Brit. J. Prev. Sco. Med., 20, 22.

Association of Indian Universities (1987). Physical fitness and sports standards in University. Printed at Printaid, New Delhi.

Astrand, P.O. and Rodahl, K. (1970). Textbook of Work Physiology, Chap. 10, McGraw-Hill, New York.

Backwin, H. and McLaughlin, S.M. (1964). Lancet 2, 1195-1196.

Banerjee, D. 91984). Sports Medicine and the Teaching Programme. Sports and Sports Medicine. Published by Mrs. Thakur, Calcutta.

Bareh, H. (1967). The History and Culture of the Khasi People. Spectrum Publications, Guwahati.

Bhatia, R. (1987). Student Motivation and Incentives. AIU. Phys. Fit. and Sports Standards in Univ. Printed at Printaid, New Delhi.

Carter, J. E. L (1980) - The Heath - Carter Somatotype Method. SDSU. Syllabus Service, San Diego.

Carter, J. E. L., Ross, W. D., Duquet, W. and Aubrey, S. P (1983) Advances in somatotype methodology and analyses Year book of phys. Anthropology, 26: 193 - 213.

Bhattacharya, A.K. (1988). Physical Education and Sports Retrospect and Prospect. Trends in Sports Sciences. Printed at Ajitson Printers, Opp. Tehsil Patiala.

Behnke, A.R. (1961). Quantitative Assessment of Body Build. J. of Applied Physiology, 16:966-968.

Blah, H.M.D. (1988). A Study on the role of the Government in the Promotion and Development of Sports and Cultural Activities in Meghalaya. M.Phil Thesis, Education Department, NEHU, Shillong.

Buskirk, E.R. (1974). Nutrition for the Athlete. In Sports Medicine. Academic Press Inc., III Fifth Avenue, New York.

Buskirk, E.R. and Tait, G.T. (1965). Proc. Conf. Med. Aspects Sports, pp. 1-9.

Carter, J.E.L. (1970). Somatotype of Athletes - A Review. Human Biol. 42:539-569.

Carter, J.E.L. and Sucec, A.A. (1966). Somatotype of Collegiate and Olympic Distance Runners U. S. Track Coaches Assoc. Quarterly Review, 36-42.

Carter, J.E.L. (1982). Physical Structure of Olympic Athletes, Part I : The Montreal Olympic Games Anthropological Project, Basel, Karger.

Carter, J.E.L. (1984). Physical Structure of Olympic Athletes Part II: The Montreal Olympic Games Anthropological Project, Basel, Karger.

Cureton, T.K. Jr. (1941). Body Build as a Framework of Reference of Interpreting phys. Fit. and Athletic performance. Suppl. Res. Quart, 12: 301 - 331.

Cureton, T.K. Jr (1951). Physical fitness of Champion Athletes Univ. of Illinois press Urbana.

Cureton, K.J., Boileau, R.A., and Lohman, T.G. (1975). Relationship between body Composition measures and AAHPER test performance in young boys. Res Quart, 46: 218-229.

Dkhar, J.W. (1991) Somatotypes of football players of Meghalaya. M.phil Thesis. Department of Anthropology. NEHU. Shillong.

Carter, J.E.L. (1985). Morphological Factors Limiting Human Performance. Limits of Human Performance. American Academy of Physical Education, Human Kinetics Campaign.

Chandran, P.S.M. (1984). The Sports Diet. Sports and Sports Medicine, pp. 379-390.

Chowdhuri, J.N. (1978). The Khasi Canvas. Published by Srimati Jati Chowdhuri, Quinton, Shillong, Meghalaya.

Chu, D. (1982). Dimension of Sport Studies. Printed in United States of America.

Conrad, K. (1963). Der Konstitution - Stypus. 2 Aufl. Berlin Springer.

Cratty, B.J. (1968). Psychology and Physical Activity. Prentice Hall, Inc., N.J.

Cureton, T.K. Ju. (1947). Physical Fitness Appraisal and Guidance. The C.V. Mosby Co., St. Louis.

Damon, A. (1970). Constitutional Medicine. In, Ovon Mering and L. Kasdan (Eds.) Anthropology and the Behavioral and Health Sciences, Pittsburgh: University of Pittsburge Press, pp. 179-195.

Damon, A., Bleibtreu, K., Elliot, O. and Giles, E. (1962). Predicting Somatotype from Body Measurements. Am. J. Phys. Anthrop. 20:461-474.

De Garay, M.L., Levine, L. and Carter, J.E.L. (1974). Genetic and Anthropological Studies of Olympic Athletes. Academic Press, New York.

Graig (1968). Factors Affecting Sports Performance. In: Sports Medicine (Eds.) A.J. Ryan & F.L. Allman Jr. Academic Press, New York.

Ghose, G. (1984). Table Tennis. In: Sports and Sports Medicine. (Eds.) Thakur. pp. 403-410.

Ghosh, A. (1988). Groom Them Young. Trends in Sports Sc. Printed at Ajitson Printers, Opp. Tehsil Patiala.

Hardayal, (1984). Physical Fitness. In: Sports and Sports Medicine. (Eds.) Thakur. Published by Mrs. Thakur, Bagmari Road, Calcutta.

Hathaway, M.L. and Foard, E.D. (1960). Height and Weights of Adults in the United States. Hum. Econ. Res. Rep. No. 10, Human Nutr. Res. Div., U.S. Dep. Agr., Agr. Res. Serv. Washington, D.C.

Heath, B.H. and Carter, J.E.L. (1966). A Comparison of Somatotype Methods. AJPA, 25:87-99.

Heath, B.H. and Carter, J.E.L. (1967). A Modified Somatotype Method. AJPA, 25:57-74.

Hirata, Kin-Itsu. (1979). Selection of Olympic Champions, Vols. I and II, Hirata Institute of Health, Chukyo.

Hirata, Kin-Itsu. (1966). Physique and Age of Tokyo Olympic Champion. J. of Sports Med. and Phys. Fitness, 6:207-222.

Hooker, J. (1956). Himalayan Journal. In: The History and Culture Of the Khasi people. Spectrum publication. Guahati

Jolk, E (1945). Report of the First S.A. Congress for physical Education. University of Stellenbosch: In Sports Sciences, Health Fitness and performance. (Eds). Sidhu, L.S. and others. 1987. patiala.

Meleski, B.W., Shoup, R.F. and Molina, R.M. (1982) Size, physique and Body Composition of Competitive female swimmers 11 through 20 years of age. Human Biol, 54: 609-621.

Hulse, F.S. (1981). Habits, Habitats and Heredity: A Brief History of Studies in Human Plasticity. AJPA, 10: 55-67.

Hunt, E.E. Jr. (1981). The Old Physical Anthropology. AJPA, 56:339-346.

Imlay, F.A. (1966). The Physique of College Baseball Players in San Diego, California, M.A. Thesis, San Diego State College.

Jyrwa, W.D. (1981). Phra Tylli Ki Ese. Printed at Khasi Jaintia Press, Mawkhar, Shillong.

Kroll, W. (1954). an Anthropometric Study of Some big ten varsity wrestlers. Res. Quart. 25:307.

Kundu, B. and Mukherji, C.d. (1988). Effects of eleven week conditioning and four week deconditioning programme on body composition and cardio respiratory responses of female students. Trends in Sports Sc. Printed at Ajitson Printers, Patiala.

Lasker, G.W. (1947). The effects of partial starvation on somatotype: An analysis of material from the Minnesota experiment. AJPA, 5:323-341.

Lewis, S. (1966). The physique of New Zealand Basketball players. N. & J. Phys. Educ. 39:25-36.

Lindegard, B. (1953). Variations in Human Body Build. Acta. Psychiatr. Neurol. (Suppl.) 88:1-63.

McLure, C.C. (1967). The Physiques of professional and amateur women golfers. M.A. Thesis, San Diego State College.

Mokha, R. and Sidhu, L.S. (1988). Somatotype of female Volleyball players of India. In: Trends in Sports Sc. printed at Ajitson printers, opp Tehsil, Patiala.

Montagu, M.F.A (1960). An Introduction to physical Anthropology. Springfield, Illinois.

Morrow, J.R., Hosler, W.W., Jackson, A.S and Kachuri, J.K. (1979). The importance of Strength, Speed and Body Size for Team Success in Woman's Inter Collegiate Volleyball Res.Quart, 50: 429.

Moody, D L. et al. (1969). The effect of a moderate exercise program on body weight and skinfold thickness in over weight college Woman. In: Med. and Sc. in sports, 1: 75-80.

Parnell, R.W. (1954) Somatotyping by physical Anthropology. Am. J. of phys. Anthrop, 12: 209 - 239.

Pollack, M. et al. (1971) Effect of walking on Body Composition and Cardiovascular function of middle aged men. J. of Applied physio, 30: 126 - 30

Methany, E. (1965). Symbolic forms of movement: The feminine image in Sports. (Eds.) Connotation of Movement in Sport and Dance. Dubuque, Iowa.

Mokha, R. and Sidhu, L.S. (1987). Role of Lean Tissue and Subcutaneous Tissue in Hockey. Sports Sciences. Patiala.

Morris, P.C. (1960). A comparative study of physical measures of women athletes and unselected college women. Ph.D. Thesis, Temple University.

Narain, J. (1987). Physical Fitness and Sports Standards in University. Printed at Printaid, New Delhi.

Pal, R. and Sharma, V.K. (1988). Effect of Interval Training on Soccer Players. Trends in Sports Sc. Printed at Ajitson Printers, Patiala.

Parnell, R.W. (1958). Behaviour and Physique. London: Edward Arnold.

Pollitzer, W.S. (1981). The Development of Genetics and Population Studies. AJPA, 56:483-489.

Robson, M. (1987). Linkages between Sports and General Education. AIU. Phys. Fit. and Sports Standards in Univ. Printed at Printaid Press, New Delhi.

Ross, W.D. (1978). Kinanthropometry: An Emerging Scientific Technology. In: Landry, Orban Biomechanics of Sport and Kinanthropometry, Vol. 6, pp. 269-281 (Symposia Specialists, Miami).

Ross, W.D. and Wilson, N.C (1974). A Stratagem for proportional growth assessment. In: Children in Exercise. Hebbelinck, M. and Berms, J. (Eds) Acta Paed Belg, Suppl. 28: 129.

Ross, W.D and Ward, R (1984). Proportionality of Olympic athletes. In: J.E.L. Carter (Ed). Physical Structure of Olympic Athlete, part II: Kinanthropometry of Olympic Athletes. Basel Karger.

Ross, W.D., Drinkwater, D.T., Baily, D.A., Marshal, G.R., Leahy, R.M. (1980). Kinanthropometry, Traditions and New Perspectives. In: Beuren Simons Kinanthropometry II. University Park Press, Baltimore.

Ryan, A.J. and Allman, F.L. Jr. (1974). Sports Medicine, Academic Press Inc., III Fifth Avenue, New York.

Shapiro, H.L. (1963). N. Y. Times. Mag. Sect., p. 13, Dec. 15.

Sharma, S.N., Singh, R.M. and Toor, D.S. (1988). Comparative effect of isonetric and isotonic exercises on jumping and throwing ability. In: Trends in Sports Sc. Printed at Ajitson Printers, Patiala.

Sheldon, W.H., Stevens, S.S. and Tucker, W.B. (1946). The Varieties of Human Physique. Harper, New York.

Sheldon, W.H., Dupertuis, C.W. and McDermott, Ed. (1954). Atlas of Men, Harper Bros, New York.

Sidhu, L.S., Singh, J., Chugh, O.P. and Sohal, M.S. (1989). Physique and Body Composition of Indian National Police Players of Team Games. Ind. J. Sports Sc., 1(2):29-34.

Sidhu, S., Herm, K.P. and Sodhi, H.S. (1989). Somatotype of State level women participants of Hockey, Basketball, Volleyball and Athletics Using Conrad's Method. Ind. J. Sports Sc. 1(2):41-50.

Singh, P.C. (1987). Sports Infrastructure in Rural and Urban Areas. In: AIU. Phys. Fit. and Sports Standards in Univ. New Delhi.

Singh, S.P. and Malhotra, P (1989). Kinanthropometry. Lunar publication, Patiala. India.

Slaughter, M.H., Lohman, T.G. and Misner, J.E. (1980). Association of Somatotype and body Composition to physical performance in 7-12 year old girls. J. Sports Med. Phys. Fit., 20: 189-198.

Sodhi, H.S., Butchiramiah, C., Jainarayan. and Kumar, R (1987). Kinanthropometric Study of Indian Volleyball players. In: Sports sc. Health Fit. and performance (Ed). Sidhu, L.S. and others. pp 67.

Spence, D.W., Disch, G.G., Fred, H.L and Coleman, A.E. (1980). Descriptive profiles of highly Skilled Woman Volleyball Players. Med. and Sc. Sports and Exer, 12: 299-302.

Snyder, E.E. and Spreitzer, E.A (1983). Social Aspects of Sports. Prentice Hall. Inc. Englewood. Cliffs. New Jersey 07632.

Singh, A. (1987). Coaching and Competition. AIU. Phys. Fit. and Sports Standards in Univ. New Delhi.

Singh, K.P. (1987). Valedictory Address. In: Phys. Fit. and Sports Standard in Univ. New Delhi.

Singh, G. and Denath, K. (1989). The Kinanthropometry of Indian National Coaching Camp at Netaji Shubhas N.I.S. Ind. J. of Sports Sc. Patiala.

Singal, P. and Kaur, S. (1993). Physique and Body Composition of Urban and Rural Jat Sikh Girls of Punjab. Ind. J. Sports Sc. Phys. Edu. 5(1):47-49.

Sodhi, H.S., Tandon, D.K. and Bawa. G.S. (1982). The physical characteristics and performance of Indian Gymnasts. SNIPES J., N.I.S. Vol. 3(3):56-64.

Sodhi, H.S. (1983). Anthropometry and body composition of Indian National Volleyball players. J. Sports Med. Phys. Fit. pp. 23, 413.

Sodhi, H.S., Kumar, R., Singh, S.P., Bhatnagar, D.P. and Mokha, R. (1988). Modern perspective of Kinanthropometry. Trends in Sports Sciences. Printed at Ajitson Printers. Patiala.

Sodhi, H.S. (1991). Sports Anthropometry (A Kinanthropometric Approach). Anova Publication, Mahali.

Sports Authority of India (1990). Protocol for Application of Battery Tests for Identification of Talent for National Sports Talent contest Scheme. Jawharlal Nehru Stadium.

Weiner, J. S. and Lourie, J. A. (1969). Human Biol. A guide to Field Methods. IBP. Handbook 9. Oxford. Blackwell Scientific publication, London.

Tait, G.T. and Buskirk, E.R. (1965). Factors Affecting Sports Performances. Proc. Conf. Med. Aspects Sports, pp. 1-9.

Tanner, J.M. (1953). Growth and Constitution. Anthropology Today (Ed.) A.L. Kroeber. Univ. of Chicago Press, Chicago, 750-770.

Tanner, J.M. (1960). Growth of Adolescence. Oxford University Press, London & New York.

Tanner, J.M. (1964). The Physique of Olympic Athletes. George Allen and Unwin, London.

Tappen, N.C. (1950). An Anthropometric and Constitutional Study of Championship Weight Lifters. Am. J. Phys. Anthrop., 8, 89.

Thakur, S. (1984). Sports and Sports Medicine. Published by Mrs. Thakur, Calcutta.

Tittel, K. and Wutscherk, H. (1972). Sport Anthropometric. Leipzig, Barth.

Tittel, K. (1978). Tasks and Tendencies of Sports Anthropometry's Development. Landry, Orban, Biomechanics of Sports and Kinanthropometry, Vol. 6, pp. 283-296 (Symposia Specialists Miami).

Tucker, W.B. and Lessa, W.A. (1940). Man: A Constitutional Investigation. Q. Rev. Biol. 15:411-455.

Westlake, D.J. (1967). The Somatotype of Female Track and Field Competitors. M.A. Thesis. San Diego State College.

Withers, R.T., Wittingham, Norton, K.I. and Dutton, M. (1987). Somatotypes of South Australian Female Games Players. Hum. Biol. 59:575-584.

Viola, G. (1932). La Constituzione Individuale. Bologna L. Cappelli.