

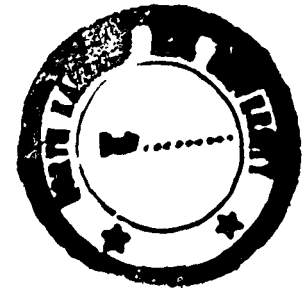
SOMATOTYPES OF FOOTBALL PLAYERS OF MEGHALAYA

Dissertation

Submitted in Partial Fulfilment of the Requirement for the Award
of the Degree of

MASTER OF PHILOSOPHY

IN ANTHROPOLOGY



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Dedicated
in the Memory of
my Father



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CERTIFICATE

Certified that the subject matter of the dissertation is the record of work done by JOHNSLY WELL DKHAR, that the contents of his dissertation entitled "SOMATOTYPES OF FOOTBALL PLAYERS OF MEGHALAYA" did not form a basis of any previous degree to him or to the best of my knowledge to anybody else, and the dissertation had not been submitted by him for research degree in any other University.

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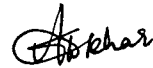
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DECLARATION

The content embodies in this dissertation is original and has not been submitted in part or full for any other diploma or degree of any University or Institution. The contents of this dissertation are true to the best of my knowledge and belief.

SHILLONG

THE 30 DECEMBER 1991



(JOHNSLY WELL DKHAR)

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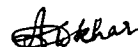
I am deeply indebted to express my sincere thanks and gratitude to Dr. R. K. Pathak, Reader, Department of Anthropology, North-Eastern Hill University, Shillong, for his inspiring and invaluable guidance rendered to me in carrying out this research work.

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CHAPTER I
INTRODUCTION

IMPORTANCE OF SPORTS

Sports activities bring people of different region and cultures together, provide a very healthy form of recreation, 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 a competitive nature though their recreative values cannot be underestimated or denied. Sports now-a-days have changed a lot and are more scientific and mass oriented, well organized, 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 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 espe-

cially 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 sportsmen.

Countries which are sports conscious, have achieved higher ranking in international competitions. These countries are already in possession of valuable information and to a significant extent have based their systems of training on this knowledge. Due to growing changes in the competitive philosophy of sports a rapport has developed among sports scientists, physicians, coaches and sportsmen to discover modern scientific techniques in terms of selection of sportsmen best suited to the activity and to derive new tactics and training methods. Countries like USSR, GDR, Cuba, USA, etc., have a well developed system for sporting talented persons and for scientifically training them, from over a period of several years.

The term 'sports' has been coined from the word 'disport' which means diverting one self merely for fun or merry-making. 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 will vary from group to group and from time to time.

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

According to Hardayal (1984),

"Each sport activity demands different types and levels of different motor abilities and when a sportsman possesses that he is said to have a specific physical fitness. It is this specific fitness which makes it possible for a player to perform unusual and extraordinary movements and to do so at a high standard of efficiency. It is also termed as 'performance fitness'."

The dictionary meaning of sport is amusement, diversion, fun, pastime through games and athletics. Sports is the only medium which can bring out in open many talent qualities of human being, under such condition it has to be considered whether it is possible to ignore the importance of sports in day-to-day life.

'A sound mind 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 developments even on the mental and moral planes. 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.

PHYSICAL FITNESS AND PERFORMANCE

Physical fitness has been defined by the Committee on Exercise and Physical Fitness of the American Medical Association (1966) as, "the general capacity to adopt and respond favourably to physical effort. The degree of physical fitness depends on the individual's state of health, constitution, and present and previous physical activity." Davis et al. (1961) have written,

"physical fitness is a product of many elements such as strength, skill, and so on. It must be remembered, however, that physical fitness is only one component of total fitness of the individual which also includes mental fitness, social fitness, and emotional fitness. Total fitness is really a capacity for living."

Astrand and Rodahl (1970) have avoided any narrow definition of physical fitness, but wrote,

"In a very broad sense, physical performance or fitness is determined by the individual's capacity for energy output (aerobic and anaerobic processes), neuromuscular function (muscle strength and technique) and psychological factors (e.g., his motivations and tactics)."

Although these definitions each emphasizes different aspects of fitness, there is no fundamental disagreement among them. Fitness as an overall concept appears to have many components, including intellectual and emotional as well as physical factors. These differ in relative importance from one period of life to another, depending on varying individual roles and responsibilities. The American Medical Association (AMA) definition of physical fitness states that physical fitness is the general capacity to adapt to physical effort. This means that, if no, or insufficient, physical effort is made, no adaptation will take place. The process of growth and development of the body is self initiating, and continues spontaneously until it reaches its maximum impelled by force that are inherent in the body, and that are predominantly genetically controlled.

In the second part of the American Medical Association (AMA) definition of physical fitness, it is stated that the degree of fitness will depend on the individual's state of health and bodily constitution. Although the individual's basic body constitution does not change during his life time, the relative composition of the body may be altered, usually by a change in the amount of fat. This may make it appear that the constitution is altered due to sometimes extreme alternation of the body contours.

Not all of the factors that affect human performance are susceptible to easy measurement. In addition to the psychological, there are anthropometric, psychological, 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 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 a lucky circumstances produce a record performance by someone 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 performance to the establishment of new world records, have been pointed out by Graig (1968) and Buskirk and Tait (1965). They include a large population from which to draw a greater number of persons included in sports, greater prestige attached to sports participation, development of keen competitive attitudes, improve 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.

Nutrients obtained from ingested food provide 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 replenishment of the substrates of fuels used to support contraction. It has been said that an athlete is no better than the adequacy of his nutrition (Buskirk, 1974).

Fortunately, with the many sources of good foods currently available there is no reason for the athlete to be inadequately nourished. The key for the athlete's nutrition as for every one else's is a diet balanced in all of the essential nutrients so that the body 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 balanced diet is likely to be as good as another. But there is no substitute for proper planning of a balanced diet, for an unbalanced diet consumed for several weeks can have dire competitive consequences. Even faithful participation in an excellent physical conditioning regimen cannot compensate for inadequate nutrition. Neither can a balanced 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 gleaned from current nutritional research should provide the basis for dietary planning. The athletic team physician and the local dieticians, i.e., in hospitals, school, 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.

SPORTS SCIENCES

Man's physical activity and movement is as old as human existence. It played numerous roles: from struggle for existence to struggle for excellence. In this role playing, fundamental motor skills developed into various movement-patterns; at times involving basic living skills, sometime forming skills for leisure time pursuits, at times braving the unconquered, often applying skills for excelling the

sporting performance, but at every stage of human history physical activities provided an exciting outlet for human expression – often creature in nature (Bhattacharya, 1988).

Physical activity has throughout the ages been acclaimed for health and recreation. It provided fun and enjoyment, provided the youthful exuberance and provided the elderly care. But in modern days sports are gradually being replaced by technology in the name of betterment, variety, improvement and excellence. Sports are being used for the purpose of diplomacy, for the purpose of humanitarian work extending warm hands of the friendly humanity, and for the purpose of cultural awareness and health consciousness.

In the modern times the growth of sports and physical education programmes in any country is much dependent on the development of sport sciences (Muthiah, 1987). These sciences are known to have developed to a considerable extent in the developed countries. Kinanthropometry, exercise physiology, biomechanics, biochemistry, psychology, sociology, nutrition, medicine, pedogogies, methods of training or coaching and physical education are some of the well known sciences in this regard. The standard of sports and competitive performance can develop through integral approach by use of knowledge from both applied and basic sciences.

Although sports are a universal phenomena, ever in the most primitive societies, the spread of European culture around the world in the last three 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 has 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 participation has been the inclusion of physical education and sports programmes 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 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.

Sports in the socialist and communist countries have become important political factors in uniting populations at home, strengthening defensive forces and promoting those

countries in the international scene. With an increasing complex urban civilization, competition increases in its importance as a means of survival. The reflection of competitive attitudes developed in education, science, business, the professions, and even attaining social prestige is naturally felt in sports. This gives rise to such statements as that made by late Vincent Hombardi, a successful football coach, who told his players that "winning is not the most important thing, it is the only thing".

Improvement in average income levels and working conditions for many part of the world today mean that more time can be taken from the day for pursuit of leisure activities and some money is available to pay for them. As far as countries and communities are concerned it means more and better facilities for sport participation and more professional instructions and supervision available. It also means greater income from spectators for both amateur and professional sports which helps to make more and better sports programmes 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 measure-

ment techniques, and improvement in coaching techniques and systems.

The improved design of faster track surfaces, resistance to the unfavourable effects of weather, such as Tartan track have helped to make for better running times indoor and outdoor meet. Improved design of indoor running tracks with wider surfaces, more scientifically banked curves, and fewer laps to the mile have also played a part. 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 experience trainers and coaches and if the athletes submit themselves whole-heartedly and fully to such coaching methods then they must attain perfection in their techniques.

ANTHROPOLOGY AND SPORTS

The morphological characteristics of sportsmen and athletes are of interest to the anthropologists, for competitive sports demands the utmost from the body and it is therefore reasonable to expect to find in athletes demonstration of the relationship of structure and function. Athletic events are amenable to study, for they 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 specialties are of interest because of the information they provide about extremes of performance in a population (Carter, 1970).

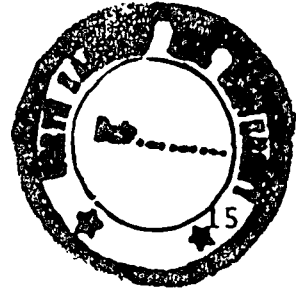
It has been demonstrated by anthropologists that different body shapes and sizes tend to make their owner more or less suitable for certain types of physical activities. The person with a relative light body and long legs (ectomorphic type) make a good long distance runner. The man who is very short and stocky (endomorph type) has the potentiality of becoming a good weight lifter. The individual who is generally well proportional and of medium to tall height (mesomorphic type) may excel in a variety of sports, especially the team sports. In terms of functional capacity these three types as 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 athlete accelerating his body,

moving it over a distance, lifting it, turning it, exerting maximum force and throwing. The relationship between body size and performance have been 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 launch 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.

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 athletics in many sports, especially those sports where records of time and distance can be established. There is no question that the average increase 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 mortality and mortality rates in the early years due to control of

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infectious diseases, more vigorous exercise in early years of life, earlier sexual maturity, and heterosis have all been implicated (Hathaway and Foard 1960, Tanner 1960; Ashcroft 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 this period of time have not apparently shared the same growth (Shapiro, 1963).

In order to evaluate in full the candidate for sports participation, ascertaining the mere presence of or absence of organic diseases is not enough. It is necessary to evaluate his physical readiness for the particular sport event in which he plans to participate. Indications of the individual's physical readiness for sports may be found in many factors, including size, body build, flexibility, strength, cardio-muscular and respiratory fitness, etc. Accurate evaluation

of the body build of an individual may yield important facts relating to his physical readiness for sports participation. Factors to be considered are his age, height, weight, ponderal index, muscular development, amount of subcutaneous fat, somatotypes and posture. The importance of body build has not been given nearly as much attention in the medical literature as has been given to simple height-weight relationships.

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 the 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 in 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 information useful 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.

Anthropometric, body composition and maturity characteristics of the athletes and sportsmen should be determined

to assess performance ability. The effect of physical training and coaching on the health of the athletes and players should be kept in mind during the training programme. The body infirmity or physical defect should be assessed. Otherwise, those on-toward effects may be met with those athletes who are suffering from diseases or deformities. One has to note whether the athletes and sportsmen are advanced in skeletal or sexual maturity or retarded and also whether they differ in height, physique and body composition. Apart from the body configuration, skeletal maturity of the sportsman is also related to physical performance.

The anthropometric dimensions selected for comparison depend on the body weight, stature, arm and calf circumferences, and skin-folds. Body composition is estimated by fatness and relative fatness is given more importance and this is considered by nothing but the ill effects of obesity or over weight on physical performances. The 'under weight' based on leanness or thin build is also taken as a determinant of the body composition.

PHYSIQUE

Interest in classifying human physique dates from at least the time of Hippocrates (460-370 B.C.), and the various systems developed since then have been well documented in summaries reported in Tucker and Lessa (1940) and Sheldon

et al. (1940). A problem in the classification of body shape is that it is difficult to measure and quantify, although it is relatively simple to observe (Tanner, 1953). Part of the problem relates to measurement (anthropometric versus observation (anthroposcopic or photoscopic) procedures. Anthropometric quantification of body types has been described by many investigators and is exemplified by the methods of Viola (1932), Lindegard (1953), Behnke (1961) and Conrad (1963).

The notion of classifying physique into some meaningful system has been the stimulus for repeated efforts in this direction. If, for example, behavioral, disease, and functional characteristics of human can be associated with certain physiques, then knowledge and understanding of those characteristics and their manipulation can be enhanced. Damon (1970) defined 'constitution' as the sum of a person's innate and relatively fixed biological development. However, Damon (1970) states that,

"to physical anthropologists, psychologists, and behavioral scientists generally, constitution means physique in relation to environmental adaptation, disease or behaviour. As such, constitution is one application to man of the structure-function relationship, the central concern of physical anthropologists. In addition, physique can be correlated with other characteristics of the individual partly because it is 'obvious and easily described'".

The strong constitutional bias of physique lasted until the 1950s. Thereafter, the shift in thinking has been from fixed classification to plasticity of humans and is supported by Pollitzer (1981), Hulse (1981), Hunt (1981), who see more emphasis on process and cause than classification, i.e., a shift from static to the dynamic viewpoint.

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).

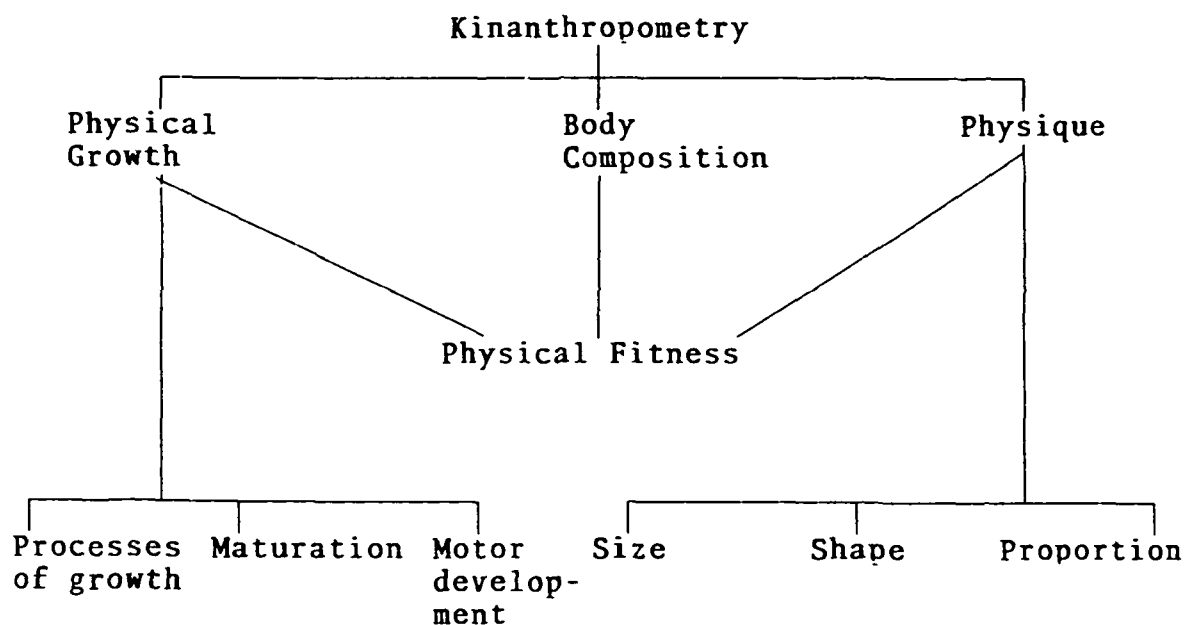
The constitution of International Society for the Advancement of Kinanthropometry (ISAK) also elaborates explanation of the science. Accordingly,

"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 number 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 this 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 in India, a National Working Group on 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 des-

cribed 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 definitions 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 ratings are based largely, but not entirely, on $\text{height}/\sqrt[3]{\text{weight}}$ 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 musculoskeletal development, as in many athletes. Low third component ratings signify short extremities and low $\text{height}/\sqrt[3]{\text{weight}}$ ratios, while high ratings signify linearity of body segments and of the body as a whole, together with high $\text{height}/\sqrt[3]{\text{weight}}$ 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 anthro-

pometry in obtaining a somatotype rating has certain inherent advantages.

- (a) It provides an objective method of somatotyping.
- (b) In the absence of a photograph, it is the 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 athletically 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 somatotypes of Meghalaya football players (men) participating at the local District 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), no one has attempted similar study upon Meghalaya (Khasi-Jaintia) sportsmen for any sport, let alone Football – the most favourite sport of 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 entirety 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 or 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 somatotypes of football players,
- ii) to examine differences in the somatotypes of football players and the general population,
- iii) to compare the present data with that reported in the literature, and
- iv) to make suggestions in the light of the above.

CHAPTER II

REVIEW OF LITERATURE

There are certain tests available for measuring general physical and motor fitness in the field of physical education. Cooper (1970) developed a cardiovascular endurance test based on running for 12 minutes. Fleishman (1964) developed a motor fitness test by investigating several test items for using the factor analysis technique. Fleishman's test can be used for the children as well as the adults. Similarly, there are other test batteries available for use in the area of general motor fitness. These include the Borrow test of motor ability (1954), the motor performance test factor analysed by Jackson (1971) and AAPHER youth fitness test (1965).

Sage (1977) points out that the greater the variety of sensory and motor experiences that individuals have during their early years the further will be their motor ability repertoire, within the similarities set by their genetic heritage. In order that every player performs to his capacity the levels of general and scientific motor fitness are required to be enhanced. Riendeam et al. (1958) examined the relationship between the percentage of body fat and performance in selected motor fitness tests. Significant negative correlations of about .29 were found between percentage of body fat and motor fitness test.

Slauhter, Lehman and Mincer (1977) in their study of the relationship between somatotype and body composition on the one hand, and physical performance on the other, concluded that somatotype components had a lower correlations with winning and jumping variables than the body composition or body size variables. Berger (1973) explains that physical conditioning is specific to sport. The demand as to what type of conditioning exercise to include in a training programme can be recognised only on systems stressed during a game and the kind of activities which provide this type of stress during practice. The body adapts in time to the types of stress placed upon it. This physiological adaptation is necessary for physical conditioning to occur. However, the nature of adaptation is specific to the kinds of activities used in training.

No matter what the component of conditioning is, be it strength, endurance, flexibility or power, the specificity of training is of primary importance. The principle of specificity has been recognised by a number of sports scientists as vital to introduce high levels of specialization not only in particular discipline but also in developing the skill of player for particular functions within the discipline. Katch and Katch (1981) explain that specificity refers to adaptation in the metabolic and physiological systems, depending upon the type of overload imposed.

Whilst somatotyping has been used in growth studies (Zuk, 1958) and by epidemiologists (Spain et al., 1955), its most extensive use has been in evaluating the relationship between physique and physical performance (Carter et al., 1982). Clinical statements regarding some outstanding athletes in general, and review of physical performance and somatotypes, have been made by Cureton (1951), McQueen (1964), Morehouse and Rasch (1963), Parnell (1958) and Willgoose (1961). Hirata (1966) presented extensive data on differences between countries in regard to the body size of their people, and suggested that countries with people whose general physique was limited to the characteristics of champions in certain events should concentrate on those events.

Many adult samples of athletes and sportsmen which have been somatotyped in different places by different investigators are such as, McLure (1967) studied the physiques of professional and amateur women golfers; Morris (1960) made a comparative study of physical measures of women athletes and unselected college women; Carter and Rendle (1965) studied the physiques of New Zealand Air Force men; Dupertuis (1965) studied the body composition of swimmers; Heath et al. (1961) studied the physiques of Hawaii born young men and women of Japanese ancestry and compared these with college men and women of the United States and England; Robert and Bamⁱⁿ

bridge (1963) studied the somatotypes of 337 Shilluk and Northern Dinka of Upper Nile Province of the Southern Sudan populations aged 18 to 45 years. Tanner (1964) provide data on difference populations with which athletes may be compared.

A review of the somatotypes of females athletes has been conducted by Carter (1970, 1981). Lowdon (1980) provide Australian data on three international surf-board riders. Recently, using Heath-Carter Method, Withers et al. (1987) studied the somatotypes of 127 South Australian Female players of different games (badminton, basketball, cricket, hockey, lacrosse, netball, soccer, softball, squash and volleyball), in which the overall somatotype was that of a mesomorph-endomorph (3-8-4, 2-2-6). Except for the cricketers all the groups means were located above the ectomorphic axis of the somato-chart in the mesomorph-endomorph, endomorphic-mesomorph and central categories.

Bailey et al. (1982) studied the somatotype characteristics of a large sample of 13,599 adult Canadian men and women using Heath-Carter anthropometric rating method. Somatotype distributions for age and sex specific sub-groups were compared using analysis of variance to test for differences among the mean somatotypes and also a test for differences in the somatotype dispersion among the groups. The findings showed that men aged 30 and over were more endo-

mesomorphic than younger men. No significant shift in male somatotypes beyond the age of 30 was observed. In case of females there were no differences in somatotypes among those aged 15 to 39 years, or among those aged 40 and over, but the older women were significantly less ectomorphic and more meso-endomorphic than the younger women. At all ages sexual dimorphism was similar, women were more endomorphic and less mesomorphic than men, with both sexes similar in terms of ectomorphy.

Carter (1966) in his comparative study showed that Channel swimmer differed in somatotype and body size from San Diego State swimmers and Olympic swimmers. Swimmer from Cleveland and Santa Clara Swim Clubs were undertaken by Dupertuis (1965) who stated that, "... these young swimmers are considerably higher than average in mesomorphy but are at or about the general mean in endomorphy and ectomorphy." Pugh et al. (1960) indicated that Channel swimmers may carry large amounts of fat primarily for adaptation to their environment in Channel swimming. In addition, Channel swimmers are considerably shorter and heavier than competitive swimmers.

In 1936, Gray carried out a study of 1179 football players in relation to the field positions in which they were placed. They varied very slightly in their age. The weight increased in successive positions and significantly

so, except the guard versus the tackle, the latter being 1.1 kg heavier. These men were the heaviest of all groups studied. Stature was also found to increase in successive positions, but not in the same order as weight, the main shift had been for the ends who were lighter than the centres and guards, but taller than both; it was noteworthy that they were taller than centres by only a trifling margin of 3 mm. If weight and height be taken as a rough criterion of mere physical power, these measurements gave the two tackles a very special characterization of the least weight for their height.

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 (1963) compared 12 year old non-athletes and football players and found no difference between the somatotype means, but the football players were taller and heavier than the non-athletes.

Heath (1963) somatotyped 66 university football players using her modification of Sheldon's method. When compared

with means for college students rated by Sheldon and others (1940), these football players were approximately one-half unit higher on the first component, one and three quarter units higher on the second component, and one and one quarter units lower on the third component. Bell (1973) studied young adult rugby players and noticed specific physical characteristics with respect to the field positions of the players.

An extensive study on college football players which included somatotype assessment was carried out by Allen (1965). Sixty-six football players at Pacific University and Lewis and Clarke College in Oregon were somatotyped by Heath. Both colleges have very small enrolments, and their teams would not in any way be considered above average by national standards. The mean somatotype for this series was $3\frac{1}{2} - 5\frac{1}{2} - 2$. Carter (1968) reviewed the literature and reported the phenotypes for the San Diego football team to be $4\frac{1}{2} - 5\frac{1}{2} - 2$.

Carter (1970) made somatotype ratings by the Heath criteria on 35 members of the 1964 San Diego State football team and on 20 University of Iowa football players on the 1958 team. Thirty-seven percent of the players were drafted by major professional teams. It was shown that players in the San Diego State team are approximately a year older than the subjects in the two samples, 2.5 cm taller, and approximately 9 kg heavier. As to somatotype, endomorphy increases

from Iowa team (3.2) through the Oregon teams (3.6) and to the San Diego team (4.2). Mesomorphy is at approximately the same value (6.25) for both the San Diego State and Iowa teams and one unit lower (5.5) for both the Oregon teams. The Iowa and San Diego State teams are similar on linearity and half a unit lower than the Oregon teams. The somato-charts show that compared to the other two teams the distribution of the San Diego State team is outstanding for its number of extreme endo-mesomorphs. The Oregon subjects are lower in the mesomorphic sector than the two samples. There are small percentage of physiques in each of the samples which are ecto-mesomorphic. From the predominance of endo-mesomorphs of the outstanding size, it appears that these characteristics are prerequisites for success in college football.

Cureton (1951) studied 24 track and field champions who were contenders for the 1948 U.S. Olympic team or championship performers at the national levels; several were Olympic champions. His mean somatotype for these competitors was $2\frac{1}{2} - 5\frac{1}{2} - 4\frac{1}{2}$. 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. This sample represented a little over a third of all those at Rome who had achieved the Olympic standard. Eleven of 22 track and field event ~~winners~~^{winner} were included in this highly select group of performers. The largest samples were from Great Britain, the United States, Australia, and New Zealand. The subjects were largely Caucasian, but some were Negro and some Oriental. Tanner found that only half the somatotypes in the general population were present in the Olympic sample, which ranged from endomesomorphs through ecto-mesomorphs to meso-ectomorphs. In general, throwers and sprinters were the most mesomorphic, with jumpers and distance runners tending to be more ectomorphic. Somatotype distributions of Cureton's and Tanner's samples were somewhat similar, especially when differences in rating method are allowed for.

Tanner (1964) makes the following comments on Olympic distance runners:

"There seems to be a gradient of decreasing mesomorphy and increasing ectomorphy as we pass from the sprints through 400 metres to the 800 metres and the longer races. There is little indication in this scanty data anyway of a mean somatotype difference between 800-1500 metre men and the longer distance runners. The means are nearly the same except the longer distance runners appear to be a trifle lower in endomorphy, which might be attributable trained down a little more".

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 ecto-mesomorphs 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 the somatypes of 'A Grade', provincial representative, and national representative basketball players in New Zealand, found that the height and weight 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 $3\frac{1}{2} - 4\frac{1}{2} - 3\frac{1}{2}$, and when comparable Heath-Carter rating is made the mean somatotype would be $3 - 5 - 2\frac{1}{2}$.

Imlay (1966) somatotyped 151 college baseball players from the San Diego country and assigned them M.4 phenotype ratings. Their mean somatotype was $4 - 5 - 2\frac{1}{2}$. 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 differs from the normative population of American males; they had a higher proportion of endo-mesomorphic physiques and a lower proportion of all other physiques. Imlay compared the sub-groups 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.

Krøll (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, and concluded these represented with agility rather than those more ponderous and bulky, as reported by European wrestlers.

Tappen (1950) took somatotype photographs of 43 to 57 entrants for the 1947 National Amateur Athletic Union (AAU) Weight Lifting Championships, and these were somatotyped by Sheldon and Krogman. Outstanding lifters in all weight classes were measured and had a mean somatotype of $3 - 6\frac{1}{2} - 1$. These competitors were characterised by very high mesomorphic and low ectomorphic ratings. The ranges on these components were also narrow. On endomorphy the range was greater but

still low at $3\frac{1}{2}$ units. Tanner (1964) studied 29 weight lifters at the British Empire and Commonwealth Games in Cardiff 1958. Fifteen weight lifters were European, nine West Indian, and five Asian. The somatochart distribution for these competitors was similar to that of AAU Champion lifters, being predominantly endo-mesomorphs and with high mesomorphic ratings. The mean for the British Empire Games lifters was approximately $3 - 6 - 1\frac{1}{2}$. Both samples were rated by Sheldon's system, in which the highest mesomorphic rating is seven.

The role of morphological characteristics in the performance of various sports events has undoubtedly been established by new and biomechanical explanations of a particular type of physique being more advantageous to the others in performance have been put forth (Berm and Hebbelinck, 1984; Carter 1978, 1981, 1982, 1984; Hirata 1979; Ross et al. 1982; Ross and Ward, 1984).

This has now been recognized in India and studies are cumulating on the physique and morphology of sportsmen taking in competitions at different levels. Kansal et al. (1980) studied the anthropometric characteristics of Indian University Football players. Sidhu and Singh (1975) gave the somatotype distribution of sportsmen specializing in different events. Kinanthropometric studies on Indian basket-

ball players are conducted by Sodhi (1980a, b). Sidhu et al. (1989a) analysed the physique and body composition of 59 national level players taking part in hockey, football, basketball, and volleyball who participated in 36th All Indian Police Games held in 1987.

Sidhu and Wadhan (1974) worked on footballers who were found to be of average height, with larger trunks and smaller lower extremities than the controls. They also had more of lean tissue in the extremities than the latter.

Among the Indian national footballers, the forwards, halves and backs were quite similar to one another and were shorter than the stoppers and goalkeepers (Sodhi and Sidhu, 1984). The forwards and halves in the national level football were bigger in size than their counterparts in the university level football, but the backs of the former were shorter than those of the latter. The stoppers and goalkeepers in the two groups did not differ appreciably from each other. The forwards in the university level and national level football had shorter lower extremities in relation to upper extremities. They also possessed broader knees in proportion to elbows.

The stoppers in the national level football had relatively broad shoulders and better developed lean tissue in

in the thighs. The goalkeepers in the national level football were tall and had proportionately smaller trunks, longer extremities and were lighter in relation to stature, the latter being more lighter than the former in this respect. However, the former possessed proportionately much broader knees than the latter. Apart from this the goalkeepers in the university level football were found to have proportionately narrower shoulders, more slender chest and smaller knees and were less mesomorphic and more ectomorphics than the goalkeepers of the state level football.

The stoppers and the goalkeepers in the national level football in India had more lean tissue in limb segments, with broader distal epiphyseal diameters of humerus and femur. It was found that the lean tissue in the limb segments of forwards, halves and goalkeepers was better developed in the national level football players than those of the University level football. The body fat was found to be least in the forwards, and maximum in the goalkeepers of the national level football players. In the case of the university level football, both the forwards and the halves had less of body fat than the backs and the stoppers. However, in the case of the national level football, the subcutaneous tissue in the limb was found to be less in the forwards, halves and backs which gradually increased in the stoppers and goal-

keepers of this group. The chest were bigger relative to the stature in the case of the players of all field positions in the national level football than those in the case of the players in the university level football. The hips gradually became narrower in the case of the backs, forwards, halves, stoppers and goalkeepers. The national level football players, in general, were more mesomorphic and less ectomorphic than the university level football players. Their knees in relation to the elbows were broader in the forwards, halves, backs and stoppers of the national level football than those of the university level football.

All players in University level and national level football possessed better developed lean tissue in the thigh in relation to that in the upper arm and possessed less of body fat than the centrals. However, among players of similar field position in the two groups, the body fat was considerably greater in the case of the state level football players.

Singh et al. (1987) conducted a study on the somatotypes of some categories of sportsmen. The study is based on 152 sportsmen taking part in various games and sports events, viz., hockey, football, basketball, cycling and throwing events. Most of the subjects were Jat Sikhs and have been studied during 1972. Besides, a group of 100 Jat Sikh men who had not been actively taking part in sports were

chosen as the central group. All subjects were in the age range of 17-25 years. Somatotypes were estimated from the anthropometric measurements with the help of Heath-Carter method. All the sports categories have shown significantly higher ratings of mesomorphy associated with lower ratings of ectomorphy as compared to the central group. Compared to the Olympic level players, those of the present study are much below in the development of musculo-skeletal system. The effect of training on subcutaneous and lean tissues of female volleyball players has been investigated by Grewal and Sidhu (1984). The somatotypes of 50 selected state level women participants of hockey, basketball, volleyball and athletics are presented by Sidhu et al. (1989b).

In modern times the growth of sports and physical education programmes in any country is much dependent on the development of sports sciences. The standard of sports and competitive performance can develop through integral approach by use of knowledge from both applied and basic sciences (Muthiah, 1987). With this view the Indian Association of Sports Scientists and Physical Educationists (IASSPE) was formed with headquarters at Patiala, Punjab, and is doing a commendable job. This Association has been holding regular National Conferences since 1985; the proceedings of the conferences are published under the names, "Modern Perspectives

in Physical Education and Sports Sciences", "Sports Sciences - Health, Fitness and Performance", "Trends in Sports Sciences", edited by Sidhu et al. (1986, 1987, 1988). In addition to these, exhaustive reviews on the subject are presented in the books by Sodhi and Sidhu (1984), Singh and Malhotra (1989), Sodhi (1991).

CHAPTER III

LAND AND PEOPLE

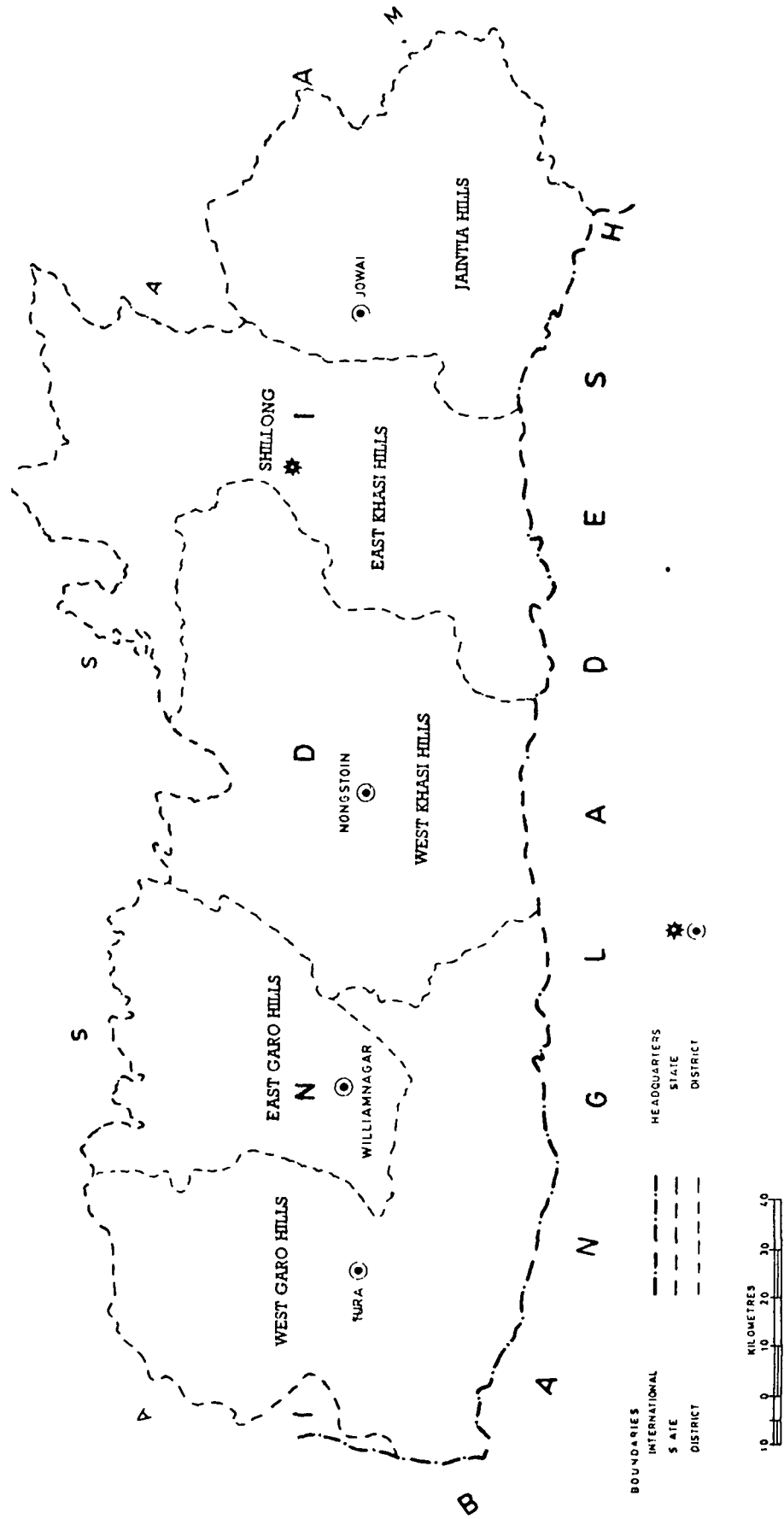
LAND

Meghalaya, the 21st State of the Indian Union, was declared a full-fledged State on 21st January 1972, comprising the areas of United Khasi and Jaintia Hills 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.

Meghalaya is interspersed with many high and low hills, valleys, rivers, plateaus and waterfalls. Since cloudiness is generally common over the hills, we see different types of clouds over the hills of Meghalaya from season to season. Fogs, mists, and nimbus clouds loom large during the rainy season and during other times patches of cumulus and stratus clouds all seen floating overhead the high hills. Hence, the State has rightly been called 'Meghalaya' meaning 'the above of clouds'. Meghalaya is a landlocked territory of lovely hills and of abounding sylvan beauty.

The State covers a total geographical area of 22,429 square kilometres and forest area of 8,784.85 square kilometres. Meghalaya is divided into five administrative districts (Fig.1). The total population of the State as per 1991 Census is as under.

MEGHALAYA ADMINISTRATIVE DIVISIONS 1991



BASED UPON SURVEY OF INDIA MAP NO. 114 THE PERSIAN OF THE SURVEY GENERAL OF INDIA. THE BOUNDARY OF PLENA VIA, SHOWN ON THIS MAP IS INTERPRETED FROM THE BIRTH (LATTER PART) OF THE ORGANISATION ACT, 1951 BUT HAS NOT TO BE VERIFIED.

THE 1951 BOUNDARY BOUNDARY SHOWN ON THIS MAP IS THE ONE EXISTING PRIOR TO THE CONCLUSION OF THE AGREEMENT ON MAR 14, 1971 BETWEEN INDIA AND PAKISTAN.

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Fig. 1

Districts	Headquarters	Area (Sq.Km.)	Population 1991 Census
Jaintia Hills	Jowai	3,819	2,19,186
East Khasi Hills	Shillong	5,196	6,57,160
West Khasi Hills	Nongstoin	5,247	2,17,462
East Garo Hills	Williamnagar	2,603	1,89,043
West Garo Hills	Tura	5,564	4,77,775

The real charm of the two-fold fascinating climate, winter and the monsoon, can be enjoyed throughout the year in the State. The climate is neither too hot nor too cold and during the winter season no snowfall occurs. During the months of February, March, October and November the weather is very pleasant. The maximum temperature recorded at Shillong (East Khasi Hills) and Tura (West Garo Hills) are 26° and 34° Celsius, respectively. The rains begin by the second week of May and continue till the end of September. It is observed that Mawsynram is now receiving more rainfall than Cherrapunjee. It appears to be the heaviest rainfall in the world with an average (month of July) of 9,591 mm (Mawsynram) and 5,421 mm (Cherrapunjee).

The soils of Meghalaya may be broadly grouped into hill soils and plain alluvium. In some places, we find red loamy soils, fine silt constituting the major fractions.

They are also characterised by a very high organic matter and nitrogen content. At other places, we find clayey to fairly heavy clays. The soil of the paddy lands are heavy loams and contain a fairly large amount of organic matter.

In Meghalaya, 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 land holdings are small and there are no holdings beyond 20 hectares.

The absence of rationalised land administration in the State is due to non-survey of the lands cadastrally. In order to ascertain necessary facts on landholdings and to adopt land reform measures, the Government appointed a Land Reforms Commission. The Commission has since submitted its report and in accordance with the observations of the Commission, the Government decided to cadastrally survey the entire State and prepare preliminary records under the Meghalaya Land Survey and Records Preparation Act, 1980, and which has been passed by the State Legislature in 1980. The cadastral Survey Scheme now forms the basis of the State's Five Year Plans. The survey scheme expects to cover about 450 villages a year so as to complete the cadastral survey of the entire State (of about 4,874 villages in 10 to 15 years time. For once the lands are properly surveyed and

records of holding rights ascertained, the Government can gainfully plan long-term economic measures for the welfare of its people, where 85% of the people live in rural areas and whose economy is entirely agro-based.

The State flora is rich both in extent and number. There are upwards of 2,000 flowering plants, 150 species of ferns and a profusion of mosses, fungi and lichens. More than 250 species of orchids, 25 species of bananas, 20 species of palms, 150 species grass are available. Wild apples, scarlet rhododendrous abound in the higher parts of central plateau. There are also different types of fruits like, orange, pine apples, banana etc.

In the State there are dense forests in which different types of trees are present like, sal, teak, tita-champ, hollock, bola, gogra, birch, toon, chaplash, pine, chilawni, walnut and mahogany. In Khasi and Jaintia Hills in the higher altitudes of about 1000 metres, pine trees are found and in Garo Hills, in lower altitudes rich sal forests abound.

There are dense forest of cane and bamboos in the Garo Hills, and in Northern Khasi Hills tapping of pine trees yield resin and turpentine.

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, minivet, grey-tit and backed-tit, hoopoe and woodpecker 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.

Meghalaya is also called the land of butterflies. Diverse climatic conditions, rich and luxuriant vegetation, evergreen hills and overglades makes the hills of Meghalaya the perfect breeding grounds of rare species of butterflies. Some 500 species of butterflies are said to have found in the State. Notable among them are Kaiser-Hind, Black and Yellow birdwing, leaf-butterfly, lacewing butterfly, the Rajah, the Swallow tails, the white and the blue species of butterflies, etc. Of all the Meghalayan butterflies, Kaiser-Hind is the most beautiful and highly prized and the black and yellow birdwing, the largest of all species.

Both food crops and cash crops are called subsistence crops. The greater proportion of the State's population sub-

sists 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 total area under various food crops in the State is estimated at about 126 lakh hectares and the production of total foodgrains during 1980-81 had been estimated at 1.50 lakh tonnes. The major food crops are paddy, maize, wheat, millets and pulses. Cash crops are potatoes, jute and mesta, cotton, ginger, turmeric, sugarcane, oilseed, tapioca, black pepper, arecanut and betelvines.

Cattle, poultry, pigs, goats, buffaloes and sheep are important livestock of Meghalaya. There are at least 4 lakh cattle heads which form the most significant livestock of the state. The state offers immense scope for the development of fish-culture. Both cold and warm water fisheries can be suitably established. There are numerous rivers, streams, lakes, bheels and reservoirs in the State which provide ideal fish-breeding grounds. Fishes like carp, mahaser, trout, magur and singi can be reared and profitably cultured in the stream and water bodies that are located at different altitude and height in the State. The trouts are well adapted to streams in cold seasons also when other fishes migrate down streams.

Meghalaya is rich in mineral resources but due to

lack of proper survey and difficult means of communication they have not been properly tapped and assessed. Recent survey by the State and the Central Geological Departments have led to the discovery of gold and uranium in the State. Phosphate prospecting is in progress in the Jaintia Hills near Jowai town. The principal minerals found in the State are coal, limestone, sillimanite, dolomite, refractory clay, fireclay, mica, corundum, kaolin, glass sand, felspar, garnet, gypsum, china clay and lithomargic clay.

PEOPLE

Meghalaya consists of mainly three tribes, viz. Khasi, Jaintia and Garo, almost all traditional inhabitants in the hills are basically Mongoloid. The scholars surmise that Mongolian immigrants were believed to have entered from Burma and other South-East Asiatic countries. After a complete study of these three tribes, their physical structure, language, way of living and their personal habits, Sir Joseph Hooker reached a conclusion that these tribes were from an Indo-China race. Likewise, L.A. Waddell believed that these tribes are from Mongolian family. S.K. Chatterjee's opinion is that these Indo-Mongoloids were known as 'Kiratas'. It is mentioned in the 'Mahabharat', that the Kiratas were hillmen living in the Eastern Himalayas, whose original home was in Himalayan slopes and in the mountains of the East, almost in Assam.

Some scholars are of this opinion that almost all the traditional inhabitants in the hills are basically Mongoloid and with the single exception of the Khasis and Jaintias, all of them belong to the Tibeto-Chinese linguistic fold and more often to its Tibeto-Burman sub-family. The Khasis are believed to be of Austro-Asiatic descent, the Jaintias are Mongoloid while the Garos are of Tibetan origin.

Das (1981) described a tribe called the Khasi, a member of the Indo-Mongoloid group. They speak a dialect of the Mon-Khmer linguistic group and in that sense they are an Austro-Asiatic people. They have a short stature and belongs to dolichocephalic and mesocephalic heads.

All three tribes of Meghalaya are found to be more or less short in height. They have muscular bodies and highly developed calves. Khasi and Jaintias are light brownish colour whereas Garos are slightly darker and all these tribes have Mongolian features with narrow eyes, broad high cheek-bones and flat platyrhine nose. These tribals are of a cheerful nature, peace-loving, hospitable, humorous and sociable.

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. 'Synteng' holds a similar significance. According to a tradition, 'Teng' was the ancient

mother and therefore 'Synteng' means children of an ancestral mother. Jaintia seems to have been an Aryanization of the original Khasi word Synteng which developed into Jaintia. The association of Khasi-Synteng with the mothers seems, therefore, very significant.

Khasi, Jaintia and Garo men, by and large have discarded their traditional costume and have adopted western dress. The traditional dress of male was 'dhoti' and 'turban'. Khasi and Jaintia male wear sleeveless coat. Khasi and Jaintia women have stuck to their traditional garment. Women's traditional costume dhara means a jainsem made of pure silkworm on special ceremonies like Christians or on the occasion of local festivals. The dress of Jaintia women can be distinguished from that of the Khasi women. Khasi and Jaintia women are found of decorating themselves with beautiful ornaments made of pure gold. The Garo women wear garment of hand-made cloth girdling round the waist and lower down upto the calf of the leg.

Khasi, Jaintia and Garo believe in one Supreme God, the Creator of the Universe. The Khasi believe in one God called U Blei. Almost half of the Khasi population has given up old beliefs and the practice of sacrifices. The Khasis called their religion Niam Khasi or Khasi Religion. Seng Khasi (named non-Christians), however, continue to worship

their own God and practise their own beliefs. Garos usually worship spirits, most of the spirits being connected with their agriculture life. Tarata-Rabuga is the supreme spirit and under his command the world was created according to Garo beliefs. Today more than fifty per cent of the Garos have accepted the Christian religion. The religion of the Pnars (Jaintias) strikingly resembles Hinduism. Taro (goddess) was worshipped by the Jaintia to whom pigs were sacrificed. Now the main religion of the hill tribes of Meghalaya is more or less Christianity.

The Khasi, the Jaintia and the G^āro trace descent through the mother. Property is transmitted through women. Women amongst the Khasi and Jaintia enjoy a position of unusual dignity and importance. Women have, for generations, been custodians 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 the 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 was uncle. In fact, the Jaintia belong to the same race as the Khasi, most of the customs and beliefs are common between them. But in Jaintia society the husband is like a stranger in his wife's house and can hardly interfere in the family matters. He has to provide the family finance no doubt but it is not his business to bother about the domestic affairs. The woman is in overall control of the household affairs of the family. It is the husband's brother-in-law and the uncles of the wife who pay the vital role in his wife's family matter. Men seldom care to know about the daily needs of their family although they work hard to earn as much as possible in order to provide for the needs of the family and for the savings. Like Khasi and Jaintia, the Garo are a matrilineal people. Though women inherit property, they do not wield exclusive right over it, their husbands having the final word in exercising authority over household possessions as well as the property handed down.

The Khasi and Jaintia trace descent through the mother, the property is transmitted through women, notably the youngest daughter (ka khadduh). Sometimes, the youngest son may also

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inherit ancestral properties, yet he can have self-acquired property. Among the Garo, they select one of their daughters (not necessarily the youngest or the eldest) to be the inheritors. The daughter nominated by the parents to be the inheritess stays permanently in the parental household after her marriage and thus, she along with her husband is expected to look after the property as well as the parents in their old age. After the death of the older couple, the younger couple inherits the property of the household and thus become the owner of the household.

The Khasi, the Jaintia and the Garo marriage within the clan is strictly prohibited. If a Khasi man, say of the Swer clan marries a woman of the Wahlang clan, the son or daughter becomes a Wahlang, not a Swer. After marriage, the husband goes to live with his wife in his mother-in-law's house. Among the Jaintia, the son-in-law does not go to live in the wife's house. He comes at sunset to his mother-in-law's house to spend the night with his wife. Early next morning he leaves the house to do his work in his mother's house. Among the Garo, marriage is strictly exogamous. The proposal for marriage always comes from the woman's side and it is the woman who normally chooses her husband. After marriage the son-in-law comes to live in his wife's parents' house.

The staple food of these tribes 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 and Jaintia men as well as women. Smoking and drinking is also quite common among males.

SPORTS IN MEGHALAYA

The most important and exciting indigenous sports among the Khasi are archery, hunting and fishing. Archery occupies the pride and place, and assumed the character of national sports amongst the Khasi and Jaintia. 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 mother of the 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 primeval mother who repeats her warning to the contestants before the commencement of every game of archery. In the past, archery competitions were occasionally accompanied with some elements of sorcery. At present, it is more connected with gambling locally known as Thohtim or teer.

As regards fishing, people in the past would catch the fish with a fishing trap locally known as puron. Now angling has become more and more popular. There is no other community in the country which is as much fond of fishing as the Khasi. Even the ladies have been acquainted with the art of fishing. Among other forms of sports mention may be made of wrestling locally known as ka ia lympat, tug of war locally known as ka iatan tyllai, pep top spinning locally known as kiew dieng btuid, randos, haishong syiem tied dieng-khun, point game locally known as ka ialeh poin, flying kites and rusni locally known as ka pynher kotkudi bad rusni.

In modern times football has become very popular with men, while basketball with women. Football was introduced in Meghalaya (Shillong) by emigrants from East-India, before the great earthquake in 1897 (Laitphlang, 1985) and ever since it has come to the most popular sport of the Khasi and Jaintia. Due to lack of training facilities, in the early days, the local teams were no match to the strong military teams. Gradually, the coming together of players from different parts of the State and thus the formation of the Khasi-Jaintia Association, help them to win many football matches. Eye witness spoke highly of the ability, skill and high quality of ball control of the early players as also as their tough physical discipline. It seems they have imbibed such

qualities from the Khasi traditional sports of archery where the contestants maintain a strict discipline and honest observation of the terms of contract in a challenge to a contest. Meghalaya has produced many good players of football who participated at different levels, e.g., All India University (Mr. Phimdrophin Sohliya), Inter-State (Mr. Ernest Jyrwa), Captain of Assam Football Team (Mr. Keston Shullai), Olympic (Mr. Shlur Nongbri - *selected for trial*) and Asian School Games (Mr. Fullmoon Pyrtuh).

CHAPTER IV

MATERIAL AND METHODS

MATERIAL

THE SUBJECTS

The subjects of the present study are Khasi and Jaintia adult men. Though the Garo people also inhabit Garo Hills District of Meghalaya, they do not form the subject of enquiry for the present study because of certain limitations as, i) the origin and affinities of the Garo are different from that of Khasi-Jaintia, ii) they do not have any district level team participating in Inter-District competitions, iii) there is no Garo players in the State level Football Team of Meghalaya, and iv) there were constraints of time in carrying out the present study.

AREA OF FIELD WORK

Three Districts of Meghalaya, that is, East Khasi Hills District, West Khasi Hills District, and Jaintia Hills District, form the area of field work for the present study. Following are the places from where data were collected during July-September 1991.

East Khasi Hills District	- Shillong (urban)
	Smit (rural)
West Khasi Hills District	- Nongstoin (urban)
	Mawkyrwat (rural)
Jaintia Hills District	- Jowai (urban)
	Khliehriat (rural)

DATA

The data for the present study comprises a total of 260 men, of which 143 men are football players, while 117 men form our 'control' sample, that is, these men do not play football, and nor do they participate in any other sports activity. This control sample has been taken in order to examine differences/similarities in the physique of players and the general population. Samples for football players are divided into three categories: Rural Team, Urban Team, District Team, for each of the three districts. The fourth category of sample is formed by the football players of Meghalaya State Team 1991. The control samples are drawn from the same urban and rural area, as for players. Since the District Level Football Teams comprise of players from both urban and rural areas, the combined urban and rural controls are taken as control at District level. The sample distribution is presented in Table 1.

All football players range in age from 18 to 33 years. The control subjects were selected in such a manner that their age range is also the same as for football players. Care was taken to include only those subjects who are apparently normal and healthy. Basic background information was gathered from each subject, which includes name, place of birth, domicile, tribe/sub-tribe, education, occupation, marital status, number of children, total family income.

Table 1 - Sample distribution of Football players and control, according to area and level of participation.

Area	Players	Control
East Khasi Hills		
Urban Team	26	27
Rural Team	13	14
District Team	16	-
West Khasi Hills		
Urban Team	15	16
Rural Team	12	13
District Team	11	-
Jaintia Hills		
Urban Team	19	29
Rural Team	18	18
District Team	13	-
Meghalaya (State Team)	16	-
	159*	117

* Actually a total of 143 football players are investigated. Total sample of football players shown in the above table is 159, since the 16 players of State Team also play for one or the other District Teams.

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 land-

marks 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 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 Lowrie, 1969).

The football players of the present study were also administered a set of questions relating to their training, experience, various facilities enjoyed by them, difficulties faced by them in the course of pursuing their interest in football. They were also investigated for personal habits relating to smoking, drinking and chewing.

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 the 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 amounts of tension beyond the fingertips. 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 measurement. Time was allowed for the full pressure of the caliper to take effect, but not so long 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, halfway between the acromion 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 in a position one to two inches above the right anterior superior iliac spine so that the fold runs forward and slightly downward.

6. **Calf** – The subject sits on a chair with his foot on the floor and the leg vertical. 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 runs vertically.

BONE DIAMETERS

GENERAL INSTRUCTIONS

Instrument: Sliding caliper.

Definition of Measurement: 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 to the arm. 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 of the 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 the elbow fully flexed. The subject is instructed to 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 rating system consisting of 3-sequential numerals, 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 (Ectomorphy) refers to the relative linearity of individuals and is based on ponderal index. Before obtaining the somatotype rating, appropriate data were entered in the appropriate 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 the 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 care-

fully 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 (\downarrow) 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 Muscle: Biceps in cm unit, so it would be best to divide skinfold thickness measurement by 10, then subtract the value from Muscle: Biceps). In case of calf, again subtract 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 numerical values. Consider only columns, ignore the 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 count the column deviations of the other three encircled figures along the row. Add the total deviation of the 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 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 $\text{height}/\sqrt[3]{\text{weight}}$ (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. Encircle the value. Now, the third component is obtained.

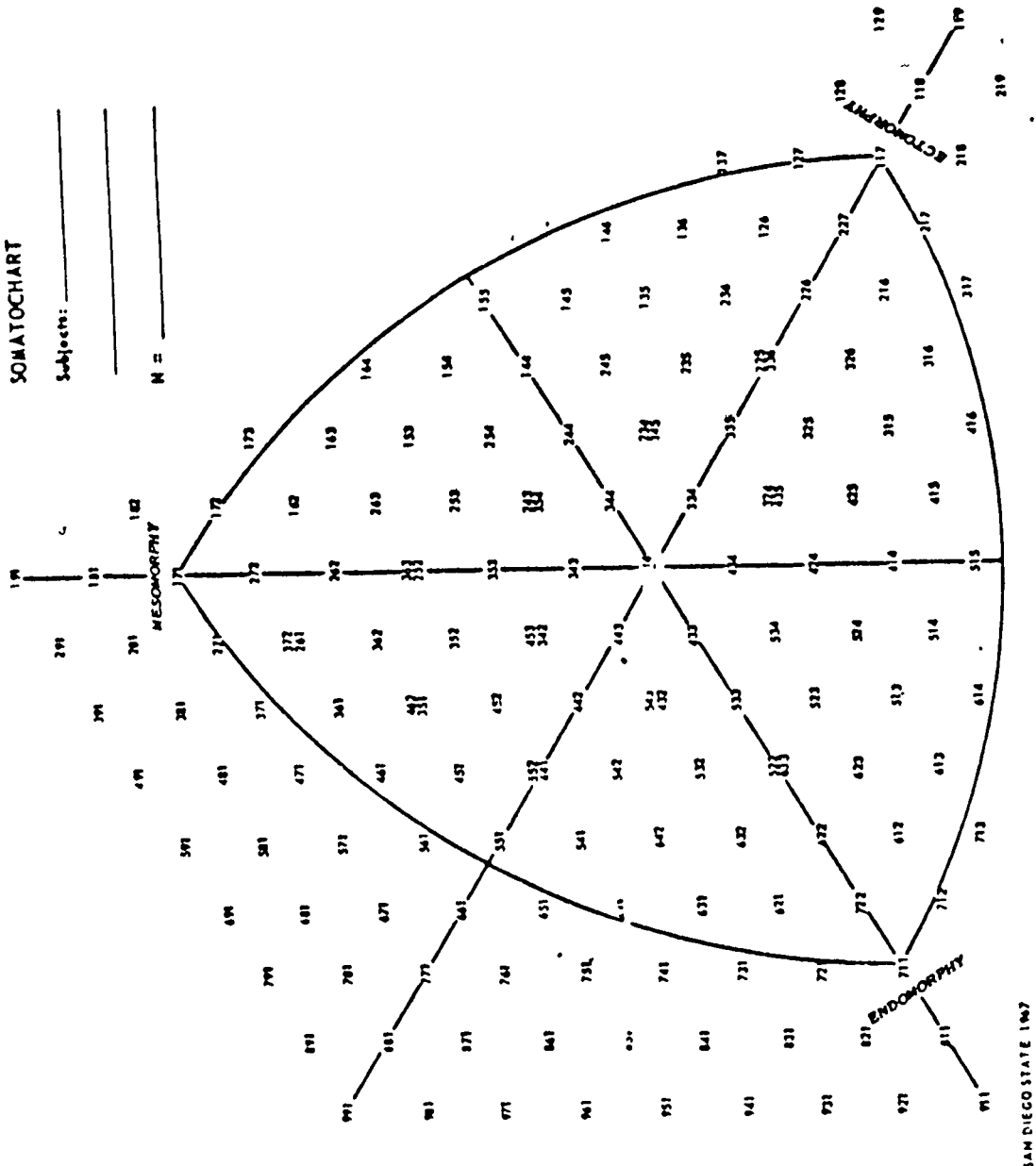
SOMATOCHART (Fig. 2)

Sheldon used a somatotype triangle to represent individual somatypes in it. The somatotype triangle has all the three sides of equal length and are arc-shaped. The corners of the triangle represent the extremes in each component. The left corner at the base of the triangle represents

SOMATOCHART

Subjects: _____

 N = _____



SAN DIEGO STATE 1967

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

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 ~~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 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) **Balanced 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) **Balanced ectomorph** - Third component dominates, first and second components 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).

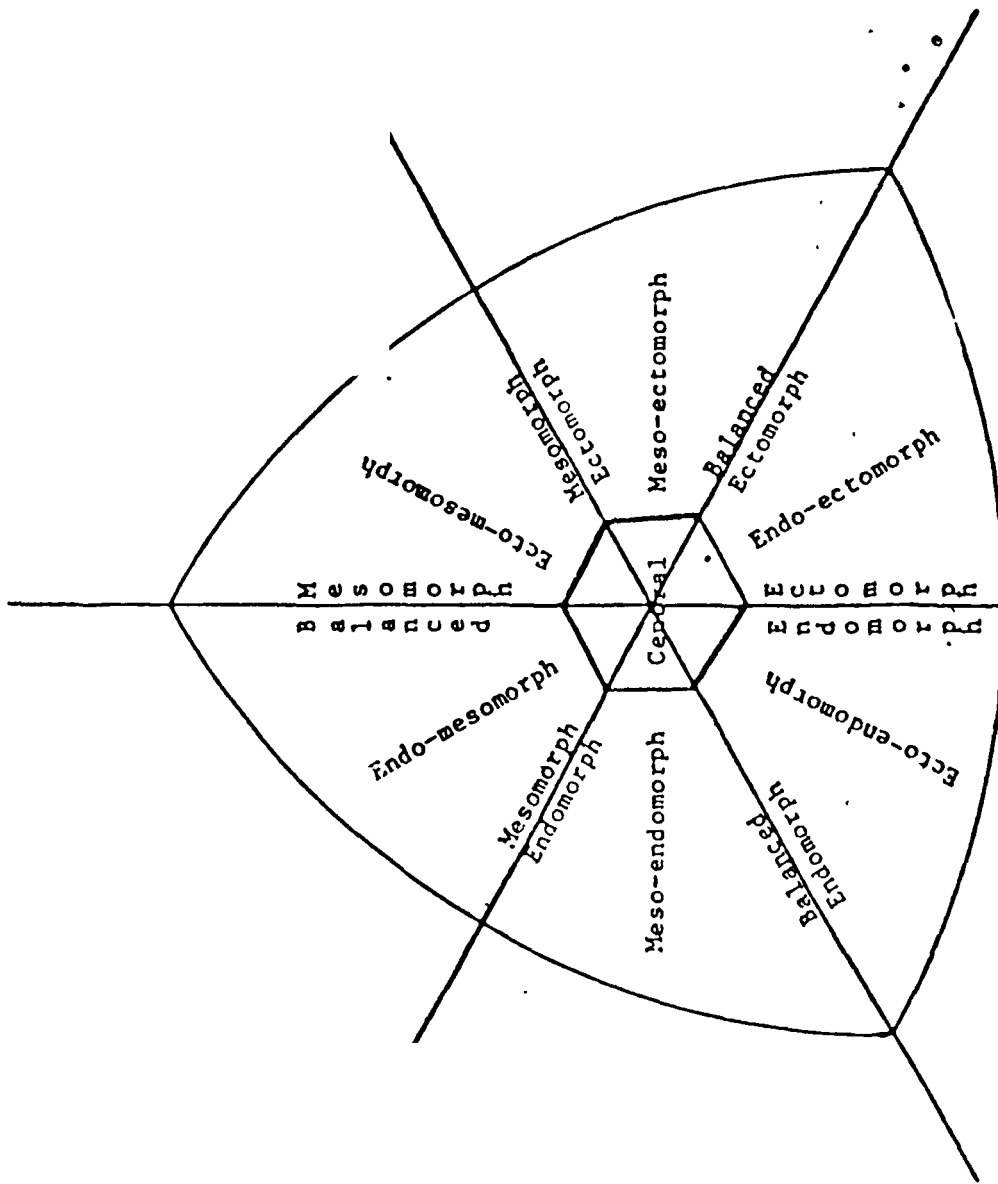


Fig. 3. A diagrammatic representation of thirteen somatotype categories based on the axes and sectors of the somatochart.

- 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) **Ectomorphic 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 than 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.

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

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. **Somatotype Attitudinal Distance** – The SDD is used for distances on the two-dimensional somatochart. However, somatotypes are best represented by a point in three dimensional spaces called a somatopoint. The distance between any two somatopoints is the Somatotype Attitudinal Distance (SAD) and is calculated in component units.

$$SAD_{A,B} = \sqrt{(I_A - I_B)^2 + (II_A - II_B)^2 + (III_A - III_B)^2}$$

Where I, II and III represent endormophy, mesomorphy, and ectomorphy components of a somatotype, and A and B are two somatotypes. The average of the SAD's of a sample is the somatotype attitudinal mean or SAM.

$$SAM = \sum_i^n \frac{SAD_i}{n}$$

The SAD and SAM can be substituted for SDD and SDI. Because there is some loss of information about the somatotype when it is plotted in two-dimensions, three dimensional analysis is preferred. However, SDD and SDI are useful for analysis of plots on the somatochart.

6. Wherever appropriate, some anthropometric measurements were also subjected to simple descriptive statistics.

7. **Simple Descriptive Statistics**

Mean (\bar{x}): It is the sum of individual values divided by their total number and is given as,

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

Where, $\sum x$ = 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

The football players were rated individually for each component using Heath-Carter Somatotype Rating Method. The individual somatotype ratings are plotted on Somatocharts I to X, for each of the ten samples of players, and on Somatochart XI for the (combined) control subject, under study.

SOMATOTYPE DISTRIBUTIONS

Table 2 presents the number and percentage of football players distributed into various somatotype categories. On the whole it can be seen from the table that out of a total of 13 generalized categories of somatotypes, the players of the present study are distributed only among 5 categories, viz., Endomorphic-Mesomorph, Balanced Mesomorph, Ectomorphic-Mesomorph, Mesomorph-Ectomorph and Mesomorphic-Ectomorph. A majority, i.e. varying between 46 to 66% of players belonging to the urban, rural and district samples of East Khasi Hills, West Khasi Hills as well as State level team players, are Ectomorphic-Mesomorph. This means that in these players Mesomorphy is dominant, and Ectomorphy is greater than Endomorphy. On the other hand, among the urban, rural and district samples of Jaintia Hills a majority (between 31 and 61%) of players are balanced Mesomorph - meaning that though Mesomorphy is dominant, Ectomorphy and Endomorphy components are equal.

The somatotypes of our 'control' group are also distributed in the same five categories (Table 3) as observed for players. In the East Khasi Hills a majority (37%) of urban control subjects are Ectomorphic-Mesomorph, while the rural majority (35%) are balanced Mesomorph. Among the urban controls of West Khasi Hills an equal percentage (37.5) of subjects are Balanced Mesomorph and Ectomorphic-Mesomorph; however, a great percentage (61) of rural subjects of this District are Ectomorphic-Mesomorph. The control subjects of Jaintia Hills present slightly different picture, the majority (31%) of urban men being Balanced Mesomorph while a majority of rural men equally fall under Balanced Mesomorph, and Ectomorphic-Mesomorph categories.

To determine the significance of differences between the distributions of various groups the chi-square test was applied, and the results are presented in Table 4. No significant differences are observed between urban and rural players as well as control subjects belonging to each of the three Districts. Players of the three District Teams also do not significantly differentiate from each other on the basis of distributions of somatotype categories. Similarly, while comparing the somatotype distribution of players of each District Team with that of the State Team, statistically insignificant differences are found.

MEAN SOMATOTYPES

Table 5 shows the mean and standard deviation of different components of physique in players and control groups. A perusal of this table would reveal that for all the groups considered in the present study the Mesomorphy component is dominant, followed by Ectomorphy and Endomorphy. The mean somatotypes for State players are: 1.28-5.69-1.94 and control: 1.66-4.65-2.89. This means that the football players have relatively greater musculo-skeletal development compared to the general population. Somatochart (XII) gives a comparative picture of mean somatotypes of control, State and District level players.

Inter-group comparisons have been made, and the statistical differences (t-values) in mean somatotypes of players and control are presented in Table 6. Except Endomorphy component which reveals significant difference between the mean of urban and rural players of the East Khasi Hills, West Khasi Hills and Jaintia Hills. Comparing the mean somatotype ratings of District level football players it is found that East Khasi Hills significantly differ from West Khasi Hills players for Ectomorphy and from Jaintia Hills players for Endomorphy; the West Khasi Hills and Jaintia Hills players of District team significantly differ for Endomorphy. However, mesomorphy, the dominant component of the subjects of the

present study, does not reveal any significant differences between the three district level players groups.

Mean somatotypes of district players are also compared with that of the State players. It is clear from Table 5 and 6 that, the mean Mesomorphy and Ectomorphy ratings of West Khasi Hills, and mean Endomorphy rating of Jaintia Hills District level players are significantly different from the State level players. On the other hand, none of the three components show statistically significant differences in the mean ratings of State players and East Khasi Hills district level players. It may be mentioned here that eight of the sixteen State players also play at East Khasi Hills district level, while seven play at Jaintia Hills and one one at West Khasi Hills district level.

Further, the data on all the 40 district level football players were combined, mean somatotypes calculated, and compared with the State players. No significant differences are observed between combined districts and State players, for either of the three components of physique. In fact, all the players of district team can be referred to as 'professional football players', while the urban and rural players of the present study may not be professionals. The players of combined Districts as well as State Team significantly differ from the general population (control) in all the three components of somatotype.

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 of value to know the absolute value of the component rating comparison with other 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 (1973) and Ross et al. (1974) 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 7, and discussed below.

By using the formulae for obtaining the x and y coordinates, any somatotype given on the somatochart can easily be verified. Table 7 gives the means for x and y coordinate 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 and control subjects the lowest value for y.

The location of a somatotype in term of x and y coor-

ordinates on 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}). A schematic representation of this is presented in Fig. 4 for State players. The SDI values listed in Table 7 tell us the average distance of the somatotype from their mean (\bar{S}) in different groups.

The deviations of mean somatotypes of various groups of players from the control group have been studied (in two dimensions) with the help of Somatotype Dispersion Distance (SDD) and is measured in y-units. It is clear from the SDD values listed in Table 7 that the somatotype of control group is farthest from State players (3.12) and, closest to urban players (0.32) of West Khasi Hills. The Somatotype Attitudinal Distance (SAD) of control group with different groups of players indicate the magnitude of differences in somatotypes (in three dimensions) expressed in component units. The SAD between control and urban players (Table 7) of Jaintia Hills is highest (2.48) and lowest (1.51) between control group and rural players of West Khasi Hills.

In team sports, such as football there may be a mechanical advantage of a particular type of physique of players in different field positions, like forward, stopper, half-back, full-back and goal keeper. In the present study, the

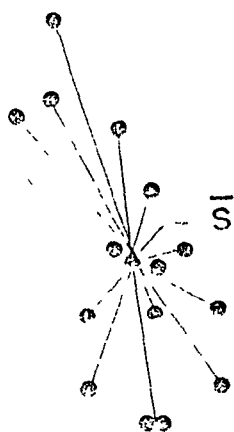
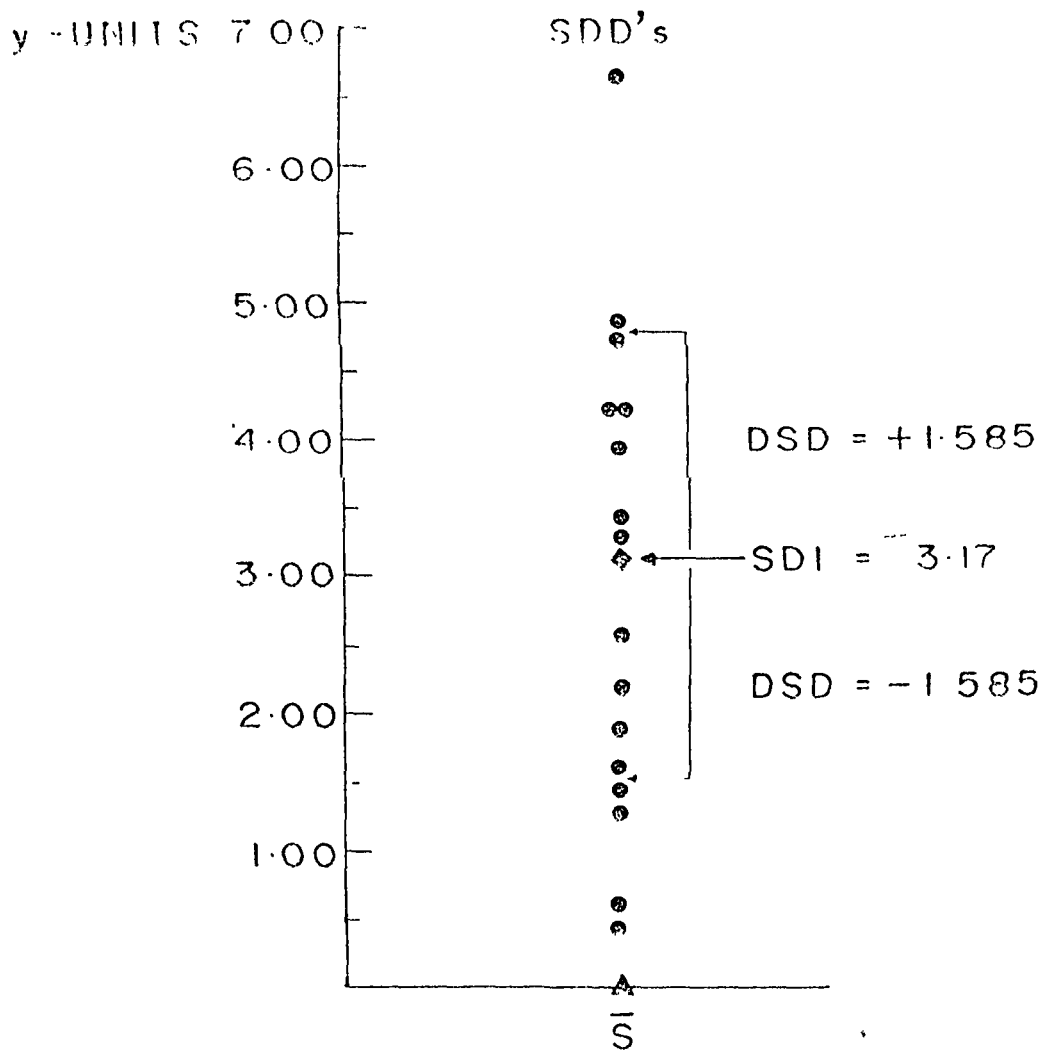


Fig.4 : A schematic representation of the Somatoplots about their Mean (\bar{S}) and SDD's from \bar{S} . data from Football Players of Meghalaya State Team, N = 16.

data on 40 professional football players (all Districts combined) were classified according to their playing positions in the field, and mean somatotypes have been calculated (Somatochart XII₂). Very recently modern terminology for different playing positions have been adopted in the sports of football, however, here the results are presented according to 5 traditional positions used by various authors so that the results are comparable.

The mean and standard deviation of the three components of physique in football players according to position in field are presented in Table 8. The table also gives t-values between different positions, for each component. It is clear from the table that Endomorphy value is lowest among stoppers and highest among goal keepers; Mesomorphy greatest among half-backs and lowest among goal keepers; while half-backs are the least and goal keepers the most Ectomorphic. Statistically significant differences for mean Endomorphy ratings are observed between forwards and stoppers, and stoppers and goal keepers. Goal keepers have significantly different mean Mesomorphy and Ectomorphy ratings from players of all other positions. Ectomorphy ratings of forwards and half-backs also show significant difference. Among all the positions, goal keepers reveal the most divergent somatotypes.

In addition to basic background information, such

as, name, date of birth, mental status, economic status etc., the football players of the present study were administered a set of question relating to their experience and training in playing football, various difficulties faced by them in the course of pursuing their interest in football, health problems as well as relating to their personal habits like, smoking, drinking, chewing etc. These information have been analyzed in terms of percentages, and comparisons are made between rural, urban, district and State level football players (Table 9). The finding of the results depicted in Table 9 are: i) more than 75% of all players have been playing football for the last 9 to 10 years, ii) 81% of State players have had formal training whereas at least 50% of District Teams and Urban players received formal training, on the other hand, only about 9% of Rural players have undergone training, iii) almost cent per cent players of all the District Teams, Urban and Rural teams, as well as State players complained of improper playgrounds, iv) while all the State players have proper sports kit, 27% District players, 31% urban, and 86% rural players lack proper sports kit, v) 37% State players, 63% urban players, 70% District players and 97% Rural players, expressed that the coaching received by them is either inadequate or improper, vi) it is surprising to find that not only all the urban and rural players, but also the District and State players do not receive any regular

financial support from the Government, vii) there is no provision for any special diet for at least 60% of State players, 50% of District, Urban players, and 95% of Rural players, viii) almost cent per cent players at all levels felt that they should be provided exposure to more and better teams within and outside the country, ix) more than 93% of players of present study admit that they are not in a position to devote adequate time for practising, either because of their studies or profession, x) it is surprising to find that at least 56% State players, 67% District players, 60% Urban and 79% Rural players are habitual smokers, xi) it is more surprising to know that more of our State (62%) and District (52%) players indulge in drinking, as compared with 46% urban and 23% rural players, xii) more than 90% of all players regularly chew kwai (betel leaf and nut with lime), and occasionally with tobacco, xiii) none of the District or Urban players report any health problem, while one State player and about 14% rural players have some or the other health problem.

Table 2 - Number and percentage (within brackets) of Football Players in various Somatotype Categories.

Somatotype Category	East Khasi Hills		West Khasi Hills		Jaintia Hills		Meghalaya State			
	Urban	Rural	District	Urban	Rural	District				
Balanced endomorphy	-	-	-	-	-	-	-			
Mesomorphic endomorphy	-	-	-	-	-	-	-			
Mesomorph-endomorphy	-	-	-	-	-	-	-			
Endomorphic mesomorphy	1(3.85)	1(7.69)	1(6.25)	2(13.33)	-	2(10.53)	1(5.56)	2(15.38)	1(6.25)	
Balanced mesomorphy	8(30.77)	3(23.08)	6(37.5)	3(20.00)	3(25.00)	3(27.27)	6(31.58)	11(61.11)	6(46.15)	6(37.5)
Ectomorphic mesomorphy	15(57.69)	8(61.54)	9(56.25)	7(46.67)	8(66.67)	6(54.55)	4(21.05)	5(27.78)	2(15.38)	9(56.25)
Mesomorph-ectomorphy	2(7.69)	1(7.69)	-	2(13.33)	1(8.33)	1(9.09)	3(15.79)	1(5.56)	1(7.69)	-
Mesomorphic-ectomorphy	-	-	-	1(6.67)	-	1(9.09)	4(21.05)	-	2(15.38)	-
Balanced ectomorphy	-	-	-	-	-	-	-	-	-	-
Endomorphic ectomorphy	-	-	-	-	-	-	-	-	-	-
Endomorph-ectomorphy	-	-	-	-	-	-	-	-	-	-
Ectomorphic endomorphy	-	-	-	-	-	-	-	-	-	-
Control	-	-	-	-	-	-	-	-	-	-

Table 3 - Number and Percentage (within brackets) of control subjects in various somatotype categories.

Somatotype Category	East Khasi Hills		West Khasi Hills		Jaintia Hills		Total Urban & Rural all Districts combined
	Urban	Rural	Urban	Rural	Urban	Rural	
	Balanced endomorphy	-	-	-	-	-	
Mesomorphic-endomorph	-	-	-	-	-	-	-
Mesomorph-endomorph	-	-	-	-	-	-	-
Endomorphic mesomorph	2(7.407)	1(7.143)	2(12.50)	-	4(13.791)	2(11.111)	11(9.402)
Balanced mesomorph	6(22.222)	5(35.714)	6(37.50)	3(23.077)	9(31.034)	7(38.889)	36(30.769)
Ectomorph-mesomorph	10(37.037)	4(28.857)	6(37.50)	8(61.538)	8(27.586)	7(38.889)	43(36.752)
Mesomorph-ectomorph	8(29.930)	3(21.429)	2(12.50)	2(15.385)	7(24.138)	2(11.111)	24(20.573)
Mesomorphic ectomorph	1(3.704)	1(7.143)	-	-	1(3.448)	-	3(2.564)
Balanced ectomorph	-	-	-	-	-	-	-
Endomorphic ectomorph	-	-	-	-	-	-	-
Endomorph-ectomorph	-	-	-	-	-	-	-
Ectomorphic endomorph	-	-	-	-	-	-	-
Control	-	-	-	-	-	-	-

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

Groups compared	χ^2 value	df	Significance (at 5% level)
Players			
East Khasi Hills (EKH):			
Urban vs. Rural	0.43	3	Insignificant
West Khasi Hills (WKH):			
Urban vs. Rural	3.11	4	"
Jaintia Hills (JH):			
Urban vs. Rural	6.87	4	"
District Level Players:			
EKH vs. WKH	4.02	4	"
EKH vs. JH	7.33	4	"
WKH vs. JH	6.88	4	"
District vs. State Players:			
EKH vs. State	0.00	2	"
WKH vs. State	2.29	4	"
JH vs. State	7.57	4	"
Control			
Urban vs. Rural:			
East Khasi Hills	1.27	4	"
West Khasi Hills	5.05	3	"
Jaintia Hills	2.32	4	"

Table 5 - Mean and standard deviation of different components of physique in players and control groups.

Group	N	Endomorphy		Mesomorphy		Ectomorphy	
		Mean	SD	Mean	SD	Mean	SD
Players							
East Khasi Hills							
Urban	26	1.25	0.38	5.35	1.09	2.25	0.83
Rural	13	1.31	0.43	5.54	1.72	2.58	1.02
District	16	1.34	0.47	5.47	1.26	2.00	0.63
West Khasi Hills							
Urban	15	1.40	0.43	4.77	1.07	2.47	0.87
Rural	12	1.08	0.19	4.96	1.16	2.46	0.75
District	11	1.18	0.25	4.77	0.31	2.50	0.18
Jaintia Hills							
Urban	19	1.44	0.57	4.92	1.69	2.39	1.15
Rural	18	1.61	0.44	5.64	1.43	1.97	0.74
District	13	1.69	0.38	5.08	1.90	2.08	1.07
State Team	16	1.28	0.41	5.69	1.29	1.94	0.68
Districts (combined)	40	1.41	0.44	5.15	1.52	2.15	0.86
Control (Combined)	117	1.66	0.61	4.65	1.14	2.89	0.83

Table 6 - Statistical differences (t-values) in Mean Somatotypes of Players, and Control.

Groups compared	t-values		
	Endomorphy	Mesomorphy	Ectomorphy
East Khasi Hills (EKH):			
Urban vs. Rural Players	-0.58	-0.51	-1.41
West Khasi Hills (WKH):			
Urban vs. Rural Players	+3.57**	-0.61	+0.04
Jaintia Hills (JH):			
Urban vs. Rural Players	-1.49	-1.95	+1.82
District Level Players:			
EKH vs. WKH	+1.06	+1.81	-2.37*
EKH vs. JH	-3.54**	+0.90	-0.42
WKH vs. JH	-5.30**	-0.61	+1.45
District vs. State Players:			
EKH vs. State	+0.56	-0.62	+0.61
WKH vs. State	-1.16	-2.33*	+2.77*
JH vs. State	+3.76**	-1.35	+0.83
Combined Districts vs. State	+1.51	-1.89	+1.34
Combined Districts vs. Control	-3.90**	+2.72**	-6.62**
State vs. Control	-4.71**	+4.33**	-7.31**

* = $p > .05$

** = $p > .01$

Table 7 - Plot coordinates (x, y), Somatotype Dispersion Index (SDI), Somatotype Dispersion Distance (SDD), Somatotype Attitudinal Distance (SAD) of various groups of players and control.

Group	x	y	SDI	Two Dimensions SDD	Three Dimensions SAD
Players					
East Khasi Hills					
Urban	1.00	7.19	3.84	2.11	1.80
Rural	1.26	7.19	3.83	2.19	1.97
District	0.78	7.59	2.85	2.52	1.88
West Khasi Hills					
Urban	1.10	5.13	2.87	0.32	1.97
Rural	1.37	6.37	2.35	1.50	1.51
District	1.32	5.73	2.84	0.94	1.70
Jaintia Hills					
Urban	0.95	5.95	3.99	0.87	2.48
Rural	0.39	7.67	3.87	2.75	1.90
District	0.42	6.38	4.25	1.57	2.38
State Team	0.66	8.16	3.17	3.12	1.73
Combined Districts	0.81	6.68	3.30	1.61	1.91
Control	0.93	5.08	3.99	-	-

Table 8 - Mean and standard deviation of the three components in Football players according to position in field, and differences (t-values) in mean somatotypes.

Positions	Endomorphy		Mesomorphy		Ectomorphy	
	Mean	SD	Mean	SD	Mean	SD
Forwards (N=15)	1.47	0.44	5.23	1.77	2.23	0.84
Stoppers (N=5)	1.20	0.27	5.40	1.34	2.00	0.79
Half-backs (N=7)	1.36	0.38	5.57	1.48	1.64	0.75
Full-backs (N=8)	1.44	0.68	5.19	1.44	2.19	0.96
Goal Keepers (N=5)	1.50	0.00	4.00	0.94	2.90	0.55

	t-values		
	Endomorphy	Mesomorphy	Ectomorphy
Forwards vs. Stoppers	+2.24*	-0.30	+0.75
Forwards vs. Half-backs	+0.81	-0.65	+2.23*
Forwards vs. Full-backs	+0.15	+0.08	+0.14
Forwards + Goal Keepers	-0.38	+2.72*	-2.78*
Stoppers vs. Half-backs	-1.13	-0.28	+1.08
Stoppers vs. Full-backs	-1.19	+0.36	-0.53
Stoppers vs. Goal Keepers	-3.75**	+2.56*	-2.85*
Half-backs vs. Full-backs	-0.38	+0.69	-1.68
Half-backs vs. Goal Keepers	-1.27	+3.05*	-4.56**
Full-backs vs. Goal Keepers	-0.33	+2.47*	-2.30*

* = $p > .05$

** = $p > .01$

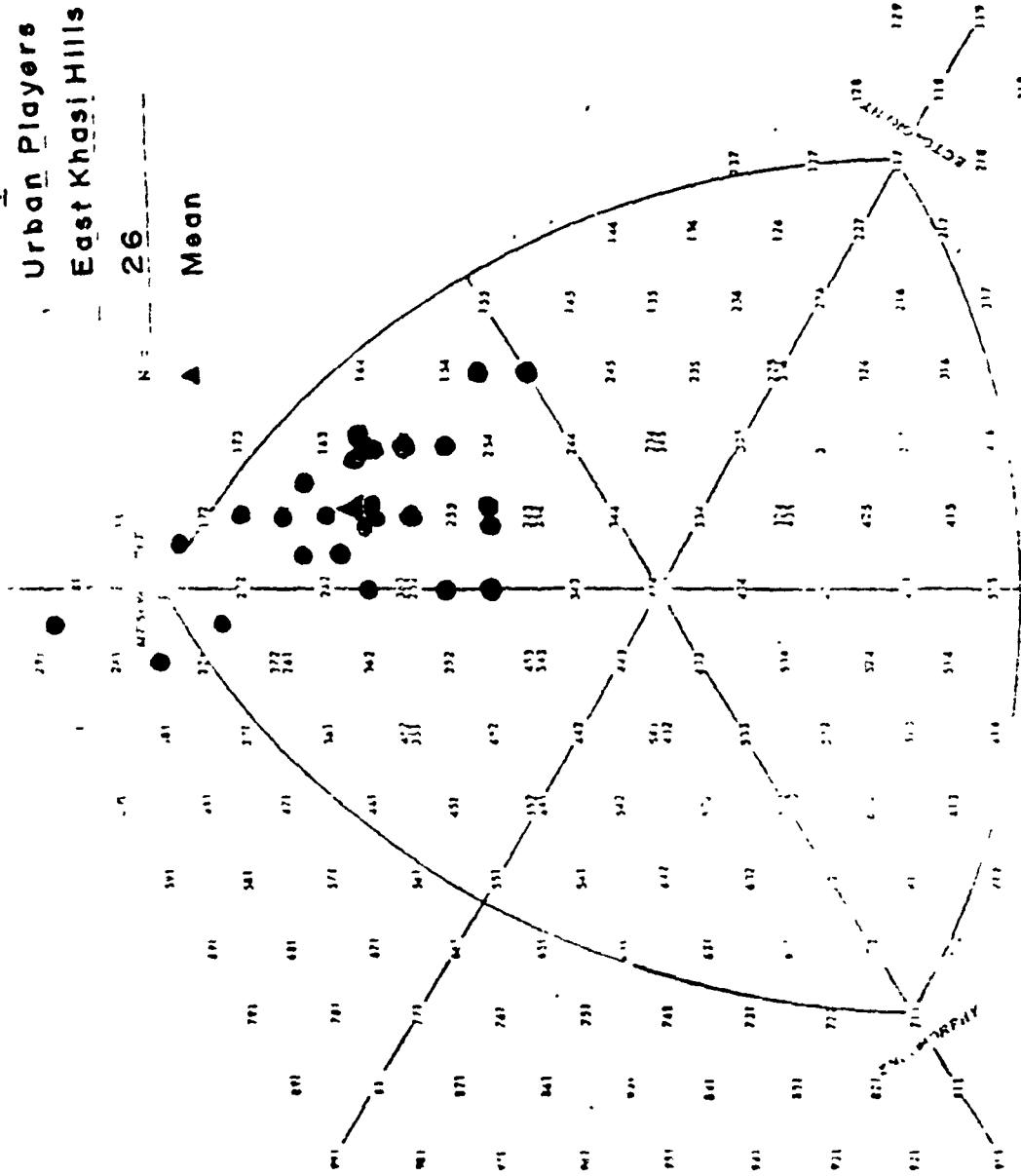
Table 9 - Experience, training, difficulties, and personal habits, health problems, as reported by football players (Figures are percentage of players)

Group	Experience of playing football		Formal Training	Difficulties faced by the players						Personal Habits					
	9 Or 10 years	10 or 11 years		Impro- per play-ground	Lack of Sports kit	Inade- quate/ Impro- per coach- ing	No scho- lar- ship etc.	No special diet	Lack of practi- cing time	Lack of Expo- sure	Studies of Job	Smok- ing	Chew- ing (Kwai)	Drink- ing	Health pro- blem
State Team Players (N = 16)	75.00	25.00	81.25	100.00	00.00	37.50	100.00	6.25	93.75	100.00	100.00	56.25	93.75	62.50	6.25
District Team Players (N = 40)	82.50	17.50	57.50	97.50	27.50	70.00	100.00	52.50	97.75	97.75	100.00	67.50	95.00	52.50	00.00
Urban Team Players (N = 60)	83.33	16.67	51.67	98.33	31.67	63.33	100.00	50.00	93.33	100.00	98.33	60.00	90.00	46.67	00.00
Rural Team Players (N = 43)	88.37	11.67	9.30	100.00	86.05	97.67	97.67	95.35	97.67	100.00	97.67	79.07	90.70	23.25	13.95

I
Urban Players
East Khasi Hills

N = 26

▲ Mean

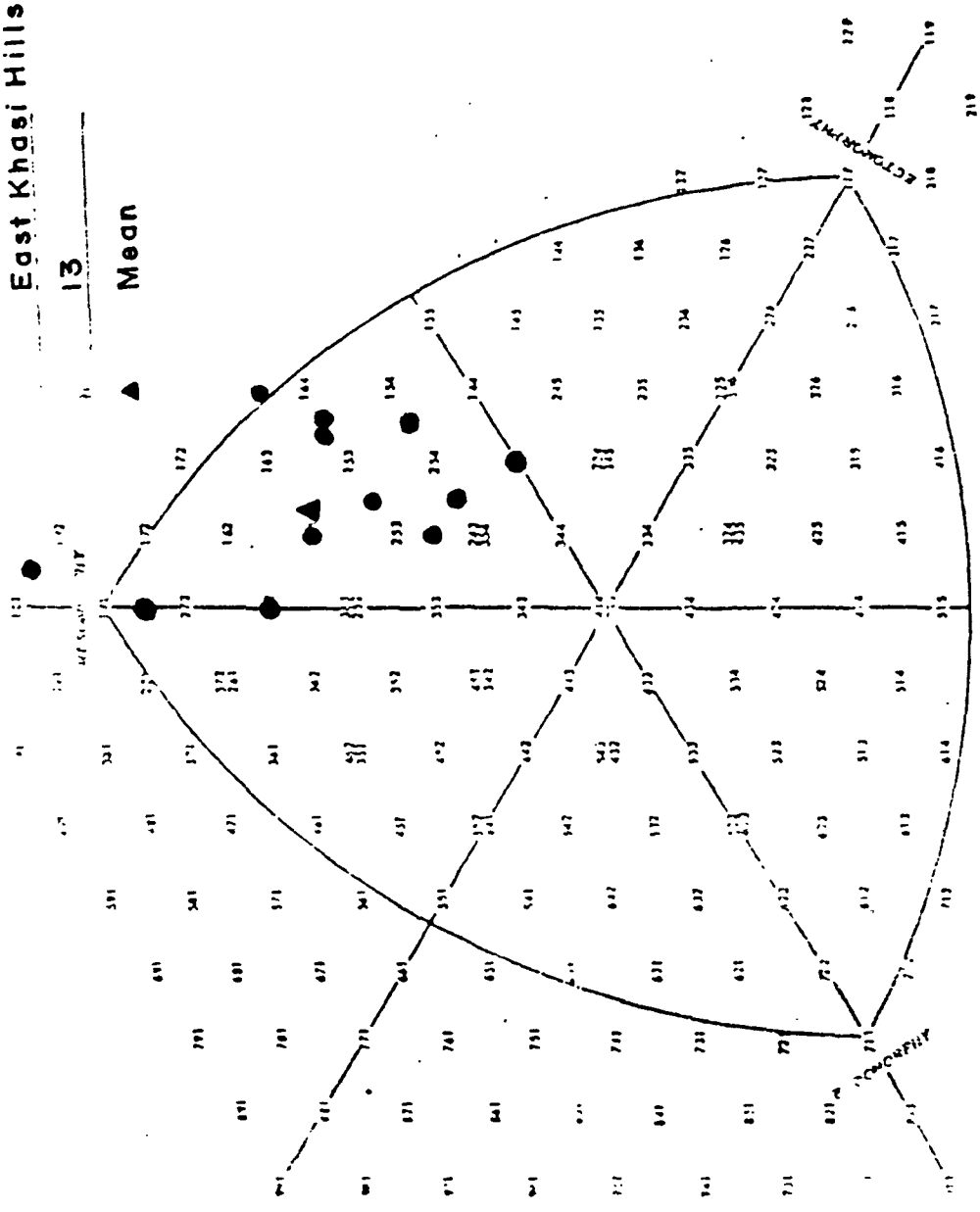


SAN DIEGO STATE 1947

II
Rural Players
East Khasi Hills

13

Mean

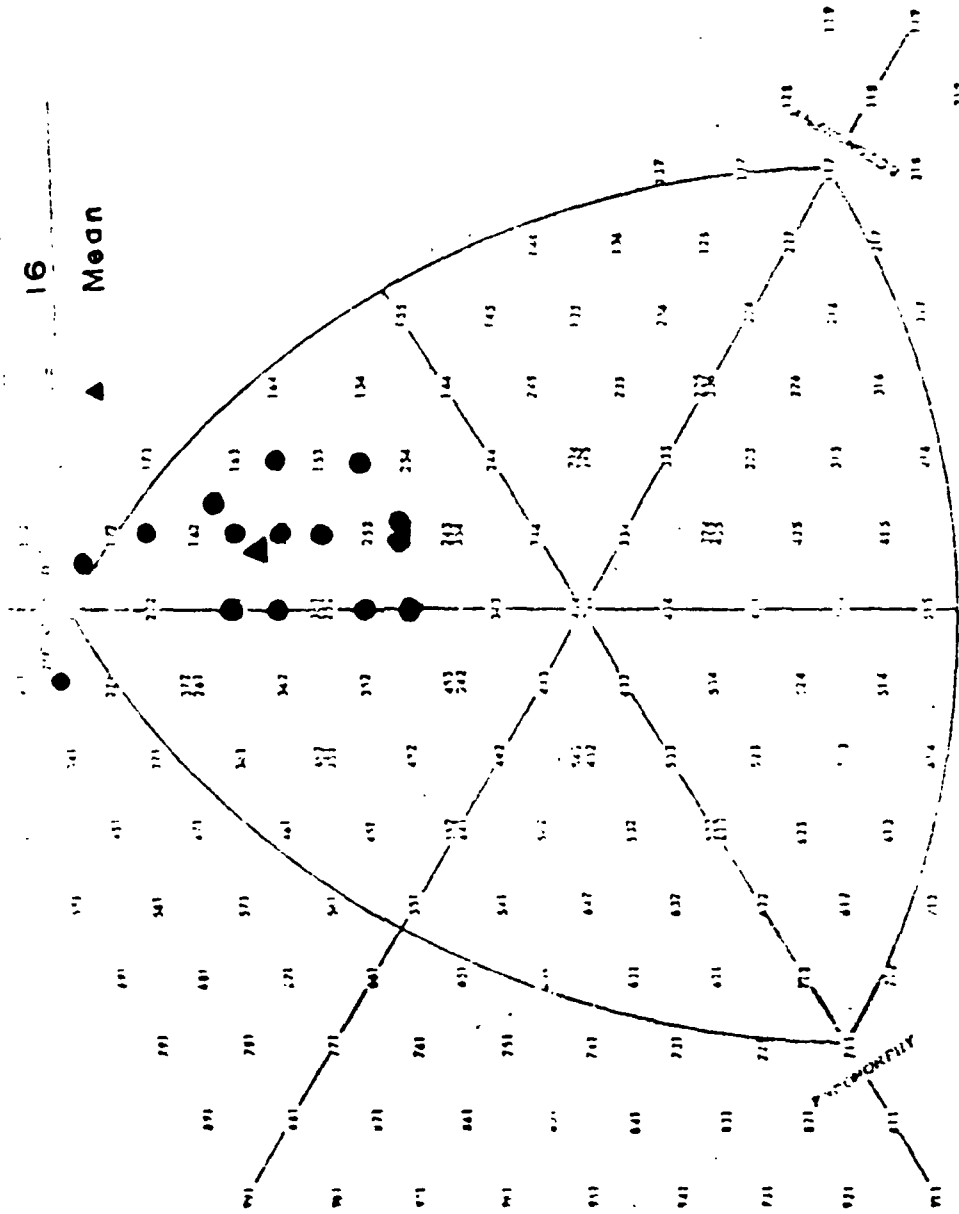


3 MICROSTATE 1007

III
Dist. Players
East Khasi Hills

16

▲ Mean

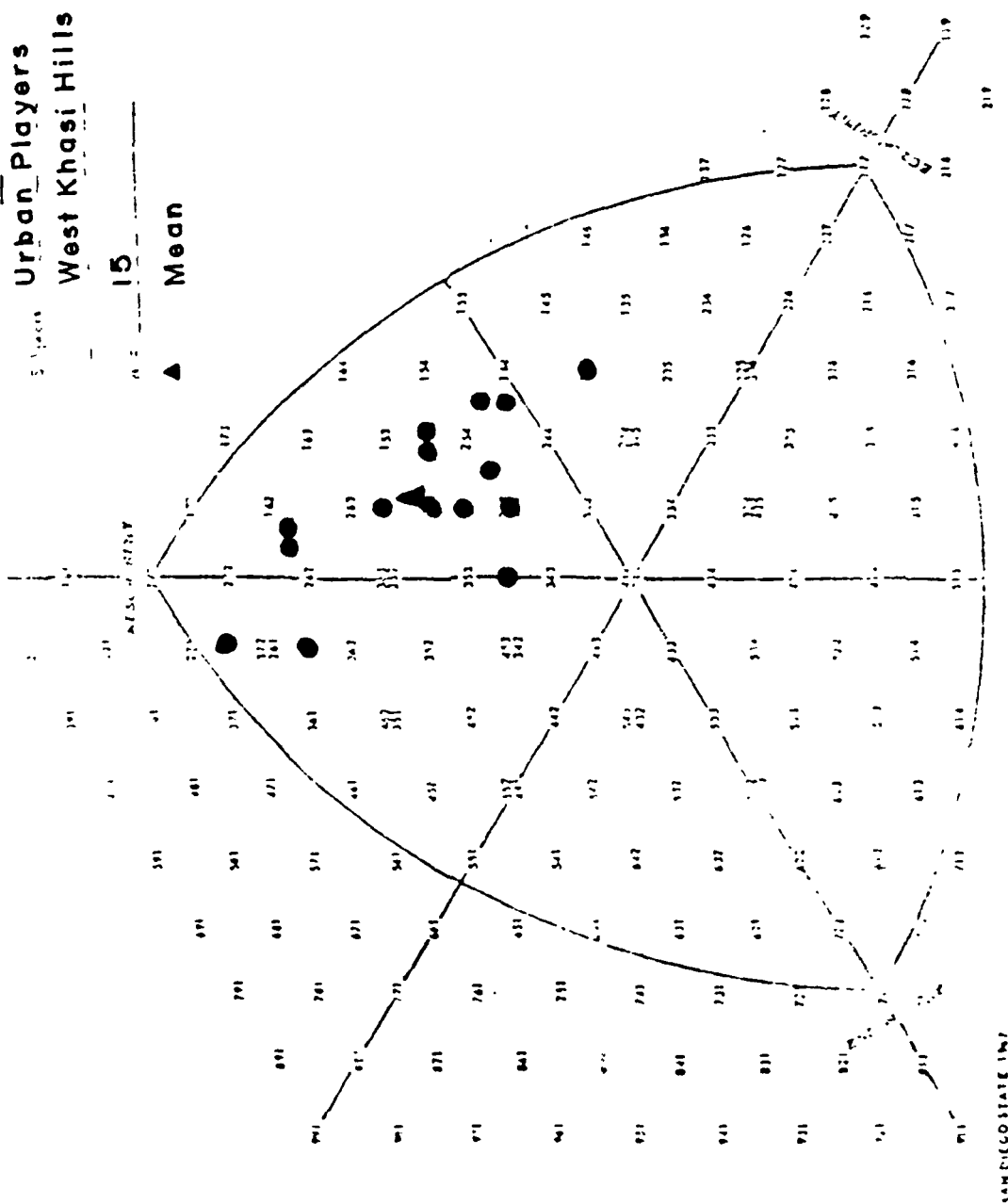


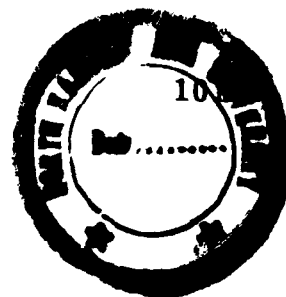
STATE 197

IV
Urban Players
West Khasi Hills

15

▲ Mean

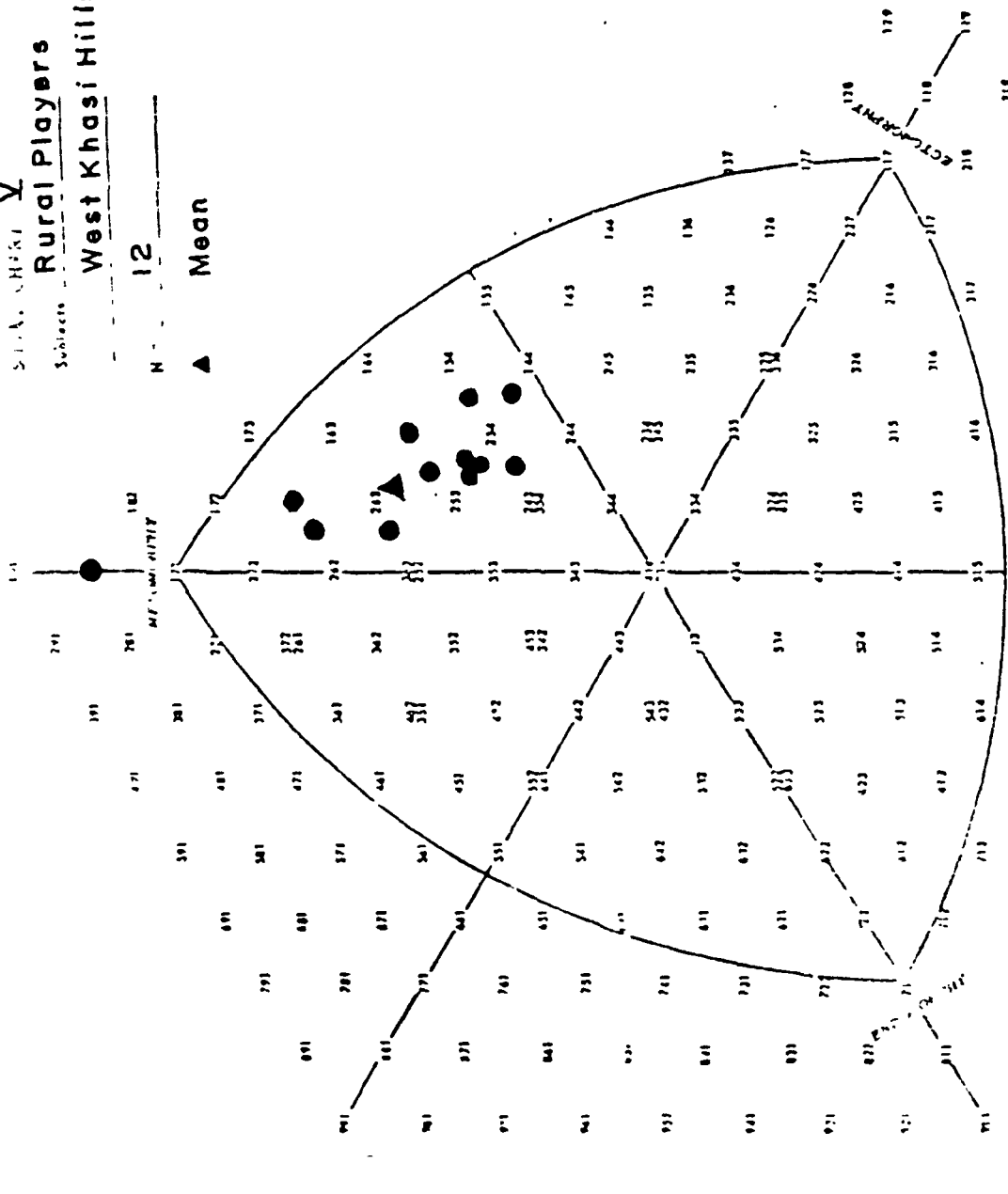




STUDY SERIES V
Rural Players
West Khasi Hills

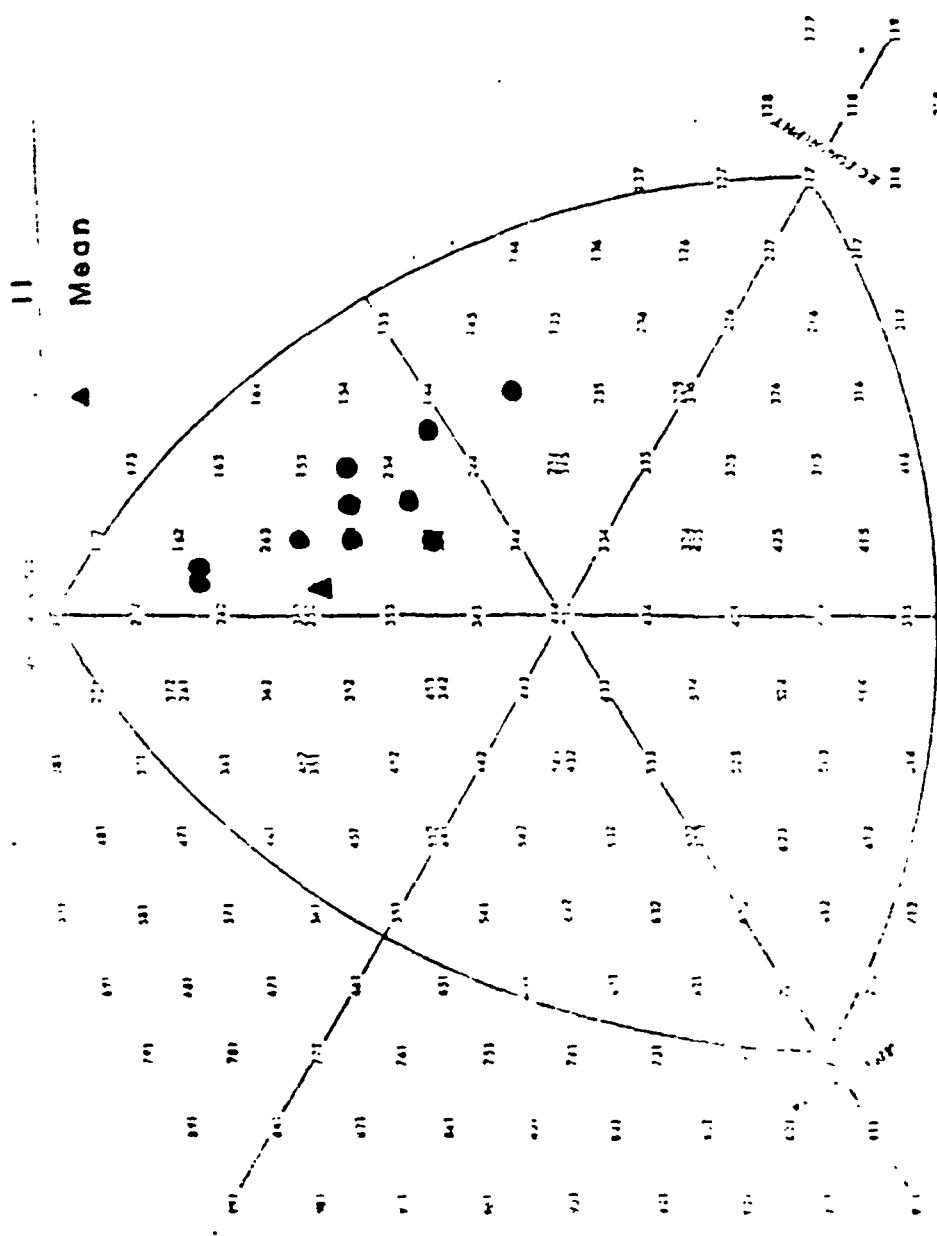
Subjects
 N = 12

▲ Mean



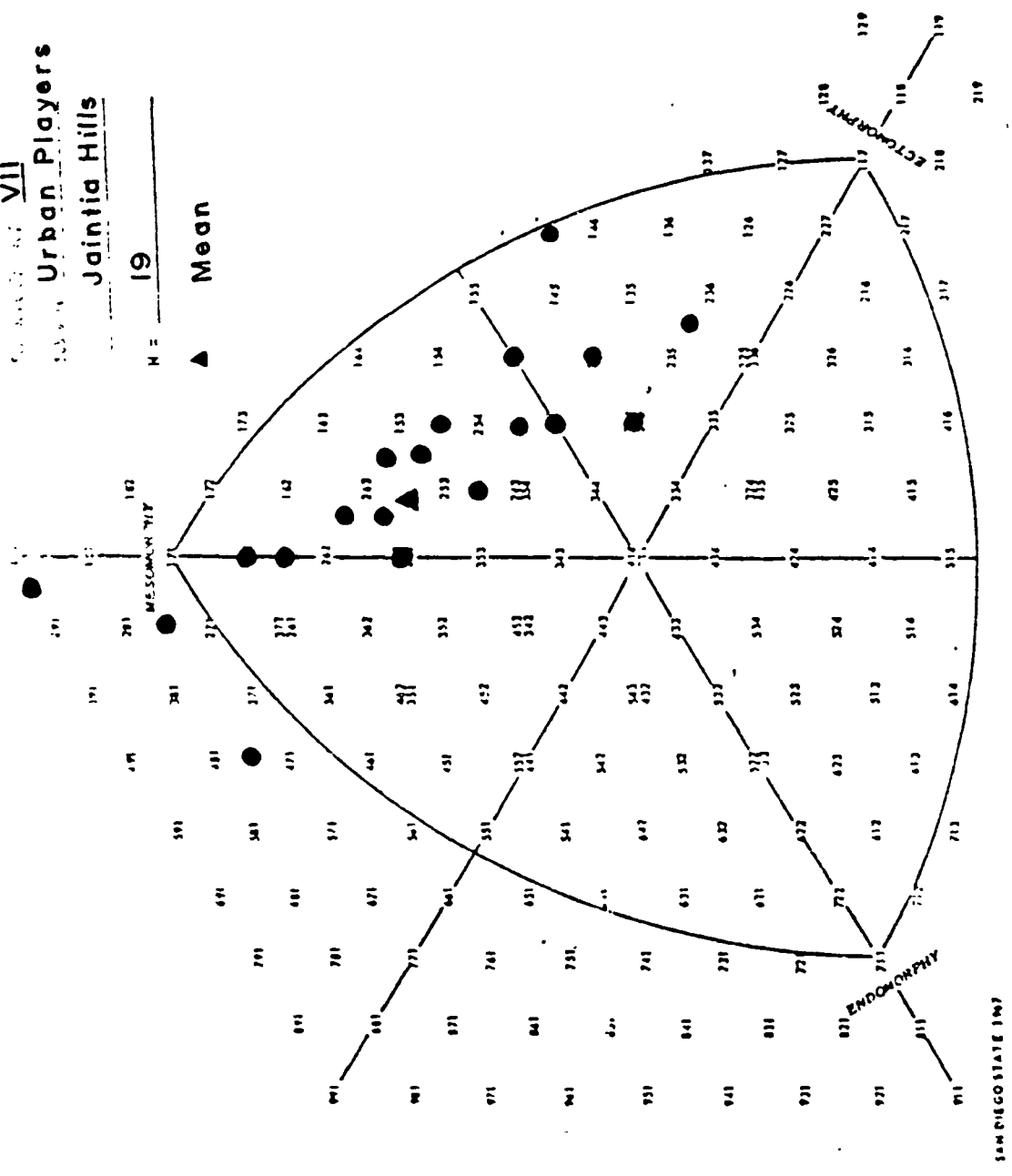
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VI
Dist. Players
West Khasi Hills



Continued on **VII**
Urban Players
Jaintia Hills

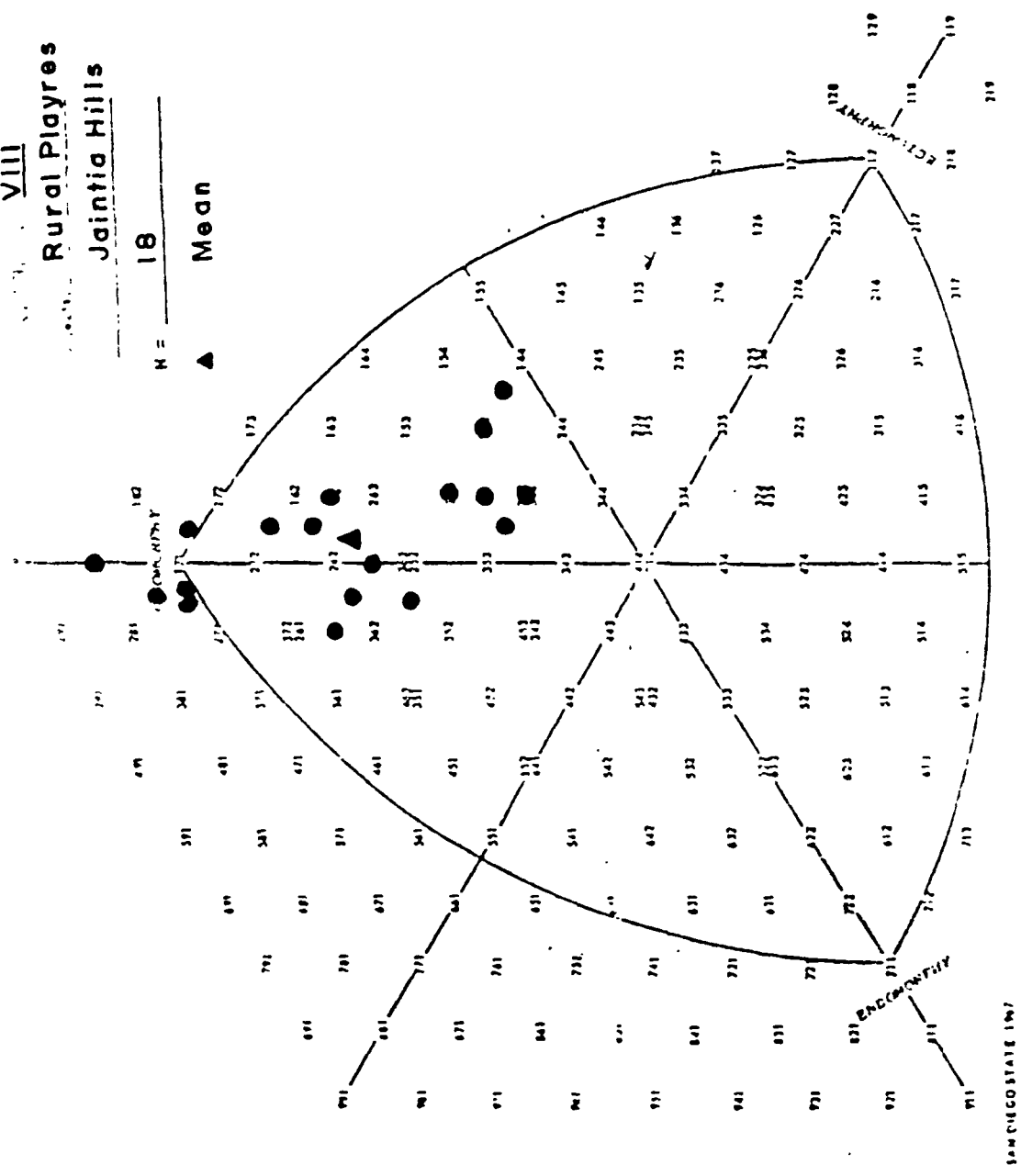
N = 19
 ▲ Mean



197

VIII
Rural Playres
Jaintia Hills

N = 18
▲ Mean

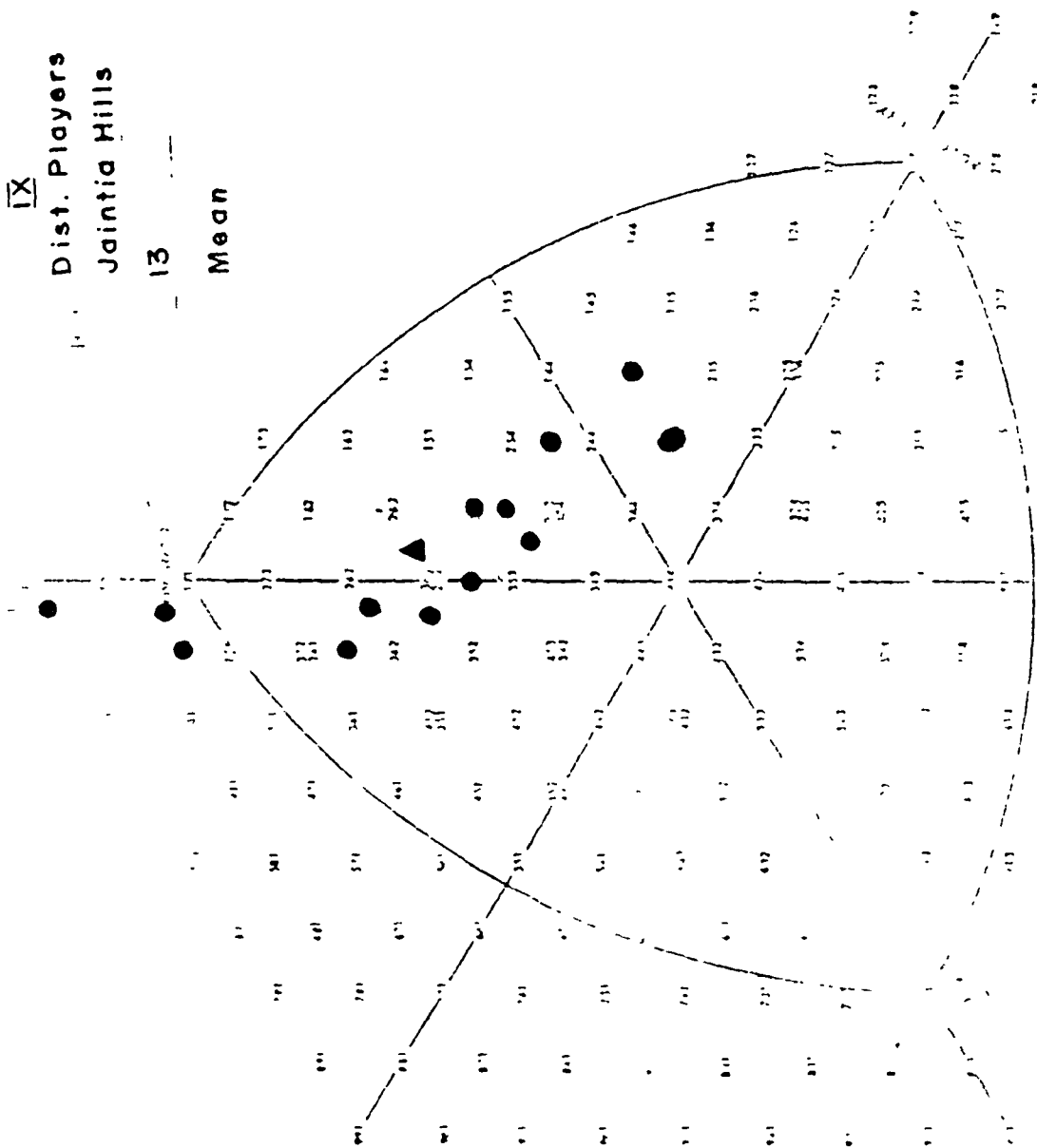


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IX
Dist. Players
Jaintia Hills

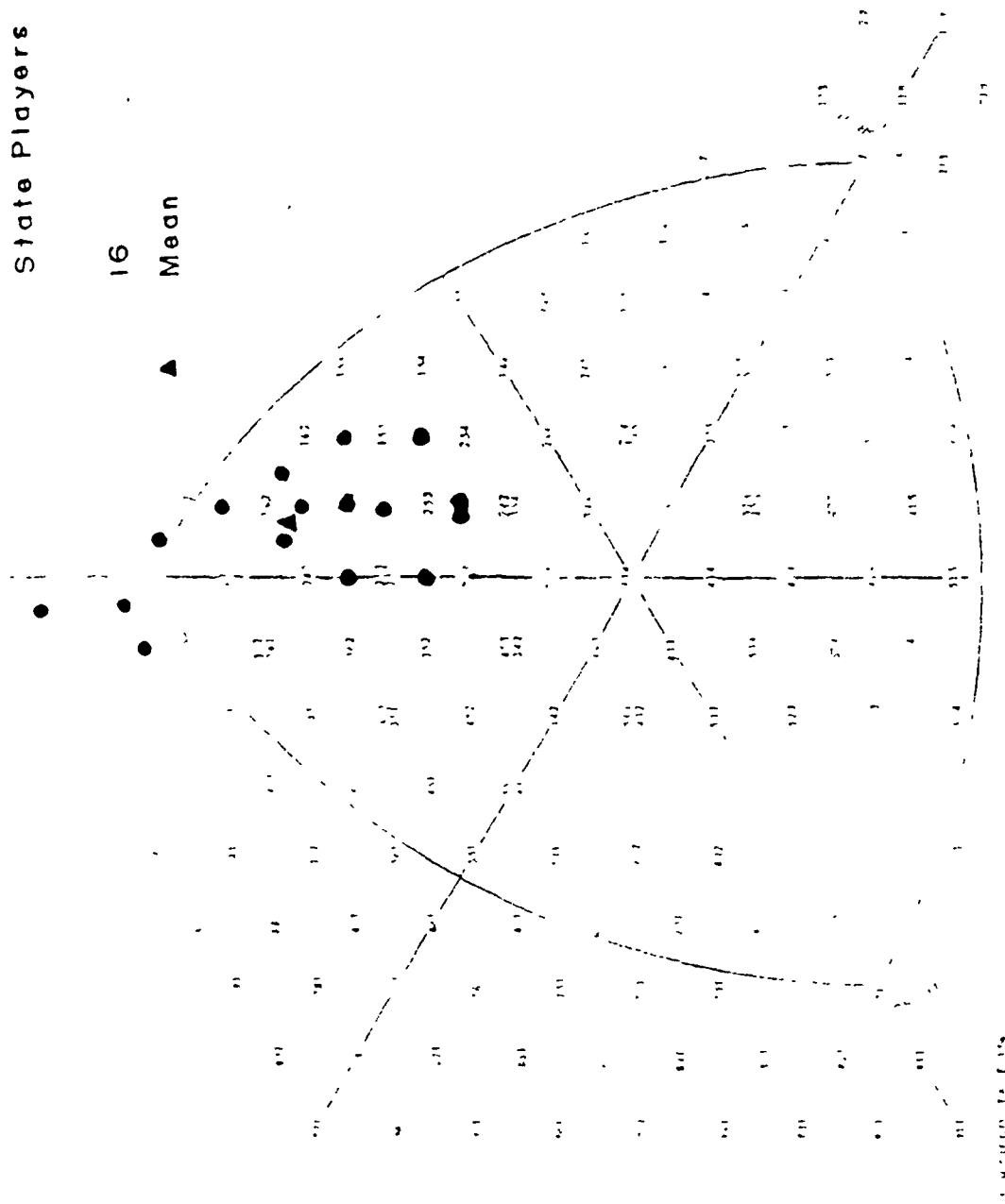
13

Mean

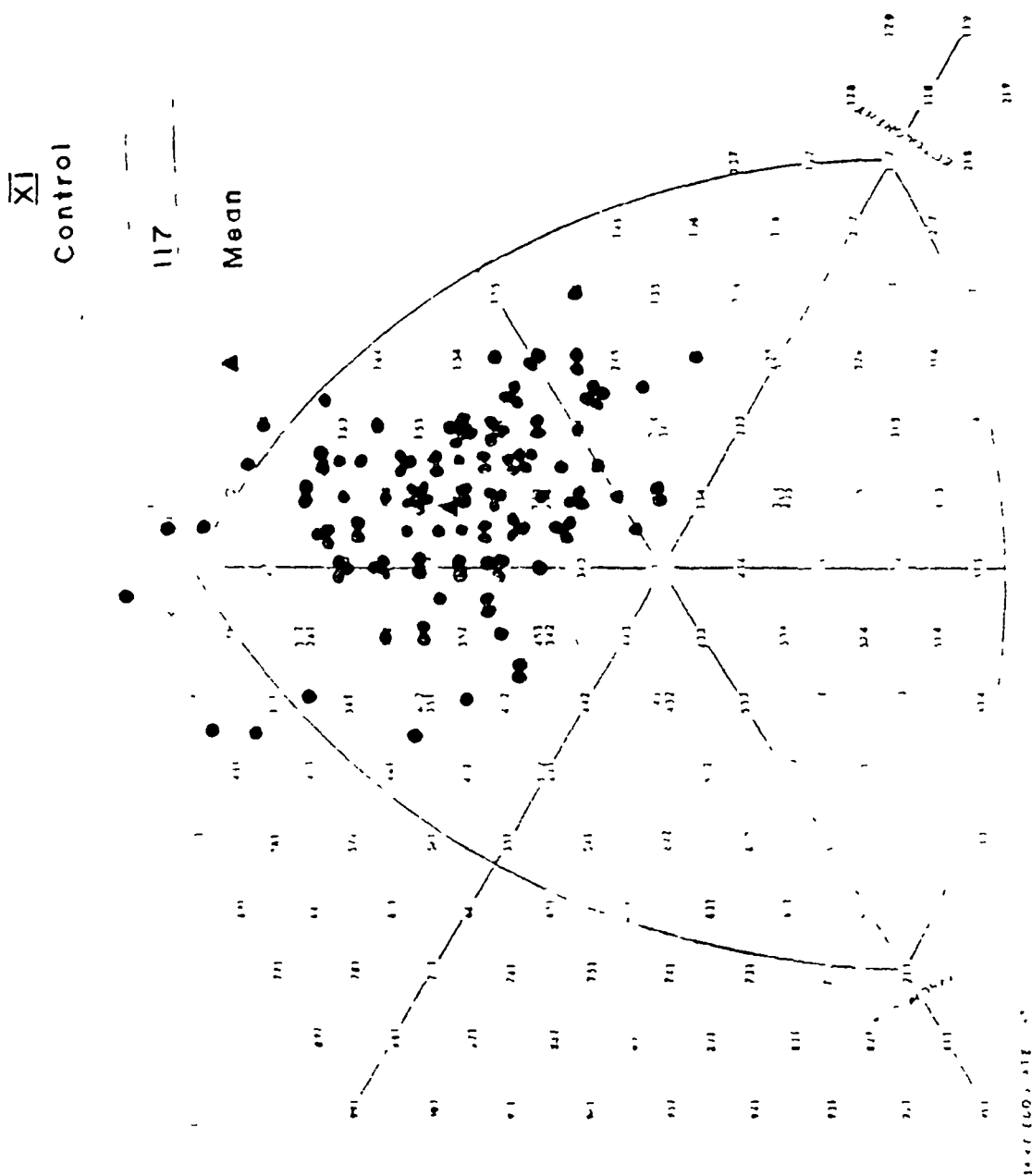


STATISTICAL TABLE 1927

\bar{X}
State Players



PERFORMANCE

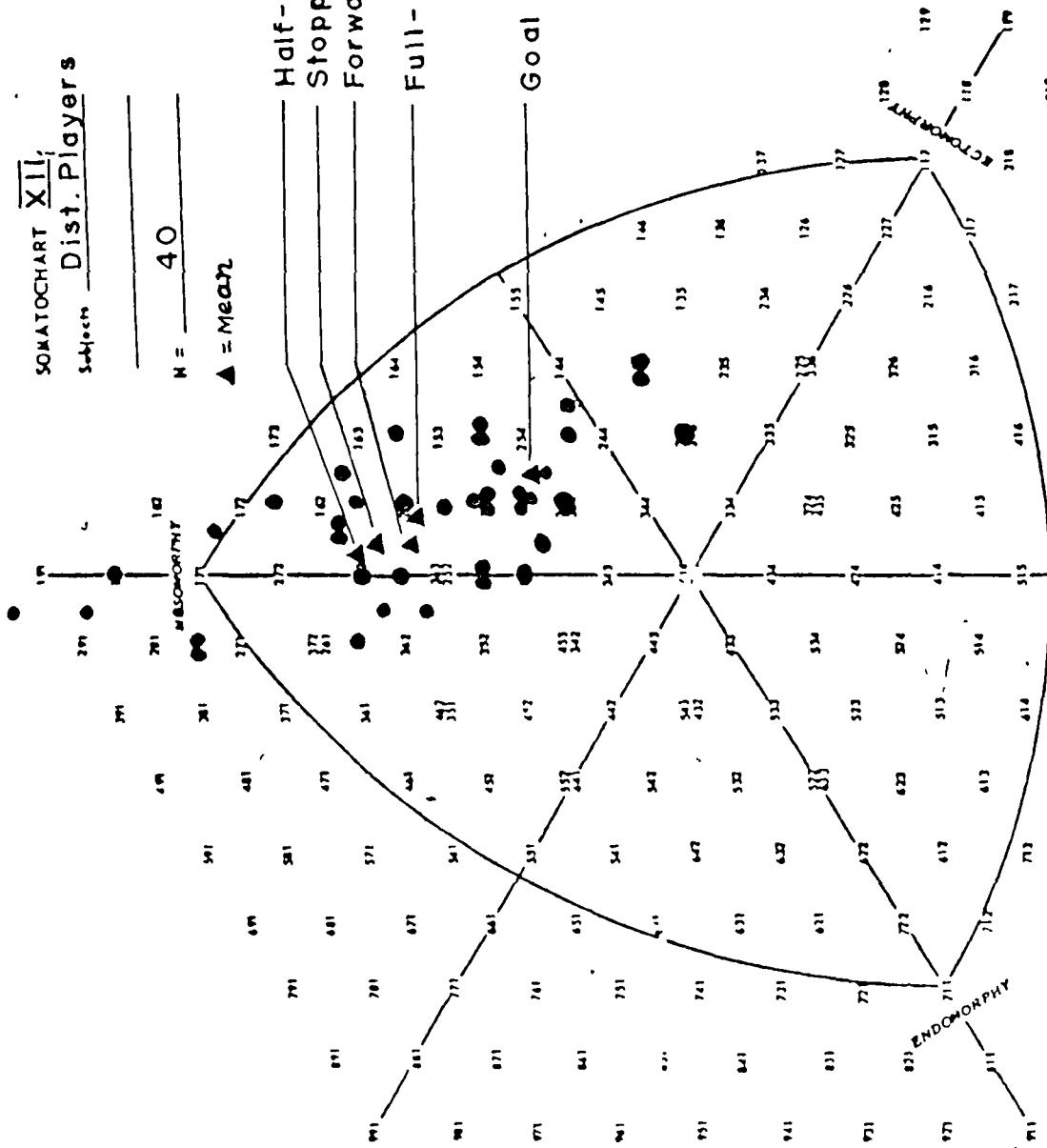


SOMATOCHART XII;
Subjects Dist. Players

N = 40

▲ = Mean

Half-Backs
Stoppers
Forwards
Full-Backs
Goal Keepers



CHAPTER VI

DISCUSSION

In this chapter a comparison of results of the present data on somatotypes with other data available in literature is made. Of course our limitations of such comparisons are, i) very few studies have been conducted on Indian football players, ii) many of these studies do not report 'standard deviations' for different components of physique, iii) many reports have not presented data in relation to the field position of players, and iv) most studies have avoided giving the values for x and y coordinates. Due to the above constraints the comparisons presented here are few; statistical inferences, comparisons according to field positions and plotting of mean somatotypes are limited.

Sodhi and Sidhu (1984) presented the mean somatotypes of State level football players (who undertook a course for coaching in Netaji Subhas National Institute of Sports, Patiala) in relation to the field positions in which they play. The results of this study are compared with the present study (Tables 10, 11). It is clear from the mean somatotype figures that football players of Meghalaya, in four field positions - forwards, halves, backwards, and stoppers are less endomorphic as well as ectomorphic, but more mesomorphic than the State level players studied by Sodhi and Sidhu (1984) all the t-values, for the three components being statistically significant at 1% level. However, though the Meghalaya goal

keepers are less Endomorphic ($t = -5.23$, $p > .01$), they do not reveal statistically significant differences for mean Mesomorphic and Ectomorphic ratings.

Data on All India Police Football players and Inter-University Football players have been presented by Sidhu et al. (1989) and Singh et al. (1987), respectively. It can be seen from Tables 10 and 11 that football players of the present study are less Endomorphic and Ectomorphic, and more Mesomorphic (all t -values show statistically significant differences) than the Police as well as Inter-University players.

A. Sidhu and Wadhan (1974) worked on footballers who were found to be of average height, with larger trunks and smaller lower extremities than the controls. They also had more of lean tissue in the extremities than the latter.

Among the Indian national footballers, the forwards, halves and backs were quite similar to one another and were shorter than the stoppers and goalkeepers (Sodhi and Sidhu, 1984). The forwards and halves in the national level football were bigger than their counterparts in the University level football, but the backs of the former were shorter than those of the latter. The stoppers and goalkeepers in the two groups did not differ appreciably from each other. The forwards

in the University level and national level football had shorter lower extremities in relation to upper extremities. They also possessed broader knees in proportion to elbows.

The stoppers in the national level football had relatively broad shoulders and better developed lean tissue in the thighs. The goalkeepers in the national level football were tall and had proportionately smaller trunks, longer extremities and were lighter in relation to stature, the latter being more lighter than the former in this respect. However, the former possessed proportionately much broader knees than the latter. Apart from this the goal keepers in the university level football were found to have proportionately narrower shoulders, more slender chest and smaller knees and were less Mesomorphic and more Ectomorphic than the goal keepers of the State level football.

The stoppers and the goal keepers in the national level football in India had more lean tissue in limb segments, with broader distal epiphyseal diameters of humerus and femur. It was found that the lean tissue in the limb segments of forwards, halves, and goal keepers was better developed in the national level football players than those of the university level football. The body fat was found to be least in the forwards, maximum in the goal keepers of the national level football players. In the case of the university level

football, both the forwards and the halves had less body fat than the backs and the stoppers. However, in the case of the national level football, the subcutaneous tissue in the limbs was found to be less in the forwards, halves and backs which gradually increased in the stoppers and goal keepers of this group. The chests were bigger relatively to the stature in the case of the players of all fields positions in the national level football than those in the case of the players in the university level football. The hips in relation to stature were broader in the controls. The hips gradually became narrower in the case of the backs, forwards, halves, stoppers and goal keepers. The national level football players, in general, were more mesomorphic and less ectomorphic than the university level football players. Their knees in relation to the elbows were broader in the forwards, halves, backs and stoppers of the national level football than those of the university level football.

All players in University level and national level football possessed better developed lean tissue in the thigh in relation to that in the upper arm and possessed less of body fat than the controls. However, among the players of similar field positions in the two groups, the body fat was considerably greater in the case of the state level football players.

Carter (1972) reported mean somatotypes of American football players of Oregon, San Diego State Team and University of Iowa Team. Since Carter has not given the standard deviations for the mean values of the components, statistical significance between his and present results could not be tested. The American footballers happen to be more Endomorphic and Mesomorphic, but less Ectomorphic than the Meghalaya players (Table 10).

In 1936, Gray carried out a study of 1179 football players in relation to the field positions in which they played. They varied very slightly in their age. The weight increased in successive positions and significantly so, except the guard versus the tackle, the latter being only 1.1 kg heavier. These mean were the heaviest of all groups studied. Stature was also found to increase in successive positions, but not in the same order as weight, the main shift had been for the ends who were lighter than the centres and guards, but taller than centres by only a trifling margin of 3 mm. If weight and height together be taken as a rough criterion of mere physical power, these measurements gave the two tables a very special characterization of the least weight for their height.

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 a 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 (1963) compared 12 year old non-athletes and football players and found no differences between the somatotypes means, but the football players were taller and heavier than the non-athletes.

Heath (1963) somatotyped 66 university football players, using her modification of Sheldon's method. When compared with means for college students rated by Sheldon and others (1940), these football players were approximately one-half unit higher on the first component, one and three quarter units higher on the second component, and one and one quarter units lower on the third component.

An extensive study on college football players including somatotype assessment was carried out by Allen (1965). The mean somatotype of 66 college football players studied by Heath was found to be 3.5-5.5-2 (Carter, 1970).

Carter (1968) worked on 55 college football players and found Parnell's M. 4 phenotypes to be 4.5-5.2-2. He also noticed significant differences between the backs and the linemen.

Carter (1970) rated members of the 1964 San Diego State football team and 20 university of Iowa football players according to the Heath criteria. It appears from his results that preponderance of Endosomorphs is a prerequisite of success in football.

Bell (1973) studied young adult rugby players and notice specific physical characteristics with respects to the field positions of the players.

The somatotypes of football players of present study have been compared with those of Indian and Olympic players of different sports (Table 12). Data on Indian players has been taken from Singh et al. (1987) and Sidhu et al. (1989). Since the values of x and y coordinates were available for Indian players, their mean somatotypes have been plotted in Somatochart XIII. The data on olympic players is taken from Sodhi (1991); mean somatotypes could not be plotted because the values of x and y coordinates of olympic players were not available.

All Indian players of hockey, basketball, throwers,

cyclists, and volleyball, are high on Endomorphy and Ectomorphy, but low on Mesomorphy, when compared with football players of present study. Volleyball players in Endomorphy, throwers in Mesomorphy and Ectomorphy happen to be closest to the three respective components of physique of football players of Meghalaya. When compared with olympic players of hockey, basketball, weight lifting, wrestling, boxing and swimming, the football players of present study are less Endomorphic; however, they are more Mesomorphic than olympic swimmers, hockey and basketball players. Football players of present study are high on Ectomorphy than the olympic weight lifters and wrestlers.

The physique of the olympic players can be assumed to be the most desirable in their respective events. However, almost every time the new records are being set-up and there are reports on mankind getting bigger, larger and maturing faster during the last hundred years or so. Thus, there are probabilities that the most desirable physique of today may not be exactly so in future. However, there cannot be any compromise on muscularity. Judging the football players of present study in the light of the most desirable physique of Indian players, it may be concluded that football players of Meghalaya are more muscular. However, they have to achieve more muscularity, when compared with American football players

and olympic players of other sports, in order to be near the most desirable physique.

It may be emphasized that shape and size are but two determinants of success in a particular sport since performance is determined by the interaction of these variables with psychological status, physiological capacities, technique, skill and socio-economic factors (Jackson et al., 1987). It is also probable that anthropometric limitations are more evident (Stepnicka, 1977) in habitual skills like weight lifting than in perceptual pursuits like field games where the performance requirements are more complex. A man will not be attracted to a particular sport because he has a particular physique, nor that because he succeeds he will necessarily be of a particular physique, for many factors make a 'champion' (Carter, 1970).

Interest in talent search in all sports has dramatically increased in recent years in our country. Talented sportsmen in comparison with less gifted players, do have a greater chance of success, given the same amount of training and coaching. Talent spotting, till recent years in our country was purely based on personal experience and intuition except that a few efforts have been made for talent hunt by the Indian Hockey Federation in 1969, Laxmibai National College of Physical Education, Gwalior, in 1977-78, and at

present by the Sports Authority of India (Mall, 1989). Now-a-days, especially in Eastern Europe, teams of sport scientists, working with the top class coaches, in the concerned sport, single out the basic physical characteristics of body and psychological qualities, which might be the performance-limiting factors for the sport concerned. It is necessary then to find individuals with these attributes and characteristics at the grass-root level, using a series of scientifically prepared tests, having objectivity, reliability and validity.

The search for the identification of young children gifted in sports and games has gained increasing importance over the years as competition at almost all levels has intensified. This has been accompanied by a corresponding increase in the overall quality of sporting performance. It is realized that while genetic predispositions are of importance for a successful sports career, nevertheless studies carried out in many countries have proved that while there are also many parents who had never competed in any sport in their life. In vast countries like India, where climatic conditions vary food habits are different and wide gaps in socio-economic levels exist, the identification and selection of correct material assumes more significance for preparation of elite sports persons (Sports Authority of India, 1990).

In the light of findings of present study and the foregoing discussion following suggestions may be made. i) One of the major applications of somatotyping is to explore age changes in the individual physiques; have 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 survey should be conducted among Khasi-Jaintia children. 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 Intenational level. ii) To bring our players at par with other State, National and International players and improve their performance, arrangements should be made for imparting formal training, adequate and best coaching, proper playinggrounds, complete sports kit for each player, regular scholarships and special diets, and greater exposure to teams at higher competitive levels. Private clubs, business groups, voluntary organizations, etc. along with the Government may sponsor these facilities and activities. iii) All the players should be made aware of the ill effects of smoking, drinking, etc. and follow disciplined schedules and have regular health check-ups.

Table 10 - Mean (+ SD) Somatotype ratings for the three components of physique among Football players.

Players	N	Endomorphy		Mesomorphy		Ectomorphy	
		Mean	SD	Mean	SD	Mean	SD
Football							
Meghalaya (Present Study)							
Forwards	15	1.47	0.44	5.23	1.77	2.23	0.84
Halves	7	1.36	0.38	5.57	1.48	1.64	0.75
Backwards	8	1.44	0.68	5.19	1.44	2.19	0.96
Stoppers	5	1.20	0.27	5.40	1.34	2.00	0.79
Goal Keepers	5	1.50	0.00	4.00	0.94	2.90	0.55
State Level (Sodhi & Sidhu, 1984)							
Forwards	32	2.31	0.75	3.81	0.76	3.31	0.96
Halves	16	2.37	0.87	3.37	0.72	3.53	1.07
Backwards	13	2.42	0.67	3.96	0.90	3.38	0.96
Stoppers	14	2.32	0.77	3.50	0.73	3.57	0.83
Goal Keepers	8	3.12	1.22	3.31	0.53	3.75	0.76
Indian National Police (Sidhu <i>et al.</i> , 1989)							
	9	2.45	0.43	3.23	0.63	2.78	0.75
Inter-University (Singh <i>et al.</i> , 1987)							
	31	3.00	1.27	4.00	0.79	3.00	1.07
Meghalaya (Present Study)							
	40	1.41	0.44	5.15	1.52	2.15	0.86
Oregon (America)							
	66	3.60	-	5.50	-	2.10	-
San Diego (America)							
	35	4.20	-	6.30	-	1.40	-
University of Iowa (America)							
	20	3.20	-	6.20	-	1.60	-

Table 11 - Statistical differences (t-values) for the three components of physique of Football players.

Comparisons	Endomorphy	Mesomorphy	Ectomorphy
1. Meghalaya (Present Study)			
vs.			
State Level (Sodhi & Sidhu, 1984)			
Forwards	-6.98*	+4.12*	-5.40*
Halves	-5.20*	+5.11*	-6.67*
Backwards	-4.41*	+2.99*	-3.79*
Stoppers	-6.40*	+4.43*	-5.73*
Goal Keepers	-5.23*	+2.03	+0.45
2. Meghalaya (Present Study)			
vs.			
Indian National Police (Sidhu <u>et al.</u> , 1989)			
	-9.30*	+8.47*	-3.11*
3. Meghalaya (Present Study)			
vs.			
Inter-University (Singh <u>et al.</u> , 1987)			
	-9.48*	+5.83*	-4.91*

* = $p > .01$

Table 12 - Mean somatotype of Indian and Olympic Sportsmen.

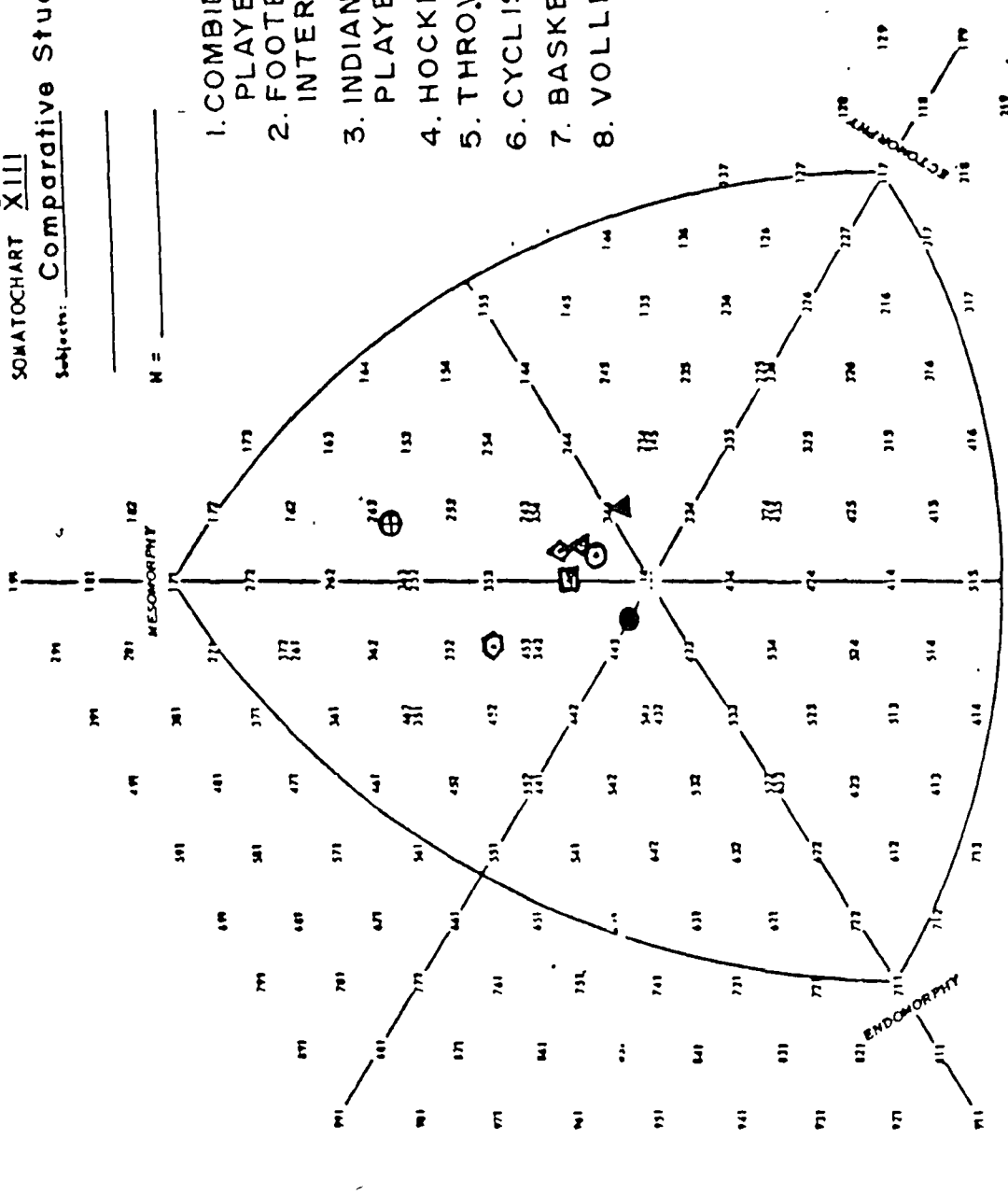
Activity Group	Endomorphy	Mesomorphy	Ectomorphy	Coordinate	
				x	y
Indian					
Football (Present Study)	1.41	5.15	3.15	--	-
Hockey (Singh <u>et al.</u> 1987)	3.50	4.00	3.00	-0.50	1.50
Basketball (")	3.00	4.00	3.50	0.50	1.50
Throwers (")	3.50	5.00	2.50	-1.00	4.00
National Cyclists (")	2.76	3.50	3.21	0.45	1.87
Volley Ball (Sidhu <u>et al.</u> , 1989)	2.40	2.96	3.04	1.00	0.84
Olympic					
Hockey (Sodhi, 1991)	2.50	4.79	2.70	-	-
Basketball (")	2.00	4.30	3.50	-	-
Weight Lifting (")	2.40	7.10	1.00	-	-
Wrestling (")	2.40	6.40	1.60	-	-
Boxing (")	1.90	5.30	2.60	-	-
Swimming (")	2.10	5.00	2.90	-	-

SOMATOCHART XIII

Subjects: Comparative Study

N =

- 1. COMBINED DISTRICT PLAYERS (Present)
- 2. FOOTBALL PLAYERS INTER-UNIVERSITY
- 3. INDIAN NATIONAL POLICE PLAYERS
- 4. HOCKEY
- 5. THROWERS
- 6. CYCLISTS NATIONAL
- 7. BASKET BALL
- 8. VOLLEY BALL



SAN DIEGO STATE 1967

SUMMARY

A study on Somatotypes of Football players of Meghalaya is made with the following objectives:

- i) to report the somatotypes of football players,
- ii) to examine differences in the somatotypes of football players and the general population (or control sample),
- iii) to compare the present data with that reported in the literature, and
- iv) to make suggestions in the light of the above.

The subjects of the present study are Khasi and Jaintia adult men, ranging in age from 18 to 33 years. A total of 143 football players participating at local (urban, rural), District and State level, and 117 control subjects were investigated. The data were collected from East Khasi Hills, West Khasi Hills and Jaintia Hills Districts of Meghalaya. Heath and Carter (1967) Anthropometric Somatotype Method was used. Somatotype categories and mean somatotypes have been calculated and plotted on Somatocharts. Other statistics applied include, Somatotype Dispersion Index, Somatotype Dispersion Distance, Somatotype Attitudinal Distance, percentage frequencies, mean, standard deviation, chi-square, and Student's t-test. The important findings of the present study are as follows.

- i) Football players of Meghalaya are predominantly Ectomorphic-Mesomorph.
- ii) Out of a total of 13 generalized categories of somatypes, they are distributed only among 5 categories.
- iii) On the basis of somatotype categories no significant differences are observed between urban and rural, District and State level players.
- iv) Similarly, Chi-square test does not differentiate the football players from control according to distribution of various somatypes categories.
- v) Statistically significant differences are observed for all the three components of physique between football players and control, on the basis of mean somatotype ratings. The mean somatotype of Meghalaya State level players is 1.28-5.69-1.94, while that of the control sample is 1.55-4.65-2.89.
- vi) The values for Somatotype Dispersion Distance and Somatotype Attitudinal Distance show that football players are quite distant from the control subjects.
- vii) Mean somatypes of players according to their playing position in field reveal significant differences for one or the other of the three components, between Goal keepers and Forwards, Stoppers, Halves and Backs. Goal keepers happen to be the most Endomorphic and Ectomorphic, and the least Mesomorphic of all players.

- viii) A majority of football players of present study have sufficient experience, formal training, and complained of improper playgrounds, lack of sports kit, inadequate coaching, lack of financial assistance, special diet, practicing time, and exposure to better teams at higher levels. Most of the players are habitual smokers and chewers, and indulge in drinking also.
- ix) Players of Meghalaya are more mesomorphic, but less Ectomorphic and Endomorphic than other Indian players of football. Differences in mean somatotypes of players in five field positions are also significant.
- x) American football players are high on Endomorphy and Mesomorphy, but low on Ectomorphy, when compared with players of Meghalaya.
- xi) Indian players of all other sports considered in the present study are more Endomorphic and Ectomorphic, and less Mesomorphic than our football players.
- xii) When compared with Olympic players of various sports, football players of present study are less Endomorphic, but high on Mesomorphy and Ectomorphy than Olympic players of some of the sports.
- xiii) In the light of present study it is suggested that, in order to search talent, extensive somatotype surveys should be conducted among Khasi-Jaintia children.

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