Chapter I

INTRODUCTION

Man has all along been making relentless efforts to equal, break and set new heights with an unquenchable thirst for perfection and excellence and a deep sense of competitive zeal and fervour. The great athletes and performers have always shown disdain for any physical limits with a fervent desire to excel. These men of great sporting acumen have continuously pitted themselves against their rivals and the apparent restraints of their muscles and nerves so as to smash and create one record after another in quick successions. It could then very rightly be stated that the ultimate limits of human performance are rather unpredictable.

Physical activity has been a part of the lives of all people. Human evolution started with movement, and the development of the Homo Sapiens was largely dependent on action of the muscles. It must be conjectured that primitive physical activity was primarily a survival activity—the incessant search for food, clothing, shelter and protection from the hostile environment and secondly, it became a means of preparing youth for adult life, as the games were taken from life's
activities and became a recognized way to improve strength, speed and skill, and other qualities necessary for survival. Physical education and sport provide one of the best means for achieving educational goals not only in the psychomotor but also in the cognitive and affective domains.

Physical activity is an inherent trait of a human being. It develops of its own in a natural way. It becomes all the way imperative to identify the nature and the degree of this natural talent and to nurture, modify and refine it to get the cherished outcomes. The children perform a lot of activities such as running, jumping, throwing, catching, kicking, striking etc. These activities are known as natural or universal skills because they seem common to all the people all over the globe irrespective of geographical, regional, national or racial barriers. These natural abilities ultimately develop into more and more complex and specific sports' skills. The acquisition, modification and perfection of these skills is due to the increased capability of the individual that comes with growth and development. The extent or the degree of these natural traits differs from person to person. These skills combine together and develop into complex forms of highly specified movements obtained through rigorous and strenuous practice and specialized

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training. They lay foundations for the fundamental skills and the ultimate complex sports techniques. Modern sports are the outcome of a long and concerted efforts through improvement, modification and refinement of these simplest forms over the ages. Sports are the higher, complex and well-manned forms of these natural abilities.

Competition is a product of the modern times. It is a challenge which motivates, stimulates and inspires the individual to run faster, jump higher, and throw farther and to strive to do better than before and to exhibit greater strength, endurance and skill to dominate others. In the modern world of sports, the competitors attach greater significance to winning as the philosophy of participation in the field of games and sports has undergone a notable change.

Competition enhances performance and the performance can be achieved, maintained or peaked through competition. Performance is the underlying key-note of all the sports as the sports have become prestigious aspect to prove one's superiority over others.²

Progress and high degree of excellence are the true reflexes of this ever-evolving and charming world of competitive sports. Competition is proving over-demanding and has been thus putting a great deal of pressure on the sportspersons to take sports as a full time business for earning name, fame and the material wealth as well. Competitive sports have catalysed the race for supremacy and excellence. Not to speak of the individual sportspersons or teams but the nations' honour and prestige also finds involvement in the most prestigious and elite international contests or competitions. The coaching as well as the training methods have undergone a sea change in the modern times and the sports scientists, sports psychologists, the coaches and the trainers are preparing the sportspersons on the basis of the scientific principles of coaching and training. This is the very obvious reason why the athletes of today are performing better and still better performance can, of course, be expected from the athletes of tomorrow. It would be better to say that in the modern sports, the slow process of evolution seems to have been overtaken and surpassed by the revolution of scientific methods and the new techniques and tactics in the area.
The process of coaching through constant honing and polishing wears down all the knobs and makes what often seemed like ordinary abilities into a coordinated and smoothly functioning organism. Different and the most sophisticated methods are being employed to coax every centimetre, every fraction of a second, every ounce of energy out of the athlete, who is considered to be machine.\footnote{John T. Powell, "Development of Olympic Athletes," \textit{Olympic Review} 193 (Nov. 1983): 750.}

A sportsperson can perform optimally only when he is in a perfect state of physical, physiological and psychological preparedness for a given competitive event or performance. He must, of course, be fully equipped technically and tactically. Such a performance cannot be expected overnight or all of a sudden. It can only be materialized through long and sustained efforts over the years following unflinching discipline and an unwavering commitment. In this process, the parents, the physical educator, and the coach or trainer have to play a specific role at particular stages in the making of these men of great sporting acumen.
Henry, the pioneer in the field of specificity, established "the theory of specificity" stating that there is a degree of generality and specificity in the performance of motor tasks.\(^5\)

Furthermore, Thirstrup\(^6\), Berger\(^7\), Sandhu\(^8\), Singh\(^9\) and Singh\(^10\) concluded that fitness is specific to the activity or the game. They state that the specific fitness is the key point of success for the sportspersons in the elite competitions. The development of specific fitness requires an appropriate level of motor abilities in relation to the requirement of the game concerned. The limitations of the sports concerned have also to be given consideration while undertaking any fitness or coaching programme.

Physical proficiency is an important area of motor performance. Ability refers to a more general trait of the individual which has been

\(^8\) Gurbaksh Singh Sandhu, *Volleyball Basic and Advanced* (Chandigarh: Publishers of Sports Literature, 1982), pp. 3-5.
inferred from response consistencies on certain kinds of tasks. The abilities are fairly enduring traits, which in the adult, are more difficult to change. Many of these abilities are, of course, themselves a product of learning, and develop at different rates, mainly during childhood and adolescence. Some abilities like colour vision depend more on genetic than learning factors, but most abilities depend on both to some degree. In any case, at a given stage of life, they represent traits which the individual brings with him when he begins to learn a new task. These abilities are related to performances in a variety of human tasks. The individual who has a great many highly developed basic abilities can become proficient at a great variety of specific tasks.\(^\text{11}\)

In the case of motor abilities, individual differences may depend on the sensitivity of sense organs in the muscles and the joints, on the composition of muscular tissue, or on differences in the structure of the central nervous system. Within the boundaries set by heredity, environmental factors and learning play a major role in influencing the ability development. Basic abilities begin to be acquired early in life.

There is a definite sequence of developmental stages in the structural characteristics of the individual.\textsuperscript{12}

Proficiency in any sport requires an ideal integration of numerous abilities developed into an ideal degree. However, performance measures of these abilities do vary from activity to activity. Fleishman identified the dimensions underlying the human performance into the physical proficiency (fitness) area and the psychomotor area. The factors of strength, power, stamina, flexibility, coordination and balance constituted proficiency whereas reaction-time, speed of movement, arm-hand steadiness, visual perception, manual dexterity and rate control were the abilities considered under psychomotor domain.\textsuperscript{13}

Games and sports are the healthy means of recreation and relaxation; effective tools for rehabilitation and social adjustment; foster peace and international goodwill and understanding; serve as preventive and curative measures and above all, sports inculcate healthy spirit with a fervent zeal and desire to compete and excel. Sports serve as a tool for emotional release, affirmation of identity, social control, tool for socialization, social change, development of

\textsuperscript{12} Ibid.

collective conscience and a feeling of success and satisfaction. To win sport is also to win life.\textsuperscript{14}

Sports no longer remain confined to the physical aspect alone for its roots lie tentacled through human anatomy and physiology, exercise physiology, sports biomechanics, sports medicine, sports psychology sports sociology, health education etc. Scientific principles of coaching and training are being applied to the sportspersons right from their early stage onwards to make them explore and realize the otherwise impossible looking possibilities. Such a peak performance can not be thought of under normal or natural circumstances or conditions. The sportspersons are being prepared in a mechanized manner. The concept of optimal physical and motor development (psychomotor) has to be understood by the parents, and the sports specialists concerned.

A physically educated person is one who is a perfect integration of cognitive, affective and psychomotor domains of learning behaviour. Psychomotor domain is perhaps the most important of all these domains so far as the field of physical education, games and sports is concerned. It comprises physical and motor elements, both. Every

human action involves movement of some sort. Movement is an integral feature of a human being and is thus a tool of life. Games and sports is a science of perfect, deliberate and desirable movements. Movement is the fundamental feature of games and sports. Motor performance depends on the physical components like strength, speed, power, agility, endurance, balance, flexibility, kinesthetic sense and the coordinative abilities.\textsuperscript{15}

Psychomotor variables act as the medium for the realization of cognitive and affective domains of learning and motor behaviour. All these domains of learning are inseparable identities and work in perfect harmony and unison with one another. The psychomotor variables are primarily concerned with muscular contraction. Performance of motor skills involves neural, physiological and psychological aspects and is a continuum that runs the gamut from physical to cognitive and there is always an integration between these aspects of human behaviour.\textsuperscript{16}

Psychomotor movement is a complex quality and is influenced by the physical performance factors which underlie the action of all movements. These factors comprise speed, power, strength, reaction


\textsuperscript{16} Ibid.
time, speed of movement, agility, flexibility, balance, kinesthetic perception, coordinative abilities and the like. This psychomotor movement can be restricted or enhanced by certain structural factors encompassing height, weight, body type, structure and posture. These physical performance factors are effective in the enhancement of psychomotor performance of the sportspersons.17

Psychomotor elements exercise a great control and influence over performance in sports. Total fitness of the performers is of utmost importance in order to get optimal performance at the prestigious sports competitions at the international level. Fitness of the players has become a very complex but soughtafter proposition for the very obvious reasons. We do see and find nowadays that the winners and the runners-up are adjudged by the slightest difference of mere fractions of a second. Fitness is a product of exercise and training. The perfect and harmonious integration of various psychomotor, physiological, emotional and social attributes accounts for the total fitness of an individual and forms the basis for maximal performance. All these components of total fitness are mutually interdependent and are required in different measures or proportions according to the type and

nature of the activity or sport being undertaken. Psychomotor fitness of an individual is a perfect blending of physical as well as motor fitness and goes a long way in yielding the excellent outcomes. The nations exhibiting excellence in the international sports do attach great significance to the total fitness level of their players. Different sports activities call for different levels of fitness. The level of fitness varies depending upon the level of competition as well. Participation in the top-notch competitive volleyball requires the player to be in a state of optimum fitness.

Volleyball is one of the most exciting and spectacular games in the world. The modern game of volleyball has evolved from a recreational pastime invented in 1895 by William G. Morgan, the physical education director of the Youngmen's Christian Association (YMCA) gymnasium at Holyoke, Massachusetts USA. Like all great games, the dramatic rise in the popularity of the game lies in its essential simplicity for this is the game suitable for the people of all age groups, genders and can be played indoors and outdoors.

There are 210 national federations in the International Volleyball Federation (Fédération Internationale de Volleyball, FIVB), the

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international governing body for the sport, which is located in Lausanne, Switzerland. The International Volleyball Federation was organized in 1947. Indoor volleyball was introduced in the Pan American Games in 1955 and was introduced in the Olympic Games in 1964 at Tokyo where volleyball made its debut as an Olympic sport. Beach Volleyball debuted as a medal sport at the 1996 Olympics in Atlanta, Georgia, USA. Junior Olympic Volleyball for players 18 years of age and younger, was established in 1977.\textsuperscript{19}

Volleyball became part of the Asian Games for the first time in the men’s section only in the Third Asian Games held in 1958 at Tokyo, in Japan.\textsuperscript{20}

Volleyball is a game in the true sense of the word. The players having specific responsibilities have to manoeuvre a definite, planned and strategic offensive and defensive pattern. Each defensive move depends upon a good pass from the service or spike, a good set, a well-timed and perfectly executed spike. The failure of any one of these players does affect the others and gives the opposition an opportunity to

\textsuperscript{19} Microsoft (R) Encarta (R) Encyclopedia 2000 (C) 1993-1999 Microsoft Corporation
take the offensive with little difficulty. Spike is playing a key role in the volleyball game. The effective spike is not only deterrent to opponent, but also a major means of scoring for home team. The spiker is a spectacular hitter. In volleyball, as also in other games, the weak player remains the main target by the opponents, and his team-mates cannot camouflage him. Each player has a designated assignment in a team for spiking, setting, passing or serving. Each court position carries with it a specific offensive and defensive responsibility. A well-trained player knows where he is to be in a particular situation. His movements are useful and he always keeps his eye on the ball during play. Volleyball is played with more precision and accuracy, more strategy, more advanced techniques and tactics, and more power these days.

Each of the wide variety of the techniques in this game has its different physical requirements. As a consequence the player must work on a wide ranging programme designated to improve his strength, muscular endurance, cardio-vascular efficiency, flexibility and agility. Volleying requires strength of fingers and wrists, blocking and smashing, the ability to jump high enough to contact the ball when it is above the net height etc. Improvement in the physical performance
above the minimum level in all cases leads to improved technical performance.\textsuperscript{21}

"The competitive volleyball is a techno-tactical sport" (Matsudaira).\textsuperscript{22} The requirement of the performance in this sport is the development of high degree of conditional and coordinative abilities. Therefore, the factors like power, speed, endurance, agility and flexibility must be measured (Hornak).\textsuperscript{23}

Modern volleyball is a game of power and tactics but the success does not accrue from power alone but is rather a display of power, absolute alertness, shrewdness and playing ability. The game nowadays is characterized by a high degree of precision, accuracy and differentiation coupled with absolute self-control and a great deal of movement and concentration. The speed of the game means that the player must be thinking about the attack at the one moment and the defence at the very next moment or of both at the same time. Playing tactics including tactical formations, moves, substitutions, use of time-

outs and the libero, team line-ups, positional and rotational orders, and a lot more intricacies of the game carry urgent significance and do affect the outcome of the game.

For the spectator, the game is fast and full of contrasting action, from the power of the spike to the agile recovery shots in the backcourt. The small playing area concentrates the action so that the spectators have a clear view of the game all the time.²⁴

The skills in volleyball are relatively more significant than the level of fitness. But it does not mean, at all, that a low level of fitness will ever do for this game. A high level of fitness delays the onset of fatigue and thus enables the player to maintain his level of skill for a longer duration to get the best out of him. It is a very brisk and dynamic game and requires long practice sessions for cardio-respiratory and muscular endurance.

Emphasizing the requirements of a volleyball player, Matsudaira, once Japan's national team coach said, "I would like to be able to select a team who has the individual skills of the Czechoslovakian team, power of the Soviet team, the ability and team play of the Japanese

team, the jumping ability of the Cuban team and the competitive and fighting spirit of the Korean team."

Volleyball requires a high degree of running manoeuvrability and total body agility so that the player is able to gain good court positions on both the offensive and defensive manoeuvres. Fast acceleration is also required to be able to sprint to the advantageous positions while making attacks and counter-attacks (Sandhu).²⁵ Even more important is to lift the spiked ball and drops by diving and rolling and again making quick recovery for further defence or offense.

Training and coaching in volleyball has assumed a scientific character. Inventions and innovations in the methodology of training have transformed the character of the game to a considerable extent. As far as the research work in this field in India is concerned, the number of studies undertaken is insufficient and unsatisfying. A lot more needs to be done to explore the possibilities of bettering the prospects and the future of this game in India. Till date, the fate and the state of volleyball is rather dismal and disheartening although some flashes of good performance by the Indian volleyballers in the fifties and

the sixties have been reported in the literature (Singh 1973; Singh 1974; Uppal 1974; Joseph 1983; John 1984).

Nicholls\textsuperscript{26} recommends power, agility, coordination, flexibility, muscular and cardio-respiratory endurance and concentration as well as quick thinking and reaction time as the primary factors for better performance in the game of volleyball.

The main emphasis, in the modern volleyball, is being given on 'block' wherein single or multiple blocks are usually being employed. The players over two metres height find selection. It further necessitates the spikers to have similar physical characteristics as well as tremendous amount of jumping ability to outclass the blockers in the actual game situations.\textsuperscript{27}

The studies on the morphological aspects of volleyballers have revealed that the body mass and height of the players bear high relationship. A study on the Western Australian Men and Women volleyball players has found out that performance in this game betters with an increase in height and body musculature. The height of a

\textsuperscript{26} Nicholls, Modern Volleyball, pp 220-227.
\textsuperscript{27} Mariana Fiedler et.al. Volleyball (G.D.R.: German College for Physical Culture, 1979), p.39.
volleyball player has been considered as the most important pre-requisite and positive pre-disposition for better performance.\textsuperscript{28, 29}

A vital part of the volleyball offense is the spike, a powerful smash over the net. An outstanding volleyball player will be effective in spiking by jumping high up in the air, using perfect timing in hitting the ball powerfully and placing it so that it is very or almost difficult to return. Sometimes, a tip, a placement, is a lightly hit ball deflected or dropped into the court of the opponents and is used by the spiker to surprise the opposing blockers when they anticipate a spike and are up against the spiker.

A good spiker must also be strong in defense. He must be tall, fit and capable of making a explosive spring. Power of legs (thighs) decide a good jump during spiking and power of the shoulders and the arms give enough force to 'kill the ball'. The ingredients of volleyballers are power, speed, judgement of distance and space, concentration training, agility, flexibility, peripheral vision and ability to remain high-up


for a sufficiently longer duration. Quickness is of imperative significance both in attack and defence.\textsuperscript{30}

The physical abilities found to be superior and of great relevance in the top-class volleyballers include jumping ability, strength, reaction-time and the ability to make lateral movements.\textsuperscript{31} The physiological responses and the requirements of volleyballers are similar to most team sports which lay a primary emphasis on arm and leg power particularly for the spikers and the blockers. Quickness results from the complex combination of the body, eye-hand coordination and visual judgement and perception.

Explosive strength is of paramount significance in volleyball performance. Flexibility is necessary for better adjustment to different positional requirements. Quick and accurate responses to various stimuli are of vital importance. Men's volleyball usually emphasizes more power or explosive type of participation.

Explosive strength is an urgent factor accountable for physical proficiency of an individual. It emphasizes the ability to exert maximum


energy in one explosive act. It has been termed as 'energy mobilization' or power or velocity in some of the studies. Tests of this factor include standing broad jump, vertical jump, and medicine ball put. The common feature of the tests of explosive strength is that one is required to jump, or to project oneself, or to project some object, as far or as high as possible. This factor appears distinguished from other strength factors in requiring one short burst of effort, rather than the continuous stress or repeated execution.\textsuperscript{32}

The game of volleyball is a combination of aerobic as well as anaerobic endurance. The continuous rallies and explosive jumps for spiking and block jumps for offense and defence over a considerable duration demand for aerobic endurance. Besides this, the game of volleyball requires explosive jumping ability.

Speed of movement is another important feature of any game. In the game of volleyball, the speed with which the spiker kills the ball and the quickness of the defending player in retrieving the ball with a dive or a roll are of great significance. Speed of response of the body as a whole or as a part is important in a variety of performances. It

determines how quickly a performer can respond completely and quickly to a given situation. Speed of movement of the hands is of specific importance in the game of volleyball. A player having poor speed of movement is unable to meet the spiked or dropped ball. Speed of movement also contributes to spiking and serving.

Flexibility is also one of the important psychomotor variables that contributes much to the game of volleyball. The flexion of the wrist during spiking and dodging the blocker and in serving and handling the ball with ease and perfection plays a dominant role. Wrist extension also contributes to an overhead pass. The hyperextension of the trunk increases the rate of movement which develops the linear velocity for powerful and effective spiking.

Strength is another fundamental psychomotor variable required for excellence in volleyball. Strength of arms and abdominal muscles in diving, rolling, blocking and even in serving; the strength of legs (specifically thighs) during repeated thrusts in spiking and blocking, and back strength during spiking plays a key role in shaping the outcome of this game. The specific strength of fingers, wrists and shoulders is also very important during upperhand pass, service and spiking. The strength of the extremities is most important for jumping ability. A player
lacking a requisite level of this psychomotor factor cannot keep pace with the modern standards of volleyball.

Response time or performance time as a component of motor ability or motor fitness bears great relevance to the game of volleyball as the players have to respond to the visual as well as the auditory stimuli or signals during the game situations. Reaction time is the delay in time between the presentation of a stimulus and the initiation of a volitional response. Movement time is the time taken to complete a task after it has been initiated. Response time or the performance time is the sum of the reaction time and the movement time. The relationship of reaction time and movement time to response is as shown in the Fig.1.

Response time or performance time is the soul criterion in some sports and is one of the most important factors in others. It is quite obvious that the performer who can move faster has the advantage. However, when the time of the event or task is relatively short, reaction time becomes a major factor. Reaction time is affected by a number of stimulus variables and individual variables. Stimulus variables include

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33 Phillips and Hornak, Measurement and Evaluation in Physical Education, p 262.
Fig. 1. Relationship between Reaction Time & Movement Time with Response Time / Performance Time
mode of stimulus, stimulus intensity, the presence or absence of forewarning cues, and the complexity of the stimulus or response. Individual variables include motivation, fitness, amount of practice, as well as the sex and age of the subject, and the limbs used.

Movement time is affected by the same individual variables. However, the major components of movement time are muscular efficiency, strength and endurance. Research studies have shown that significant gains can be realized in movement time through practice.

Practically speaking, the total performance or response time is the most important. Even though each performance can be broken down into reaction time and movement time but it is the combination of reaction time and movement time in each physical performance that is the ultimate indicator of success or failure.

Agility is very important ability and plays a very significant role in the game of volleyball. Quick starts and stops, rapid changes of direction and efficient foot-work are essential for successful performance. Agility is usually considered as a component of general motor ability and motor fitness. Agility tests are not only used as a component of general motor ability and motor fitness but also, as a
predictor of success in various sports activities and as a means of classifying students for activity. The game of volleyball calls for a high degree of agility on the part of the volleyball players to meet the situations on the court effectively.

Kinesthetic perception is still another very important rather key factor involved in learning specific skills. Kinesthetic sense or perception bears a deep relevance to the game of volleyball. It is the sense that gives an individual the awareness of the body parts or body as a whole through the space. This sense works without any audio or visual aid or perception. It is because of the proprioceptors like golgi bodies, tendons, ligaments, muscle fasciae and vestibular system present which provide feedback mechanism for making various movements with varying degrees of accuracy and positioning of the body or body parts as it moves into space.

Kinesthetic sense is used by both the beginners and the skilled performers. It is a consciousness of muscular movement, effort, and joint angulations, which are easily evident in the skilled performers. The
research has shown that the proprioceptors provide the feedback that aids future performances of a similar nature.\textsuperscript{34}

Tests of kinesthetic sense are used for various purposes. Primarily, a test of this sense requires the performer to execute a movement without the use of a typical visual or augmented feedback. Therefore, such tests are used to make the performer concentrate on what it feels like to perform a task. All tests of kinesthetic sense should have similar administrative components. Each performer is blindfolded and executes a series of trials on the specific test without any feedback between the trials. Limited initial practice on the movement should be allowed before the kinesthetic trials are taken. Either the sum of deviations from the criterion or the mean absolute deviation is used on the score.

Kinesthetic information is seldom acted on by the central nervous system in isolation; rather it acts in combination with information being provided simultaneously from other sensory systems. It is debatable as to whether or not kinesthesia can be improved with practice. Kinesthesia can be affected by heavy fatigue and muscular tension.

\textsuperscript{34} Ibd., pp. 252-253.
Various forms of motivational stimuli do not seem to improve kinesthetic perception.\footnote{35}

Scott (1955) and Wiebe (1954)\footnote{36} instigated a series of investigations relating to kinesthesia. The research led to several significant conclusions regarding kinesthesia. First, there is no general kinesthetic sense. Scott's study included 28 separate tests while Diebe used 21 tests. The low intercorrelations between tests shed light on the specificity of kinesthesia. Second, skilled performers usually perform better on selected tests of kinesthetic sense than do average or poorly skilled individuals. Therefore, it seems that kinesthesia can be developed and is a function of amount of practice. Finally, skilled performers depend on internal kinesthetic information than do the beginners.

In endurance sports, coordinative abilities ensure higher movement efficiency and movement economy, whereas in sprint events they facilitate a movement frequency with high explosiveness and force application. In strength dominating sports, they help in the application of short time maximum strength at the right time. In technique

\footnote{36 Phillips and Hornak, \textit{Measurement and Evaluation in Physical Education}, p. 253.}
dominated sports, coordinative abilities contribute towards better learning, stabilization with variability and the automatization of the technique which determines the maximum limits for performance improvement, whereas in team games, coordinative abilities ensure an effective use of technique and tactical abilities in the continuously changing situations.\(^{37}\)

The coordinative abilities have been considered as the performance prerequisites for any sort of playing ability. They are primarily dependent upon the processes of movement control and regulation. The coordinative abilities in sports activities do always appear in combination with one another and do not exist alone. These are important for acquiring the sports techniques, their continuous refinement and modification. The coordinative abilities encompass orientation ability, differentiation ability, balance ability, rhythm ability, coupling ability, adaptation ability and the reaction ability.\(^{38}\)

The theory of motor coordination is the basis for understanding the nature of coordinative abilities (Blume 1978, Meinel and Schnabel


Motor Coordination is a part and parcel of action regulation. Coordination abilities have also important and strong links with the motor skills as the motor coordination forms the basis of both. On the basis of the proposed definitions of Zimmermann (1983), Hertz (1985), Harre (1986), and Meinel and Schnabel 1987, the coordinative abilities are defined as "the relatively stabilized and generalized patterns of motor control and regulation processes. These abilities enable the sportsperson do a group or set of movements with better quality and effect."^39

It has been observed that the performance of the Indian volleyball team is comparatively very poor at the international level. Indian volleyball falls too short of the Olympic standards both in terms of fitness level and the technical and tactical parameters. Even at the Asian level, India stands no challenge to the countries like Japan, Korea and China. It is very strange rather unfortunate and a matter of grave concern and serious challenge to the sports-scientists and the coaches in volleyball and the physical educators. Sincere endeavour and commitment both on the part of the government and the experts in the field would go a long way in bettering the prospects and future of

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^39 Ibid.
volleyball in India. Though efforts are being made to make up and improve the standard of this game but very little success seems to have been achieved in this regard so far.

In the light of the review of the various research studies of the related literature, which are, in fact, very few, the picture seems to be bleak and indistinct. The findings of the various research investigations undertaken in this regard do reveal that various physical as well as motor ability factors do bear a very high degree of relationship with playing ability in volleyball whereas there are certain other studies as well which do indicate nearly or altogether contradictory results.

**Statement of the Problem**

The purpose of this research work was to investigate the relationship between selected psychomotor variables and coordinative abilities to playing ability in volleyball.

**Delimitations**

1. The research work was delimited to the junior level male national volleyball players of J & K.
2. The study was further delimited to the following psychomotor variables and coordinative abilities.

**Psychomotor Variables**

a) Explosive Power  
b) Speed of Movement  
c) Response Time  
d) Agility  
e) Kinesthetic Perception  
f) Flexibility

**Coordinative Abilities**  
a) Orientation Ability  
b) Differentiation Ability  
c) Balance Ability  
d) Rhythm Ability  
e) Reaction Ability

**Limitations**

The study was limited to the subjects from the Jammu region of J & K State alone.
Hypothesis

It was hypothesised that volleyball playing ability will be significantly related to psychomotor variables and coordinative abilities and that it will be possible to predict volleyball playing ability based on psychomotor variables and coordinative abilities with the help of prediction equations.

Definition and Explanation of Terms

Psychomotor

Activities that are primarily movement-oriented and emphasize over physical response are termed as psychomotor.\(^{40}\)

According to Barrow and McGee, the term 'psychomotor\(^{41}\) means an "observable voluntary human movement," and 'variables\(^{42}\) as "the traits or factors that change from one case or condition to another; the representatives of the traits, usually in quantitative form, such as a measurement or enumeration."

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\(^{42}\) Ibid., p. 578.
Psychomotor domain or area encompasses reflex movements, basic fundamental movements, perceptual abilities, physical abilities skilled movements and non-discursive movements.\textsuperscript{43}

Psychomotor variables bear direct association with muscular action or motor skill, some manipulation of materials and objects and some act requiring neuromuscular coordination.

Definition by Barrow and McGee finds application for the purpose of this study.

**Explosive Power**

Fleishman defines explosive power as "the ability of the body to mobilize one's energy effectively in making single or repeated movements requiring a maximum expenditure of force."\textsuperscript{44} It is the ability to expend a maximum of energy in one explosive act.

According to Barrow and McGee, the power is "the capacity of the individual to bring into play maximum contraction at the fastest rate.

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of speed. Power is an explosive action and is equal to the product of force times velocity.\textsuperscript{45}

Explosive power is an action where maximum muscular force is released at maximum speed in one single attempt.\textsuperscript{46}

For the purpose of this investigation, the last definition has been considered.

**Speed of Movement**

Speed of movement is defined as the rate at which a person can propel his body, or parts of his body through space.\textsuperscript{47}

**Response Time**

It is the time taken from the onset of stimulus and the end of response.

It is the interval of time between the presentation of the stimulation and the initiation of the response.\textsuperscript{48}


\textsuperscript{48} Ibid., p.245.
Phillips and Hornak state that the Response Time or Performance Time is the sum of reaction time and movement time.\textsuperscript{49}

Reaction time is the delay in time between the presentation of a stimulus and the initiation of a volitional response whereas the movement time (MT) is the time taken to complete a task after it has been initiated.

For the purpose of this study, the definition by Phillips and Hornak is applicable.

**Agility**

Agility is defined as the ability of the body parts to change direction rapidly and accurately.\textsuperscript{50}

Agility may be defined as the ability to change directions rapidly and accurately\textsuperscript{51}

It refers to the ability of a player to change his body positions quickly, accurately and efficiently in the desired direction. It depends

essentially upon strength, speed of reaction and movement and big muscle coordination. Quick starts and stops, rapid change of directions and efficient footwork are essential for successful performance in the games like volleyball. Agility is a component of general motor ability and motor fitness.\textsuperscript{52}

For the purpose of this study, the third definition is applicable.

**Kinesthetic Perception**

According to Shaver, 'kinesthetic perception is the sense that gives an individual the awareness of his body parts or body as a whole when it moves through the space or during voluntary movement.\textsuperscript{53}

Scott defines kinesthetic perception as the sense which enables us to determine the position of the segments of the body, their rate, extent, and direction of movement, the position of the entire body, and the characteristics of total body motion.\textsuperscript{54}


Sage defines kinesthesia as "the discrimination of the positions and movements of body parts based on the information other than visual, auditory or verbal. It is the bodily sense which informs us of the position of the bodily segments at any given time, total body position, direction and amplitude of limbs and trunk movements, and configurations of total bodily movement."\textsuperscript{55}

Kinesthetic sense is the ability to perceive the body's position in space and the relationship of its parts.\textsuperscript{55}

This sense is also known as proprioceptor or muscle sense. The organs of kinesthetic sense are the proprioceptors, which include specialized sensory receptors in the muscles, tendons, ligaments, joints, and the vestibular apparatus of the inner ear.

The definition put forward by Shaver finds consideration for the purpose of this investigation.

\textsuperscript{55} Nixon and Jewett, An Introduction to Physical Education 8th ed., p 186.
\textsuperscript{56} Phillips and Hornak, Measurement and Evaluation in Physical Education, pp.252-253.
Flexibility

Flexibility refers to the efficiency of body parts to move freely through their maximum range, may be extension or flexion of specific joints, without undue fatigue.

Flexibility is the ability of an individual to move the body and its parts through as wide a range of motion as possible without undue strain to the articulations and the muscle attachments.\(^{57}\)

The second definition is considered for the purpose of this study.

Coordinative Abilities

On the basis of the proposed definitions of Zimmermann (1983), Hertz (1985), Harre (1986), and Meinel and Schnabel (1987), the coordinative abilities have been defined as "the relatively stabilized and generalized patterns of motor control and regulation processes." These enable sportspersons perform a group of movements with better quality and effect.\(^{58}\)

Coordinative abilities are the generalized psychomotoric performance prerequisites having the function of movement control and regulation. 59

For the purpose of this study, the second definition has been given consideration.

**Orientation Ability**

Orientation ability is the ability to determine the body position and its parts in time and space in relation to gravity, playing field, other players, ball, equipment etc. 60

Orientation ability is the ability to analyse and change the position and movement of the body in space and time related to the defined action. 61

For the purpose of this study, the first definition receives consideration.

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Differentiation Ability

It is the ability to achieve a high degree of accuracy and economy (time adjustment) of separate body movements and mechanical phases of total movement. It is based upon conscious, precise distinction between force, space and time parameters of the motor process and those existing in the athletes mind.\textsuperscript{62}

According to Singh\textsuperscript{63} differentiation ability is the ability to achieve a high degree of accuracy and economy of separate body movements and movement phases in a motor action. It depends upon a person's capacity to precisely differentiate between the minute differences in temporal, spatial and dynamic parameters of a movement compared to the movement concept.

First definition finds consideration for this study.

\textsuperscript{62} Harre, Principles of Sports Training, p.152.
\textsuperscript{63} Singh, Science of Sports Training, p.165.
Balance Ability

According to Singer, "the balance ability is the ability to maintain body position which is necessary for the successful performance of sports skills."\(^\text{64}\)

Rhythm Ability

Singh defines rhythm ability as "the ability to perceive the externally given rhythm and to reproduce it in motor action. It also denotes the ability to reproduce a rhythm existing in motor memory in motor action."\(^\text{65}\)

Reaction Ability

"Reaction ability is the ability to initiate quickly and perform rapid and well-directed actions following a signal."\(^\text{66}\)

According to Singh, "reaction ability is the ability to react quickly and effectively to a signal."\(^\text{67}\)


**Significance of the Study**

Performance in the game of volleyball is influenced by a number of physical as well motor ability components, technical efficiency and tactical mastery and a state of psychological preparedness. The competitive volleyball is a techno-tactical sport of excellence. It is rather a display of power, absolute alertness, shrewdness and playing ability. Psychomotor variables and coordinative abilities are very important components of performance and are directly or indirectly related to the above stated factors. Psychomotor variables are associated with motor components and psychic abilities and the coordinative abilities are concerned with the technical and tactical perfection in the game.

In view of the above, the physical education teachers and the coaches in the field of volleyball have to lay an adequate emphasis on the development of these abilities or variables so as to enhance the performance level of the volleyball players.

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

1. The findings of the study will be helpful in ascertaining the relationship of volleyball playing ability to psychomotor variables and coordinative abilities.
2. The study will facilitate the physical education teachers and the coaches in developing sound training programmes in order to ensure improvement of their volleyball playing ability.

3. The study will help the physical education teachers and the coaches in evolving a sound programme for selection and nurturing of potential volleyball players.

4. The results of the present study will help in the prediction of volleyball playing ability based on the psychomotor variables and the coordinative abilities.

5. The results of the investigation will help in economizing the efforts of the physical education teachers, the coaches and the sportspersons by laying more stress on those factors which contribute to volleyball playing ability.