Chapter I

Introduction

The twenty first century is the most rapidly changing century of all times. Rapidity of changes creates unusual demands on individuals and on the system of education. It must not only include the human body and knowledge but also develop inquiring minds which will permit them to understand and admit what is to come tomorrow (Kumar, 2003).

As Jacks (1932), the British philosopher puts it, living becomes an art only, "when work and play, labor and leisure, mind and body, education and recreation are governed by a single vision of excellence and a continuous passion for achieving it".

Man has all along been making relentless efforts to equal, break and set new heights with an unquenchable thirst for perfection, excellence and a deep sense of competitive zeal and fervor. 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 succession. It could then very rightly be stated that the ultimate limits of human performances 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. Secondly, it became a means of preparing youth for adult life, as games were taken from life's activities and became a
recognized way to improve strength, speed and skill and other qualities necessary for survival (Barrow & Brown 1983). Physical education and sport provides 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 outcome (Fleishman, 1964).

Physical fitness is an attribute required for service in virtually all military forces. Physical fitness comprises two related concepts: general fitness (a state of health and well-being) and specific fitness (a task-oriented definition based on the ability to perform specific aspects of sports or occupations). Physical fitness is generally achieved through exercise, correct nutrition and enough rest. It is an important part of life. In previous years, fitness was commonly defined as the capacity to carry out the day’s activities without undue fatigue. However, as automation increased leisure time, changes in lifestyles following the industrial revolution rendered this definition insufficient (Kumar et.al, 2012).

Because of failing vision, unsteadiness, slower reflexes, vertigo, stiffness and muscle weakness, hazards easily outcome by younger people, become significant for the elderly because falls are common. These are more dangerous than is often realized and are often fatal in their long term consequence. Osteoporosis makes elder people, especially women, particularly susceptible to fractures, even from quite minor injuries and the resulting immobilization and decline in the level of activity can have grave
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effects. Chest and urinary infections commonly supervene and these may tip the balance against survival (Kumar et al., 2012).

Competition is a product of the modern times. It is a challenge which motivates, stimulates and inspires the individual to run faster, jump higher, 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 (Melville & de mellow 1974).

Competition enhances performance and the performance can be achieved, maintained or peaked through competition. Performance is the underlying key-note of all sports. Sport has become a prestigious aspect to prove one's superiority over others (Renewes, 1972).

Progress and high degree of excellence are the true reflexes of this ever-evolving and dynamic 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 material wealth as well. Competition sports have catalyzed the race for supremacy and excellence. Not to speak of the individual sportspersons or teams but the nations' honor and prestige also finds involvement in the most prestigious and elite international contests or competition. The coaching as well as the training methods have undergone a sea change in modern times and sports scientists, sports psychologists, the coaches and the trainers are preparing sportspersons on the basis of 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 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 centimeter, every fraction of a second, every ounce of energy out of the athlete, who is considered to be a machine (Powell, 1983).

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. She 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 pattern, 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.

Physical proficiency is an important area of motor performance. Ability refers to a more general trait of the individual which has been inferred from response consistencies on certain kinds of tasks. Abilities are fairly enduring traits, which in adults, are more difficult to change. Many of these abilities are, of course, themselves a product of learning and develop at different stages, mainly during childhood and adolescence (Fleishman, 1964).
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 (Robert & Singer, 1975).

**Psychomotor abilities**

The concept of optimal physical and motor development (psychomotor) has to be understood by the parents and the sports specialists concerned.

Psychomotor variables act as the medium for the realization of cognitive and affective domains of learning and motor behavior. 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 integration between these aspects of human behavior (Harold, Barrow & McGee, 1979).

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 time, and 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 (Phillips & Hornak, 1979).

Psychomotor elements exercise a great control and influence over performance in sports. Total fitness of the performance is of utmost importance in order to get optimal performance in the prestigious sports competitions at the international level.

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 fielding 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 Handball requires the player to be in a state of optimum fitness (Kumar, 2003).

Psychomotor learning is the relationship between cognitive functions and physical movements. Psychomotor learning is demonstrated by physical skills such as movement, coordination, manipulation, dexterity, grace, strength, speed; actions which demonstrate the fine motor skills, such as use of precision instruments or tools,
or actions which evidence gross motor skills, such as the use of the body in dance, musical or athletic performance. Behavioral examples include driving a car, throwing a ball, and playing a musical instrument. In psychomotor learning research, attention is given to the learning of coordinated activity involving the arms, hands, fingers, and feet, while verbal processes are not emphasized.

Psychomotor abilities which influence the capacity to manipulate and control objects including:

**Figure 1.1: Psychomotor Abilities**

**Arm-hand Steadiness**: The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position (Ward, Reveille, Learch, Davis & Weisman, 2008).

**Control Precision**: The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
**Finger Dexterity:** The ability of make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate or assemble very small objects.

**Manual Dexterity:** The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects (Ward et al, 2008).

**Multi-limb Coordination:** The ability to coordinate two or more limbs (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the whole body is in motion.

**Rate Control:** The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object or scene.

**Reaction Time:** The ability to quickly respond (with the hand, finger, or foot) to a signal (sound, light, picture) when it appears.

**Response Orientation:** The ability to choose quickly between two or more movements in response to two or more different signals (lights, sounds, pictures). It includes the speed with which the correct response is started with the hand, foot, or other body part.

**Speed of Limb Movement:** The ability to quickly move the arms and legs (Ward et al, 2008).

**Wrist-Finger Speed:** The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.
In sports today best performance can only be achieved through a meticulously planned, executed and controlled training system based on scientific knowledge, theoretical and methodical fundamentals of sport training.

The developing tendencies in international sport, especially in team games are identified as the increase in game tempo, tougher body game and greater variability in technique and tactics. An increased performance level can only be achieved by working and training of all major components i.e. technique coordination, tactics, physical fitness and psychological qualities. Apart from these components, one more factor which is today known as coordinative abilities also play a greater role. A sportsman can compete effectively only by a certain coordinative mastery of the technique (Kumar, 2003).

Different games are provided to do body activities, differently. Handball players are equally conductive to developing these skills amongst players. The theory of coordinative abilities is rapidly getting recognition in the world of sports. However, there is no general agreement regarding the number of coordinative abilities required for sports.

The methods of evaluation of coordinative abilities have also not yet been finally formulated. The control regulation process is required to function in a particular manner which is further automatized to a great extent during skill performance. Motor coordination is a part of an action regulation and hence, closely linked with the process and regulation of cognitive psychic-abilities, (e.g., motives, derives etc.) movements and an execution aspect of an action (Hirtz, Menal & Schobel, 1987) have pointed out that for coordinative abilities these aspects of action regulation are important and dominant factors (Kumar et.al, 2012).
Coordinative abilities are the generalized psychomotoric performance prerequisites having the functions of movement control and regulation (Singh, 1991).

Coordinative abilities serve the formation of the overall movement from partial movements in a consistent and coordinated way. If these movements are coordinated, we can achieve the highest level of general motor coordination needed for the performance of motor skills, as they are considered general motor and psychological conditions for sports achievements through which an individual can control motor performances in all sports activities (Abdel Khaleq, 2003).

Coordinative abilities enable the sportsman to do a group of movements with better quality and effect.

The speed of learning of skill and its stability is directly dependent on the level of various coordinative abilities. Coordinative abilities are needed for maximal utilization of conditional abilities, technical and tactical skills (Singh, 1991).

Insufficient training of coordinative abilities limits the performance abilities especially at higher levels. On the contrary, better developed coordinative abilities provide an essential base for faster and effective learning, stabilization and variation in technique and their successful execution in game situations (Kalb, 1989).

In different sports requirement of coordinative abilities differ and these abilities ensures higher economy of movement, whereas in some sports events they help in higher frequency of movement with high explosiveness and force application. In strength sports they help in putting maximum effort in a short time and at the right time. But, where the technique dominates the event, these abilities help in better learning, stabilization, variability and autoimmunization. Apart from performance
improvement, in team games coordinative abilities ensures an effective use of tactical abilities in the continuous changing situations (Kalb, 1989).

In sports seven coordinative abilities are of essential importance. In different sports the comparative significance of these abilities is though different (Singh, 1991). Physical education teachers and coaches should be well versed with these important coordinative abilities for putting up good performance in various physical education activities and sports (Kumar, 2003).

Coordinative abilities primarily depend upon the motor control and regulation process of control of the nervous system. The theory and motor coordination, therefore, is the basis of understanding the nature of coordinative abilities as mentioned by Bloume (1978). Different specialists have explained different number of coordinative abilities. Zacroskij (1971) stated that agility depends upon three coordinative abilities. According to Hirtz (1973) agility depends upon 18 coordinative abilities. He has pointed out five most important coordinative abilities such as: Orientation Ability, Differentiation Ability, Reaction Ability, Balance Ability and Rhythmic Ability (Kumar, 2012).

Schnabel was of the opinion that the concept of the agility be replaced by the concept of following the nature of three coordinative abilities: Differentiation Ability, Orientation Ability and Reaction Ability.

Differentiation ability enables the sportsman to perceive micro- differentiation regarding the temporal, dynamic, spatial aspect of movement execution and the differentiation can be in regard to an implement or movement like serve, movement serve, water feeling, etc (Singh, 1991).
Orientation permits the sportsman to determine the position and movement of his own body and/or of a moving object (opponent, partner) with regard to space. Coupling or combination movement allows the sportsman to coordinate partial movement of his body with regard to space, time and dynamics.

Reaction ability permits the sportsman to effective action quickly and purposefully, according to a signal and for sudden change in situations.

Balance ability helps in keeping the total body in a certain position or to re-establish it.

Rhythm ability enables the sportsman to perceive the externally given rhythm and to reproduce it in a motor action. It also denotes the ability to reproduce a rhythm, existing in motor memory in motor action (Singh, 1991).

Performance

Performance in the game of Handball 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 Handball is a techno-tactical sport of excellence. It is rather an exhibit of power, absolute awareness, wisdom and playing ability.

Modern Handball is a fast game, characterized by incredible athletic performances by athletes. In fact, modern Handball players are able to perform many different moves, jumps, running, change of directions and technical movements in very short time and with an order determined by the tactical situation (BujjiBabu & Johnson, 2013). Running with and without the ball, in line and with different paths,
jumping, throwing, passing and receiving in motion or during flight, represents the technical characteristics of a modern top Handball player. Then, to excel at the highest levels, it is important that training methodologies are developed on a simple basis: specificity. The closer to the demands of the performance, the better the training is. Of course, to obey to the law of specificity we have to know exactly what are the physiological demands of handball performance. Unfortunately, in sport science literature, very few works have been presented in which a deep analysis of Handball performance has been conducted (INTRA, 2013). The aim of this work is to analyze the literature findings and some experiences conducted in Iran with some first league teams and national teams.

**Handball**

Handball is an Olympic sport played professionally in many European countries (Marques & González-Badillo, 2006). However, notwithstanding the professionalization which is advancing in this sport, a lack of scientific information on its performance can be noticed.

Handball is a very strenuous body-contact team sport that places heavy emphasis on running, jumping, running speed, throwing and requires substantial strength levels to hit, block, push and hold during game actions (Wallace & Cardinale, 1997).

Handball has increased in status as a sport since its introduction in 1972, into the Summer Olympic Games (Hasan, Reilly, Cable & Ramada, 2007)

Handball is a sport that presents physical efforts characteristics of high intensity and of short duration, with emphasis in the motor capacities of velocity and strength,
especially the explosive strength and velocity strength. (Souza, Gomes, Leme & Silva, 2006)

The human hand is unique in being free of habitual locomotors duty and devoted entirely to functions of manipulation. Its effectiveness in these activities is due to particular configuration of the bones and muscles which permits opposition of the pulp surface of the thumb to the corresponding surfaces of the other four finger tips in a firm grasp, together with a highly elaborated nervous control and sensitivity of the fingers. Hand is a very complex structure capable of not only a multitude of motor tasks but also of relaying sensory information about the temperature, the shape and texture of objects to the rain (Barut, Demirel & Kiran, 2008).

Team handball is the second most popular participation team sport worldwide. Millions of participations and spectators enjoy the physical, high-scoring, non-stop action of a handball match. The physical and psychological demands necessary to reach an elite level of play in handball are extraordinary. Handball at the highest level of play demands the development and refinement of many fitness, technical, tactical and psychological skills (Silva, 2006).

It is a fast – paced sport involving two teams of seven players who pass, throw, catch and dribble a small ball with their hands. A game consists of two 30-minute halves with a 10-minute half-time break. Handball is a kind of intermittent sport, which similar to some other kinds of intermittent sports such as rugby, soccer, hockey and basketball. During the matches of the intermittent sports, players need to perform different type of exercise such as standing, jogging to maximal running.
There are 14 players in each handball team, with seven on the pitch at any one time. The playing positions in handball are as follows: Goalkeeper (GK), Centre or playmaker (CB), Left back (LB) and Right back (RB), Pivot (PV), Left wing (LW) and Right wing (RW).

![Handball players positions](image)

**Figure 1.2: Handball players positions**

Each team consists of 7 players on court and 7 substitute players on the bench. One player on the court must be the designated goalkeeper differing in his or her clothing from the rest of the field players. Substitution of players can be done in any number and at any time during game play. An exchange takes place over the substitution line.

Ball games require comprehensive ability including physical, technical, mental and tactical abilities. Among them, physical abilities of players exert marked effects on the skills of the players themselves and the tactics of the team. For the ball games in which the use of the hand is essential, hand morphology and functional properties could be important for the performance (Barut, et al, 2008).
The hand does not function in isolation, and is dependent on the integrity of the shoulder and elbow complexes to allow the appropriate positioning of the hand in space to complete the desired task (Barut, et al, 2008).

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.

Need for the study

Previous studies revealed that few psychomotor variables and coordinative abilities are related to performance. Psychomotor variables are associated with motor components and psychic abilities and the coordinative abilities are concerned with the technical and tactical perfection of the game.

Earlier studies were conducted on various levels; very few studies are conducted on women Handball players. So researcher is interested to investigate influence of psychomotor variables with performance of elite female Handball players, hence I look up this study.

Statement of the problem

The purpose of this research work was to investigate "Relationship of Selected Psychomotor Variables with Performance of Elite Female Handball Players"

Objectives of the Study

1. To determine the related psychomotor variables of female Handball players.

2. To find out relationship between selected psychomotor variables with performance characteristics of Handball players.
3. To study positional wise differences of Handball players in psychomotor ability and performance.

4. To predict the performance of elite female Handball players by psychomotor variables, if any.

**Delimitations**

1. The study was delimited to female players.

2. The study was delimited to 120 Iran elite female handball players.

3. The study was delimited to 18-25 years old elite female handball players.

4. Only the following Psychomotor abilities were assessed: Explosive Power by Sargent Vertical Jump test, Speed of movement by Nelson speed of movement test, Agility by SEMO agility test, Kinesthetic perception by Horizontal space test and Flexibility by Upward-Backward movement of arms test, Orientation ability by Numbered medicine ball run test, Differentiation by Backward medicine ball throw test, Rhythm ability by Straight and rhythm run test.

5. The performance was assessed by five points rating scale prepared by the researcher with consultation of experts in Handball.

**Limitations**

1. Researcher was not able to control lifestyle of the subjects.

2. Researcher was not able to control level of training of the subjects.

3. Researcher was not able to control diet of the subjects.

4. Researcher was not able to control genetic symptoms of the subjects.

5. Researcher was not able to control motivation of the subjects during the test.
The study was conducted on samples drawn from different teams in different places (cities).

**Hypotheses of the study**

1. There is no significant relationship between the selected psychomotor variables with performance of elite female Handball players.
2. Players playing in different positions do not differ significantly in their psychomotor variables.
3. Players playing in different positions do not differ significantly in their performance.
4. Only few psychomotor variables best predict the performance of elite female Handball players.

**Definitions of the terms:**

**Elite Handball player:**

A Handball player is one who is currently or who has previously competed as a professional player or as a national or international level player (Zwierko, Lesiakowsk, & Florkiewicz, 2005).

**Handball player:**

One who participates in or is skilled at handball game or one who plays handball game professionally (Zwierko, et al, 2005).
Psychomotor variable

According to Barrow and McGee (1979), the term "Psychomotor", means an "observable voluntary human movement" and variables, as "the traits or factors that change from one case or condition to another; the representatives of the traits, are usually in quantitative form, such as a measurement or enumeration".

Psychomotor domain encompasses reflex movements, basic fundamental movements, perceptual abilities, physical abilities skilled movements and non-discursive movements (James & Morrow, 1995).

Activities that are primarily movement – oriented and emphasize over physical response are termed as psychomotor (Robert & Singer, 1975).

Psychomotor variables bear direct association with muscular action or motor skill, some manipulation of materials and objects and some requiring neuromuscular coordination. Definition by Barrow and McGee finds application for the purpose of this study.

Explosive Power

Explosive power is an action where maximum muscular force is released at maximum speed at one single attempt (Phillip & Hornak, 1979).

Fleishman defines explosive power as "the ability of the body to mobilize ones’ energy effectively, in making single or repeated movements requiring a maximum expenditure of force (Fleishman, 1964). It is the ability to expend maximum energy in one explosive act."
According to Barrow and McGee (1979), power is "the capacity of the individual to bring into play maximum contraction at the fastest rate of speed. Power is an explosive action and is equal to the product of force time's velocity."

**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 (Johnson & Nelson, 1982).

This variable was measured by using Nelson Speed of Movement Test.

**Agility**

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 of handball. Agility is a component of general motor ability and motor fitness (Hockey, 1973).

Agility is defined as the ability of the body parts to change direction rapidly and accurately (Barrow & McGee, 1979).

Agility of the subjects was measured by using SEMO-Agility Test.

**Kinesthetic Perception**

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 (Shaver, 1981).
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 (Scott, 1955).

Kinesthetic defines as "the discrimination of the positions and movement of body parts on the information other than visual, auditory on verbal. It is the body sense which informs us of the position of the body segments at any given time, total body position, direction and amplitude of limbs and trunk movement and configurations of total body movement (Nixon & Jewett, 1980).

Kinesthetic sense is the ability to perceive the body's position in apace and the relationship of its parts (Phillips & Hornak, 1979).

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, joins and the vestibular apparatus of the inner ear.

This variable was measured through the application of Horizontal Space Test.

**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 (Johnson & Nelson, 1982).

Flexibility was assessed by applying: a Modified Sit and Reach Test.
Coordinative Abilities

On the basis of the proposed definitions of Zimmermann (1983), Hertz (1985), Harre (1986), Meinel and Schnabel (1987) the coordinative abilities have been defined as "the relatively stabilized and generalized patterns of motor control and regulation processes" (Singh, 1991).

Coordinative abilities are understood as relatively stabilized and generalized patterns of motor control and regulation processes (Singh, 1991).

Coordinated actions of the human body are executed by the controlled application of muscular forces which produce distinctive patterns of segment motions. Neuromuscular coordination reflects the ability of athletes to perform their sports activities or events with a smooth, balanced, and fluid motion.

Coordinative movements are harmonious adjustment of action, as of muscles in producing complex movements.

Coordinated actions of the human body are executed by the controlled application of muscular forces which produce distinctive patterns of segment motions.

Coordinative abilities are the generalized psychomotoric performance prerequisites having the function of movement control and regulation (Kalb, 1989).

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 and equipment etc (Harre & Barsch, 1982).
Orientation ability is the ability to analyze and change the position and movement of the body in space and time related to the defined action.

Orientation permits the sportsman to determine the position and movement of his own body and/or of a moving object (opponent, partner) with regard to space. Coupling or combination movement allows the sportsman to coordinate partial movement of his body with regard to space, time and dynamics (Singh, 1982).

It was assessed by using Numbered Medicine Ball Run Test.

**Differentiation ability**

Differentiation ability 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 athlete's mind (Harre & Barsch, 1982).

According to Singh, 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.

Differentiation ability enables the sportsman to perceive micro- differentiation regarding the temporal, dynamic, spatial aspect of movement execution and the differentiation can be in regard to an implement or movement like serve, movement serve, water feeling, etc.

It was determined by using Backward Medicine Ball Throw Test.
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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.

It is the ability to preview 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 (Singh, 1991).

It was measured through Straight and Rhythm Run Test.

Performance

Performance in sports is a unity of execution and result of sports action or a complex sequence of sports action measured or evaluated according to agreed and determined norms. It is assessed by experts in the field (Barrow & McGee, 1979).

Significance of the study

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

1. The finding of the study will be useful in ascertaining the relationship of Handball playing ability to psychomotor variables.

2. The study will make easy the physical education teachers and the coaches in evolving complete training programs in order to ensure improvement of their Handball playing ability.
3. The study may help the physical education teachers and coaches in developing a complete program for selection and development of potential Handball players.

4. The results of the present study will help in the prediction of Handball playing ability based on the psychomotor variables.

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

6. The present study will help the coaches, sport teachers and trainers to understand the dominant factors that indicate Handball performance in female handball players.

7. The result of this study will help the Handball players to understand and improve their performances in the games.