PERFORMANCE OF VOLLEYBALL PLAYERS BASED ON FITNESS PARAMETERS

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Abstract:

Background: Ball games require comprehensive ability including physical, technical, mental and tactical abilities. Physical attributes of players have a noticeable impact on both individual player talent and team strategy. Players must thus be physically capable of meeting the demands of the sport. One of the most played games worldwide is volleyball. Unfortunately, Indian volleyball players fall well short of the world's standards in terms of performance. The study's goal is: The purpose of the current research was to evaluate volleyball players' flexibility, muscular endurance, power, and cardio-respiratory endurance and compare the findings with those of controls who were of a similar age. Additionally, to compare the results of the volleyball players with those of the existing literature's analysis of international standards and to provide some recommendations for raising their level of performance. Materials and Methods: The research included 40 male volleyball players who ranged in age from 17 to 26 as well as 40 male controls who were of a similar age. Flexibility, muscular endurance, power, and cardio-respiratory endurance were among the physical fitness measures examined; results were analyzed using an unpaired 't' test. Results: It was evident that players' levels of physical fitness were higher overall than those of their age-matched controls, but when the values of the subjects were compared to worldwide standards, our subjects fell short of the requirements recommended for top volleyball players. Gonclusion: The volleyball players have better benefit of flexibility muscular endurance, power and cardio-respiratory endurance.

Key Words: *Flexibility, Muscular Endurance,Power, Cardio-Respiratory Endurance, BicycleErgometry, VO_2 max.*

Introduction:

Today, sport has evolved into a massive, intricate cultural phenomenon. Its reach is incredible, and almost everyone has been affected by it in some manner. There is widespread involvement.

Experts in physical education and sports have highlighted the value of conducting research into the specific structures associated with the various sports activities for the identification and development of sporting talent as well as for improved performance at various levels of sporting competition.

The performance of an athlete is influenced by a variety of things. Physical, mental, technical, and tactical are these. Physical prowess is the most crucial among them. Skills, training, motivation, and physiological variables all affect performance. Coaches, physical educators, and sports scientists in particular have expressed tremendous worry about the poor performance of Indian athletes and sportsmen in the international tournament. Long-term efforts have been made to raise the bar for our athletes, but little progress has been made in this area thus far.

One of the most played games worldwide is volleyball. It is a game of strength, agility, and speed. In this game, physical fitness is really important. Therefore, factors relating to the athletes' health have a significant impact on their performance.

In order to measure the basic physical fitness parameters of volleyball players' flexibility, muscular endurance, power, and cardio-respiratory endurance, as well as to identify any gaps in physical fitness, the current study was conducted. This will allow us to develop some useful recommendations for raising volleyball players' performance levels. In light of this, a research was conducted to evaluate the physical fitness characteristics of volleyball players for university teams and those competing at higher levels than universities (state and national levels) in comparison to age-matched controls and international standards.

Materials and Methods: With the ethical committee's consent, the current research was conducted at the sports physiology lab of the physiology department at Dr. Vaishampayan Memorial Government Medical College, Solapur.40 male volleyball players, ages 17 to 26, who had just been chosen for a university team and were still competing at the collegiate, state, or national levels were included in this research. Our study group was this. 40 age-matched male students from Dr. Vaishampayan Memorial Government Medical College in Solapur, including undergraduates, interns, and residents, made up the control group. The research took six months to complete and was conducted in 2011–2012.

Surprisingly few research have been conducted on the physical fitness indices of male volleyball players in India; hence, the current study attempted to address this gap by selecting male subjects. All individuals from the study and control groups provided informed written permission before participating in the research.

Exclusion criteria:

1) Participants who did not routinely practice were not included in the research.
2) Players who suffered injuries during games or practices were not included. Sprains and strains were considered minor ailments, but recurring shoulder dislocations, ankle joint fractures, patellar fractures, ligament injuries, etc. were significant ones.
3) Participants with serious cardio-pulmonary or respiratory illnesses in the past were disqualified from the trial.

Following physical fitness parameters were taken in both the groups and standard methods were employed to measure fitnessparameters.

1. Flexibility :

Test of sitting and extending the arm: This test gauges the growth of hip and back flexion as well as the extension of the hamstring muscles in the legs. The goal is to test how far a person can reach with straight legs while extending his hands beyond his foot line.

A line perpendicular to the measuring tape was drawn at a distance of 15 inches on the floor after it was hit with a measuring tape. The subject was instructed to sit down after an appropriate amount of warming up, align his heels with the near edge of the perpendicular line with the tape in between the two heels, then move his seat back beyond the zero end of the tape. In order to prevent the subject's heels from crossing the perpendicular line as he extended forward, the assistant stood and braced his toes on the subject's heels. Additionally, two aides locked the knees of the victims. The individual was then instructed to extend forward gradually and steadily without jerks, maintaining his heels no more than 5 inches apart, while also attempting to touch the fingers of both hands as far down the stick as feasible. The subject's test result, which was entered on the record sheet as the best of three tries, was

measured to the closest quarter-inch [1].

2. Muscular Endurance :

(a) Muscular endurance was assessed in the current research using a dynamic relative type. This style involves the performer doing the same movement repeatedly over an extended period of time and a certain distance. The exam is graded in terms of the numbers of accurate ex- ecutions performed. In the current investigation, the following tests were conducted:

(b) Push-ups:

The goal was to gauge the strength of the upper body's muscles, namely the arms and shoulder girdle. The performer was instructed to push up to the straight arm support after lowering their body till their chest touched the mat while in a straight arm front leaning rest posture. Without stopping, the exercise was performed as many times as feasible. The number of correctly performed push-ups determined the score. The scoring was stopped when the performer stopped to rest. Precautions: The performer should not droop or pike his body but should maintain a straight line throughout the activity.

(c) • The trial was not counted if the chest did not contact or if the arms were not fully stretched during an execution.

(d) Therefore, only the total number of push-ups that properly performed were recorded [1].

(e) Sit-ups:

The quantity of sit-ups performed with the knees bent was counted to gauge the abdominal muscles' endurance. The only tools needed for this exam were a yardstick and a mat.

The participant was instructed to bend his knees over the yardstick while moving his heels as near to his seat as possible while lying on his back. The performer was instructed to progressively move his feet forward while the yardstick was securely gripped under his knees. The heel line and seat line were drawn to indicate how far the feet stayed from the seat during the bent knee sit up exercise at the moment when the yardstick drooped to the mat. The individual was then instructed to do sit-ups and interlace her fingers behind her neck. Alternately bringing the right elbow to the inside of the left knee and the left elbow to the inside of the right knee. The individual was instructed to complete the task as many times as they could.

Precautions taken:

i) If the fingertip contact behind the head was lost.

ii) When the elbows did not touch the knees.

iii) When the individual lifted their elbow off the ground.

3. In the participants' record sheet, the total number of sit-ups performed was tallied and recorded.

4. Power (vertical jump):

A vertical leap performed without contact (Sargent chalk jump)

This exercise was designed to assess the leg strength needed to leap vertically upwards. A yardstick, numerous pieces of chalk, and a smooth wall surface at least 12 feet from the floor were required tools and supplies. The subject was instructed to hold a one-inch piece of chalk in his hands closest to the wall while standing with his side to the wall, reaching as

high as he could with his heels on the floor, and making a mark on the wall. This was the subject's typical reach, measured in cm.

After that, the participant was instructed to leap as high as they could while adopting a crouching position with their legs bent at a roughly straight angle. The subject drew a spot on the wall that represented the height of the leap, and this point was documented. The person performed this vertical leap without being approached.

b) Approaching vertical jump:

The participant was instructed to approach the spikes three steps from the wall. The subject was instructed to approach the wall, give himself a moment to compose himself, leap with a two-foot takeoff as high as he could, reaching for the wall's highest point with both of his hands outstretched, then mark the wall with chalk.

The best leap with approach was identified after 3–5 attempts. The subject's score was recorded and placed into his record profile as the number of centimeters between the normal reach and the leap with approach measured closest to the half centimeter.

Aerobic Capacity (Cardio-respiratoryendurance):

Many exercise physiologists regard VO2 max [Maximum Oxygen Uptake] as the most accurate indicator of aerobic capacity or cardio-respiratory fitness.

Bicycle ergometers were used in the current investigation to determine VO2 max [2]. Measures the amount of labor. A bicycle ergonomicer is a stationary bike that can be adjusted for the seat height and pedaling resistance, allowing for a broad range of workloads.

Procedure:

The Ergo meter was leveled before being connected to the mains. The subject was instructed to sit, and after making the necessary modifications to the handle height and angle, the stop switch was started for a certain number of wheel revolutions. The subject was then instructed to pedal continuously at 50 RPMs while minimizing the load. The load was adjusted to the appropriate amount and the stopwatch was reset after 30 to 45 seconds of warming up. For six minutes, the individual was instructed to continuously pedal at 50 RPMs.

The performer's heart rate was recorded at the conclusion of each minute. If there was a difference of more than 5 beats per minute between the heart rate recorded at the end of minutes 5 and 6, the test was extended for an additional 1 to 2 minutes until a steady state was reached. The heart rate at that load was defined as the average of the previous two minutes. [3]

Our final goal was to determine the subject's work output in units of time to determine KPM/min (Kilo pound meters per minute). The following formula determines this:

$$KPM/min = 2NW/T$$

Where,

N = Number of wheel rotations W = Balance reading in kilograms (Load) T = Time, in minutes.

Then, by maintaining one end of a ruler on the KPM/min scale and the other end at the pulse rate scale, we were able to determine VO2 max using the Modified Astrands Rhyming nomo- gram. The reading in liters was obtained from the ruler's intersection with the VO2 max scale. According to the table, the age factor was corrected by multiplying

the value of VO2 max in Lit/min by the age factor.

By multiplying the VO2 max value by 1000 and dividing it by the subjects' body weight, the value in ml/min/Kgs was obtained. The equation is:

VO_2 max (ml/min/Kgs) = [(VO_2 max in Lit/min X 1000)/Body weight]

A standard table created by the American Heart Association, in which the standards are divided into five groups, was used to interpret maximal oxygen uptake (Low, Fair, Average, Good and High). Thus, it is possible to determine a person's level of cardio-respiratory fitness.

Results:

Table 1: Flexibility Test of Study and Control Groups

Test	Study/Control subjects	Mean	SD	SEM	p value	S/NS
Trunk Flexibility (inches)	Study subjects	20.38	2.835	0.448	< 0.05	S
	Control subjects	17.16	2.533	0.401		
Shoulder Goniometry (Degrees)	Study subjects	178.45	2.012	0.318	< 0.05	S
	Control subjects	175.05	2.087	0.330		
Knee Goniometry (Degrees)	Study subjects	140.25	5.615	0.888	< 0.05	S
	Control subjects	135.43	2.438	0.385		

S: Significant, NS: non-significant, SD: STD deviation, SEM: STD Error Mean

Table 2: Muscular Endurance Tests of Study and Control Groups

Test	Study/Control subjects	Mean	SD	SEM	p value	S/NS
Pushups (No.)	Study subjects	28.90	4.174	0.660	< 0.05	S
	Control subjects	19.08	7.054	1.115		
Sit ups (No.)	Study subjects	38.80	6.843	1.082	< 0.05	S
	Control subjects	19.18	8.000	1.265		

S: Significant, NS: non-significant, SD: STD deviation, SEM: STD Error Mean

Table 3: Power of Study and Control Groups

Power Testing	Study/Control subjects	Mean	SD	SEM	p value	S/NS

Without approach (cms)	Study subjects	51.45	9.556	1.511	< 0.05	S
	Control subjects	39.125	8.585	1.357		
With approach (cms)	Study subjects	62.60	9.737	1.540	< 0.05	S
	Control subjects	48.30	11.407	1.804		

S: Significant, NS: non-significant, SD: STD deviation, SEM: STD Error Mean

Table 4: Cardio-respiratory Endurance (Bicycle Ergometry) of Study & Control Groups

	Study/Control subjects	**Mean**	**SD**	**SEM**	**p value**	**S/NS**
VO_2 Max (ml\kg\cms)	Study subjects	44.559	6.7545	1.067	< 0.05	S
	Control subjects	30.668	4.405	0.696		

S: Significant, NS: non-significant, SD: STD deviation, SEM: STD Error Mean

Discussion:

1) Flexibility:

The ability to move one's body and its parts through a wide range of motion without putting undue strain on the joints and muscular attachments is known as flexibility.

Flexibility adds a new dimension to performance, allowing for more freedom and ease of movement as well as some significant implications for increased injury prevention.

There is no universal test for whole body flexibility, and flexibility in one joint does not always translate to flexibility in other joints. Flexibility varies depending on the joint and the sport [4].

It is utilized in many skills since it is a fundamental competence exam. The range of flexibility varies amongst the various joints. Therefore, in this respect, the individual joints may be verified.

Two types of flexibility tests are present;

1] Tests of relative flexibility are those that are intended to be measured in relation to the length or breadth of a particular body component. In these tests, we evaluate the length or breadth of an influential body component in addition to movement.

2] Tests of absolute flexibility - In these tests, we exclusively assess the motions in regard to an unwavering performance objective.

Flexibility ratings may be expressed as linear measures when using a tape measure or flexomeasure, or as rotatory measurements, where scores are expressed as rotational degrees

and are calculated by using a protractor or goniometer.

Because volleyball players must make quick movements in the forward, sideways, or downward directions, hip and back flexibility are crucial. Therefore, we chose the sit-and-reach test.

The mean trunk flexibility of the study individuals in our research was 20.38" whereas the mean trunk flexibility of the control subjects was 17.16". This difference was determined to be statistically significant.

The mean values for the sit and reach test among national level volleyball players, according to M.J. Duncan et al. [5], were 23 12"; this value was higher than that of our individuals.

Hip flexion and vertical leap show a strong and favorable association, according to Lee E.J. et al [6]. His results corroborate the idea that increased flexibility is associated with improved skill performance. He has thus concluded that improved hip flexibility could enhance leaping ability.

By measuring the range of motion of shoulder flexion using a goniometer, the flexibility of the shoulder joint has been evaluated.

The shoulder joint flexed at an average angle of 178.45 degrees in research participants but only at an average angle of 175.05 degrees in control participants.

The maximal shoulder flexion value reported by AAOS (American Academy of Orthopedic Surgeons) [7] is 180 degrees, hence the results of our investigation are consistent with AAOS.

The flexibility of the knee joint was measured to be 140.25 degrees in study participants and 135.43 degrees in control participants, with the difference statistically significant.

The average knee flexion, according to Boone et al. [8], was 140.2 +/- 5.2 degrees. Their results and ours are consistent.

As a result, we may draw the conclusion that the research participants in our study are more flexible than the control group, and that the results for knee flexion and shoulder flexion are in line with international norms.

Several lower back and hamstring stretch exercises that should be performed consistently, correctly, and progressively are indicated for developing trunk flexibility.

2) Muscular Endurance:

The capacity to perform a sequence of muscle contractions without becoming exhausted is known as muscular endurance. It has been said that volleyball is a "Interval" sport having both anaerobic and aerobic components. Players require strong physical endurance since they must bend, leap, and move repeatedly throughout lengthy matches or tournament play. It is one of the traits needed to succeed in volleyball [9].

In our investigation, the ability of the study subject and the control group to do the maximum number of push-ups was measured. Maximum push-ups were performed on average by research participants at 28.90 and by control participants at 19.08, with the difference being statistically highly significant. However, as compared to volleyball players at the national level, our patients' muscular endurance was poor.

Similarly, the number of successfully performed sit-ups with bent knees has been used to

measure lower body muscular endurance. In our research, the mean number of correctly performed sit-ups by study participants was 38.8 and for controls, it was 19.18; this difference was statistically significant. When compared to national level [66-above advanced] elite athletes, our subjects fall intointermediate performance level.

This means, though the muscular endurance of our study group bears statistical significance with the control group but still it lags behind when compared to national or international standards.

Berger, Richard A. et al [10] have shown that training [dynamic overload] programmes improved performance on muscular endurance exercises. But, Dennison J.D. et al [11] have stressed equal importance of both isotonic as well as isometric exercise programmes in improving muscular endurance.

Thus, muscular endurance can be improved by proper weight training, isotonic exercise and isometric exercises.

3) Power (vertical jump):

Power is the capacity to exert the greatest amount of force in the shortest amount of time, as in actions like throwing and leaping. The distance that the body or another object is pushed through space is used to quantify athletic power.

Volleyball is a power-based sport. The muscles that generate power in volleyball must be strong for optimal performance. A volleyball player must leap hundreds of times during the game or tournament to execute blocking or spiking techniques, therefore having explosive strength in the legs is crucial. Thus, strength, speed, and technique are all necessary for a strong vertical leap during the spike and block.

We discovered that the vertical leap without an approach was 51.45 cm in research participants and 39.12 cm in control participants. Statistics have shown that the difference is considerable. Additionally, it was discovered that the vertical leap with three stride approaches was 62.60 cm in research individuals and 48.30 cm in control subjects, which was once again statistically significant.

Volleyball players on the national team and university teams had vertical jump-ing distances of 54.4 +/- 4.5 cm and 45.5 +/- 6.4 cm, respectively, according to Fleck S.J. et al. [12]. Since the bulk of the volleyball players in our research were collegiate athletes, our findings concur with his.

In contrast to our research, S. K. Saggar et al. [13] reported that the vertical leap with approach score for international volleyball players was 76.00 cm.

For volleyball players to significantly increase their vertical jumping ability as well as spike and block jumps during competitive play, Hakkinen et al. [14] recommend 2-3 weekly sessions of physical conditioning for strength and explosive strength training in addition to 4-5 weekly sessions of playing drills and competitive games.

Plyometric exercises, which are high-intensity workouts that improve speed, agility, and power, weight training, and sprint training have all been highlighted by Lawrence Grey, Kumar V, et al. [15] for volleyball players. They've discovered enormous gains in speed, agility, and strength, which has increased volleyball's vertical jump. According to Kasabalis A. et al. [16], there is a significant link between volleyball players' anaerobic power and their

ability to jump. They hypothesized that a player's vertical jump may be able to predict their maximum anaerobic power and serve as a useful field screening test for coaches to use in volleyball training.

The most crucial sort of training for a volleyball player, according to Mac Colloway [17], is developing their power and core strength. According to what he has said, support is provided by the abdominals and low back while power is generated by the simultaneous response of the hips, knees, and ankles. For the development of power, he has recommended hang deans, push press-jerks, power shrugs, and plyometric exercises (jumps, hops, bounds, etc.).

According to Sheppard J.M. [18], volleyball players need to develop their vertical leap in order to spike and countermove as they go from the junior to senior national teams.

We thus draw the conclusion that power is one of the most crucial factors affecting volleyball players' performance levels at the highest level based on the results and recommendations of several researchers. Exercises such as isotonic and isometric weight training, rope skipping, ankle strength-ening, ballistic resistance, hip flexibility, sprinting, and most importantly plyometrics, aid in enhancing vertical leaping ability for the development of spiking and block abilities in the sport of volleyball.

4) Aerobic capacity [Cardio-Respira-tory Endurance]:

The capacity of the circulatory and respiratory systems to adapt to and recover from the consequences of exercise or labor is referred to as cardio respiratory endurance.

By evaluating a person's current physical state, one may categorize them and forecast their performance in certain activities.

Large muscular groups are moderately contracted for relatively extended periods of time, and the cardio respiratory systems are significantly loaded since they directly support muscle function throughout this time. This is what is meant by cardio respiratory endurance. The efficiency of these two systems therefore becomes the limiting element in endurance, making oxygen delivery to the tissue the primary restriction in intense activities with prolonged duration. Therefore, increasing the flow of oxygen to the working muscles is the main goal of cardio respiratory endurance training. Cardiopulmonary endurance is therefore one of the essential elements of physical fitness.

Maximum oxygen uptake [VO2 max], which measures the quantity of oxygen used per kilogram of body weight per minute of activity, is widely regarded as the most accurate indicator of this capacity.

The link between heart rate and oxygen intake has been used in tests to predict oxygen consumption since the latter is thought to be the most accurate indicator of cardio respiratory fitness. Because it is rapid and simple to measure, heart rate provides a wealth of information about the body's response to the stress of exercise. As a result, it may be a useful tool for tracking how demanding an exercise program is and for giving a reliable indication of a person's health when measuring cardiovascular fitness.

The maximum amount of oxygen that a person can inhale when at sea level while doing physical labor is known as VO2 max.

The sport of volleyball combines anaerobic and aerobic elements. For extended matches or

tournaments when players must play three to four matches in a day, good cardio respiratory fitness is essential.

VO2 max was discovered in the current investigation utilizing a bicycle ergometer. The mean VO2 max was determined to be 44.55 ml/kg/min for research individuals and 30.68 ml/kg/min for control subjects, with a statistically significant difference between the two.

According to Smith D.J. et al [19], the VO2 max of the Canadian national volleyball team was 56.7 ml/kg/min while that of university volleyball players was 50.3 ml/kg/min. Our values are lower than his values for players on university teams since the bulk of the individuals in our research are members of a university team.

The VO2 max of inactive individuals was found to be 36.8 +/- ml/kg/min by Verma S.K. et al. [20] and to be 50 +/- 3.9 ml/kg/min by top volleyball players. Our study's values for both the subjects and the controls are consistent with his conclusion.

For cardiovascular function, Pollock et al [21] examined the training effects of running, walking, and biking. Significant improvements are produced by all three programs. When frequency, duration, and intensity are kept constant throughout training, training effects are independent of training mode.

Our research indicates that while the VO2max of the study participants is greater than that of the controls, it is still below than International Standards.

The relevance of lower body muscular strength and maximum aerobic capacity with higher playing level in volleyball players has been highlighted by Gabett T. and Georgieff B. [22].

As a result, numerous researchers have focused on different training techniques to enhance cardio respiratory endurance. Running, walking, biking, and a variety of isotonic and isometric activities are among them. All of these exercises, when done at a level that results in a 60% difference between maximal and resting heart rates, will unquestionably increase cardiorespiratory endurance.

Our research is intended to assist coaches in creating some common selection standards for choosing players for successful volleyball teams. In order to decide the best course of action to follow when building a program for that specific person, testing should also be done to evaluate what inadequacies there are and in which areas. An individual player will benefit from it and be able to perform better.

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