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An analytical study of selected physiological and anthropometric variables on volleyball playing ability of inter university male volleyball players

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Abstract
The purpose of the present study was to analyse the relationship between the selected physiological and anthropometric variables such as resting pulse rate, breath holding time, height and hand and leg length on volleyball playing ability of inter university male volleyball players. For this purpose 252 male volleyball players those who were represented for various universities and participating in the north zone inter university volleyball tournament held at C.S.J.M. University, Kanpur during the year 2018 were selected for the present study. The criterion variables such as, resting pulse rate, breath holding time, height and leg length were tested by counting the pulse at resting condition for one minute, holding the breath for maximum duration in seconds, steadiometer and measuring tape, and the volleyball playing ability was assessed with the help of two coaches and a national volleyball referee's ratings. Pearson Product Moment correlation was used to find out the relationship between the selected physiological and anthropometric variables such as resting pulse rate, breath holding time, height and leg length, and volleyball playing ability of various university male volleyball players. There was a significant relationship between the volleyball playing ability and physiological and anthropometric variables.

Keywords: Volleyball, physiology, resting pulse rate, breath holding time, anthropometric, height, hand and leg length

Introduction
'Sports' is a popular spectacle and a mass social movement of contemporary times. In the process of historical development sports has occupied a prominent place both in the moral culture of a society. Its social significance continues to soar. The term sports is sometimes extended to encompass all competitive activities in which offense and defense are played, regardless of the level of physical activity. Both games of skill and motor sport exhibit many of the characteristics of physical sports, such as skill, sportsmanship, and at the highest levels, even professional sponsorship associated with physical sports.

Volleyball, game played by two teams, usually of six players on a side, in which the players use their hands to bat a ball back and forth over a high net, trying to make the ball touch the court within the opponents' playing area before it can be returned. To prevent this a player on the opposing team bats the ball up and toward a teammate before it touches the court surface-that teammate may then volley it back across the net or bat it to a third teammate who volleys it across the net. A team is allowed only three touches of the ball before it must be returned over the net.

History
Volleyball was invented in 1895 by William G. Morgan, physical director of the Young Men's Christian Association (YMCA) in Holyoke, Massachusetts. It was designed as an indoor sport for businessmen who found the new game of basketball too vigorous. Morgan called the sport "mintonette," until a professor from Springfield College in Massachusetts noted the volleying nature of play and proposed the name of "volleyball." The original rules were written by Morgan and printed in the first edition of the Official Handbook of the Athletic League of the Young Men's Christian Associations of North America (1897).

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The game soon proved to have wide appeal for both sexes in schools, playgrounds, the armed forces, and other organizations in the United States, and it was subsequently introduced to other countries.

In 1916 rules were issued jointly by the YMCA and the National Collegiate Athletic Association (NCAA).

The first nationwide tournament in the United States was conducted by the National YMCA Physical Education Committee in New York City in 1922. The United States Volleyball Association (USVBA) was formed in 1928 and recognized as the rules-making, governing body in the United States. From 1928 the USVBA-now known as USA Volleyball (USAV) has conducted annual national men's and senior men's (age 35 and older) volleyball championships, except during 1944 and 1945. Its women's division was started in 1949, and a senior women's division (age 30 and older) was added in 1977. Other national events in the United States are conducted by member groups of the USAV such as the YMCA and the NCAA.

Volleyball was introduced into Europe by American troops during World War I, when national organizations were formed. The Fédération Internationale de Volley Ball (FIVB) was organized in Paris in 1947 and moved to Lausanne, Switzerland, in 1984. The USVBA was one of the 13 charter members of the FIVB, whose membership grew to more than 210 member countries by the late 20th century.

International volleyball competition began in 1913 with the first Far East Games, in Manila. During the early 1900s and continuing until after World War II, volleyball in Asia was played on a larger court, with a lower net, and nine players on a team.

The FIVB-sponsored world volleyball championships (for men only in 1949; for both men and women in 1952 and succeeding years) led to acceptance of standardized playing rules and officiating. Volleyball became an Olympic sport for both men and women at the 1964 Olympic Games in Tokyo.

European championships were long dominated by Czechoslovakian, Hungarian, Polish, Bulgarian, Romanian, and Soviet (later, Russian) teams. At the world and Olympic level, Soviet teams have won more titles, both men's and women's, than those of any other nation. Their success was attributed to widespread grassroots interest and well-organized play and instruction at all levels of skill. A highly publicized Japanese women's team, Olympic champions in 1964, reflected the interest of private industry in sport. Young women working for the sponsoring company devoted their free time to conditioning, team practice, and competition under expert and demanding coaching. Encouraged by the Japanese Volleyball Association, this women's team made its mark in international competition, winning the World Championship in 1962, 1966, and 1967, in addition to the 1964 Olympics. At the end of the 20th century, however, the Cuban women's team dominated both the World Championships and the Olympics.

The Pan American Games (Involving South, Central, and North America) added volleyball in 1955, and Brazil, Mexico, Canada, Cuba, and the United States are frequent contenders for top honours. In Asia, China, Japan, and Korea dominate competition. Volleyball, especially beach volleyball, is played in Australia, New Zealand, and throughout the South Pacific.

A four-year cycle of international volleyball events, recommended by the FIVB, began in 1969 with World Cup championships, to be held in the year following the Olympic Games; the second year is the World Championships; in the third the regional events are held (e.g., European championships, Asian Games, African Games, Pan American Games); and in the fourth year the Olympic Games.

Volleyball requires a minimum of equipment and space and can be played indoors or outdoors. The game is played on a smooth-surfaced court 9 metres (30 feet) wide by 18 metres (60 feet) long, divided by a centre line into two equal areas, one of which is selected by or assigned to each of the two competing teams. Players may not step completely beyond the centre line while the ball is in play. A line 3 metres (10 feet) from and parallel to the centre line of each half of the court indicates the point in front of which a back court player may not drive the ball over the net from a position above the top of the net. (This offensive action, called a spike, or kill, is usually performed most effectively and with greatest power near the net by the forward line of players.) A tightly stretched net is placed across the court exactly above the middle of the centre line; official net heights (measured from the top edge of the net to the playing surface—in the middle of the court) are 2.4 metres (8 feet) for men and 2.2 metres (7.4 feet) for women. Further adjustments in net height can be made for young people and others who need a lower net. A vertical tape marker is attached to the net directly above each side boundary line of the court, and, to help game officials judge whether served or volleyed balls are in or out of bounds, a flexible antenna extends 1 metre (3 feet) above the net along the outer edge of each vertical tape marker. The ball used is around 260 to 280 grams (9 to 10 ounces) and is inflated to about 65 cm (25.6 inches) in circumference. A ball must pass over the net entirely between the antennae. A service area, traditionally 3 metres (10 feet) long, is marked outside and behind the right one third of each court end line. At the 1996 Olympic Games the service area was extended to 9 metres (30 feet). The service must be made from within or behind this area. A space at least 2 metres (6 feet) wide around the entire court is needed to permit freedom of action, eliminate hazards from obstructions, and allow space for net support posts and the officials' stands. A clear area above the court at least 8 metres (26 feet) high is required to permit the ball to be served or received and played without interference.

Informally, any number can play volleyball. In competition each team consists of six players, three of whom take the forward positions in a row close to and facing the net, the other three playing the back court. (An exception to this rotation is the libero, a position introduced at the 2000 Olympics; see below.) Play is started when the right back (the person on the right of the second row) of the serving team steps outside his end line into the serving area and bats the ball with a hand, fist, or arm over the net into the opponents' half of the court. The opponents receive the ball and return it across the net in a series of not more than three contacts with the ball. This must be done without any player catching or holding the ball while it is in play and without any player touching the net or entering the opponents' court area. The ball must not touch the floor, and a player may not touch the ball twice in succession. A player continues to serve until his team makes an error, commits a foul, or completes the game. When the service changes, the receiving team becomes the serving team and its players rotate clockwise one position, the right forward shifting to the right back position and then serving from the service area. Either team can score, with points being awarded for successfully hitting the ball onto the opposing side's half of the court, as well as when the opposing side commits errors or fouls, such as hitting the ball out of bounds, failing to return the ball, contacting the ball more than three times before returning it, etc. Only one point

at a time is scored for a successful play. A game is won by the team that first scores 25 points, provided the winning team is ahead by 2 or more points, except in the fifth set, when a team needs to score only 15 points and win by 2 points.

The 2000 Olympics introduced significant rule changes to international competition. One change created the libero, a player on each team who serves as a defensive specialist. The libero wears a different colour from the rest of the team and is not allowed to serve or rotate to the front line. Another important rule change allowed the defensive side to score, whereas formerly only the serving team was awarded points.

For the physiological systems of the body to be fit, they must function well enough to support the specific activity that the individual is performing. Physiological systems are highly adoptable of exercise. Each task has major physiological components and fitness for the task requires effective functioning of appropriate systems. A normal pulse rate for a healthy adult, while resting, can range from 60 to 100 beats per minute (BPM), although well-conditioned athletes may have a healthy pulse rate much lower than 60 BPM, say 30-45 BPM. The pulse is a decidedly low tech/high yield and antiquated term still useful at the bedside in an age of computational analysis of cardiac performance. The heart rate can be (much) higher than the pulse rate depending upon the cause or etiology. In this case, the heart rate is determined by auscultation of the heart apex, in which case it is not the pulse. Anthropometry is the measure of woman/ man (anthro=man, pometry=measure). The study of anthropometry is the study of human body measurements to assist in understanding human physical variations and aid in anthropological classification.

Methodology
To achieve purpose of the present study, two hundred and fifty two university male volleyball players from sixteen universities, such as, C.C.S. University, Meerut, Chatrapati Sahuji Maharaj Kanpur University, Kanpur, Aligarh Muslim University (AMU), Uttar Pradesh, Babasaheb Bhimrao Ambedkar University
(BBAU), Uttar Pradesh, Banaras Hindu University (BHU), Uttar Pradesh, University of Allahabad, Uttar Pradesh, Bundelkhand University, Deen Dayal Upadhyay Gorakhpur University, Dr. B.R. Ambedkar University, Dr. Ram Manohar Lohia Awadh University, Gautam Buddha University, Lucknow University, Madan Mohan Malaviya University of Technology, Veer Bahadur Singh Purvanchal University, Amity University, Noida, Uttar Pradesh and Mahatma Gandhi Kashi Vidyapith, Varanasi, Uttar Pradesh were selected as subjects. The age of the subjects were ranged between 18 and 25 years. The following selected physiological and anthropometric variables such as, resting pulse rate, breath holding time, height, hand and leg length selected for the present study. Pulse rate per minute at resting condition, holding the breath for maximum duration in seconds, steadiometer and measuring tape were used to measure the resting pulse rate per minute, breath holding time, height and hand & leg length. The Pearson Product Moment correlation was used to find out the relationship between the selected physiological and anthropometric variables such as resting pulse rate, breath holding time, height and hand length, and volleyball playing ability of various university male volleyball players.

Analysis of data
The data collected on resting pulse rate, breathe holding time,

height and leg length on volleyball playing ability were analysed and presented in the following Table 1.

Table 1: Descriptive statistics for all selected variables

S. No.	Variables	Mean	S.D.
1.	Resting Pulse Rate	64.52	4.521
2.	Breath holding time	53.23	3.671
3.	Height	159.51	4.008
4.	Leg Length	0.93	0.0644
5.	Volleyball Playing Ability	7.40	1.076

Table 2: Correlation between selected criterion variables of male university volleyball players

	Rate	Holding time			Playing ability
Resting Pulse Rate	1.00	0.167*	-0.203*	- 0.197*	- 0.160*
Breath Holding Time	-	1.00	- 0.259*	- 0.282*	- 0.072
Height	-	-	1.00	0.986*	- 0.260*
Leg Length	-	-	-	1.00	- 0.274*
Volleyball Playing Ability	-	-	-	-	1.00

From the scores exhibited in Table 2 following inferences were drawn:

The correlation between resting pulse rate and breath holding time was positive and r = 0.167 and it was as much as higher than the 0.008 (*p*>0.01) and found to be statistically significant
1. The correlation between resting pulse rate and height was positive and r = – 0.203 and it was as much as higher than the 0.001 (*p*>0.01) and found to be statistically significant.
2. The correlation between resting pulse rate and leg length was positive and r = – 0.197 (*p*>0.01) and it was as much as higher than the 0.002 and found to be statistically significant.
3. The correlation between resting pulse rate and volleyball playing ability was positive and r = – 0.160 and it was as much as greater than the 0.011 (*p*>0.01) and found to be statistically significant.
4. The correlation between breath holding time and height was positive and r = – 0.259 (*p*>0.01) and it was as much as higher than the 0.00001 and found to be statistically significant.
5. The correlation between breath holding time and leg length was positive and r = – 0.282 (*p*>0.01) and it was as much as higher than the 0.00001 and found to be statistically significant.
6. The correlation between breath holding time and volleyball playing ability was negative and r = –0.072 (*p*>0.01) and it was as much as lesser than the 0.252 and found to be statistically significant.
7. The correlation between height and leg length was positive and r = 0.986 (*p*>0.01) and it was as much as higher than the 0.00001 and found to be statistically significant.
8. The correlation between height and volleyball playing ability was positive and r = – 0.260 (*p*>0.01) and it was as much as higher than the 0.00001 and found to be statistically significant.
9. The correlation between leg length and volleyball playing ability was positive and r = – 0.274 (*p*> and it was as much as higher than the 0.00001 and found to be statistically significant.

It is evident from the Table 2 that there is a significant

relationship between volleyball playing ability and resting pulse rate, breath holding time, height and leg length of male university volleyball players in each variable separately. Multiple regression equation was computed only because the multiple correlations were sufficiently high to warrant prediction from it. Then, the correlation identified the independent variables to be included and their order in the regression equation. Multiple correlations were computed by forward selection method on data obtained for the male volleyball players in volleyball playing ability and the results were presented in Table 3.

Table 3: Multiple correlation co-efficient for the predictors of volleyball playing ability of male volleyball players

S. No.	Variables (Forward selection)	R	R square	Adjusted R square	R square change
1.	Leg Length	0.274	0.075	0.072	0.075
2.	Leg Length and Resting Pulse Rate	0.350	0.123	0.116	0.048
3.	Leg Length, Resting Pulse Rate and Breath Holding Time	0.374	0.140	0.130	0.017

From the Table 3, it is found out that the multiple correlations co-efficient for predictors, such as leg length, resting pulse rate and breath holding time is 0.374, which produces multiple correlations with volleyball playing ability of male university volleyball players. R square values show that the percentage of contribution of predictors to the volleyball playing ability (dependent variable) is in the following order.

1. About 8% of the variation in volleyball playing ability was explained by the regression model with one predictor, such as leg length.
2. About 12% of the variation in volleyball playing ability was explained by the regression model with two predictors such as, leg length and resting pulse rate.
3. About 13% of the variation in the volleyball playing ability was explained by the regression model, with three Predictors leg length, resting pulse rate and breathe holding time.

Multiple regression equation was computed and the results were presented in Table 4.

Table 4: Regression coefficients for the predicted variables with volleyball playing ability of male university volleyball players

S. No.	Variables	B	Std. error	Beta weights
1.	(Constant)	11.670	0.947	
	Leg Length	- 4.586	1.016	- 0.274
2.	(Constant)	22.499	3.09	
	Leg Length	- 5.318	1.012	-0.318
	Resting Pulse Rate	- 0.157	0.043	-0.222
3.	(Constant)	24.469	3.191	
	Leg Length	-5.912	1.039	-0.354
	Resting Pulse Rate	-0.146	0.043	-0.206
	Breath Holding Time	-0.04	0.018	-0.138

From Table 4, the following regression equations were derived for university volleyball players with dependent variables.

1. Regression Equation in obtained scores form = X_C

$$X_C = (- 5.912) X_1 + (0.146) X_2 + (0.04) X_3 + 24.469$$

Where
X_c = Volleyball playing ability,
X_1 = Leg Length, X_2 = Resting Pulse rate and X_3 = Breath Holding Time.

2. Regression Equation in standard scores form = Z_C

$$Z_C = (-0354) Z_1 + (- 0.206) Z_2 + (- 0.138) Z_3$$

Where
Z_c = Volleyball playing ability,
Z_1 = Leg length,
Z_2 = Resting pulse rate
Z_3 = breath holding time.

The regression equation for the prediction of volleyball playing ability of male volleyball players includes resting pulse rate, height and leg length. As the multiple correlations on volleyball playing ability with the combined effect of these independent variables are highly significant, it is apparent that the obtained regression equation has a high predictive validity.

Results and Discussion
The results of the study has shown that there was a significant relationship between volleyball playing ability and resting pulse rate, height and leg length among male university volleyball players. The study is in line with the findings of P. Krustrup *et al*, (2009) [7] reported that there was a significant relationship between the volleyball playing ability and heart rate. Amusa (1979) [8], have reported that there was a significant correlation between the height and volleyball playing ability. Bell, Cobner and Evans (2000) [9] have found that there was a significant relationship between the leg length and volleyball playing ability. But there was no significant correlation between the volleyball playing ability and breath holding time.

Conclusions
Based on the results of the study the following conclusions were drawn:

1. There was a significant correlation between volleyball playing ability and resting pulse rate, height and leg length among male university volleyball players. But there was no significant correlation between the breath holding time and volleyball playing ability.
2. The regression equation for the prediction of volleyball playing ability of inter university volleyball players including, resting pulse rate, breath holding time and leg length were significant.
3. As the multiple correlations on playing ability with the combined effect of these independent variables are highly significant, it apparent that the obtained regression equation has a high predictive validity.

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