Chapter IV

ANALYSIS OF DATA AND RESULTS OF THE STUDY

The analysis of data collected on one hundred and thirty five male school volleyball players is presented in this chapter. The data on volleyball playing ability along with physical, physiological and motor skill variables was examined by Pearson's Product Moment correlation\(^1\) to find out the relationships of playing ability to each of these variables separately. Multiple correlation\(^2\) between physical variables and playing ability, physiological variables and playing ability and motor skill variables and playing ability were computed to assess the combined effects of speed, arm strength, explosive power, dynamic balance, agility, wrist flexibility, ankle flexibility, trunk hyper extension, shoulder flexibility, age, height and weight to playing ability,


pulse rate, systolic blood pressure, diastolic blood pressure, pulse pressure, body fat, lean body weight and cardiovascular endurance to playing ability and volleying, serving, passing and set up to playing ability respectively. Multiple regression equation\(^3\) was developed in order to determine the volleyball playing ability on the basis of physical, physiological and motor skill variables separately. The data was further examined by 't' ratio\(^4\) to find out the significant difference between successful and unsuccessful volleyball players. 'F' ratio\(^5\) was also applied to find out the significant difference among all rounders, spikers and set uppers in all the variable. When differences were found to be significant, Scheffe


nd Newman - Keuls post hoc tests\textsuperscript{6} were applied to assess the significant differences between the paired means.

**Level of Significance**

The level of significance to check the relationship obtained by person's Product Moment correlation, Multiple correlation, 't' ratio and 'F' ratio was set at .05 level of confidence which was considered appropriate because the research processes adopted did not involve highly sophisticated equipment demanding the application of more stringent levels of significance. In using the product moment correlation, a value of .169 was needed to be significant at the .05 level of confidence for 135 degree of freedom.\footnote{Clark and Clarke, Research Processes in Physical Education, Recreation and Health, p. 231.}

**Findings**

Relationship of Physical, Physiological and Motor Skill Variables to Playing Ability

The scores of each of the independent variables of

\footnote{Ibid.}
physical, physiological and motor skill domains were correlated with criterion variables, the volleyball playing ability in order to find out relationship between the dependent and independent variables which are presented in Tables 2, 3, 4.

**TABLE 2**

**RELATIONSHIP TO PHYSICAL VARIABLES TO VOLLEYBALL PLAYING ABILITY**

<table>
<thead>
<tr>
<th>Variables Correlated</th>
<th>Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed and Playing Ability</td>
<td>-0.56*</td>
</tr>
<tr>
<td>Arm strength and Playing Ability</td>
<td>0.65*</td>
</tr>
<tr>
<td>Explosive Power and Playing Ability</td>
<td>0.68*</td>
</tr>
<tr>
<td>Dynamic Balance and Playing Ability</td>
<td>0.46*</td>
</tr>
<tr>
<td>Agility and Playing Ability</td>
<td>-0.61*</td>
</tr>
<tr>
<td>Wrist Flexibility and Playing Ability</td>
<td>0.26*</td>
</tr>
<tr>
<td>Ankle Flexibility and Playing Ability</td>
<td>0.39*</td>
</tr>
<tr>
<td>Trunk Hyper Extension and Playing Ability</td>
<td>-0.28*</td>
</tr>
<tr>
<td>Shoulder Flexibility and Playing Ability</td>
<td>-0.55*</td>
</tr>
<tr>
<td>Age and Playing Ability</td>
<td>0.19*</td>
</tr>
<tr>
<td>Height and Playing Ability</td>
<td>0.35*</td>
</tr>
<tr>
<td>Weight and Playing Ability</td>
<td>0.34*</td>
</tr>
</tbody>
</table>

N = 135

*Significance at .05 level of confidence

$r_{.05} (133) = 0.169$. 
Table 2 shows that playing ability in volleyball is significantly related to each of the physical variables such as speed ($r=-0.56$) Fig. 12, arm strength ($r=0.65$) Fig. 13, explosive power ($r=0.68$) Fig. 14, dynamic balance ($r=0.46$) Fig. 15, agility ($r=-0.61$) Fig. 16, wrist flexibility ($r=0.26$) Fig. 17, ankle flexibility ($r=0.39$) Fig. 18, trunk hyper extension ($r=-0.28$) Fig. 19, shoulder flexibility ($r=-0.55$) Fig. 20, age ($r=0.19$) Fig. 21, height ($r=0.35$) Fig. 22 and weight ($r=0.34$) Fig. 23 because their calculated values are greater than the value of .169 needed to be significant at .05 level of confidence with 133 degrees of freedom.

Therefore, it is evident that speed, arm strength, explosive power, dynamic balance, agility, wrist flexibility, ankle flexibility, trunk hyper extension, shoulder flexibility, age, height, and weight contribute to volleyball playing ability.

The graphical presentation of relationship between physical variables and volleyball playing ability are given in Fig. 12 to 23.
FIG 12. Relationship Between Speed and Volleyball Playing Ability.
FIG. 13. Relationship Between Arm Strength and Volleyball Playing Ability.
FIG. 15. Relationship Between Dynamic Balance and Volleyball Playing Ability.
FIG. 16. Relationship Between Agility and Volleyball Playing Ability.
FIG. 17. Relationship Between Wrist Flexibility and Volleyball Playing Ability.
FIG. 13. Relationship Between Ankle Flexibility and Volleyball Playing Ability.
FIG. 21. Relationship Between Age and Volleyball Playing Ability.
FIG. 22: Relationship Between Height and Volleyball Playing Ability.
FIG. 23. Relationship Between Weight and Playing Ability.
### TABLE 3
RELATIONSHIP OF PHYSIOLOGICAL VARIABLES TO VOLLEYBALL PLAYING ABILITY

<table>
<thead>
<tr>
<th>Variables Correlated</th>
<th>Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Rate and Playing Ability</td>
<td>-0.44*</td>
</tr>
<tr>
<td>Systolic Blood Pressure and Playing Ability</td>
<td>-0.12</td>
</tr>
<tr>
<td>Diastolic Blood Pressure and Playing Ability</td>
<td>-0.16</td>
</tr>
<tr>
<td>Pulse Pressure and Playing Ability</td>
<td>0.09</td>
</tr>
<tr>
<td>Body Fat and Playing Ability</td>
<td>0.44*</td>
</tr>
<tr>
<td>Lean Body Weight and Playing Ability</td>
<td>0.33</td>
</tr>
<tr>
<td>Cardiovascular Endurance and</td>
<td>-0.47*</td>
</tr>
<tr>
<td>Playing Ability</td>
<td></td>
</tr>
</tbody>
</table>

N = 135

*Significance at .05 level of confidence

\[
r_{.05}(133) = 0.169
\]

Table 3 indicates that the volleyball playing ability is significantly related to pulse rate \((r=-0.44)\) Fig. 24,
body fat \( (r=0.44) \) Fig. 28, lean body weight \( (r=0.33) \) Fig. 29 and cardiovascular endurance \( (r=-0.47) \) Fig. 30 as the calculated \( r \) values are greater than .169 needed to be significant at .05 level of confidence with 133 degree of freedom. Whereas volleyball playing ability is not significantly related to systolic blood pressure \( (r=-0.12) \) Fig. 25, diastolic blood pressure \( (r=-0.16) \) Fig. 26 and pulse pressure \( (r=0.09) \) Fig. 27.

Therefore it is obvious that pulse rate, body fat, lean body weight and cardiovascular endurance are essential components for the performance of the volleyball. Table mentioned above also shows that systolic blood pressure, diastolic blood pressure and pulse pressure do not contribute to volleyball playing ability. The graphical presentation of relationship between physiological variables and volleyball playing ability presented in Fig. 24 to 30.
Fig. 24. Relationship Between Pulse Rate and Volleyball Playing Ability.
FIG. 26. RELATIONSHIP BETWEEN DIASTOLIC BLOOD PRESSURE AND VOLLEYBALL PLAYING ABILITY.
Volleyball Playing Ability

FIG. 27 Relationship Between Pulse Pressure and Volleyball Playing Ability.
FIG. 28 Relationship Between Body Fat and Volleyball Playing Ability.
FIG. 29. Relationship Between Lean Body Weight and Volleyball Playing Ability.
### Table 4

**Relationship of Motor Skill Variables to Volleyball Playing Ability**

<table>
<thead>
<tr>
<th>Variables Correlated</th>
<th>Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleyball Serving and Playing Ability</td>
<td>0.52</td>
</tr>
<tr>
<td>Volleyball Passing and Playing Ability</td>
<td>0.44</td>
</tr>
<tr>
<td>Volleyball Setting and Playing Ability</td>
<td>0.50</td>
</tr>
<tr>
<td>Cardio-vascular Endurance</td>
<td>r = -0.47</td>
</tr>
</tbody>
</table>

![Diagram](image)

**FIG. 30. Relationship Between Cardio-vascular Endurance and Volleyball Playing Ability.**
### Table 4

**Relationship of Motor Skill Variables to Volleyball Playing Ability**

<table>
<thead>
<tr>
<th>Variables Correlated</th>
<th>Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleying and Playing Ability</td>
<td>0.73*</td>
</tr>
<tr>
<td>Serving and Playing Ability</td>
<td>0.58*</td>
</tr>
<tr>
<td>Passing and Playing Ability</td>
<td>0.44*</td>
</tr>
<tr>
<td>Set up and Playing Ability</td>
<td>0.42*</td>
</tr>
</tbody>
</table>

N = 135

*Significance at .05 level of confidence

r_{.05} (133) = 0.169

Table 4 reveals that all motor skill variables are significantly correlated to volleyball playing ability such as volleying (r=0.73) Fig. 31, serving (r=0.58) Fig. 32, passing (r=0.44) Fig. 33 and set up (r=0.42) Fig. 34 as the correlated values are greater than the value of .169 required to be significant at .05 level of confidence with 133 degree of freedom.
It is observed that volleying, serving, passing and set up are underlying factors of playing ability in volleyball. The graphical presentation of relationship between motor skill variables and volleyball playing ability have been depicted in figures 31 to 34.


Multiple correlation was applied to assess the combined effect of physical variables to volleyball playing ability, physiological variables to volleyball playing ability and motor skill variables to volleyball playing ability respectively which are presented in tables 5, 6 and 7.

Multiple correlation was used to assess the combined contribution of speed, arm strength, explosive power, dynamic balance, agility, wrist flexibility, ankle flexibility, trunk hyper extension, shoulder flexibility, age,
FIG. 31. Relationship Between Volleying and Volleyball Playing Ability.
FIG. 32. Relationship Between Serving and Volleyball Playing Ability.

$\rho = 0.58$
FIG. 33. Relationship Between Passing and Volleyball Playing Ability.
FIG. 34. Relationship Between Set up and Volleyball Playing Ability.
height and weight to playing ability as multiple correlation gives the correlation between a dependent variable and the combined effect of a number of independent variables, which are weighted so as to give a maximum correlation. To obtain this correlation, playing ability in volleyball (c) was treated as the dependent variable and the speed (1), arm strength (2), explosive power (3), dynamic balance (4), agility (5), wrist flexibility (6), ankle flexibility (7), trunk hyper extension (8), shoulder flexibility (9), age (10), height (11), and weight (12), were considered the independent variables have been presented in table 5.

---

TABLE 5
COMBINED CONTRIBUTION OF PHYSICAL VARIABLES
TO VOLLEYBALL PLAYING ABILITY,

<table>
<thead>
<tr>
<th>Criterion Variable</th>
<th>Independent Variables</th>
<th>Multiple Correlation</th>
<th>Coefficient of Multiple correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Strength</td>
<td>(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosive Power</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Balance</td>
<td>(4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agility</td>
<td>(5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist Flexibility</td>
<td>(6)</td>
<td>Rs.357</td>
<td>0.7286*</td>
</tr>
<tr>
<td>Ankle Flexibility</td>
<td>(7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk Hyper Extension</td>
<td>(8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Flexibility</td>
<td>(9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>(10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>(11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>(12)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 135
*Significant at .05 level of confidence
\( r .05 (131) = 0.241 \)

Table 5 reveals that combined contribution of explosive power, agility and ankle flexibility is significant at .5 level of confidence as the computed value of 0.7286 (Rs.357) for multiple correlation was more than the value of
0.241 required for the multiple correlation coefficient to be significant at .05 level of confidence with 131 degrees of freedom. From the obtained value of multiple correlation it can be deduced that the explosive power, agility and ankle flexibility taken together contribute to volleyball playing ability as shown in Fig. 35.

Multiple correlation was used with physiological variables to assess the combined contribution of pulse rate, systolic blood pressure, diastolic blood pressure pulse pressure, body fat, lean body weight and cardiovascular endurance to volleyball playing ability. To obtain this correlation, playing ability was treated as the dependent variable and the pulse rate (1), systolic blood pressure (2), Diastolic blood pressure (3), Pulse pressure (4), body fat (5), lean body weight (6), and cardiovascular endurance (7), as the independent variables. The multiple correlation coefficient (Rc.764) computed between criterion variable
FIG. 35. Combined Contribution of Explosive Power Agility and Ankle Flexibility.
and independent variables has been presented in table 6.

**TABLE 6**

**COMBINED CONTRIBUTION OF PHYSIOLOGICAL VARIABLES TO VOLLEYBALL PLAYING ABILITY**

<table>
<thead>
<tr>
<th>Criterion Variable</th>
<th>Independent variables</th>
<th>Multiple correlation of Multiple correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleyball Playing Ability (C)</td>
<td>Pulse Pressure (4)</td>
<td>Rs.764</td>
</tr>
<tr>
<td></td>
<td>Body Fat (5)</td>
<td>Pulse Rate (1)</td>
</tr>
<tr>
<td></td>
<td>Lean Body Weight (6)</td>
<td>Systolic Blood Pressure (2)</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular endurance (7)</td>
<td>Diastolic Blood Pressure (3)</td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence.

$r .05(131) = 0.241.$
Table 6 has disclosed that combined contribution of cardio-vascular endurance, lean body weight and pulse pressure to playing ability was significant at .05 level of confidence, as the computed value of 0.5978 (Rc.764) for multiple correlation was more than the value of 0.241 required for the multiple correlation to be significant at .05 level of confidence with 131 degrees of freedom. From the obtained value of multiple correlation it can be inferred that the cardiovascular endurance, lean body weight and pulse pressure together favourably contribute to volleyball playing ability as shown in Fig. 36.

Multiple correlation was also used with motor skill variables to assess the combined contribution of volleying, serving, passing and set up to playing ability. To obtain this correlation, playing ability was treated as the dependent variable and the volleying (V), Serving (S), Passing (P) and Set up (U) as the independent variables. The multiple correlation coefficient (Rc. 7378) computed between criterion variable and independent variables has been presented in Table 7.
Cardio-Vascular Endurance, Lean Body Weight, Pulse Pressure.

TABLE 7

COMBINED CONTRIBUTION OF MOTOR SKILL VARIABLES TO VOLLEYBALL PLAYING ABILITY

<table>
<thead>
<tr>
<th>Criterion Variable</th>
<th>Independent Variables</th>
<th>Multiple Correlation</th>
<th>Coefficient of Multiple Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleying (V)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volleyball Serving (S)</td>
<td></td>
<td>Rc. VS</td>
<td>0.7378*</td>
</tr>
<tr>
<td>Volleyball Playing Ability (C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing (P)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set up (U)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence.

\[ r_{0.05 (131)} = 0.241 \]

Table 7 shows that combined contribution of volleying, serving, passing and set up to playing ability is significant at .05 level of confidence, as the computed value of 0.7378 (Rc.VS) for multiple correlation was more than the value of 0.241 required for the multiple
correlation coefficient to be significant at .05 level of confidence with 131 degrees of freedom. From the obtained value of multiple correlation it can be concluded that the volleying and serving taken together contribute to volleyball playing ability as shown in Fig. 37

Multiple Regression Analysis

The multiple regression analysis performed to develop equations for the prediction of playing ability on the basis of the physical, physiological and motor skill variables separately resulted in the following equations:

**Physical Variables**

\[ X_c = 0.0582 \, X_3 \text{ (Explosive Power)} - 0.4119 \, X_5 \text{ (Agility)} + 0.0177 \, X_7 \text{ (Ankle Flexibility)} + 4.26 \]

**Physiological Variables**

\[ X_c = -0.0723 \, X_7 \text{ (Cardiovascular Endurance)} + 0.0584 \, X_6 \text{ (Lean Body Weight)} + 0.0463 \, X_4 \text{ (Pulse Pressure)} + 7.68 \]
FIG. 37. Combined Contribution of Volleys and Serves to Volleyball Playing Ability.
Motor Skill Variables

\[ X_C = 0.113 X_1 \text{ (Volleying)} + 0.037 X_2 \text{ (Serving)} - 2.64 \]

Where \( X_C \) is the predicted playing ability score in numbers.

Significance of Differences in Physical, Physiological and Motor Skill Variables Between Successful and Unsuccessful Volleyball Players

For testing the significance of difference between the means of successful and unsuccessful volleyball players in the physical, physiological and motor skill variables 't' test was employed. The data pertaining to this study are given in Table 8, 9 and 10.
### TABLE 8

**SIGNIFICANCE OF DIFFERENCE OF MEAN BETWEEN SUCCESSFUL AND UNSUCCESSFUL VOLLEYBALL PLAYER IN PHYSICAL VARIABLES**

<table>
<thead>
<tr>
<th>Variables (Unit)</th>
<th>Successful Volleyball Players Mean ± S.D.</th>
<th>Unsuccessful Volleyball Players Mean ± SD.</th>
<th>d</th>
<th>S.E.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (Second)</td>
<td>6.76 ± 0.18</td>
<td>7.19 ± 0.19</td>
<td>0.43</td>
<td>0.05</td>
<td>8.60*</td>
</tr>
<tr>
<td>Arm Strength (Number)</td>
<td>790.75 ± 127.61</td>
<td>458.45 ± 100.40</td>
<td>332.30</td>
<td>37.93</td>
<td>8.76*</td>
</tr>
<tr>
<td>Explosive Power (Centimeter)</td>
<td>54.17 ± 1.75</td>
<td>41.20 ± 4.76</td>
<td>12.97</td>
<td>0.66</td>
<td>19.65</td>
</tr>
<tr>
<td>Dynamic Balance (Number)</td>
<td>88.92 ± 6.32</td>
<td>78.59 ± 4.92</td>
<td>10.33</td>
<td>1.88</td>
<td>5.49*</td>
</tr>
<tr>
<td>Agility (Second)</td>
<td>11.33 ± 0.29</td>
<td>12.51 ± 0.43</td>
<td>1.18</td>
<td>0.09</td>
<td>13.11*</td>
</tr>
<tr>
<td>Wrist Flexibility (Degree)</td>
<td>176.17 ± 8.36</td>
<td>165.32 ± 14.57</td>
<td>10.85</td>
<td>2.75</td>
<td>3.95</td>
</tr>
<tr>
<td>Ankle Flexibility (Degree)</td>
<td>86.00 ± 10.32</td>
<td>73.65 ± 7.23</td>
<td>12.35</td>
<td>3.05</td>
<td>4.05*</td>
</tr>
<tr>
<td>Trunk Hyper Extension (Inch)</td>
<td>41.33 ± 1.44</td>
<td>43.83 ± 2.20</td>
<td>2.50</td>
<td>0.46</td>
<td>5.43*</td>
</tr>
<tr>
<td>Shoulder Flexibility (Inch)</td>
<td>9.75 ± 0.97</td>
<td>13.05 ± 1.93</td>
<td>3.30</td>
<td>0.33</td>
<td>10.00</td>
</tr>
</tbody>
</table>
### TABLE 8 (Contd.)

<table>
<thead>
<tr>
<th>Variables (Unit)</th>
<th>Successful Volleyball Players Mean ± S.D.</th>
<th>Unsuccessful Volleyball Players Mean ± S.D.</th>
<th>$d$</th>
<th>S.E.</th>
<th>$t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Calendar year)</td>
<td>16.42 ± 0.51</td>
<td>17.59 ± 1.21</td>
<td>0.83</td>
<td>0.18</td>
<td>4.61</td>
</tr>
<tr>
<td>Height (inches)</td>
<td>70.67 ± 2.15</td>
<td>68.39 ± 2.19</td>
<td>2.28</td>
<td>0.65</td>
<td>3.51</td>
</tr>
<tr>
<td>Weight (Pound)</td>
<td>200.42 ± 13.65</td>
<td>128.30 ± 12.20</td>
<td>12.12</td>
<td>4.09</td>
<td>2.96</td>
</tr>
</tbody>
</table>

$N = 135$

*xSignificant at .05 level of confidence.

't' *05 (133) = 1.98.*

The mean difference in each of the physical variables were analysed by 't' test for statistical significance of difference between successful and unsuccessful volleyball players. It is evident from the table 8 that there are significant differences in all the physical variables such as speed, arm strength, explosive power, dynamic balance, agility, wrist flexibility, ankle flexibility, trunk hyper extension, shoulder
flexibility, age, height and weight. Hence all the obtained 't' value are greater than table 't' value of 1.98 required to be significant at .05 level of confidence with 133 degree of freedom. The graphical presentation of the mean difference in each of the physical variables is presented in figures 38 to 49.
FIG. 38 Mean Difference Between Successful and Unsuccessful Volleyball Players in Speed.

Scale
'y' axis
1 cm = 1 Second

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 39 Mean Difference Between Successful and Unsuccessful Volleyball Players in Arm Strength.

Scale
'y' axis
1 cm = 100 Pounds
FIG. 40. Mean Difference Between Successful and Unsuccessful Volleyball Players in Explosive Power.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 41 Mean Difference Between Successful and Unsuccessful Volleyball Players in Dynamic Players.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 42 Mean Difference Between Successful and Unsuccessful Volleyball Players in Agility.

Scale
'y' axis
1 cm = 2 Seconds

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 43 Mean Difference Between Successful and Unsuccessful Volleyball Players in Wrist Flexibility.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 44 Mean Difference Between Successful and Unsuccessful Volleyball Players in Ankle Flexibility.

Scale
'y' axis
1 cm = 10°
FIG. 45 Mean Difference Between Successful and Unsuccessful Volleyball Players in Trunk Hyper Extension.
Scale
'y' axis
1 cm = 2 inches

FIG. 46 Mean Difference Between Successful and Unsuccessful Volleyball Players in Shoulder Flexibility.

[Diagram showing the mean difference in shoulder flexibility between successful and unsuccessful volleyball players, with a scale of 1 cm = 2 inches.]
FIG. 47 Mean Difference Between Successful and Unsuccessful Volleyball Players in Age.

Successful Volleyball Players

Unsuccessful Volleyball Players
Scale
'y' axis
1 cm = 10 inches

FIG. 48 Mean Difference Between Successful and Unsuccessful Volleyball Players in Height.

Successful Volleyball Players

Unsuccessful Volleyball Players
Scale
'y' axis
1 cm = 20 Pounds

FIG. 49 Mean Difference Between Successful and Unsuccessful Volleyball Players in Weight.

Successful Volleyball Players

Unsuccessful Volleyball Players
### Table 9

**Significance of Difference of Mean Between Successful and Unsuccessful Volleyball Players in Physiological Variables**

<table>
<thead>
<tr>
<th>Variables (unit)</th>
<th>Successful Volleyball Players Mean ± S.D.</th>
<th>Unsuccessful Volleyball Players Mean ± S.D.</th>
<th>d</th>
<th>S.E.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Rate (Heart Beat per minute)</td>
<td>66.42 ± 1.56</td>
<td>72.76 ± 3.94</td>
<td>6.34</td>
<td>0.57</td>
<td>11.1</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mm. Hg.)</td>
<td>118.58 ± 4.03</td>
<td>120.77 ± 5.21</td>
<td>2.19</td>
<td>1.25</td>
<td>1.75</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mm. Hg.)</td>
<td>77.83 ± 4.82</td>
<td>79.67 ± 5.17</td>
<td>1.84</td>
<td>1.47</td>
<td>1.25</td>
</tr>
<tr>
<td>Pulse Pressure (mm. Hg.)</td>
<td>40.08 ± 2.61</td>
<td>41.11 ± 2.47</td>
<td>1.03</td>
<td>0.79</td>
<td>1.30</td>
</tr>
<tr>
<td>Body Fat (kg.)</td>
<td>10.33 ± 1.15</td>
<td>8.66 ± 1.63</td>
<td>1.67</td>
<td>0.36</td>
<td>4.64*</td>
</tr>
<tr>
<td>Lean Body Weight (Kg.)</td>
<td>53.50 ± 5.44</td>
<td>49.68 ± 4.43</td>
<td>3.82</td>
<td>1.62</td>
<td>2.36*</td>
</tr>
<tr>
<td>Arteriovenous Endurance (Second)</td>
<td>9.48 ± 0.24</td>
<td>10.45 ± 0.46</td>
<td>0.97</td>
<td>0.08</td>
<td>12.13*</td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence.

\[ t_{0.05 (133)} = 1.98 \]
The mean difference in each of physiological variables were analysed by 't' test for statistical significance of differences between the successful and unsuccessful volleyball players. The mean differences in testing pulse rate, body fat, lean body weight and cardiovascular endurance were found statistically significant. The resting pulse rate obtained 't' value 11.12, body fat 4.64, lean body weight 2.36 and cardiovascular endurance 12.13 which is greater than the table 't' value of 1.98 at .05 level of confidence. The other variables such as systolic blood pressure, diastolic blood pressure and pulse pressure were found statistically insignificant. The graphical presentation of the mean difference in each of the physiological variables is depicted in figures 50 to 56.
FIG. 50 Mean Difference Between Successful and Unsuccessful Volleyball Players in Pulse Rate.

Scale
'y' axis
1 cm = 10 Beat/Sec.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 51 Mean Difference Between Successful and Unsuccessful Volleyball Players in Systolic Blood Pressure.

Successful Volleyball Players

Unsuccessful Volleyball Players

Scale
'y' axis
1 cm = 20 mm./Hg.
FIG. 52 Mean Difference Between Successful and Unsuccessful Volleyball Players in Diastolic Blood Pressure.

- Successful Volleyball Players
- Unsuccessful Volleyball Players
FIG. 53  Mean Difference Between Successful and Unsuccessful Volleyball Players in Pulse Pressure.

Successful Volleyball Players

Unsuccessful Volleyball Players
Scale
'y' axis
1 cm = 2 Kgs.

FIG. 54 Mean Difference Between Successful and Unsuccessful Volleyball Players in Body Fat.

- Successful Volleyball Players
- Unsuccessful Volleyball Players
FIG. 55 Mean Difference Between Successful and Unsuccessful Volleyball Players in Lean Body Weight.

Scale
'y' axis
1 cm = 10 Kgs.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 56 Mean Difference Between Successful and Unsuccessful Volleyball Players in Cardio-vascular Endurance.

Scale
'y' axis
1 cm = 2 Seconds
TABLE 10
SIGNIFICANCE OF DIFFERENCE OF MEAN BETWEEN SUCCESSFUL AND UNSUCCESSFUL VOLLEYBALL PLAYERS IN MOTOR SKILL VARIABLES

<table>
<thead>
<tr>
<th>Variables (Unit)</th>
<th>Successful Volleyball Players Mean ± S.D.</th>
<th>Unsuccessful Volleyball Players Mean ± S.D.</th>
<th>d</th>
<th>S.E.</th>
<th>'t'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleying (Point/Min.)</td>
<td>46.50±1.24</td>
<td>39.20±3.49</td>
<td>9.30</td>
<td>0.48</td>
<td>19.1</td>
</tr>
<tr>
<td>Serving (Points)</td>
<td>34.83±1.99</td>
<td>27.95±3.30</td>
<td>6.88</td>
<td>0.65</td>
<td>10.56</td>
</tr>
<tr>
<td>Passing (Point)</td>
<td>17.50±0.52</td>
<td>15.78±1.07</td>
<td>1.72</td>
<td>0.13</td>
<td>9.55</td>
</tr>
<tr>
<td>Set up (Point)</td>
<td>17.17±1.27</td>
<td>15.52±0.89</td>
<td>1.65</td>
<td>0.38</td>
<td>4.34*</td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence.

't' .05 (133) = 1.98

The mean difference in each of the motor skill variables were analysed by 't' test for statistical significance of difference between successful and unsuccessful volleyball players. The mean difference in all the motor
Skill variables such as volleying, serving, passing and set up were found statistically significant. 't' value obtained in volleying is 19.38, serving is 10.58, passing is 9.56 and set up is 4.34 which are greater than table 't' value of 1.98. The graphical presentation of the mean difference in each of the motor skill variables is shown in figures 57 to 60.
FIG. 57 Mean Difference Between Successful and Unsuccessful Volleyball Players in Volleysing.

Scale
'y' axis
1 cm = 5 points

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 58 Mean Difference Between Successful and Unsuccessful Volleyball Players in Serving.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 59 Mean Difference Between Successful and Unsuccessful Volleyball Players in Passing.

Successful Volleyball Players

Unsuccessful Volleyball Players
FIG. 60 Mean Difference Between Successful and Unsuccessful Volleyball Players in Set up.

Successful Volleyball Players

Unsuccessful Volleyball Players

Scale
'y' axis
1 cm = 2 points
Analysis of Variance of Physical, Physiological and Motor Skill Variables Among All Rounders, Spikers and Set Uppers

To find out the significant differences of physical physiological and motor skill variables of three groups namely all rounder, spiker and set upper 'F' test (analysis of variance) was employed. Where the 'F' value was found to be significant at .05 level of confidence Scheffe S and Newman - Keuls post hoc tests were used to establish which of the paired mean were most significant and the data pertaining to the findings are presented in tables 11, 12, 13, 14, 15 and 16.

TABLE 11
ANALYSIS OF VARIANCE OF THE MEAN DIFFERENCES OF PHYSICAL VARIABLES

<table>
<thead>
<tr>
<th>Physical Variables (Unit)</th>
<th>Sources of Variances</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (Second)</td>
<td>Between Groups</td>
<td>2</td>
<td>1.71</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>5.20</td>
<td>0.04</td>
<td>21.50*</td>
</tr>
</tbody>
</table>

*Significant at .05 level.
### TABLE 11 (Contd.)

<table>
<thead>
<tr>
<th>Physical Variables (Unit)</th>
<th>Sources of Variances</th>
<th>df.</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm Strength (Number)</td>
<td>Between Groups</td>
<td>2</td>
<td>692357.56</td>
<td>346178.78</td>
<td>23.75*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>1923992.41</td>
<td>14575.70</td>
<td></td>
</tr>
<tr>
<td>Explosive Power (cns.)</td>
<td>Between Groups</td>
<td>2</td>
<td>1080.50</td>
<td>540.25</td>
<td>20.04</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>3558.43</td>
<td>26.96</td>
<td></td>
</tr>
<tr>
<td>Dynamic Balance (Number)</td>
<td>Between Groups</td>
<td>2</td>
<td>557.59</td>
<td>278.80</td>
<td>9.13</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>4029.49</td>
<td>30.53</td>
<td></td>
</tr>
<tr>
<td>Agility (Second)</td>
<td>Between Groups</td>
<td>2</td>
<td>4.05</td>
<td>2.03</td>
<td>7.81</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>34.63</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Wrist Flexibility (degree)</td>
<td>Between Group</td>
<td>2</td>
<td>2351.42</td>
<td>1175.71</td>
<td>6.06</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>25609.88</td>
<td>194.01</td>
<td></td>
</tr>
<tr>
<td>Physical Variables (Unit)</td>
<td>Sources of Variances</td>
<td>df</td>
<td>Sum of Squares</td>
<td>Mean Squares</td>
<td>'F'</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------</td>
<td>----</td>
<td>----------------</td>
<td>--------------</td>
<td>-----</td>
</tr>
<tr>
<td>Ankle Flexibility (Degree)</td>
<td>Between Groups</td>
<td>2</td>
<td>237.16</td>
<td>118.58</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>8980.28</td>
<td>68.03</td>
<td></td>
</tr>
<tr>
<td>Trunk Extension (inch)</td>
<td>Between Groups</td>
<td>2</td>
<td>6.25</td>
<td>3.13</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>666.35</td>
<td>5.05</td>
<td></td>
</tr>
<tr>
<td>Shoulder Flexibility (inch)</td>
<td>Between Groups</td>
<td>2</td>
<td>74.51</td>
<td>37.26</td>
<td>9.63*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>510.42</td>
<td>3.87</td>
<td></td>
</tr>
<tr>
<td>Age (Calendar year)</td>
<td>Between Groups</td>
<td>2</td>
<td>8.25</td>
<td>4.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>179.75</td>
<td>1.36</td>
<td>3.04</td>
</tr>
<tr>
<td>Height (inch)</td>
<td>Between Groups</td>
<td>2</td>
<td>158.16</td>
<td>79.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>536.43</td>
<td>4.06</td>
<td>19.48*</td>
</tr>
</tbody>
</table>
TABLE II (Contd.)

<table>
<thead>
<tr>
<th>Physical Variables (Unit)</th>
<th>Sources of Variances</th>
<th>df.</th>
<th>sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (Pound)</td>
<td>Between Groups</td>
<td></td>
<td>3984.60</td>
<td>1992.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>17971.14</td>
<td>136.15</td>
<td>14.63</td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence

'F'.05(2,132) = 3.07

Table II reveals that there were significant differences in physical variables among all rounders, spikers, and set uppers as obtained 'F' ratio of speed, arm strength, explosive power, dynamic balance, agility, wrist flexibility, shoulder flexibility height and weight were 21.5, 23.75, 20.04, 9.13, 7.81, 6.06, 9.63, 19.48 and 14.63 respectively which were much higher values than the value 3.07 required for 'F' ratio to be significant at .05 level (2,132) degree of freedom.
Scale
'y' axis
1 cm = 1 Second

FIG. 61 Mean Difference Among All Rounders, Spikers and Set Uppers in Speed.
Scale
'y' axis
1 cm = 100 pounds

FIG. 62 Mean Difference Among All Rounders, Spikers and Set Uppers in Arm Strength

- All Rounders
- Spikers
- Set Uppers
FIG. 63 Mean Difference Among All Rounders, Spikers and Set Uppers in Explosive Power.
FIG. 64 Mean Difference Among All Rounders, Spikers and Set Uppers in Dynamic Balance.

- **All Rounders**
- **Spikers**
- **Set Uppers**
FIG. 65 Mean Difference Among All Rounders, Spikers and Set Uppers in Agility.
FIG: 66 Mean Difference Among All Rounders, Spikers and Set Uppers in Wrist Flexibility.
FIG. 57 Mean Difference Among All Rounders, Spikers and Set Uppers in Ankle Flexibility.

- **All Rounders**: 77.56
- **Spikers**: 75.43
- **Set Uppers**: 73.63
Scale
'y' axis
1 cm = 5 inches.

FIG. 68. Mean Difference Among All Rounders, Spikers and Set Uppers in Trunk Hyper Extension.

- All Rounders
- Spikers
- Set Uppers
FIG. 69. Mean Difference Among All Rounders, Spikers and Set Uppers in Shoulder Flexibility.
FIG. 70. Mean Difference Among All Rounders, Spikers and Set Uppers in Age.
FIG. 71. Mean Difference Among All Rounders, Spikers and Set Uppers in Height.

- All Rounders
- Spikers
- Set Uppers
Scale
'Y' axis
1 cm = 20 Pounds

FIG. 72. Mean Difference Among All Rounders, Spikers and Set Uppers in Weight.
No significant difference was obtained among three groups i.e. all rounder, spiker and set upper in ankle flexibility, trunk hyper extension and age. Mean difference among groups are presented in Figures 61 to 72.

As the 't' ratio were found significant in the case of physical variables, the Scheffe post hoc test was applied to test the significance of difference between paired means separately for different groups which are presented in Table 12.

TABLE 12

SIGNIFICANT DIFFERENCES BETWEEN THE PAIRED MEAN OF PHYSICAL VARIABLES

<table>
<thead>
<tr>
<th>Physical Variables (Unit)</th>
<th>All Rounders</th>
<th>Spikers</th>
<th>Set Uppers</th>
<th>H.D.</th>
<th>C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (Second)</td>
<td>6.94</td>
<td>7.08</td>
<td></td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>6.94</td>
<td></td>
<td>7.25</td>
<td>0.31*</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.08</td>
<td>7.25</td>
<td>0.17*</td>
<td>0.09</td>
</tr>
<tr>
<td>Arm Strength (Number)</td>
<td>618.56</td>
<td>538.22</td>
<td></td>
<td>80.34</td>
<td>86.26</td>
</tr>
<tr>
<td></td>
<td>618.56</td>
<td></td>
<td>422.97</td>
<td>159.90*</td>
<td>83.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>538.22</td>
<td>422.97</td>
<td>115.25*</td>
<td>56.01</td>
</tr>
<tr>
<td>Explosive Power (cm.s.)</td>
<td>47.31</td>
<td>44.45</td>
<td></td>
<td>2.86</td>
<td>3.71</td>
</tr>
<tr>
<td></td>
<td>47.31</td>
<td></td>
<td>39.76</td>
<td>7.55*</td>
<td>3.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44.45</td>
<td>39.76</td>
<td>4.69*</td>
<td>2.41</td>
</tr>
<tr>
<td>Physical Variables (Unit)</td>
<td>All Rounders</td>
<td>Spikers</td>
<td>Set Uppers</td>
<td>M.D.</td>
<td>C.D.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------</td>
<td>---------</td>
<td>------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Dynamic Balance (Point)</td>
<td>83.75</td>
<td>80.47</td>
<td>77.71</td>
<td>6.04*</td>
<td>3.72</td>
</tr>
<tr>
<td></td>
<td>83.75</td>
<td>80.47</td>
<td>77.71</td>
<td>2.76*</td>
<td>2.65</td>
</tr>
<tr>
<td>Agility (Second)</td>
<td>12.07</td>
<td>12.29</td>
<td>12.56</td>
<td>0.49*</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>12.07</td>
<td>12.29</td>
<td>12.56</td>
<td>0.27*</td>
<td>0.24</td>
</tr>
<tr>
<td>Wrist Flexibility (Degree)</td>
<td>175.94</td>
<td>167.80</td>
<td>163.01</td>
<td>8.14</td>
<td>9.94</td>
</tr>
<tr>
<td></td>
<td>175.94</td>
<td>167.80</td>
<td>163.01</td>
<td>4.79</td>
<td>6.47</td>
</tr>
<tr>
<td>Shoulder Flexibility (Inch)</td>
<td>11.31</td>
<td>12.29</td>
<td>13.41</td>
<td>2.10*</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>11.31</td>
<td>12.29</td>
<td>13.41</td>
<td>1.12*</td>
<td>0.92</td>
</tr>
<tr>
<td>Height (Inch)</td>
<td>70.50</td>
<td>69.39</td>
<td>67.60</td>
<td>1.11</td>
<td>1.44</td>
</tr>
<tr>
<td></td>
<td>70.50</td>
<td>69.39</td>
<td>67.60</td>
<td>1.79*</td>
<td>0.93</td>
</tr>
<tr>
<td>Weight (Pound)</td>
<td>134.88</td>
<td>135.06</td>
<td>124.14</td>
<td>0.18</td>
<td>8.33</td>
</tr>
<tr>
<td></td>
<td>134.88</td>
<td>135.06</td>
<td>124.14</td>
<td>10.92*</td>
<td>5.41</td>
</tr>
</tbody>
</table>

*Significant at .05 level.
From the above table 12, it is observed that there were significant differences between all rounders and set uppers; spikers and set uppers in speed, arm strength, explosive power, dynamic balance, agility, shoulder flexibility height and weight, whereas there was no significant difference in all rounders and spikers in these above mentioned variables. In wrist flexibility, all rounders - set uppers had significant differences but all rounders spikers and spikers-set uppers did not exhibit significant difference at the .05 level of confidence.
### Table 13

**Analysis of Variance of the Mean Differences of Physiological Variables**

<table>
<thead>
<tr>
<th>Physiological Variables (Unit)</th>
<th>Sources of Variance</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Rate (Heart Beat per minute)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>315.98</td>
<td>157.99</td>
<td>10.22</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>2041.01</td>
<td>15.46</td>
<td></td>
</tr>
<tr>
<td>Systolic Blood Pressure (mm.Hg.)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>240.65</td>
<td>120.33</td>
<td>4.67</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>3403.60</td>
<td>25.78</td>
<td></td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mm.Hg.)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>228.79</td>
<td>114.40</td>
<td>4.52</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>3320.94</td>
<td>25.16</td>
<td></td>
</tr>
<tr>
<td>Pulse Pressure (mm.Hg.)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>18.37</td>
<td>9.19</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>790.62</td>
<td>5.99</td>
<td></td>
</tr>
<tr>
<td>Body Fat (Kilogram)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>79.78</td>
<td>39.89</td>
<td>18.13*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>290.69</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td>Lean Body Weight (Kilogram)</td>
<td>Between Groups 2</td>
<td>2</td>
<td>398.85</td>
<td>199.43</td>
<td>10.62*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>2477.73</td>
<td>18.77</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 13 (Contd.)

<table>
<thead>
<tr>
<th>Physiological Variables (Unit)</th>
<th>Sources of Variance</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular Endurance (Second)</td>
<td>Between Groups</td>
<td>2</td>
<td>10.63</td>
<td>5.32</td>
<td>28.00</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>25.64</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

\[ N = 135 \]

*Significant at .05 level of confidence  
\[ F_{0.05}(2,132) = 3.07 \]

Table 13 reveals that there were significant differences in physiological variables among all rounders, spikers and set uppers as obtained 'F' ratio of pulse rate, systolic blood pressure, diastolic blood pressure, body fat, lean body weight and cardiovascular endurance were 10.22, 4.67, 4.55, 18.13, 10.62 and 28 respectively which were much higher values than the value 3.07 required for 'F' ratio to be significant at .05 level (2,132) degree of freedom. Insignificant difference was found in pulse pressure \((F=1.53)\). Mean difference among groups are presented in figures 73 to 79.
Scale
'y' axis
1 cm = 10 Beats/Min.

FIG. 73. Mean Difference Among All Rounders, Spikers and Set Uppers in Pulse Rate.
FIG. 74. Mean Difference Among All Rounders, Spikers and Set Uppers in Systolic Blood Pressure.
FIG. 75. Mean Difference Among All Rounders, Spikers and Set Uppers in Diastolic Blood Pressure.
Scale
'y' axis
1 cm = 5 mm./Hg.

FIG. 76. Mean Difference Among All Rounders, Spikers and Set Uppers in Pulse Pressure.
FIG. 77. Mean Difference Among All Rounders, Spikers and Set Uppers in Body Fat.
Scale
'y' axis
1 cm = 10 Kgs.

FIG. 78. Mean Difference Among All Rounders, Spikers and Set Uppers in Lean Body Weight.
FIG. 79 Mean Difference Among All Rounders, Spikers and Set Uppers in Cardio-Vascular Endurance.

All Rounders

Spikers

Set Uppers
As the 'F' ratio were found significant in the physiological variables the Scheffe's post hoc test was used to test the significance of differences between paired means separately for different groups which are presented in table 14.

<table>
<thead>
<tr>
<th>Physiological Variables (Unit)</th>
<th>All Rounders</th>
<th>Spikers</th>
<th>Set Uppers</th>
<th>M.D.</th>
<th>C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Rate (Heart Beat per minute)</td>
<td>69.94</td>
<td>70.86</td>
<td>73.64</td>
<td>70.86</td>
<td>73.64</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mm. Hg.)</td>
<td>119.44</td>
<td>119.04</td>
<td>121.80</td>
<td>119.04</td>
<td>121.80</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mm. Hg.)</td>
<td>77.56</td>
<td>78.38</td>
<td>80.74</td>
<td>78.38</td>
<td>80.74</td>
</tr>
</tbody>
</table>

*Significant at the .05 level
TABLE 14 (Cont’d.)

<table>
<thead>
<tr>
<th>Physiological Variables (Unit)</th>
<th>All Rounders</th>
<th>Spikers</th>
<th>Set Uppers</th>
<th>M.D.</th>
<th>C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Fat (Kilogram)</td>
<td>9.77</td>
<td>9.54</td>
<td></td>
<td>0.23</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>9.77</td>
<td>9.54</td>
<td>8.07</td>
<td>1.70*</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.07</td>
<td>1.47*</td>
<td>0.69</td>
</tr>
<tr>
<td>Lean Body Weight (Kilogram)</td>
<td>51.51</td>
<td>51.89</td>
<td></td>
<td>0.38</td>
<td>3.10</td>
</tr>
<tr>
<td></td>
<td>51.51</td>
<td>51.89</td>
<td>48.37</td>
<td>3.14*</td>
<td>2.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>48.37</td>
<td>3.52*</td>
<td>2.01</td>
</tr>
<tr>
<td>Cardiovascular Endurance (Seconds)</td>
<td>9.86</td>
<td>10.15</td>
<td></td>
<td>0.29</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>9.86</td>
<td>10.15</td>
<td>10.61</td>
<td>0.75*</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.61</td>
<td>0.46*</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Significant at .05 level of confidence.

Table 14 reveals that there were significant differences in all rounders- set uppers and spikers- set uppers in pulse rate, body fat, lean body weight and cardiovascular endurance whereas no difference was there between all rounders and spikers in these variables. Further spikers and set uppers had significant difference in systolic blood pressure and diastolic blood pressure but all rounders
spikers and all rounders-set uppers were found insignificant in these variables.

**TABLE 15**

**ANALYSIS OF VARIANCE OF THE MEAN DIFFERENCES MOTOR SKILL VARIABLES**

<table>
<thead>
<tr>
<th>Motor Skill Variables (Unit)</th>
<th>Source of Variance</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>'F'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleying (Point)</td>
<td>Between Groups</td>
<td>2</td>
<td>199.77</td>
<td>99.89</td>
<td>5.87*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>2248.11</td>
<td>17.03</td>
<td></td>
</tr>
<tr>
<td>Serving (Point)</td>
<td>Between Groups</td>
<td>2</td>
<td>102.87</td>
<td>51.44</td>
<td>3.80*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>1788.34</td>
<td>13.55</td>
<td></td>
</tr>
<tr>
<td>Passing (Point)</td>
<td>Between Groups</td>
<td>2</td>
<td>6.12</td>
<td>3.06</td>
<td>2.41</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>168.28</td>
<td>1.27</td>
<td></td>
</tr>
<tr>
<td>Set up Point</td>
<td>Between Groups</td>
<td>2</td>
<td>4.28</td>
<td>2.14</td>
<td>2.06</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>132</td>
<td>137.03</td>
<td>1.04</td>
<td></td>
</tr>
</tbody>
</table>

N = 135

*Significant at .05 level of confidence

F_{.05(2, 132)} = 3.07
From the above table 15, it is evident that there were significant differences in volleying and serving of motor skill variables as obtained 'F' value 5.87 and 3.07 required for 'F' ratio to be significant at .05 level of confidence with 132 degree of freedom. Passing and set up were found statistically insignificant as there 'F' value 2.41 and 2.06 are less than the required value to be significant. Mean difference among all rounders, spiker and set uppers depicted in Figures 80 to 83.

As the 'F' ratio were found significant in volleying and serving of motor skill variables, the Scheffe S and Newman-Keuls post-hoc tests were applied to find out the significance of difference between paired means separately for different groups which is presented in table 16.
Scale
'y' axis
1 cm = 5 points.

FIG. 80. Mean Difference Among All Rounders, Spikers and Set Uppers in Volleying.
FIG. 81. Mean Difference Among All Rounders, Spikers and Set Uppers in Serving.
FIG. 82 Mean Difference Among All Rounders, Spikers and Set Uppers in Passing.
FIG. 83. Mean Difference Among All Rounders, Spikers and Set Uppers in Set Up.
<table>
<thead>
<tr>
<th>Motor Skill Variables (Unit)</th>
<th>All Rounders</th>
<th>Spikers</th>
<th>Set Uppers</th>
<th>M.D.</th>
<th>C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volleying (Point)</td>
<td>41.75</td>
<td>41.12</td>
<td></td>
<td>0.63</td>
<td>2.93</td>
</tr>
<tr>
<td></td>
<td>41.75</td>
<td></td>
<td>38.87</td>
<td>2.88</td>
<td>3.15</td>
</tr>
<tr>
<td></td>
<td>41.12</td>
<td>38.87</td>
<td></td>
<td>2.25*</td>
<td>1.83</td>
</tr>
<tr>
<td>Serving (Point)</td>
<td>30.06</td>
<td>29.22</td>
<td></td>
<td>0.84</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>30.06</td>
<td></td>
<td>27.76</td>
<td>2.30*</td>
<td>1.34</td>
</tr>
<tr>
<td></td>
<td>29.22</td>
<td>27.76</td>
<td></td>
<td>1.46*</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Significant at .05 level of confidence

Table 16 shows that there were significant differences in spikers and set uppers in volleying whereas no significant difference were found between all rounders-spikers and all rounders set uppers in this variable. In serving, all rounders - set uppers and spikers - set uppers had significant difference but the difference in all rounders and spikers were found statistically insignificant.
Discussion of Findings

Relationship of Physical, Physiological and Motor Skill Variables to Volleyball Playing Ability

The statistical analysis of data revealed that volleyball playing ability was significantly related to speed arm strength, explosive power, dynamic balance, agility, wrist flexibility, ankle flexibility, trunk hyper extension, shoulder flexibility, age, height, and weight. Obviously, the physical variables mentioned above are essential for volleyball players in order to give top class performance.

Speed is basically the result of applying force to mass. Both running speed and speed movement are dependent on muscular strength. Hence a person possess good running speed likely to have higher speed of movement. It is a vital factor in a game of volleyball. The game demands that the player should be fast enough so as to receive the ball after covering a considerable distance. Moreover, the modern games of volleyball demands that the player should be able to change places quickly so as to contribute their best. Hence, speed correlated significantly with volleyball playing ability. This finding is in confirmity with the opinions of Sandhu.9

9Sandhu, Volleyball Basic and Advanced, p. 11.
Arm strength is a pre-requisite in many sports and game of volleyball in no exception to it. The game requires strong arms so that a player may be able to serve hard and spike forcefully besides blocking the opponent's smash. The test chosen to measure arm strength involved both strength and muscular endurance of the arm. A player has to repeatedly execute different techniques in a game of volleyball which requires the strength and strength endurance of arms for efficient performance. The significant relationship of arms strength to volleyball playing ability is supported by Disch\textsuperscript{10} and his associates.

The modern game of volleyball is called power volleyball. The power of a player and volleyball performance go hand in hand. The player with superior jumping ability are very successful in a game of volleyball specially during the attack and block. It has been considered an integral part of the game itself. Significant relationship between

\textsuperscript{10}Disch et al., \textit{Basketball Volleyball: Tips and techniques}, pp. 65-71.
explosive power and volleyball playing ability may be due to the fact that the modern game of volleyball involves a lot of spiking to complete the attack and a lot of blocking in terms of first hand defense over the net. The results of the studies is in conformity with the findings of Khayambashi,11 Clarena,12 Joseph13 and Murugeson.14

Dynamic balance is a prerequisite towards the good performance in volleyball. A player has to maintain balance while performing various techniques of the game. For instance, a player has to jump so as to either smash or block and immediately after performing the task, one has to land in such a way so that the player is not only in a state of balance but on is in ready position to do another movement depending upon the situation. This study is


12 Clarena, Completed Research in Health, Physical Education and Recreation, p. 106.


consonance with the result of Toyoda.

The game of volleyball requires various movements such as running forward, sideward, and backward, coming to a sudden halt, jumping with different types and body movement in the air. Modern game of volleyball demands that a player must understand to use different movements not only at the correct time but also as quickly and accurately as possible as and when demanded. Agile players are able to deceive opponents by altering their movement at last the movement. Similarly a defensive player too has to execute various movements as quickly and accurately as possible so as to thwart the plan of the opponents. This finding is agree with the studies of Phipps and Bhola.

It is acknowledged by eminent sports trainers that flexibility is a basic requirement for a good performance of any skill and consecutively to a sport. Flexibility helps in synchronizing the various movements pattern


16 Phipps, Journal of Physical Education Recreation and Dance, pp. 54-56.

performed at a greater speed. The game of volleyball requires flexibility of different parts of the body so as to give better performance. Ankle flexibility is essential for gaining greater height while jumping and also while landing. Wrist flexibility is required for the purpose of deceiving the opponents by tilting the wrist and changing the direction of the ball at the last movement when an individual is in the act of spiking. Trunk and shoulder flexibility are required mainly for spiking as these will provide more space for movement besides to provide an individual with considerable amount of time. Both these variables are likely to help the player towards better performance in volleyball. Trunk hyper extension further makes it possible to apply body weight behind the spike so that more force can be applied. Besides this flexibility underlies the performance in co-ordinative movement and provide the base for the development of certain other components like strength, speed, agility etc. The result of the study are confirmity with Kattrath, Clarke, Uppal and Singh.

18 Alexjos Katrath, "Variations in Selected Physical and Physiological Variables of Volleyball and Basketball players" (Unpublished Master's Thesis, Jiwaji University).


20 Uppal and Singh, SNIPES Journal p. 42.
Age of a player is significant factor in order to learn and execute the different motor skill required in the game of volleyball. Moreover, understanding about a skill also improves with age. Hence age is significantly related to volleyball performance in this study which involved players from 14 to 19 years of age. The results of present study agree with the opinions of Lamp, Espenschade, and Shephard.

Now a days the taller players are preferred in volleyball as height is an important contributory factor towards volleyball playing ability. A player with good height can smash the ball easily besides spiking over the opponent's block by spending considerably less energy. A taller player has an advantage in terms of blocking the opponent's smashes with considerable ease. Moreover, a taller player may psychologically effect the opponents' performance. The results of the study are in consonance

21 Lamp, Research Quarterly, pp. 189-197.

22 Espenschade, Research Quarterly p. 144.

with the findings of Grewal\textsuperscript{24} and Mathew\textsuperscript{25}.

Excess of weight is definitively disadvantageous or the players of volleyball but certain degree of weight is essential towards volleyball performance. Weight will be helpful in increasing the force applied to the ball in executing different techniques of the game. Greater momentum will result from greater weight. The findings of the study is supported by Mathew\textsuperscript{26}, Puhl\textsuperscript{27} and his associates.

Statistical analysis of data (product moment correlation) revealed that there is significant relationship between volleyball playing ability to each of the following physiological variables such as pulse rate, body fat, lean body weight, cardiovascular endurance. The


\textsuperscript{25}Mathew, Unpublished Master's Thesis, Jiwaji University, 1984.

\textsuperscript{26}Ibid.

\textsuperscript{27}Puhl et.al. Research Quarterly, pp.257-262.
significant relationship between pulse rate and volleyball playing ability may be because pulse rate is an indicator of the cardio-respiratory fitness of the individual. It is generally seen that most fit sportsmen have lower resting pulse rate than the unfit sportsmen. The game of volleyball requires a high level of fitness from a player as there is no fixed duration of game and the intensity also varies from team to team.\textsuperscript{28,29,30,31}

It is known fact that cardiovascular endurance plays an important role towards volleyball playing ability. A few of the variables of cardiovascular endurance are blood pressure (systolic and diastolic) and pulse pressure. However the result of the study reveals that there is a insignificant relationship between each of the systolic

\textsuperscript{28} A.K. Uppal, "Comparative Effects of Two Duration Load Methods and Interval Running Method on Cardio-Respiratory Endurance and Selected Physiological Variables (Unpublished Doctoral Thesis, Jiwaji University, Gwalior).

\textsuperscript{29} Y. Henderson, H.W. Haggard and F.S. Dolley "The Efficiency of the Heart and Significance of Rapid and Slow pulse rate" cited by Karpovich and Sinning, \textit{Physiology of Muscular Activity}, p.213.


\textsuperscript{31} Charles A. Bucher, \textit{Foundation of Physical Education}, p. 463.
blood pressure, diastolic blood pressure and pulse pressure to volleyball playing ability. This may be because above mentioned variables were recorded under resting condition. Moreover it is the opinion of the researchers that the combined effect of systolic blood pressure, diastolic blood pressure might have been significant in relation to volleyball playing ability. The findings of the study are supported by Parks\textsuperscript{32} and Sarkar\textsuperscript{33}

Certain degree of fat is an important factor to be considered in performing various motor movements as it serves a major source of fuel for skeletal muscle during endurance activities. But, excess fat is a deterrent to volleyball performance because while the muscle contracts fat acts as a hinderance. Fat is an extra weight which a person has to carry or in other words, a person will be spending considerably more energy for performing a task.

\textsuperscript{32}Charles James Parks, "The Effect of a Physical Fitness Programme on Body Composition, Flexibility, Heart Rate, Blood Pressure and Anxiety Levels of Citizens" Dissertation Abstracts International 41 (July 1980):157 A.

\textsuperscript{33}Lakshmi Narayan Sarkar,"Changes in Selected Physical and Physiological Variables Resulting Among Professional Men Students in Physical Education at Different Stages of Training" (Unpublished M.Phil Thesis, Jiwaji University, Gwalior.)
However, in this study, the positive relation between fat and volleyball playing ability was obtained. This may be due to the reason that the level of volleyball players was only upto district level who participated in the state level tournament and the study was confined to Himachal Pradesh State where standard of volleyball is not very high. The other reason may be due to the fact that their food intake was uncontrolled and activity was not intense as the game was only played during the season which might have resulted in excess of fat among the volleyball players. The results of the study are in consonance with the findings of Pande and Kumar, Fox and Mathew, and Sarkar.

Significant positive relationship between lean body weight and volleyball playing ability may probably be because a player will be able to move his body by spending

---


as less energy as possible. Performance in any sport increases only if there is an increase in lean body weight. Because lean body weight consists of mainly muscle mass which creates the movements. Hence in order to strike hard lean body weight is essential. The finding is in conformity with the studies of Puhl\textsuperscript{37} et al and Shaver\textsuperscript{38}.

The significant relationship between cardiovascular endurance and volleyball playing ability may attributed to the fact that fitness is of utmost important for the game of volleyball. Without it, one can not be in the right place at the right time. It is no use having excellent fundamental techniques without fitness as a player will not be able to exhibit his skills throughout the length of the game. It has been said, that skill alone will not win against extremely fit opposition as the game of volleyball is a fast moving game. The finding


\textsuperscript{38} Shaver, \textit{Essential of Exercise Physiology}, pp. 126-128.
of this study is supported by Howard and Clarke.

The significant relationship between each of the motor skill variables and volleyball playing ability may be due to a simple logic, that is, a skillful player will score better in volleyball playing ability than unskillful player. Besides this, the items for motor skill include essential elements of the game. Hence a positive relationship between volleyball playing ability to each of the motor skill variables such as volleying, serving, passing and set up was obtained. The result of the present study agree with the findings of Cox and French.

---


41 Cox, Dissertation Abstracts International, p. 5685 A.

42 French, Research Quarterly, pp. 150-156.
Combined Contribution of Physical Variables to Volleyball Playing Ability, Physiological Variables to Volleyball Playing Ability and Motor Skill Variables to Volleyball Playing Ability

The findings of the study revealed that physical variables (explosive power, agility and ankle flexibility) contribute significantly towards volleyball playing ability. The significant combined effect of explosive power, agility and ankle flexibility to volleyball playing ability may be attributed to the fact that modern game of volleyball requires power, agility and flexibility to a great extent as the ankle flexibility and explosive power will help an individual to jump higher as well as to smash as hard as possible. Besides these, the modern game demands that the individual must be quick enough so as to receive the ball as a result of various kinds of smashes, drops and service where flight of the ball changes as result of spin imparted to the ball. Moreover, at times a player may have to cover a considerable unanticipated distance in order to lift the ball all of a sudden. The result of the study is agree with the findings of
Bale and Phipps.

The findings of the study revealed that the physiological variables (cardiovascular endurance, lean body weight and pulse pressure) contribute significantly towards volleyball playing ability. The significant combined effect of cardiovascular endurance, lean body weight and pulse pressure may be because that the modern game requires players who have a greater lean body weight so that they may be able to execute different moments of the game with a considerable ease. Cardiovascular endurance has its unique contribution in volleyball as the game normally continuous for a longer duration with sub maximal intensity. Though pulse pressure also increases as a result of participation in a game of volleyball but it is of great significant during the recovery process where a higher pulse pressure is maintained so as to supply necessary nutrients to the different

---


parts of the body. The study is agree with the opinions of Clarke.  

The findings of the study revealed that motor skill variables such as volleying, serving contribute significantly towards volleyball playing ability. The game of volleyball consists of different techniques but the most basic and fundamental techniques are serving and volleying. The other techniques such as spiking, passing, setting etc. are dependent on these techniques. It is assumed that if a player is good in serving and volleying, he can play the game better provided the other factors are the same. The findings of this study is supported by Cox and French.

Multiple Regression Analysis

Results of multiple regression analysis presented

---

45 Clarke, Physical Fitness Research Digest, p.1.

46 Cox, Dissertation Abstracts International, p. 5685 A.

47 French, Research Quarterly, pp. 150-156.
in the preceding sections of this chapter seem to indicate that physical variables; physiological variables and motor skill variables separately act as determinants towards volleyball playing ability with a reasonable degree of accuracy under the limitation of the study.

Explosive power has a greater loading in the regression equation followed by agility and ankle flexibility in the physical variables.

The modern game of volleyball is aptly called power volleyball, as a player has to execute various action which needs explosive power. Power is one quality which a successful volleyball player must posses, no matter whether he is spiker, setter or all rounder.

The game of volleyball involves many movements in which a player has to run fast and changes his position suddenly according the need of the moment. The modern game of volleyball requires that a player must be agile enough so as to execute various movements as quickly and accurately as possible.

Ankle flexibility is very important for the stretching type of movement in the game of volleyball.
It helps to make best use of the explosive power. It contribute to the jump, as at the time of leaving the ground, the player comes completely on toes which brings in a change of lever from class III to Class II and the class II lever is meant for developing strength. The result is agree with the finding of Bhola.48

Cardiovascular endurance has a greater loading in the regression equation followed by lean body weight and pulse pressure amongst the physiological variables. As there is no time limit and some matches can last for several hours, if the teams are evenly matched. Therefore the modern game demands efficient functioning of the heart and lungs for optimal performance of the game.

Lean body weight is pre-requisite for volleyball players as they will be able to apply more power to the game because of the greater muscle mass. Moreover lean body mass will be of help to a player as greater lean body weight indicates lack of fat which one has to carry. Besides cardiovascular endurance and lean body weight, pulse pressure is an important variable which contribute

towards volleyball performance. Greater pulse pressure indicates that the recovery process as a result of exercise will be a quicker and the individual volleyball player will come back to normal within a limited time which shows the efficiency of the cardio-respiratory system.

Volleying has the greater loading in the regression equation followed by serving amongst the motor skill variables. It is due to the facts that volleying serving are the basic fundamentals of the game of volleyball and all other skills are dependent upon them. Generally volleying is used in controlling while receiving, passing, setting and playing long high ball to the opponents' back court. It is also used occasionally to drop the ball softly just over the net.

Besides volleying, serving is an important skill. If the service is executed properly, then it forces the opponents to be on their defense and it helps the serving team to launch their attack on the opponents.
Significance of Difference of Physical, Physiological and Motor Skill Variables Between Successful and Unsuccessful Volleyball Players.

The analysis of data from table 8 reveals that there is significant difference between successful and unsuccessful volleyball players in each of the physical variables. This may be because a successful volleyball players requires, speed, arm strength, explosive power, balance, agility, flexibility, age, height and weight so as to give a better performance. Hence speed, strength, power, balance, agility, flexibility, age, height and weight underlie the performance in the game of volleyball. The present findings are in agreement with the opinions of Sodhi et al.

The analysis of data in relation to physiological variables between successful and unsuccessful volleyball groups shows that pulse rate, body fat, lean body weight and cardio-vascular endurance play a vital role towards volleyball performance. Successful volleyball player have

---

lower pulse rate, greater lean body weight, abandoned endurance besides body fat in order to give a better performance. Hence lower pulse rate, greater lean body weight, cardiovascular endurance and body fat are important physiological variables towards successful performance in a game of volleyball. The findings of the study is in agreement with the research done by Sodhi.\textsuperscript{50}

The analysis of data between successful and unsuccessful volleyball groups in motor skill variables shows that \textit{volleying}, serving and set up of successful group is significantly better than the unsuccessful group. Better volleyball performance demands the perfection of fundamental techniques. Hence \textit{volleying}, serving, passing and set up are underlying factors in the game of volleyball.

\textbf{Analysis of Variance of Physical, Physiological and Motor Skill Variables Among All Rounders, Spikers and Set Uppers}

Analysis of variance in table 11 reveals that there is a significant difference in speed, arms strength,

explosive power, dynamic balance, agility, wrist flexibility, shoulder flexibility, height and weight among all rounders, spikers and set uppers. Further post hoc test in table 12 reveals that there is a significant difference between speed of all rounders and set uppers and also spikers and set uppers. As there is a very high relationship between speed and power, hence all rounders and set uppers, besides spikers and set uppers showed a significant difference. Above table also reveals that there was no significant between all rounders and spikers as they are required to do almost similar type of task during the game. The finding is confirmity with the study of Bale.51

With regards to arm strength, table 12 shows that there is a significant difference between all rounders and set uppers besides spikers and set uppers. This may be because spikers and all rounders are most often required to execute various actions which require arm strength and

power. The insignificant difference between all rounders and spikers in arms strength may be attributed to the similarity of task during the game. The finding of the study is agree with Cassell.\textsuperscript{52}

Post hoc test in relation to explosive power reveals that there is a significant difference between all rounders-set uppers and spikers-set uppers whereas insignificant difference is obtained between all rounders and spikers. The significant difference may be due to the fact that all rounders and spikers have to jump very often in the game in order to execute different skills in comparison to set uppers. The set uppers in general do not jump very often as their main task is to supply ball to the team mates. Hence significant difference between all rounders-set uppers and spikers-set uppers were obtained. The insignificant difference between all rounders and spikers may be because of the reasons that both these types of players have to perform considerable numbers of jumps during the game either to spike or to

\textsuperscript{52} Cassell, \textit{Dissertation Abstracts International}, p. 4805 A.
block the ball. Besides these, fake jumps are also executed so as to confuse the opponents. Hence insignificant difference was obtained between all rounders and spikers.

Analysis of data from table 12 reveals that there is a significant difference between all rounders—set uppers and spikers—set uppers in dynamic balance whereas there is no significant difference between all rounders and spikers in above mentioned variable. The significant difference may be due to the fact that all rounders and spikers are most often required to execute various action such as spike, block besides fake jumps over the net which require an individual to jump and land not only in a balanced position but one must be in such a position so as to initiate another movement according the situation of the game. The insignificant difference between all rounders and spikers in dynamic balance may be attributed to the similarity of task during the game.

Table 12 reveals that there is a significant difference between all rounders—set uppers and spikers—set uppers in agility whereas all rounders and spikers are found insignificant in this variable. The significant
difference may be because all rounders and spikers have
to run forward, sideward, backward, coming to a sudden
halt, jumping with different strides and body movement
in the air in order to meet the demands of the game
quickly, accurately and at the correct time. Insignificant
difference between all rounders and spikers may be due to
the fact that both type of players have to perform a
similar task in a game of volleyball and hence insigni-
ficant relationship has been obtained.

Analysis of data from table 12 reveals that there
is a significant difference between all rounders and set
uppers in wrist flexibility whereas there is no significant
difference between all rounders—spikers and spikers—set
uppers. The significance difference may be due to the
reasons that all rounders have to use wrist very often
in performing various techniques of the game such as set
up, smash etc. Set uppers use their wrist to a lesser
degree than all rounders as their main job is to set up the
ball. Hence a significant difference between all rounders
and set uppers was obtained. The insignificant difference
between all rounders—spikers may be because both of them
involve similar nature of work as spike, block and fake etc.
The insignificant difference between spikers and set uppers
in wrist flexibility may be because of the reason that
spikers are mainly concerned with spiking and most often use one hand to spike the ball. Set uppers are also confined mainly limited skill with a special emphasis on setting up the ball which might involve the wrist of a player. More over the test employed for measuring wrist flexibility considered flexibility of both wrists and hence insignificant difference between spikers and set uppers was obtained.

It can be seen from table 12 that there is significant difference in shoulder flexibility between all rounders set uppers and spikers- set uppers whereas insignificant difference was obtained between all rounders and spikers. The above finding may be because all rounders and spikers use their shoulder to a greater degree than set uppers. Since the movement of all rounders and spikers in terms of shoulder flexibility are almost of the same, hence insignificant difference between all rounders and spikers was obtained.

Table 12 shows that a significant difference exist between all rounders set uppers and spikers-set uppers in height. This may be due to the fact that the modern game of volleyball requires tall players who will be of immense benefit to the team in terms of spiking and
blocking. Usually set upper is an individual who is extra ordinary in setting up the ball irrespective of the height. Usually a shorter player may have an advantage as a set uppers because one will be able to go under the ball easily by bending the knees so that the perfect set up may be made. Hence significant difference in all rounders-set uppers and spikers - set uppers were obtained. The insignificant difference between all rounders and spikers may be due to the fact that both type of players should have a greater height so as to contribute their best to the game. Height is advantageous for both all rounders and spikers in the sense that they will be able to smash and block the ball with a little efforts. Hence insignificant difference between all rounders and spikers was obtained. This finding is agree with the study of Bale.\(^5^3\)

The analysis of data from table 12 reveals that a significant difference exist between all rounders-set uppers and spikers - set uppers in weight whereas insignificant difference was obtained between all rounders

---

and spikers. The significant difference between all-rounders - set uppers and spikers - set uppers may be due to the fact that all rounders and spikers are generally tall and well built so as to kill the ball as hard as possible besides having more lean body weight and hence their weight was more. Set uppers in India generally are shorter in height but are not well built as they have to perform various types of movements in game which require extra ordinary agility, hence they were lighter in weight. It is because of the above mentioned reasons that all rounders and spikers are comparatively heavier than set uppers. The insignificant difference between all rounders and spikers in weight may be because the game demands tall and well built players for these positions. Hence insignificant difference in weight was obtained between all rounders and spikers.

Analysis of variance in table 13 reveals that there is significant difference in each of the physiological variables namely pulse rate, systolic blood pressure, diastolic blood pressure, body fat, lean body weight and cardiovascular endurance among all rounders, spikers and set uppers.
Post hoc test reveals that there is significant difference between pulse rate of all rounders - set uppers and spikers - set uppers whereas insignificant difference was obtained between all rounders and spikers. The above findings may be due to the reason that all rounders and spikers have to do considerably more work than the set uppers and the task of all rounders and spikers is almost the same. Hence significant difference between all rounders - set uppers, spikers - set uppers and insignificant difference between all rounders and spikers were obtained.

In regard to systolic and diastolic blood pressure, table 14 shows that there is significant difference between spikers - set uppers whereas insignificant difference was obtained between all rounders - spikers and all rounders - set uppers. The above findings may be because of the training effect. The intensity of training for spikers is comparatively greater than that of all rounders and set uppers which must have resulted in adaptation of spikers. Moreover, it is reported by many researchers that as a result of training systolic and diastolic blood pressure reduce in the subjects. The demand of the game for spikers and all rounders is almost of similar nature and the
same but spikers have a comparatively greater load. Moreover the set uppers main task is to move forward, backward and sideward so as to lift the ball for the team mates besides jumping for the block. Hence insignificant difference between all rounders - spikers and all rounders-set uppers were obtained. The findings of the shoulder are in consonance with the study of Fox and Mathews.\(^{54}\)

The analysis of data with regards to body composition such as body fat and lean body weight, showed that there is significant difference between all rounders - set uppers and spikers - set uppers whereas insignificant difference was obtained between all rounders and spikers. It is a known fact that top class sportsman have comparatively less body fat and greater lean body weight in comparison to mediocre sportsmen. The result of this study reveals that spikers and all rounders have more body fat and lean body weight than the set uppers. The above finding may be because the standard of performance of inter district level is mediocre in Himachal Pradesh. Besides this it is a known fact that intermittent training is imparted to the players i.e the training is not carried out throughout the year which must have resulted in greater body fat and lean body weight with regard to spikers and all rounders.

\(^{54}\)Fox and Mathews, The Physiological Basis of Physical Education and Athletics, p. 318.
Analysis of data with regard to cardiovascular endurance shows that all rounders and spikers have a significantly greater endurance than set uppers whereas insignificant difference was obtained between all rounders and spikers. The above findings might have occurred because the spikers and all rounders have to undertake greater load than set uppers which places more stress on the circulatory and respiratory systems of the players. Comparatively the intensity of load is less for set uppers which might have resulted in the occurrence of the above findings. The result is consonance with the study of Cassell.\textsuperscript{55}

The findings with regard to motor skill variables presented in table 16, reveals that there is a significant difference between set uppers and spikers in volleying ability whereas insignificant difference was observed between all rounders - spikers and all rounders - set uppers. Further, the findings of this study reveals that

\textsuperscript{55}Cassell, Dissertation Abstracts International, p. 4805 A.
volleying ability was more in case of all rounders followed by spikers and the least by the set - uppers. The reason for this occurrence may be because of the test employed for measure volleying ability was one in which taller player had an advantage over shorter players. Since all rounders and spikers were taller than set uppers, hence the above findings were obtained. The insignificant difference between all rounders - spikers and all rounders - set uppers might have occurred because of involvement of all the players from various teams irrespective of their performance. Since the majority of the players were poor in skill, hence the insignificant difference might have been obtained.

The analysis of data in table 16 with regard to serving shows that there is a significant difference between all rounders - set uppers and spikers - set uppers whereas insignificant difference were obtained between all rounders and spikers. The significant difference may be because of the nature of the game. The modern game is rightly called power volleyball as power is mainly applied in order to execute different skill of the game and serving is no exception. In serving the ball is to
be hit as hard as possible besides cutting the ball so as to apply different kind of spin. Usually the serving action is similar to spiking action hence all rounders and spikers have scored better in serving ability. The insignificant difference in serving ability between all rounders and spikers may be because both these type of players are well versed in spiking ability and the action is all most similar to spiking. Hence insignificant difference between all rounders and spikers in serving ability was obtained.