CHAPTER - IV

STATISTICAL ANALYSIS OF DATA AND RESULTS OF THE STUDY

IV.1 Statistical Analysis

The statistical analysis of data collected on seventy University level male basketball players has been presented in this chapter.

Basketball being a team game, performance of the subjects in this study was determined by the standardised skill test (AAHPERD Basketball Skill Test) and it was deemed appropriate to find out a representative variable (criterion measure) from the four observed varieties (Speed Spot Shooting - $X_1$, Accuracy Speed Passing - $X_2$, Controlled Dribbling - $X_3$ and Defensive Movement - $X_4$).

The variable $X_5 = (X_1 + X_2 - X_3 - X_4)$ is the variable representing the aggregation of the response variables $X_1$, $X_2$, $X_3$ and $X_4$. This is approximately equal to the first principal component of the data set ($X_1$, $X_2$, $X_3$, $X_4$). In this thesis $X_5$ is at times referred to criterion variable (Basketball Performance).

The data on basketball performance alongwith physical, physiological, anthropometrical and psychological variables (Speed - $X_{10}$, Flexibility - Trunk - $X_{11}$, Shoulder - $X_{12}$, Agility - $X_{13}$, Explosive leg strength - $X_{14}$, Cardio-respiratory Endurance - $X_{15}$, Haemoglobin content - $X_{16}$, Resting Heart rate - $X_{17}$, Vital capacity - $X_{18}$, Blood Pressure - Systolic - $X_{19}$, Diastolic - $X_{20}$, Arm length - $X_{27}$, Ponderal Index - $X_{28}$, Crural Index - $X_{29}$, Arm Ratio - $X_{30}$, Sports Competition Anxiety - $X_{32}$, Achievement Motivation -
$X_{33}$, Sports Self Confidence - Trait - $X_{34}$, State - $X_{35}$ and composition of 16 P.F - $X_{52}$ were examined by Pearson's Product Moment Correlation to find out the relationship of basketball performance to each of these aforesaid variables separately and correlation matrix were prepared. Best subsets regression method of multiple regression analysis was used to assess the combined effect of all the physical, physiological, anthropometrical and psychological variables on basketball performance.

Multiple regression analysis was done in order to predict the basketball playing ability on the basis of physical, physiological, anthropometrical and psychological variables.

**IV.2 Level of Significance**

The level of significance to check the relationship obtained by application of the Pearson's Product Moment Correlation and the Best Subsets Regression Method of Multiple Regression Analysis was set at .05 level which was considered appropriate to serve the purpose of this study.

**IV.3 Findings**

The scores of each of the independent variables physical, physiological, anthropometrical and psychological were correlated with the criterion variable (the basketball performance) in order to find out the relationship between the criterion and the independent variables which are presented in Table Nos. 3, 4, 5 & 6.
TABLE - 3
RELATIONSHIP OF PHYSICAL VARIABLES TO BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Physical variables</th>
<th>Coefficient of Correlation 'r'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>-0.936*</td>
</tr>
<tr>
<td>2.</td>
<td>Trunk Flexibility</td>
<td>0.972*</td>
</tr>
<tr>
<td>3.</td>
<td>Shoulder Flexibility</td>
<td>0.361*</td>
</tr>
<tr>
<td>4.</td>
<td>Agility</td>
<td>0.914*</td>
</tr>
<tr>
<td>5.</td>
<td>Explosive Leg Strength</td>
<td>0.986*</td>
</tr>
<tr>
<td>6.</td>
<td>Cardio-respiratory Endurance</td>
<td>0.937*</td>
</tr>
</tbody>
</table>

N = 70
*Significant at .05 level of confidence.
\(r_{0.05(68)} = 0.289\).

Table 3 shows that the basketball performance was significantly related to speed, Trunk Flexibility, Shoulder Flexibility, Agility, Explosive leg strength and cardio-respiratory endurance which in other words establishes the positive contribution of these physical variables in particular on basketball performance.

TABLE - 4
RELATIONSHIP OF PHYSIOLOGICAL VARIABLES TO BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Physiological variables</th>
<th>Coefficient of Correlation 'r'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Haemoglobin content</td>
<td>0.925*</td>
</tr>
<tr>
<td>2.</td>
<td>Resting Heart Rate</td>
<td>-0.978*</td>
</tr>
<tr>
<td>3.</td>
<td>Vital Capacity</td>
<td>0.983*</td>
</tr>
<tr>
<td>4.</td>
<td>Systolic Blood Pressure</td>
<td>0.938*</td>
</tr>
<tr>
<td>5.</td>
<td>Diastolic Blood Pressure</td>
<td>0.860*</td>
</tr>
</tbody>
</table>

N = 70
*Significant at .05 level of confidence.
\(r_{0.05(68)} = 0.289\).
Table 4 reveals that the basketball performance was significantly related to Haemoglobin content, Resting Heart Rate, Vital Capacity, Systolic Blood Pressure and Diastolic Blood Pressure. Hence, it is evident that Haemoglobin content, Resting Heart Rate, Vital Capacity, Systolic Blood Pressure and Diastolic Blood Pressure contribute to basketball performance.

**TABLE - 5**

**RELATIONSHIP OF ANTHROPOMETRIC VARIABLE TO BASKETBALL PERFORMANCE**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Anthropometric variables</th>
<th>Coefficient of Correlation 'r'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Arm length</td>
<td>0.981*</td>
</tr>
<tr>
<td>2.</td>
<td>Ponderal Index</td>
<td>0.944*</td>
</tr>
<tr>
<td>3.</td>
<td>Crural Index</td>
<td>-0.786*</td>
</tr>
<tr>
<td>4.</td>
<td>Arm Ratio</td>
<td>0.867*</td>
</tr>
</tbody>
</table>

N = 70

*Significant at .05 level of confidence.

\[ r_{.05}(68) = .289 \]

Table 5 reveals that basketball performance was significantly related to Arm Length, Ponderal Index, Crural Index, and Arm Ratio, which justifies that Arm length, Ponderal Index, Crural Index and Arm Ratio contribute to basketball performance.
TABLE 6

RELATIONSHIP OF PSYCHOLOGICAL VARIABLES TO BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Psychological variables</th>
<th>Coefficient of Correlation 'r'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sports Competition Anxiety</td>
<td>-0.874*</td>
</tr>
<tr>
<td>2.</td>
<td>Achievement Motivation</td>
<td>0.976*</td>
</tr>
<tr>
<td>3.</td>
<td>Sports Self Confidence (Trait)</td>
<td>0.987*</td>
</tr>
<tr>
<td>4.</td>
<td>Sports Self Confidence (State)</td>
<td>0.896*</td>
</tr>
<tr>
<td>5.</td>
<td>Composition of 16 PF</td>
<td>0.975*</td>
</tr>
</tbody>
</table>

N = 70

*Significant at .05 level of confidence.

r.05(68) = .289.

Table 6 shows that performance in basketball was significantly related to Sports Competition Anxiety, Achievement Motivation, Sports Self Confidence (Trait), Sports Self Confidence (State) and composition of 16 P.F. It is, therefore, evident that Sports Competition Anxiety, Achievement Motivation, Sports Self Confidence (Trait), Sports Self Confidence (State) and Composition of 16 P.F contribute to basketball performance.

Correlation Matrix for selected Physical, Physiological, Anthropometric and Psychological variables chosen for basketball performance in the present study are presented in Table 7, 8, 9 and 10 respectively.
**TABLE - 7**

CORRELATION MATRIX FOR SELECTED PHYSICAL VARIABLES FOR BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>$X_5$</th>
<th>$X_{10}$</th>
<th>$X_{11}$</th>
<th>$X_{12}$</th>
<th>$X_{13}$</th>
<th>$X_{14}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{10}$</td>
<td>-0.936</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{11}$</td>
<td>-0.972</td>
<td>0.923</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{12}$</td>
<td>0.261</td>
<td>-0.227</td>
<td>0.225</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{13}$</td>
<td>0.914</td>
<td>-0.867</td>
<td>0.906</td>
<td>0.201</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{14}$</td>
<td>0.986</td>
<td>-0.945</td>
<td>0.982</td>
<td>0.225</td>
<td>0.923</td>
<td></td>
</tr>
<tr>
<td>$X_{15}$</td>
<td>0.937</td>
<td>-0.984</td>
<td>0.926</td>
<td>0.249</td>
<td>0.860</td>
<td>0.949</td>
</tr>
</tbody>
</table>

$X_5$ = (Criterion) Basketball Performance  
$X_{10}$ = Speed  
$X_{11}$ = Trunk Flexibility  
$X_{12}$ = Shoulder Flexibility  
$X_{13}$ = Agility  
$X_{14}$ = Explosive Leg Strength  
$X_{15}$ = Cardio Respiratory Endurance.

**TABLE - 8**

CORRELATION MATRIX FOR SELECTED PHYSIOLOGICAL VARIABLES FOR BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>$X_5$</th>
<th>$X_{16}$</th>
<th>$X_{17}$</th>
<th>$X_{18}$</th>
<th>$X_{19}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{16}$</td>
<td>0.925</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{17}$</td>
<td>-0.978</td>
<td>-0.915</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{18}$</td>
<td>0.983</td>
<td>0.933</td>
<td>-0.988</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{19}$</td>
<td>0.938</td>
<td>0.903</td>
<td>-0.935</td>
<td>0.933</td>
<td></td>
</tr>
<tr>
<td>$X_{20}$</td>
<td>0.860</td>
<td>0.737</td>
<td>-0.891</td>
<td>0.869</td>
<td>0.777</td>
</tr>
</tbody>
</table>

$X_5$ = (Criterion) Basketball Performance  
$X_{16}$ = Haemoglobin Content  
$X_{17}$ = Resting Heart Rate  
$X_{18}$ = Vital Capacity  
$X_{19}$ = Blood Pressure (Systolic)  
$X_{20}$ = Blood Pressure (Diastolic)
### TABLE - 9
CORRELATION MATRIX FOR SELECTED ANTHROPOMETRIC VARIABLES FOR BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>$X_5$</th>
<th>$X_27$</th>
<th>$X_28$</th>
<th>$X_29$</th>
<th>$X_30$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{27}$</td>
<td>0.981</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{28}$</td>
<td>0.944</td>
<td>0.950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{29}$</td>
<td>-0.786</td>
<td>-0.809</td>
<td>-0.784</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{30}$</td>
<td>0.867</td>
<td>0.882</td>
<td>0.845</td>
<td>-0.709</td>
<td></td>
</tr>
</tbody>
</table>

$X_5$ = (Criterion) Basketball Performance  
$X_{27}$ = Arm Length  
$X_{28}$ = Ponderal Index  
$X_{29}$ = Crural Index  
$X_{30}$ = Arm Ratio

### TABLE - 10
CORRELATION MATRIX FOR SELECTED PSYCHOLOGICAL VARIABLES FOR BASKETBALL PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>$X_5$</th>
<th>$X_{32}$</th>
<th>$X_{33}$</th>
<th>$X_{34}$</th>
<th>$X_{35}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_{32}$</td>
<td>-0.874</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{33}$</td>
<td>0.976</td>
<td>-0.872</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{34}$</td>
<td>0.987</td>
<td>-0.882</td>
<td>0.989</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{35}$</td>
<td>0.896</td>
<td>-0.830</td>
<td>0.894</td>
<td>0.909</td>
<td></td>
</tr>
<tr>
<td>$X_{52}$</td>
<td>0.975</td>
<td>-0.848</td>
<td>0.967</td>
<td>0.981</td>
<td>0.888</td>
</tr>
</tbody>
</table>

$X_5$ = (Criterion) Basketball Performance  
$X_{32}$ = Sports Competition Anxiety  
$X_{33}$ = Achievement Motivation  
$X_{34}$ = Sports Self Confidence (Trait)  
$X_{35}$ = Sports Self Confidence (State)  
$X_{52}$ = Composition of 16 P.F
The Best Subsets Regression Method of Multiple Regression Analysis was computed through Statistical data analysis software called MINITAB for selecting the most contributing variables towards the Basketball performance.

In this method researcher chose the Best Subsets of regression based on the amount of variation explained by the multiple regression equation formed by these variables. The formal criterion is called the Mallow's Cp criterion. The subset of regressions giving the lowest value of Cp was to be chosen.

Multiple Regression Analysis of Basketball Performance on selected physical variables is presented in Table - 11.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>'t' Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-178.51</td>
<td>-2.20</td>
<td>0.032</td>
</tr>
<tr>
<td>X₁₀</td>
<td>-5.559</td>
<td>-0.70</td>
<td>0.486</td>
</tr>
<tr>
<td>X₁₁</td>
<td>4.224</td>
<td>1.26</td>
<td>0.213</td>
</tr>
<tr>
<td>X₁₂</td>
<td>0.2199</td>
<td>0.76</td>
<td>0.447</td>
</tr>
<tr>
<td>X₁₃</td>
<td>1.054</td>
<td>0.57</td>
<td>0.568</td>
</tr>
<tr>
<td>X₁₄</td>
<td>1.0652</td>
<td>5.36</td>
<td>0.000</td>
</tr>
<tr>
<td>X₁₅</td>
<td>-6.46</td>
<td>-0.37</td>
<td>0.711</td>
</tr>
</tbody>
</table>

\[ S = 2.796; \quad \text{R-Sq.} = 97.3\% \]

\( X₁₀ = \text{Speed} \quad \text{X₁₃} = \text{Agility} \)
\( X₁₁ = \text{Trunk Flexibility} \quad \text{X₁₄} = \text{Explosive Leg Strength} \)
\( X₁₂ = \text{Shoulder Flexibility} \quad \text{X₁₅} = \text{Cardio Respiratory Endurance} \)

\[ S = \text{Estimate of Residual Standard deviation} \]
\[ \text{R - Sq.} = \text{Square of the coefficient of determination} \]
From Table-11 this can be noted that only the P value corresponding to variable Explosive Leg Strength is less than 0.05 apart from the constant. Hence conclusion may be drawn that Explosive Leg Strength can be taken as the representative variable for the group of physical variables for the purpose of regression analysis.

The Regression Equation is: Basketball Performance = -225 + 1.35 (Explosive Leg Strength)

The analysis of variance for this regression is presented in Table - 12.

**TABLE - 12**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>6</td>
<td>17686.1</td>
<td>2947.7</td>
<td>376.96</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>63</td>
<td>492.6</td>
<td>7.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>18178.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table - 12 it was found that the regression was highly significant and may be used for further study including prediction of future cases.

Multiple Regression Analysis of Basketball Performance on selected Physiological variables is presented in Table - 13.
TABLE - 13
MULTIPLE REGRESSION ANALYSIS OF BASKETBALL PERFORMANCE ON SELECTED PHYSIOLOGICAL VARIABLES

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>'t' Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-248.7</td>
<td>-1.47</td>
<td>0.146</td>
</tr>
<tr>
<td>X_{16}</td>
<td>1.564</td>
<td>0.75</td>
<td>0.458</td>
</tr>
<tr>
<td>X_{17}</td>
<td>-1.0112</td>
<td>-1.26</td>
<td>0.212</td>
</tr>
<tr>
<td>X_{18}</td>
<td>39.33</td>
<td>3.84</td>
<td>0.000</td>
</tr>
<tr>
<td>X_{19}</td>
<td>1.1917</td>
<td>2.03</td>
<td>0.047</td>
</tr>
<tr>
<td>X_{20}</td>
<td>0.543</td>
<td>0.54</td>
<td>0.589</td>
</tr>
</tbody>
</table>

S = 2.870, R - Sq. = 97.1%.

X_{16} = Haemoglobin content
X_{17} = Resting Heart Rate
X_{18} = Vital Capacity
X_{19} = Blood Pressure (Systolic)
X_{20} = Blood Pressure (Diastolic)

S = Estimate of Residual Standard deviation
R - Sq. = Square of the coefficient of determination

From Table - 13 it can be noted that the P-values corresponding to variable vital capacity and systolic blood pressure are less than 0.05. Hence it can be concluded that vital capacity and systolic blood pressure can be taken as the representative variables for the group of Physiological variables for the purpose of regression analysis.

The regression equation is:

\[
\text{Basketball Performance} = -356 + 55.9 \text{ (vital capacity)} + 1.43 \text{ (Systolic Blood Pressure)}
\]

The analysis of variance for this regression is presented in Table - 14.
**TABLE - 14**

**ANALYSIS OF VARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>5</td>
<td>17651.5</td>
<td>3530.3</td>
<td>428.46</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>64</td>
<td>527.4</td>
<td>8.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>18178.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table - 14 it was found that the regression was highly significant and may be used for further study including prediction of future cases.

Multiple Regression Analysis of Basketball Performance on selected Anthropometric variables is presented in Table - 15.

**TABLE - 15**

**MULTIPLE REGRESSION ANALYSIS OF BASKETBALL PERFORMANCE ON SELECTED ANTHROPOMETRIC VARIABLES**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>'t' Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-981.4</td>
<td>-9.56</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_{27}$</td>
<td>11.751</td>
<td>9.94</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_{28}$</td>
<td>4.708</td>
<td>1.72</td>
<td>0.090</td>
</tr>
<tr>
<td>$X_{29}$</td>
<td>42.97</td>
<td>0.74</td>
<td>0.463</td>
</tr>
<tr>
<td>$X_{30}$</td>
<td>3.46</td>
<td>0.10</td>
<td>0.919</td>
</tr>
</tbody>
</table>

$S = 3.134; \quad R - \text{Sq.} = 96.5\%$

$X_{27} = \text{Arm Length} \quad X_{30} = \text{Arm Ratio}$

$X_{28} = \text{Ponderal Index}$

$X_{29} = \text{Crural Index}$

S = Estimate of Residual Standard deviation

R - Sq. = Square of the coefficient of determination
From Table - 15 it appears that only the P-value corresponding to variable Arm Length is less than 0.05 apart from the constant. Hence it can be concluded that Arm Length can be taken as the representation variable for the group of Anthropometric variables for the purpose of regression analysis.

The regression equation is:

\[ \text{Basketball Performance} = -991 + 13.1 \times (\text{Arm Length})\]

The analysis of variance for this regression is presented in Table - 16.

**TABLE - 16**

**ANALYSIS OF VARIANCE**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4</td>
<td>17540.5</td>
<td>4385.1</td>
<td>446.55</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>65</td>
<td>638.3</td>
<td>9.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>18178.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table - 16 it was found that the regression was highly significant and may be used for further study including prediction of future cases.

Multiple Regression Analysis of Basketball Performance on selected Psychological variables is presented in Table - 17.
TABLE - 17
MULTIPLE REGRESSION ANALYSIS OF BASKETBALL PERFORMANCE ON SELECTED PSYCHOLOGICAL VARIABLES

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>'t' Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-526.6</td>
<td>-4.13</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_{32}$</td>
<td>0.1875</td>
<td>-0.67</td>
<td>0.507</td>
</tr>
<tr>
<td>$X_{33}$</td>
<td>-0.0151</td>
<td>-0.03</td>
<td>0.973</td>
</tr>
<tr>
<td>$X_{34}$</td>
<td>5.448</td>
<td>4.24</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_{35}$</td>
<td>-0.0773</td>
<td>-0.23</td>
<td>0.822</td>
</tr>
<tr>
<td>$X_{52}$</td>
<td>0.11655</td>
<td>1.56</td>
<td>0.124</td>
</tr>
</tbody>
</table>

$S = 2.619$  \hspace{1cm} R-Sq. = 97.6%

$X_{32}$ = Sports Competition Anxiety \hspace{1cm} $X_{35}$ = Sports Self Confidence (State)

$X_{33}$ = Achievement Motivation

$X_{34}$ = Sports Self Confidence (Trait) \hspace{1cm} $X_{52}$ = Composition of 16 P.F

$S$ = Estimate of Residual Standard deviation

R - Sq. = Square of the coefficient of determination

Table - 17 shows that only the P-value corresponding to variable sports self confidence (Trait) is less than 0.05 apart from the constant. Hence it can be concluded that Sports Self Confidence (Trait) can be taken as the representative variable for the group of Psychological variables for the purpose of regression analysis.

The regression equation is:

Basketball Performance = -659 + 6.58 (Sports Self Confidence - Trait)

The analysis of variance for this regression is presented in Table - 18.
TABLE - 18

ANALYSIS OF VARIANCE

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>5</td>
<td>17739.7</td>
<td>3547.9</td>
<td>517.17</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>64</td>
<td>439.1</td>
<td>6.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>18178.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From Table - 18 it was found that the regression was highly significant and hence it is admissible for further predictive work.

IV.4 Discussion of Findings

The analysis of data pertaining to the relationship of selected physical, physiological, anthropometric and psychological variables to Basketball Performance reveals that the performance in Basketball was significantly related to Speed, Flexibility (Trunk and Shoulder), Agility, Explosive Leg Strength, Cardio Vascular Endurance, Haemoglobin content, Resting Heart rate, vital capacity, Blood pressure (Systolic and Diastolic), Ponderal Index and Crural index, Arm ratio, Arm length, Sports Competition Anxiety, Achievement Motivation, Sports Self Confidence (Trait), Sports Self Confidence (State) and 16 P.F.

These above observations may probably be attributed to the following facts.

One of the important dimensions of high level sports performance is fitness dimension comprising the components of physical fitness like speed, strength, agility, flexibility, explosive power of muscles, cardio-respiratory endurance etc. which provide the athletes required amount of physical fitness to reach peak performance in all sports. Basketball is a game which is played relatively in a small area requiring each player to do repeated
short sprints with a sudden stop followed by change of direction and movement, pivoting and jumping during the entire course of the game period having a little rest in between. All these activities put a tremendous strain on the leg and foot muscles and also on the cardiovascular system. Again, as a standard basketball game requires a player to make frequent forward and backward movements, repeated jumps for shooting and taking rebounds from the backboard along with fast breaks, power is another very important variable to be developed by a basketballer. So a training schedule for a basketball player must include a strength development programme, endurance development programme and power development programme as the primary requirement.

In the present study the researcher quite evidently found a significant relationship between basketball playing ability of the University level players measured by AAHPERD Basketball Skill Test and the physical variables like speed, flexibility, agility, explosive leg strength and cardio-respiratory endurance.

Findings of the present study established through the results obtained from the best subsets Regression method of Multiple Regression analysis that out of the five physical variables i.e. speed, flexibility, agility, explosive leg strength and cardio-respiratory endurance selected for the study, the explosive leg strength appeared to be the most significant predictor related with basketball playing ability although the contribution of other chosen physical variables are also significantly related with performance. That the explosive leg strength has come out in this study as the most significant representative variable among the physical variables may be due to the fact that a competitive game situation demands a basketball player to exert maximum effort and power in movements like repeated short-
sprints, sudden stop and quick change of direction, repeated jumps for shooting and taking rebounds from the backboard along with fast breaks.

This finding of the present study in respect of the explosive power of the leg muscles as a representative variable of the physical variables gets support from the observations of Pete Newell and John Benington, two eminent authorities of Basketball, who hold the strong opinion that the basketball demands muscular support and reaction of the lower extremities physical development has been concentrated principally upon the legs. ¹

Similar support can also be had from the study conducted by V. K. Joseph² on the relationship of power, agility, flexibility and measurements of selected body segments of volleyball playing ability where the researcher concluded that power is the most reliable variable in predicting volleyball playing ability of men volleyball players.

Shondell³ also reached the same conclusion in his study to identify physical and anthropometric traits possessed by successful collegiate volleyball performance.

Sridhar⁴ in this study to find the relationship of power agility, flexibility, muscular endurance and circuiorespiratory endurance concluded that power was the most significant motor fitness component that contribute to successful performance in volleyball.

² Ibid.
³ Ibid.
⁴ Ibid.
Results of the study clearly indicate that the Basketball playing ability measured by AAHPERD Basketball Skill Test has a significant relationship with the physiological variables like haemoglobin content, resting heart-rate, vital capacity and blood pressure (systolic and diastolic) selected for the study. These physiological factors greatly contribute to the total Cardiovascular efficiency of all sports persons. Cardiovascular efficiency plays a significant role in basketball performance as a basketball player has to make a nonstop continuous movement during the entire course of the competition. Cardiovascular endurance is concerned with the energy supplying systems which is directly related with physical activity of any nature.

It has become clear from the results of the study that among the physiological variables chosen for the present study vital capacity has been found to be the most significant predictor of basketball playing ability although other physiological variables do contribute significantly in enhancing performance in the game.

Cureton\textsuperscript{5} in a study on the Analysis of Vital Capacity as Test for condition of High School Boys concluded that there is a significant relationship between athletic ability and vital capacity. McCurdy and Larson\textsuperscript{6} also found that American national swimmers in peak condition had the highest vital capacity. The present study also revealed that vital capacity has the most

\textsuperscript{5} Thomas Cureton, "An Analysis of Vital Capacity as Test for Condition of High School Boys" Research Quarterly (December 1936) : 81.

\textsuperscript{6} J. H. McCurdy and Leonard Larson, The Validity of Circulo-Respiratory Measure on an Index of Endurance Condition Swimmers 'Research Quarterly' 11 (October 1990) : 3 - 11.
significant relationship with basketball playing ability and obviously lends support to the aforesaid studies.

The resting heart rate of an athlete acts as an indicator for his or her cardiac function. A more efficient cardiac function reflects in lower resting heart rate. Heart rate is influenced by many factors like posture, exercise, emotion and body temperature. Heart rate varies from person to person and is difficult to say whether this variation is due to lack of rigid control over these factors only. However, careful determination of resting heart rate is very important in experiments and tests which involve changes in heart rate during exercise. Research reports have indicated a tendency of lower resting heart rate in persons who are in a good physical condition than in non-athletic subjects.

The present study also has found a significant relationship of resting heart rate to basketball playing ability, thus supporting the findings of Elliot and Kilderry\(^7\) and Moorehouse and Miller\(^8\).

As far as Anthropometric variables are concerned the findings of this study reveal that all the anthropometric variables such as Arm length, Ponderal index, Crural index, Arm ratio have significant relationship with the criterion measure i.e. the basketball playing ability measured by AAHPERD Basketball Skill Test. Research works undertaken by Hirata\(^9\), Carter\(^10\)

\(^9\) Ibid.
\(^10\) Ibid.
deGarry et al.\textsuperscript{11} Sodhi\textsuperscript{12} on top level basketball players of different countries also support the above findings of the present study. Hirata observed that except the shot-putters 186 Tokyo Olympic basketball players were found to be tallest in his sample of different games. He further added that the top class teams in the world have a greater average height than the teams of lower standard. A significant correlation was found between the stature and performance in competition. Thus the greater the stature of a basketballer, the better will be his/her performance.

Mathew\textsuperscript{13} also drew similar conclusion from his study to determine the relationship of selected anthropometric measurements to performance on Brady Volleyball Test. He found that the variables of height, weight and arm length showed significantly higher relationships to performance in Brady Volleyball Test as compared to other measurements.

In a study conducted by Peterson\textsuperscript{14} on basketball players, height was found to be the only significant predictor of basketball playing ability.

It can be revealed from the findings of the study that among the anthropometric variables selected for the study arm length has become the most significant predictor of basketball playing ability. Various studies have established that the successful basketballers at different levels of competitions are taller. The arm length primarily adds to the height of the player. The more the arm length the more height is gained by the basketballer. The greater arm length enables the basketballer to take more biomechanical advantages in performing skills like making long
distance passes, receiving high passes, taking rebounds from the back board and shooting from different places. Sodhi in his study on national players indicated that the basketballers have proportionately longer arms longer legs and shorter trunks with narrower shoulder and broader knees.

So far Psychological variables are concerned it can be revealed from the results of the study that all the Psychological variables such as Sports Competition Anxiety, Achievement Motivation, Sports Self Confidence (trait and state) and 16 P.F are significantly related with basketball playing ability. This may be due to the fact that along with other contributing factors, the general Psychological make up of the person in terms of personality, motivational and emotional strengths also greatly influence high level sports performance of the athletes.

It has been observed from laboratory, field and clinical evidence that motor performance of an athlete can suffer due to high level anxiety. Not only performance, athlete’s health also can be affected by competition anxiety which disrupts normal sleeping pattern or creates gastrointestinal problems.\(^{15}\)

According to Gill achievement motivation induces the athlete to strive for success, persist in the face of failure and experience pride in accomplishments. Achievement motivation of competitiveness are concerned not only with the final outcome or the pursuit of excellence but also they deal with the Psychological journey of getting there.\(^{16}\)


The following figure depicts how the athletes are motivated in a Sports Specific Competitive situation according to the Need Achievement Theory developed by Atkinson and McClelland.\textsuperscript{17}

![Diagram of Need Achievement Theory]

Fig.17: Need Achievement Theory

Weinberg\textsuperscript{18} compared the resultant achievement motivation of athletes and non-athletes and found that the athletes demonstrated higher level of achievement motivation than the non-athletes. He also found that individual sports athletes demonstrated a higher level of achievement motivation than team sports athletes.

Maxson\textsuperscript{19} conducted a study to find the relationship between achievement motivation and performance in competitive swimming and concluded that there was significant positive

\textsuperscript{17} Ibid., p.76.
correlation between the scores of achievement motivation questionnaire and the swimming success survey.

Mesug\(^{20}\) however reached a different conclusion in a study to find relationship between achievement motivation and performance among Inter Collegiate Gymnasts. He found that no significant relationship existed between achievement motivation and gymnastic meet performance among men and women. Through the use of a 't' test it was found that a significant difference existed between scores attained by men and women in the McClelland Thematic Appreciation Test (MTAT).

The statistical analysis of data reveals that a combination of the personality traits measured by Cattel’s \(16\)
\(P.F.\) has a significant relationship with the basketball playing ability assessed by AAHPERD Basketball Skill Test.

The mean sten scores of most of the personality factors except factor 1 and factor \(Q_4\) show that the basketball players selected as the subjects of this present study were at more than average level while in respect of the factor 1 and factor \(Q_4\) they were almost at the average level. This indicates that the basketball players of this study had a tendency to be outgoing, more intelligent with high ego strength, dominant, non serious stronger in super ego strength, socially bold, tenderminded, suspicious, imaginative, shrewed, apprehensive, experimenting, self-sufficient with high self control concept and high ergic tension.

While McDonald\textsuperscript{21} in a study found that the varsity tennis players are more reserved and controlled other psychologists have generalised tentatively that champions may be extroverted cautioning that this topic needs more research.

So far the trait of intelligence is concerned, research findings at this time do not reveal any definite conclusions regarding relationship between athletic ability and intelligence. Cratty\textsuperscript{22} however suggested that more intelligent athlete would be more likely to succeed in those sports which require a detailed mechanical analysis.

Conflicting observations have been found by research regarding emotional stability of the athletes. Whiting and Stembridge\textsuperscript{23}, Booth\textsuperscript{24} and Kane\textsuperscript{25} have all found athletes to be emotionally stable and to exhibit low level of anxiety while Johnson,\textsuperscript{26} Ruffer\textsuperscript{27} and Ikegami\textsuperscript{28} reached the opposite conclusion stating that emotional stability in athletes is characterised by maturity, stability, quite realism, the absence of neurotic fatigue, placidness, unaffectedness optimum and self-discipline.

\textsuperscript{21} McDonald, Dissertation Abstracts International, 3975-A.
\textsuperscript{24} E.G. Booth, "Personality Traits of Athletes as Measured by the M.M.P.I." \textit{Research Quarterly} 29 (May 1958) : 127 - 138.
\textsuperscript{26} W.R. Johnson, D.C. Hutton, and B.J. Johnson, "Personality Traits of some champion Athletes as measured by Two Projective Tests : Rorschach and H-T-P" \textit{Research Quarterly} 25 (December 1954) : 484-485.
\textsuperscript{27} W.A. Ruffer, "A Study of Extreme Physical Activity Groups of Young Men" \textit{Research Quarterly} 36 (May 1965) : 183-185.
Research scholars\textsuperscript{29} in a number of studies have identified the significant role of the trait of dominance in competitive athletics. These scholars have found these athletes having a dominant character in their life situation and also exhibiting dominance in athletic achievements. Luski\textsuperscript{30} suggested that the successful tournament player is highly competitive and likely to be sadistic while the player who emphasises a non-competitive game may be masochistic, apologetic and friendly. In another study Roth and Puri\textsuperscript{31} found that male achievers tend to be extrapunitive while non-achievers tend to be intrapunitive.

It is the level of the player that determines whether a player would be serious or lively and enthusiastic. General observation is that players of high standard and calibre i.e. of professional circuit tend to be serious during competition while the same players exhibit a relaxed and lively temperament outside the competition arena.

Malamphy\textsuperscript{32} found that women athletes from individual sports events were more venturesome, less anxious and more extroverted to team sports events as measured by Cuttel's 16 P.F test. Lekic\textsuperscript{33} also supported the findings of Malumphy.

\textsuperscript{29} Alderman, *Psychological Behaviour in Sports*, p.139-140.
\textsuperscript{32} Theresa Malumphy, "Personality of Women Athletes in Inter Collegiate Competition" *Research Quarterly* 39 (October 1968) : 610-620.
Werner\textsuperscript{34}, Werner and Gotheil\textsuperscript{35} and Kroll\textsuperscript{36} have identified tough-mindedness as a personality trait of athletes. Successful athletes are generally observed to be not only physically tough but mentally tough as well. This might be due to the fact that top level sports are ruthless, cold and hard business where there is not place for the tenderminded athletes. Tough minded or mental toughness is considered to be a vital component for better performance.

The Sten scores obtained on other personality factors reveal that the basketball players of this study fall somewhere marginally above the average level. In respect of some of the personality factors, sufficient research works are not available and therefore further research in these specific areas is highly desirable. Results obtained after administering the Cattel's 16 P.F Test on the basketballers of this study indicate that although the individual personality traits might not have significant correlation with the basketball playing ability but the personality factors when combined definitely had significant correlation with the basketball playing ability.

In the present study sports self confidence (trait and state) of the basketball players has been found significantly related with the basketball playing ability measured by AAHPERD Basketball Skill Test. One of these two aspects - trait and state in respect of the sports self confidence of the basketball players,


\textsuperscript{36} W. Kroll, "Sixteen Personality Factor Profiles of Collegiate Wrestlers" \textit{Research Quarterly} 38 (March 1967) : 49-57.
trait aspect has a more significant relationship with basketball playing ability compared to the state aspect.

Research\textsuperscript{37} has indicated that the most consistent factor distinguishing highly successful athletes from less successful athletes is confidence. This implies that top athletes regardless of the sport consistently display a strong belief in themselves and their abilities. Self confidence arouses emotions, facilitates concentration, increases efforts, effects goals, game strategies and Psychological momentum. People having confidence in themselves and their abilities have a 'never giving up' attitude and view situations in which things are going against them as challenges and react with increased determination. The relation between confidence and performance is that performance improves as the level of confidence increases - upto an optimum level, whereupon further increase in confidence produce corresponding decrements in performance.\textsuperscript{38}

Based on the data collected for this study, five variables namely Explosive Leg Strength, Vital Capacity, Systolic Blood Pressure, Arm Length and Sports Self Confidence-Trait can be identified as the most significant variables contributing to the overall performance of the University level basketball players. So these variables can be utilised to predict the performance of a basketball player at the University level.


CARDIORESPIRATORY ENDURANCE vs. PERFORMANCE
(CRE)  (SPOT)

Fig. 18

Performance = Number of Speed Spot Shot in 120 seconds.

VITAL CAPACITY vs. PERFORMANCE
(VC)  (SPOT)

Fig. 19

Performance = Number of Speed Spot Shot in 120 seconds.
**SYSTOLIC BLOOD PRESSURE vs. PERFORMANCE**

**(SBP) (SPOT)**

![Graph](image)

\[ r = 0.905 \]

**Performance = Number of Speed Spot Shot in 120 seconds.**

---

**DIASTOLIC BLOOD PRESSURE vs. PERFORMANCE**

**(DBP) (SPOT)**

![Graph](image)

\[ r = 0.835 \]

**Performance = Number of Speed Spot Shot in 120 seconds.**
HAEMOGLOBIN CONTENT vs. PERFORMANCE
(HAEM) (SPOT)

Fig. 22

Performance = Number of Speed Spot Shot in 120 seconds.

RESTING HEART RATE vs. PERFORMANCE
(RHR) (SPOT)

Fig. 23

Performance = Number of Speed Spot Shot in 120 seconds.
**HAEMOGLOBIN CONTENT vs. PERFORMANCE**

*HAEM*  

*SPOT*

---

![Graph](image)

*Fig. 22*

Performance = Number of Speed Spot Shot in 120 seconds.

---

**RESTING HEART RATE vs. PERFORMANCE**

*RHR*  

*SPOT*

---

![Graph](image)

*Fig. 23*

Performance = Number of Speed Spot Shot in 120 seconds.

Performance = Number of Accuracy Speed Passing in 60 seconds.
Performance = Number of Accuracy Speed Passing in 60 seconds.
**Diastolic Blood Pressure vs. Performance (DBP) (PASS)**

![Graph showing the relationship between diastolic blood pressure (DBP) and performance (PASS). The correlation coefficient (r) is 0.844.](image)

Performance = Number of Accuracy Speed Passing in 60 seconds.

---

**Haemoglobin Content vs. Performance (HAEM) (PASS)**

![Graph showing the relationship between haemoglobin content (HAEM) and performance (PASS). The correlation coefficient (r) is 0.915.](image)

Performance = Number of Accuracy Speed Passing in 60 seconds.
**Fig. 30**

Performance = Number of Accuracy Speed Passing in 60 seconds.

**Fig. 31**

Performance = Number of Accuracy Speed Passing in 60 seconds.
SYSTOLIC BLOOD PRESSURE Vs. PERFORMANCE (SBP) (DRIB)

![Graph showing the relationship between SBP and DRIB with a correlation coefficient of r = -0.848.]

**Fig. 32**

Performance = Control Dribbling in Seconds (sum of two trials)

DIASTOLIC BLOOD PRESSURE Vs. PERFORMANCE (DBP) (DRIB)

![Graph showing the relationship between DBP and DRIB with a correlation coefficient of r = -0.774.]

**Fig. 33**

Performance = Control Dribbling in Seconds (sum of two trials)
SYSTOLIC BLOOD PRESSURE vs. PERFORMANCE (SBP) (DEFENCE)

Performance = Defensive Movement in Seconds (sum of two trials)

DIASTOLIC BLOOD PRESSURE vs. PERFORMANCE (DBP) (DEFENCE)

Performance = Defensive Movement in Seconds (sum of two trials)