CHAPTER IV

ANALYSIS OF DATA AND RESULTS OF THE STUDY

Analysis of data collected on thirty two males and twenty two females university level table-tennis players is presented in this chapter. This chapter is divided into two sections. Section I deals with prediction of male table tennis playing ability through the identification of meaningful motor fitness variables and section II is devoted to the study of identification of meaningful motor fitness variables predicting the playing ability of female table tennis players.

The data on table tennis playing ability along with motor fitness variables were examined by Pearson’s Product Moment Coefficient of Correlation to find out the relationship of table tennis playing ability to each of the motor fitness variables separately. The step-wise multiple regression coefficient between various motor fitness variables and table tennis playing ability were computed to assess the combined effect of speed (reaction time, movement speed, Choice-Response-Movement Ability, acceleration speed), Flexibility (wrist and trunk flexibility), Power (leg explosive power vertically and horizontally both), Agility (changing direction and lateral movement) and Endurance (speed endurance and abdominal muscle strength and endurance). Multiple regression equation was developed in order to predict the table tennis playing ability on the basis of motor fitness variables. The minimum level of significance to check the relationship obtained by Pearson’s Product Moment Coefficient Correlation was set at .05 level of significance, which was considered appropriate as per the nature and requirement of the study.
Section – I

Section I consist of all the steps and have been explained which lead to the findings of meaningful motor fitness variables and could enable to predict the playing ability of male table tennis players.

DESCRIPTIVE ANALYSIS OF MOTOR FITNESS VARIABLES RELATED TO THE MALE TABLE TENNIS PLAYERS.

Descriptive analysis of motor fitness test variables related to male table tennis players i.e. mean, standard deviation, standard error of mean and coefficient of variation have been presented in table 4.01

Table – 4.01

Descriptive measures of motor fitness test variables of male table tennis players

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variables</th>
<th>Unit</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>SEM</th>
<th>C.V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30m Fly Start</td>
<td>Second</td>
<td>4.31</td>
<td>5.65</td>
<td>5.21</td>
<td>.31</td>
<td>.05</td>
<td>5.95%</td>
</tr>
<tr>
<td>2.</td>
<td>Sit-ups</td>
<td>Number</td>
<td>15</td>
<td>42</td>
<td>26.84</td>
<td>6.76</td>
<td>1.19</td>
<td>25.19%</td>
</tr>
<tr>
<td>3.</td>
<td>Bend and Reach</td>
<td>Centimeter</td>
<td>3</td>
<td>9.5</td>
<td>5.45</td>
<td>1.93</td>
<td>.34</td>
<td>35.41%</td>
</tr>
<tr>
<td>4.</td>
<td>Shuttle Run</td>
<td>Second</td>
<td>9.62</td>
<td>11.81</td>
<td>10.49</td>
<td>.61</td>
<td>.11</td>
<td>5.82%</td>
</tr>
<tr>
<td>5.</td>
<td>Sargent Jump</td>
<td>Inch</td>
<td>13</td>
<td>22</td>
<td>18.00</td>
<td>2.59</td>
<td>.46</td>
<td>14.39%</td>
</tr>
<tr>
<td>6.</td>
<td>Standing Broad Jump</td>
<td>Inch</td>
<td>60</td>
<td>87</td>
<td>75.69</td>
<td>6.82</td>
<td>1.20</td>
<td>9.01%</td>
</tr>
<tr>
<td>7.</td>
<td>Lateral Movement for 10Sec.</td>
<td>Score</td>
<td>19</td>
<td>28</td>
<td>22.94</td>
<td>2.65</td>
<td>.47</td>
<td>11.55%</td>
</tr>
<tr>
<td>8.</td>
<td>Side Stepping for 30 Sec.</td>
<td>Number</td>
<td>17</td>
<td>27</td>
<td>21.97</td>
<td>2.96</td>
<td>.52</td>
<td>13.47%</td>
</tr>
<tr>
<td>9.</td>
<td>Nelson Choice – Response-Movement Ability</td>
<td>Second</td>
<td>1.91</td>
<td>2.26</td>
<td>2.08</td>
<td>.10</td>
<td>.02</td>
<td>4.81%</td>
</tr>
<tr>
<td>10.</td>
<td>Speed of Reaction (single hand)</td>
<td>Centimeter</td>
<td>25.5</td>
<td>42.66</td>
<td>33.35</td>
<td>4.69</td>
<td>.83</td>
<td>14.06%</td>
</tr>
<tr>
<td>11.</td>
<td>Speed of Movement</td>
<td>Centimeter</td>
<td>15.83</td>
<td>36.16</td>
<td>24.96</td>
<td>5.38</td>
<td>.95</td>
<td>21.55%</td>
</tr>
<tr>
<td>12.</td>
<td>Planter flexion</td>
<td>Degree</td>
<td>40</td>
<td>96</td>
<td>70.03</td>
<td>12.02</td>
<td>2.12</td>
<td>17.16%</td>
</tr>
<tr>
<td>13.</td>
<td>Dorsi flexion</td>
<td>Degree</td>
<td>40</td>
<td>96</td>
<td>71.88</td>
<td>13.10</td>
<td>2.31</td>
<td>18.22%</td>
</tr>
</tbody>
</table>
The range, mean, standard deviation, standard error of mean and coefficient of variation of motor fitness variables for male table tennis players have been presented in table 4.1. The table revealed that 30m Fly start had 5.21 mean, standard deviation .31, 0.5 standard error of mean and 5.95 percent coefficient of variation. Sit-ups had 26.84 mean, 6.76 standard deviation, 1.19 standard error of mean and coefficient of variation 25.19 percent. Bend and reach had 5.45 mean, standard deviation 1.93, and standard error of mean .34 and 35.41 percent coefficient of variation. Shuttle run had 10.49 mean, standard deviation .61, standard error of mean .11 and coefficient of variation 5.82 percent. Sargent jump had 18.00 mean, standard deviation 2.59, standard error of mean .46 and coefficient of variation 14.39 percent. Standing broad jump had 75.69 mean, 6.82 standard deviation, 1.20 standard error of mean and 9.01 percent coefficient of variation. Lateral movement for 10 Sec. had mean 22.94, standard deviation 2.65, .47 standard error of mean and 11.55 percent coefficient of variation. Side stepping for 30 Sec. had 21.97 mean, 2.96 standard deviation, .52 standard error of mean and 13.47 percent coefficient of variation. Nelson Choice-Response-Movement had 2.08 mean, .10 standard deviation, and standard error of mean .02 and 4.81 percent coefficient of variation. Speed of reaction (Single hand) had 33.35 mean, 4.69 standard deviation, .83 standard error of mean and coefficient of variation 14.06 percent. Speed of movement had mean 24.96, standard deviation 5.38, standard error of mean .95 and 21.55 percent coefficient of variation. Planter flexion had 70.03 mean, 12.02 standard deviation, 2.12 standard error of mean and 17.16 percent coefficient of variation and Dorsi flexion had mean 71.88, standard deviation 13.10, standard error of mean 2.31 and 18.22 percent coefficient of variation.

It is therefore, evident that the variance values in 30m Fly start, shuttle run, Sargent jump, standing broad jump, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice-Response-Movement, speed of reaction and planter flexion ranged between 4.81 to 17.16 percent according to the obtained values of coefficient of variation. This
level of variance was insignificant while the variance values in sit-up, bend and reach, speed of movement and dorsi flexion variables had more than 18 percent, which was significant. This level of variance might have its impact on table tennis playing ability of male players.

**RELATIONSHIP OF MOTOR FITNESS VARIABLES TO PLAYING ABILITY OF MALE TABLE TENNIS PLAYERS**

The relationship between motor fitness variables (independent variables) and table tennis playing ability of male players (criterion variable/dependent variable) was worked out and presented in table 4.02.

Table 4.02

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Motor fitness tests</th>
<th>Correlation coefficient</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30m fly start</td>
<td>-.927*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>2.</td>
<td>Sit ups</td>
<td>.884*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>3.</td>
<td>Bend and reach</td>
<td>.454*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>4.</td>
<td>Shuttle run</td>
<td>-.956*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>5.</td>
<td>Sargent jump</td>
<td>.842*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>6.</td>
<td>Standing broad jump</td>
<td>.884*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>7.</td>
<td>Lateral movement for 10 Sec.</td>
<td>.955*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>8.</td>
<td>Side stepping for 30 Sec.</td>
<td>.931*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>9.</td>
<td>Nelson Choice-Response-Movement</td>
<td>-.908*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>10.</td>
<td>Speed of reaction</td>
<td>-.972*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>11.</td>
<td>Speed of movement</td>
<td>-.935*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>12.</td>
<td>Planter flexion</td>
<td>.483*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>13.</td>
<td>Dorsi flexion</td>
<td>.580*</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>

* Significant at .01 level of confidence r > .449 (df=30)

Table (4.02) indicated that playing ability of male table tennis players was significantly related to all the motor fitness variables which the scholar had tested on the male players. These variables were 30m fly
start \( (r = -0.927) \), Sit ups \( (r = 0.884) \), Bend and reach \( (r = 0.454) \), Shuttle run \( (r = -0.956) \), Sargent jump \( (r = 0.842) \), Standing broad jump \( (r = 0.884) \), Lateral movement for 10 Sec. \( (r = 0.955) \), Side stepping for 30 Sec. \( (r = 0.931) \), Nelson Choice-Response-Movement \( (r = -0.908) \), Speed of reaction \( (r = -0.972) \), Speed of movement \( (r = -0.935) \), Planter flexion \( (r = 0.483) \) and Dorsi flexion \( (r = 0.580) \), at .01 level of significance because their calculated values were found greater than the table value of .449 (at 1% level of significance) with 30 degree of freedom.

It was observed that male table tennis playing ability was positively influenced by sit ups, bend and reach, Sargent jump, standing broad jump, lateral movement for 10 Sec., side stepping for 30 Sec., planter flexion and dorsi flexion. The negative values shown in case of 30m fly start, shuttle run, Nelson Choice-Response-Movement test were also found positively related to table tennis playing ability because less the time taken in these test variables, better the performance is and vise-versa. Similarly, the negative values shown in case of speed of reaction and speed of movement was also found positively related with male table tennis playing ability because in these two test variables subjects were required to hold the scale against the visual stimulus as early as possible to get good score in speed of reaction and speed of movement. Thus, less the score in these two tests better the performance is and vise-verse.

It is therefore, evident that 30m fly start, sit ups, bend and reach, shuttle run, Sargent jump, standing broad jump, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice-Response-Movement, speed of reaction, speed of movement, planter flexion and dorsi flexion are essentials components for the playing ability of male table tennis players.

The relationship of male table tennis playing ability with all the motor fitness test variables used for the study is graphically presented in Figures 4.01 to 4.13.
Fig. 4.01: Relationship between table tennis playing ability of male players and 30m fly start

Overall table tennis playing ability of male players

30m Fly Start (Sec.)
Fig. 4.02: Relationship between table tennis playing ability of male players and sit-ups

$r' = .884$
Fig. 4.03: Relationship between table tennis playing ability of male players and bend and reach test

$r = .454$
Fig. 4.04: Relationship between table tennis playing ability of male players and shuttle run

$r' = -0.956$
Fig. 4.05: Relationship between table tennis playing ability of male players and Sargent jump

$r^2 = .842$
Fig. 4.06: Relationship between table tennis playing ability of male players and standing broad jump

$r = .884$
Fig. 4.07: Relationship between table tennis playing ability of male players and lateral movement for 10 Sec.

$r = .955$
Fig. 4.08: Relationship between table tennis playing ability of male players and side stepping for 30 Sec.

\[ r' = .931 \]
Fig. 4.09: Relationship between table tennis playing ability of male players and Nelson Choice-Response-Movement (Seconds)

\( r = -0.908 \)
Fig. 4.10: Relationship between table tennis playing ability of male players and speed of reaction

$r = -0.972$
Fig. 4.11: Relationship between table tennis playing ability of male players and speed of movement

\[ V = -0.935 \]

Overall table tennis playing ability of male players:
- ♦
- ♦♦
- ♦♦♦
- ♦♦♦♦
- ♦ ♦♦♦♦
- ♦ ♦ ♦
- ♦ ♦
- ♦ *
- ♦♦ ♦
- ♦♦

96
Fig. 4.12: Relationship between table tennis playing ability of male players and planter flexion

$r' = .483$
Fig. 4.13: Relationship between table tennis playing ability of male players and dorsi flexion

$\gamma = .580$
CONTRIBUTION OF MOTOR FITNESS VARIABLES TO THE TABLE TENNIS PLAYING ABILITY OF MALE PLAYERS

The results of the combined contribution of motor fitness variables, through the application of multiple regressions have been presented in table 4.03.

Table 4.03

Combined Contribution of Motor Fitness test variables to playing ability of male table tennis players

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Regression Coefficient</th>
<th>$R^2$ value</th>
<th>Contribution towards $R^2$</th>
<th>Level of Significance</th>
<th>% contribution towards $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30m Fly Start</td>
<td>-4.6107</td>
<td>17.83</td>
<td>0.05</td>
<td>18.23%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Shuttle Run</td>
<td>-3.8917</td>
<td>30.30</td>
<td>0.01</td>
<td>30.99%</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nelson Choice-Response-Movement</td>
<td>-17.2334</td>
<td>26.60</td>
<td>0.01</td>
<td>27.21%</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Speed of Reaction (single hand)</td>
<td>-0.9316</td>
<td>23.05</td>
<td>0.01</td>
<td>23.57%</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Intercept [a]</td>
<td></td>
<td>160.534</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = 97.78$

F-ratio = 297.35

Level of Significance = 0.05

Difference in $R^2$ of first and final equation = .9837 - .9778 = .0059

This equation is as under

$Y = 160.534 - 4.6107 (X_1) - 3.8917 (X_4) - 17.2334 (X_9) - .9316 (X_{10})$

Where $Y =$ Playing Ability.

Many equations were tried through deleting one variable at a time in order to arrive at the best combination of variables of motor fitness.
The first regression equation consisted of total thirteen motor fitness variables, which the scholar had tested. These variables were as under.

1. 30 m Fly start (seconds)
2. Sit ups (numbers)
3. Bend and reach (centimeters)
4. Shuttle run (seconds)
5. Sargent jump (inches)
6. Standing broad jump (inches)
7. Lateral movement for 10 Sec. (score)
8. Side stepping for 30 Sec. (numbers)
10. Speed of reaction (centimeters)
11. Speed of movement (centimeters)
12. Planter flexion (Degree)
13. Dorsi flexion (Degree)

Shuttle run had -3.8917 regression coefficient with maximum contribution 30.99 percent towards $R^2$ which was significant at <.01 level, Nelson Choice-Response-Movement had -17.2334 regression coefficient with 27.21 percent contribution towards $R^2$ and the level of significance was <.01, Speed of reaction (Single hand) had -0.9316 regression coefficient with 23.57 percent contribution towards $R^2$ and the level of significance was <.01, 30m fly start had -4.6107 regression coefficient with 18.23 percent contribution towards $R^2$ which was significant at <.05 level.

The regression coefficient of shuttle run (-3.8917) highlighted that there would be an increase of 3.8917 score with decrease of one second in the existing average time in shuttle run by male players in the sample.
of the study i.e. 10.49 sec., Similarly a decrease of one unit in the average time i.e. 5.21 sec. in 30 m fly start by male players sample would contribute 4.6107 score in playing ability of male table tennis players.

The regression coefficient of Nelson Choice – Response-Movement (-17.2334) indicated that there would be an increase of 17.2334 score with a decrease of one unit of time taken for Nelson Choice–Response-Movement test. While a decrease of one centimeter below the mean of male sample i.e. 33.35 in speed of reaction test would cause an increase of .9316 score in male table tennis playing ability.

The contribution of all the motor fitness variables in the preliminary step of multiple regression was found to be 98.37 percent of variance to the table tennis playing ability of male players while the variables included in the final run equation namely time taken for 30 fly start, shuttle run, Nelson Choice-Response-Movement and holding the scale with single hand as quickly as possible in speed of reaction test variables explained as high as 97.78 percent of variance to the playing ability of male table tennis players. This showed that nine variables other than mentioned above contributed a very less share to the tune of only 0.59 percent of the variance. This indicated that four variables included in the final run equation were very powerful for predicting the table tennis playing ability of male players.

The Following regression equation were drawn

\[
Y = 160.534 - 4.6107 (X_1) - 3.8917 (X_4) - 17.2334 (X_9) - .9316 (X_{10})
\]

\[
Y = \text{Paying Ability}
\]

\[
X_1 = \text{30 m fly start}
\]

\[
X_4 = \text{Shuttle run}
\]

\[
X_9 = \text{Nelson Choice – Response-Movement}
\]

\[
X_{10} = \text{Speed of reaction (Single hand)}
\]
DISCUSSION

The descriptive analysis of the motor fitness variables revealed that table tennis playing ability of total male sample used for the study was significantly related to all the motor fitness variables i.e. 30 m fly start, sit ups, bend and reach, shuttle run, Sargent jump, standing broad jump, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice-Response-Movement, speed of reaction, speed of movement, planter flexion and dorsi flexion. Out of thirteen motor fitness test variables five variables showed negative significant relationship and among these five variables three variables namely 30m fly start, shuttle run, and Nelson Choice-Response-Movement were measured against time taken which means lesser the time taken in these two test variables better the performance and more the time taken mean lower the performance and other two variables i.e. speed of reaction and speed of movement were measured through holding the scale as early as possible after the release of it and score was recorded in centimeters, lesser the score better the performance is and vise-verse.

The contribution of motor fitness variables used for the study to total male table tennis players sample from various colleges of Panjab University, Chandigarh as presented in table 4.03 revealed that 30 m fly start, shuttle run, Nelson Choice-Response-Movement and speed of reaction could jointly predict the playing ability of male table – tennis players. Though all the thirteen motor fitness test variables were found significantly related to the table tennis playing ability, which highlighted their importance in improving the table tennis playing ability of male players. Yet, the above mentioned four motor fitness variables were the most important variables in predicting the table tennis playing ability of male players.

The result might be attributed to the facts that shuttle run develops agility in the players. Agility of the players helps in doing rapid
movements by steps, lung and jumps combined with simultaneous body turns in different directions on the table while tackling the opponent both during offense and defense movements. Barrow and McGee (1979) said that agility play an important role in physical activities, and it was revealed to a great extent in sports and game involved efficient footwork and quick changes in body position or direction such as in table tennis, badminton, basket ball etc.

Choice-Response-Movement Ability was also found highly correlated with the playing ability of male table tennis players. For hitting the ball (except in service) player performs movements in response to the movements of the opponent and the ball, opponent can place the ball with varied speed and spin in any direction on the table. The success of ball hitting depends upon the how fast a player reach to the ball, which depends upon the foot reaction ability of the player. Thus, Nelson Choice-Response-Movement Ability really contributes towards the playing ability of male table tennis players, which was indicated by the regression analysis.

Speed of reaction is very important motor fitness variables in table tennis Zhijie Zhang (2002) investigated that within a second, table tennis player have to complete one technical action and advanced table tennis players can make the ball to acquire a speed above 20 meters per second. They can make the ball hit the opposite surface of the table within 1/10 second. (The tennis players can blow the ball to reach the opposite side within ¼ second by a powerful serve). With in such a short time, the paddlers have to observe the angle and strength at which his opponent moves his bat, correctly judge the strength, swirl, hitting point and springing of coming ball, at the same time, to complete his own movement, location, drawing the bat, hitting of the ball and resumption, which greatly depends upon players speed of reaction ability. Speed of reaction and instantaneous decision requires high-speed coordination of
one's brain, eyes and all joints of muscles, which are accomplished by
the bats controlled by one's hand. Zhijie Zhang (2002) studied that
reaction of a topnotch player is extremely quick only 0.008 second while
that of a topnotch goalie in soccer is 0.012 second. Playing apart
from the net and having the lightest ball, these two characteristics
determine that this game has little danger.

30m fly start measured the reaction time, movement speed of arms
and legs, and acceleration ability. These factors are pre requisite for
modern table tennis. Similar views were also given by Janusz lapszo
(2002) that Modern table tennis requires the various type of sequential
movements to be executed at maximum speed and it is the speed of
these movements that is one of the most important factors of effective
play. Even regression analysis conducted in this study also indicated
that 30 fly start was found significant at .05 of level with table tennis
playing ability of male players. Lapszo (1996) reported that highly skilled
adult male and female players are able to perform specific movements in
table tennis faster than less skilled counter parts.

SECTION – II

In this section all the steps have been explained which lead to the
findings of meaningful motor fitness variables and could predict the
playing ability of female table tennis players.

DESCRIPTIVE ANALYSIS OF MOTOR FITNESS VARIABLES RELATED
to the female table tennis players

Descriptive analysis of motor fitness variables related to female
table tennis players i.e. mean, standard deviation, standard error of
mean and coefficient of variation have been presented in Table 4.04.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Unit</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>SEM</th>
<th>C.V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30m Fly Start</td>
<td>Second</td>
<td>5.74</td>
<td>7.62</td>
<td>6.67</td>
<td>.60</td>
<td>.13</td>
<td>9.0%</td>
</tr>
<tr>
<td>2.</td>
<td>Sit -ups</td>
<td>Number</td>
<td>11</td>
<td>30</td>
<td>19.36</td>
<td>5.79</td>
<td>1.23</td>
<td>29.91%</td>
</tr>
<tr>
<td>3.</td>
<td>Bend and Reach</td>
<td>Centimeter</td>
<td>3</td>
<td>16</td>
<td>7.25</td>
<td>3.83</td>
<td>.82</td>
<td>52.83%</td>
</tr>
<tr>
<td>4.</td>
<td>Shuttle Run</td>
<td>Second</td>
<td>10.87</td>
<td>14.16</td>
<td>12.28</td>
<td>.98</td>
<td>.21</td>
<td>7.98%</td>
</tr>
<tr>
<td>5.</td>
<td>Sargent Jump</td>
<td>Inch.</td>
<td>9</td>
<td>15</td>
<td>10.41</td>
<td>1.65</td>
<td>.35</td>
<td>15.85%</td>
</tr>
<tr>
<td>6.</td>
<td>Standing Broad Jump</td>
<td>Inch.</td>
<td>43</td>
<td>66</td>
<td>54.91</td>
<td>6.96</td>
<td>1.48</td>
<td>12.88%</td>
</tr>
<tr>
<td>7.</td>
<td>Lateral Movement for 10 Sec.</td>
<td>Score</td>
<td>16</td>
<td>23</td>
<td>19.50</td>
<td>2.24</td>
<td>.48</td>
<td>11.49%</td>
</tr>
<tr>
<td>8.</td>
<td>Side Stepping for 30 Sec.</td>
<td>Number</td>
<td>15</td>
<td>22</td>
<td>18.45</td>
<td>2.79</td>
<td>.59</td>
<td>15.12%</td>
</tr>
<tr>
<td>10.</td>
<td>Speed of Reaction (single hand)</td>
<td>Centimeter</td>
<td>29.00</td>
<td>43.66</td>
<td>35.69</td>
<td>6.06</td>
<td>1.29</td>
<td>16.98%</td>
</tr>
<tr>
<td>11.</td>
<td>Speed of Movement</td>
<td>Centimeter</td>
<td>22.16</td>
<td>36.83</td>
<td>29.85</td>
<td>5.89</td>
<td>1.26</td>
<td>19.73%</td>
</tr>
<tr>
<td>12.</td>
<td>Plantar Flexion</td>
<td>Degree</td>
<td>42</td>
<td>92</td>
<td>66.86</td>
<td>14.71</td>
<td>3.14</td>
<td>22.00%</td>
</tr>
<tr>
<td>13.</td>
<td>Dorsi Flexion</td>
<td>Degree</td>
<td>44</td>
<td>86</td>
<td>66.86</td>
<td>12.40</td>
<td>2.64</td>
<td>18.55%</td>
</tr>
</tbody>
</table>

The range, mean, standard deviation, standard error of mean and coefficient of variation of motor fitness variables related to female table tennis players have been presented in table 4.4. The table revealed that 30m fly start had 6.67 mean, .60 standard deviation, .13 standard of error mean and 9.0 percent coefficient of variation. Sit ups had 19.36 mean, 5.79 standard deviation, 1.23 standard error of mean and coefficient of variation 29.91 percent. Bend and reach had 7.25 mean, standard deviation 3.83, and standard error of mean .82 and 52.83
percent coefficient of variation. Shuttle run had 12.28; mean .98 standard deviation, .21 standard error of mean and 7.98 percent coefficient of variation. Sargent jump had 10.41 mean, standard deviation 1.65, and standard error of mean .35 and 15.85 percent coefficient of variation. Standing broad jump had 54.91 mean, 6.96 standard deviation, 1.48 standard error of mean and coefficient of variation 12.68 percent. Lateral movement for 10 Sec. had mean 19.50, standard deviation 2.24, .48 standard error of mean and 11.49 percent coefficient of variation. Side stepping for 30 Sec. had 18.45 mean, 2.79 standard deviation, .59 standard error of mean and 15.12 percent coefficient of variation. Nelson Choice-Response-Movement had 2.46 mean, .19 standard deviation, standard error of mean .04 and 7.72 percent coefficient of variation. Speed of Reaction (single hand) had mean 35.69, 6.06 standard deviation, 1.29 standard error of mean and coefficient of variation 16.98 percent. Speed of movement had 29.85 mean, 5.89 standard deviation, 1.26 standard error of mean and coefficient of variation 19.73 percent. Planter flexion had 66.86 mean, 14.71 standard deviation, 3.14 standard error of mean and 22.00 percent coefficient of variation and Dorsi flexion had 66.86 mean, 12.40 standard deviation, 2.64 standard error of mean and 18.55 percent coefficient of variation.

It is therefore, evident that the variance values in 30m fly start, shuttle run, Sargent jump, standing broad jump, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice-Response-Movement and speed of reaction, ranged between 7.72 to 16.98 percent according to the obtained values of coefficient of variation. This level of variance was insignificant while the variance values in sit ups, bend and reach, speed of movement, planter flexion and dorsi flexion test variables had more than 18 percent, which was significant. This level of variance might have its impact on table tennis playing ability of female players.
RELATIONSHIP OF MOTOR FITNESS VARIABLES TO PLAYING ABILITY OF FEMALE TABLE TENNIS PLAYERS

The relationship between motor fitness variables (Independent variables) and table tennis playing ability of female players (criterion/dependent variables) was worked out and presented in table 4.05.

Table 4.05

Relationship between Playing ability and Selected Motor Fitness Variables of Female Table – Tennis Players

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Motor fitness tests</th>
<th>Correlation coefficient</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>30m fly start</td>
<td>-.785*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>2.</td>
<td>Sit ups</td>
<td>.887*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>3.</td>
<td>Bend and reach</td>
<td>.706*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>4.</td>
<td>Shuttle run</td>
<td>-.895*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>5.</td>
<td>Sargent jump</td>
<td>.381 NS NS</td>
<td>NS</td>
</tr>
<tr>
<td>6.</td>
<td>Standing broad jump</td>
<td>.517 NS NS</td>
<td>NS</td>
</tr>
<tr>
<td>7.</td>
<td>Lateral movement for 10 Sec.</td>
<td>.913*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>8.</td>
<td>Side stepping for 30 Sec.</td>
<td>.968*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>9.</td>
<td>Nelson Choice-Response-Movement</td>
<td>-.928*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>10.</td>
<td>Speed of reaction (single hand)</td>
<td>-.921*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>11.</td>
<td>Speed of movement</td>
<td>-.959*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>12.</td>
<td>Planter flexion</td>
<td>.778*</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>13.</td>
<td>Dorsi flexion</td>
<td>.748*</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>

* Significant at .01 level of confidence $r > .537$ (df=20)

The above table (4.05) showed significant relationship of female table tennis playing ability to some of the motor fitness variables such as 30m fly start (-.785), sit ups (.887), bend and reach (.706), shuttle run (-.895), lateral movement for 10 Sec. (.913), side stepping for 30 Sec.
Nelson Choice-Response-Movement (-.928), speed of reaction (-.921), speed of movement (-.959), planter flexion (.778), dorsi flexion (.748) at .01 level of significance, because their calculated values are greater than the table value .537 (at 1% level of significant) with 20 degree of freedom. Whereas, table tennis playing ability of female players was not found significantly related to two motor fitness test variables these were Sargent jump (.381) and standing broad jump (.517).

It was observed that table tennis playing ability of female players was positively influenced by sit-ups, bend and reach, lateral movement for 10 Sec., side stepping for 30 Sec., planter flexion and dorsi flexion. The negative values shown in case of 30m fly start, shuttle run, Nelson Choice-Response-Movement were also found positively related to female table tennis playing ability because these variables were measured against time taken, means less the time taken better the performance is and vice-versa. Similarly, negative values shown in case of speed of reaction and speed of movement were also found positively related to female table tennis playing ability because in these two tests subject were required to hold the scale against visual stimulus as early as possible to get good score in speed of reaction and speed of movement test variables. Thus, less the score in these two test variables better the performance is and vise-versa.

It is therefore, evident that 30m fly start, sit-ups, bend and reach, shuttle run, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice-Response-Movement, speed of reaction, speed of movement, planter flexion and dorsi flexion were essential components for the table tennis playing ability of female players.

Fig. 4.14: Relationship between table tennis playing ability of female players and 30m fly start

$r' = -0.785$

Overall table tennis playing ability of female players

30m Fly Start (Sec.)
Fig. 4.15: Relationship between table tennis playing ability of female players and sit-ups.

$\rho = 0.887$
Fig. 4.16: Relationship between table tennis playing ability of female players and bend and reach test

'\( r \) = .706
Fig. 4.17: Relationship between table tennis playing ability of female players and shuttle run

'r' = -.895
Fig. 4.18: Relationship between table tennis playing ability of female players and Sargent jump

$r' = .381$
Fig. 4.19: Relationship between table tennis playing ability of female players and standing broad jump

'\textit{r}' = .517
Fig. 4.20: Relationship between table tennis playing ability of female players and lateral movement for 10 Sec.

$r' = .913$
Fig. 4.21: Relationship between table tennis playing ability of female players and side stepping for 30 Sec.

*r* = .968
Fig. 4.22: Relationship between table tennis playing ability of female players and Nelson Choice-Response-Movement

\[ \gamma = -0.928 \]
Fig. 4.23: Relationship between table tennis playing ability of female players and speed of reaction

'\( r \) = -0.921

<table>
<thead>
<tr>
<th>Speed of Reaction (Cms)</th>
<th>Overall table tennis playing ability of female players</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>N</td>
</tr>
<tr>
<td>45</td>
<td>J</td>
</tr>
<tr>
<td>40</td>
<td>CD</td>
</tr>
<tr>
<td>35</td>
<td>r</td>
</tr>
<tr>
<td>30</td>
<td>*</td>
</tr>
<tr>
<td>25</td>
<td>♦</td>
</tr>
<tr>
<td>20</td>
<td>♦</td>
</tr>
<tr>
<td>15</td>
<td>♦</td>
</tr>
<tr>
<td>10</td>
<td>♦</td>
</tr>
<tr>
<td>5</td>
<td>♦</td>
</tr>
<tr>
<td>0</td>
<td>♦</td>
</tr>
</tbody>
</table>
Fig. 4.24: Relationship between table tennis playing ability of female players and speed of movement

'\( r \) = -0.959
Fig. 4.25: Relationship between table tennis playing ability of female players and planter flexion

'r' = .778
Fig. 4.26: Relationship between table tennis playing ability of female players and dorsi flexion

\[ r = .748 \]

Overall table tennis playing ability of female players

Dorsi Flexion (Degree)
CONTRIBUTION OF MOTOR FITNESS VARIABLES TO THE TABLE TENNIS PLAYING ABILITY OF FEMALE PLAYERS

The results of the combined contribution of motor fitness variables through the application of multiple regressions have been presented in Table 4.06

Table 4.06
Combined Contribution of Motor Fitness Test Variables to Playing Ability of Female Table Tennis Players

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Regression Coefficient</th>
<th>$R^2$ value</th>
<th>Contribution towards $R^2$</th>
<th>Level of Significance</th>
<th>% contribution towards $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Sit ups</td>
<td>.4238</td>
<td>8.52</td>
<td>.01</td>
<td>8.74</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sargent jump</td>
<td>-1.1233</td>
<td>11.93</td>
<td>.01</td>
<td>12.24</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Lateral movement for 10 Sec.</td>
<td>2.0055</td>
<td>97.50</td>
<td>39.85</td>
<td>.01</td>
<td>40.87</td>
</tr>
<tr>
<td>8</td>
<td>Side stepping for 30 Sec.</td>
<td>1.9751</td>
<td>37.20</td>
<td>.01</td>
<td>38.15</td>
<td></td>
</tr>
</tbody>
</table>

(a) Intercept (a) = -47.6167

$R^2 = 97.50$

F-ratio = 165.80

Level of Significance = .05

Difference in $R^2$ of first and final equation = .9851 - .9750 = .0101

This equation is as under

$Y = - 47.6167 + .4238(X_2) - 1.1233(X_5) + 2.0055(X_7) + 1.9751(X_8)$

Where $Y$ = Playing Ability.
Many equations were tried through deleting one variable at a time in order to arrive at the best combination of dependent variables of motor fitness. The first regression equation consisted of total thirteen motor fitness variables, which the scholar had tested. These variables were as under

1. 30m fly start (Seconds)
2. Sit ups (Numbers)
3. Bend and reach (Centimeters)
4. Shuttle run (Seconds)
5. Sargent jump (Inches)
6. Standing broad jump (Inches)
7. Lateral movement for 10 Sec. (Score)
8. Side stepping for 30 Sec. (Numbers)
10. Speed of reaction (Centimeters)
11. Speed of movement (Centimeters)
12. Planter flexion (Degrees)
13. Dorsi flexion (Degrees)

Lateral movement for 10 Sec. had 2.0055 regression coefficient with 40.87 percent contribution towards R² and level of significance was < .01, side stepping for 30 Sec. had 1.9751 regression coefficient and contributed 38.18 percent towards R² which was significant at < .01 level, Sargent jump had -1.1233 regression coefficient with 12.24 percent contribution towards R² and level of significance was < .01, sit ups had .4238 regression coefficient with 8.74 percent contribution towards R² which was significant at < .01 level.
The regression coefficient of side stepping for 30 sec. (1.9751) highlighted that there would be an increase of 1.9751 score with increase of one more test score in the existing average test score in side stepping for 30 sec. by female subjects in the sample of the study i.e. 18.45 test scores. Similarly an increase of one more test score in the average test score i.e. 19.50 in lateral movement for 10 sec. by female players sample of the study would contribute 2.0055 score in playing ability of table tennis players.

The regression coefficient of Sargent jump (-1.1233) indicated that an increase of 1.1233 score in female table tennis playing ability would occur with an increase of one inch vertical jumping ability while an increase in one number in sit ups test variable would contribute .4238 score towards female table tennis playing ability.

The contribution of all motor fitness variables in the preliminary multiple regression was found to be 98.51 percent of variance to the playing ability of female table tennis players while the variables included in the final run equation, namely side stepping for 30 sec, lateral movement for 10 sec., sit ups and Sargent jump explained as high as 97.50 percent of variance to the playing ability of female table tennis players. This indicated that nine variable other than mentioned above secured a very less share to the tune of only 1.01 percent of the variance. This revealed that four variable included in the final run equation were very powerful in predicting the playing ability of female table tennis players.

The following regression equation were drawn

\[ Y = -47.6167 + .4238 (x_2) - 1.1233 (x_5) + 2.0055 (x_7) + 1.9751 (x_8) \]

\[ Y = \text{Playing ability} \]

\[ X_2 = \text{Sit-ups} \]

\[ X_5 = \text{Sargent jumps} \]
Descriptive analysis of table 4.05 showed that out of thirteen motor fitness test variables used for the study only two motor fitness variables i.e. Sargent jump and standing broad jump was non-significant and rest of the eleven test variables was found significant at .01 level. These were 30m fly start, sit-ups, bend and reach, shuttle run, lateral movement for 10 Sec., side stepping for 30 Sec., Nelson Choice–Response–Movement, speed of reaction, speed of movement, planter flexion, dorsi flexion. Out of eleven motor fitness test variables, five variables were showed negative significant relationship and among these, three variables namely 30m fly start, shuttle run, and Nelson Choice–Response–Movement were measured against time taken which means lesser the time taken in these variables better the performance is and vise-a-versa and remaining other two variables i.e. speed of reaction and speed of movement were measured through holding of scale against visual stimulus as early as possible when ever it release and score was recorded in centimeters. Lesser the score in speed of reaction and speed of movement motor fitness test variables better the performance is and vise-a-versa. So, all the eleven motor fitness variables bore positive significant relationship with playing ability of female table tennis players.

The contribution of motor fitness variables to total female sample of table tennis players from various colleges of Panjab University Chandigarh as presented in table 4.06 revealed that sit ups, Sargent jump, lateral movement for 10 Sec. and side stepping for 30 Sec. could jointly predict the playing ability of female table tennis players. Though the relationship of all the motor fitness variables except two i.e. Sargent jump and standing broad jump was not found significant to the table tennis playing ability, which showed their importance in improving the
table tennis playing ability among female players. Yet, sit ups, Sargent jump, lateral movement for 10 Sec. and side stepping for 30 Sec. were the most important predictors in female table tennis playing ability.

Lateral movement for 10 Sec. was found highly correlated with the playing ability of female table tennis players. It develops agility among the players and helps in table coverage both offensively and defensively. To play successfully player are required to move her body as fast as possible to the place where the ball is flying and after successfully hitting the ball, next job is to reach as quickly as possible the best position at the playing table for covering the possible lines of flight, position and speed of the returning ball, that could be possible, if the player possess good agility.

Side stepping for 30 Sec. provides speed endurance, which is also one of the important fitness parameter required in the game of table tennis. During the play, player remains in motion throughout the game and there intensity of movement action is very high. Chunhwei, Tsu et.al (1982) have reported from the data collected during the world championships, according to them the measured motor density in an competitive encounter of three games is from 302 to 1246 hand movement, i.e. an average from 0.26 to 0.69 movements per second. The three game encounters take from 18 to 44 minutes depending on the style of play of the competitors. Even the importance of speed endurance as indicated by regression analysis could also be attributed to the fact that table tennis players are required to perform various type of sequential movements at maximum speed for continues long period.

The importance of Sargent jump as indicated by regression analysis could also be attributed to its frequent use during quick lateral, backward, forward movements and jumps combined with simultaneous body turns in different direction for table coverage and for performing
various type of strokes effectively. That could be possible, only if the player possess good leg strength.

Sit-ups variable measured abdominal muscle strength and endurance. Good abdominal muscle strength endurance is pre-requisite for getting good coordination of whole body and its play major role in performing all types of general and specific skill movements involved in the game of table tennis.