

## **CHAPTER IV**

### **RESULTS AND DISCUSSIONS**

#### **4.1 OVER VIEW**

The purpose of the study was to find out the effect of skill based exercises with varied frequencies of tabata training on selected bio motor variables, physiological and performance related variables namely, cardiovascular endurance, agility, explosive power, mean arterial blood pressure, anaerobic power, vital capacity, passing, shooting and overall playing ability among handball players. To achieve the purpose, the investigator randomly selected eighty (N=80) handball players from Chennai district, Tamilnadu, India. The age group ranged between 20-25 years. The selected subjects were fit to undergo the experimental training and gave their written consent to participate in this study. The research design of the study was random group design.

The selected subjects were randomly divided in to four groups and assigned in to skill based exercises with tabata training once in a week (Group I), skill based exercises with tabata training twice in a week (Group II), skill based exercises with tabata training thrice in a week (Group III) and control group (Group IV). Each group consisted of twenty (n=20) subjects. All the three experimental groups were underwent regular handball training for a period of sixteen weeks. And in addition the experimental group I underwent tabata training once in a week on Wednesdays, experimental group II underwent tabata training twice in a week on Tuesdays and Fridays and experimental group III underwent tabata training thrice in a week on Mondays, Thursdays and Saturdays. The pre and post tests were conducted on all the four groups on the selected criterion variables.

## **4.2 TEST OF SIGNIFICANCE**

The data collected from different group's handball players due to skill based exercises with varied frequencies of tabata training groups and control group were compared for the differences. The difference obtained in the selected bio motor physiological and performance related variables was tested through statistical treatment. Statistical technique Analysis of covariance (ANCOVA) was employed to test the differences among the four groups.

## **4.3 LEVEL OF SIGNIFICANCE**

The subjects were compared on selected criterion variables among different groups. The data on selected criterion variables cardiovascular endurance, explosive power, agility, mean arterial blood pressure, vital capacity, anaerobic power, passing, shooting and playing ability were collected. The Analysis of covariance (ANCOVA) was used to find out the significance differences if any, between the groups on selected criterion variables separately. In all the cases, 0.05 level of confidence was fixed to test the significance, which was considered as appropriate.

#### 4.4 COMPUTATION OF ANALYSIS OF COVARIANCE AND POST HOC TEST

##### 4.4.1 RESULTS ON CARDIOVASCULAR ENDURANCE

The statistical analysis comparing the initial and final means of cardiovascular endurance due to skill based exercises with varied frequencies of tabata training groups and control group among college level handball players is presented in table V.

**TABLE V**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON**  
**CARDIOVASCULAR ENDURANCE**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	2617.0	2641.5	2624.0	2655.5	B	18130.0	3	604315924	0.38
SD	114.87	124.36	135.03	108.50	W	1210250	76	15924	
Post test	2687.5	2752.0	2763.0	2669.0	B	71005.0	3	23668.33	2.52
SD	135.64	135.59	163.32	116.89	W	1415190.	76	18620.92	
Adjusted post test	2705.83	2744.66	2774.0	2646.99	B	1798.36	3	59939.45	32.94*
					W	136454.1	75	1819.38	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table V, the pre test mean on cardiovascular endurance of skill based exercises with tabata training one day per week group was 2617.0 with standard deviation  $\pm 114.87$ , pre test mean of skill based exercises with tabata training two days per week group was 2641.5 with standard deviation  $\pm 124.36$ , the pre test mean of skill based exercises with tabata training three days per week group was 2624.0 with standard deviation  $\pm 135.03$  and pre test mean of control group was 2655.5 with standard deviation  $\pm 108.50$ . The obtained 'F' ratio 0.38 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table

F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table V, the post test mean on cardiovascular endurance of skill based exercises with tabata training one day per week group was 2687.5 with standard deviation  $\pm 135.64$ , the post test mean of skill based exercises with tabata training two days per week group was 2752.0 with standard deviation  $\pm 135.59$ , the post test mean of skill based exercises with tabata training three days per week group was 2763.0 with standard deviation  $\pm 163.32$ , and the post test mean of control group was 2669.0 with standard deviation  $\pm 116.89$ . The obtained 'F' ratio of 2.52 on post test means of the groups was not significant at 0.05 level as the obtained F value was less than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted means on cardiovascular endurance of experimental group I was 2705.58, experimental group II was 2744.66, for experimental group III was 274.00 and control group was 2646.99. The obtained 'F' value on adjusted means was 32.94. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on cardiovascular endurance of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table VI.

**TABLE VI**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc Analysis on**  
**Cardiovascular Endurance**

<b>SEWT3DG EXP III</b>	<b>SEWT2DG EXP II</b>	<b>EWT1DG EXP I</b>	<b>CG</b>	<b>MD</b>	<b>CI</b>
2774.00	2744.66	-	-	29.34*	12.21
2774.00	-	2705.58	-	68.42*	
2774.00	-	-	2646.99	127.01*	
-	2744.66	2705.58	-	39.08*	
-	2744.66	-	2646.99	97.67*	
-	-	2705.58	2646.99	58.59*	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 36.74. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD:29.34).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 68.42).

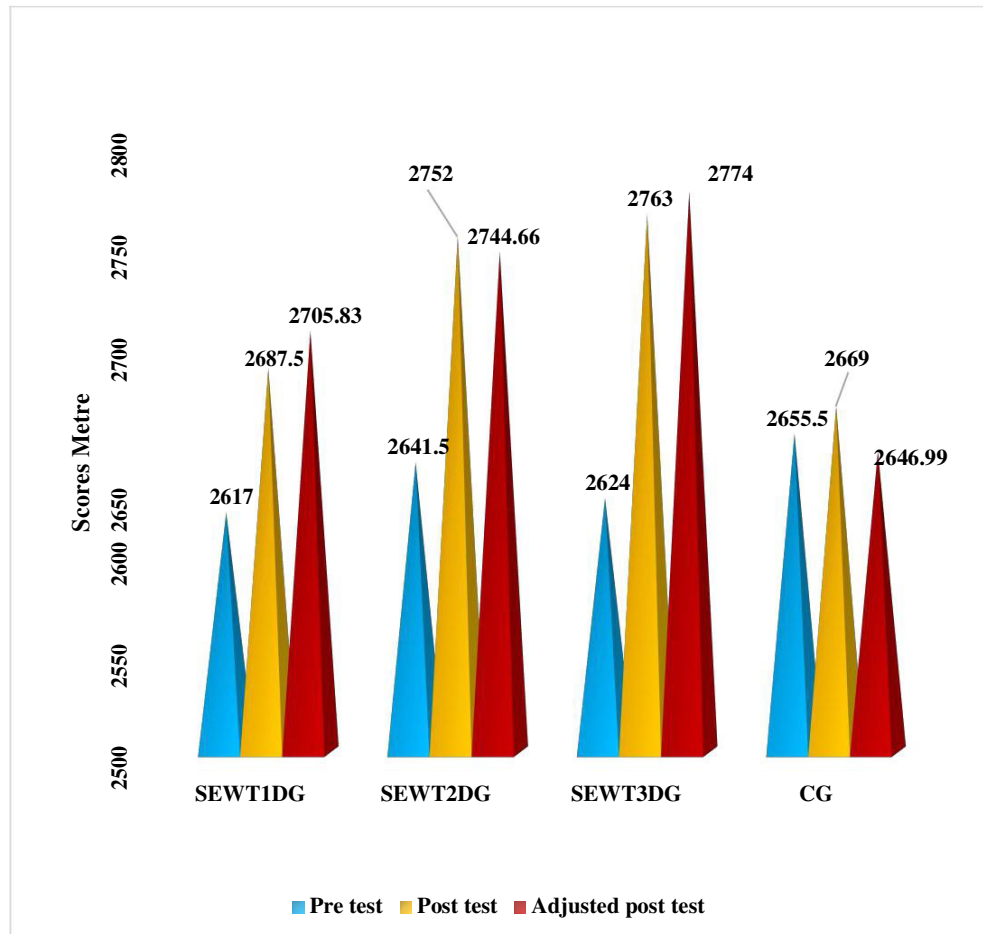
Skill based exercises with three days per week tabata training group Vs control group (MD: 127.01).

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 39.08).

Skill based exercises with two days per week tabata training group Vs control group (MD: 97.67).

Skill based exercises with one day per week tabata training group Vs control group (MD: 58.59).

The initial, final and adjusted post test means value of experimental and control group on cardiovascular endurance are presented through a diagram for better understanding of the results of the study in figure 7.



**Figure 7. Graphical Representation of Pre Post and Adjusted Post Test mean on Cardiovascular Endurance (Scores in Metre).**

#### **4.4.1.1 DISCUSSION ON THE FINDINGS OF CARDIOVASCULAR ENDURANCE**

The results presented in Table V proved significant improvement on cardiovascular endurance, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table VI proved that where compared to control group, skill based exercises with varied frequencies of tabata training group significantly improved in cardiovascular endurance among handball players. The post hoc results further proved that where compared between treatment groups, it was found that skill based exercises with three days per week tabata training was significantly better than skill based exercises with two days per week tabata training and skill based exercises with one day per week tabata training on cardiovascular endurance among handball players.

This could be due to that, exercises enhanced performance usually accompanies the physiological adaptation elicited by training. The physiological changes are increase in the heart size, increases in the plasma volume, increases in the stroke volume, increases in the oxygen extraction and also cardiac output increases.

The findings of the present study were in agreement with the findings of Costigan et al (2015) who identified that high intensity interval training improved aerobic capacity significantly. The study conducted by Foster et al (2015) and also with the agreement with the present study. Fortner et al (2014) identified that on cardiovascular and metabolic demands of the kettle bell swing using tabata interval versus traditional resistance protocol and resulted significant improvement on cardiovascular and metabolic responses. The findings of the study proved that there was significant improvement on cardiovascular endurance, which is in the agreement with the previous findings of Hottenrott et al (2012).



Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on cardiovascular endurance. The findings of the present study proved that cardiovascular endurance significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.2 RESULTS ON EXPLOSIVE POWER

The statistical analysis comparing the initial and final means of explosive power due to skill based exercises with varied frequencies of tabata training groups and control group among handball players is presented in table VII.

**TABLE VII**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON**  
**EXPLOSIVE POWER**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	2.04	2.04	2.03	2.01	B	0.009	3	0.003	0.09
SD	0.16	0.16	0.17	0.19	W	2.32	76	0.031	
Post test	2.15	2.24	2.30	2.02	B	0.88	3	0.29	11.11*
SD	0.13	0.16	0.15	0.19	W	2.01	76	0.03	
Adjusted post test	2.14	2.23	2.30	2.04	B	0.77	3	0.26	86.97*
					W	0.22	75	0.003	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table VII, the pre test mean on explosive power of skill based exercises with tabata training one day per week group was 2.04 with standard deviation  $\pm 0.16$ , pre test mean of skill based exercises with tabata training two days per week group was 2.04 with standard deviation  $\pm 0.16$ , the pre test mean of skill based exercises with tabata training three days per week group was 2.03 with standard deviation  $\pm 0.17$  and pre test mean of control group was 2.01 with standard deviation  $\pm 0.19$ . The obtained 'F' ratio 0.09 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant

at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table VII, the post test mean on explosive power of skill based exercises with tabata training one day per week group was 2.15 with standard deviation  $\pm 0.13$ , the post test mean of skill based exercises with tabata training two days per week group was 2.24 with standard deviation  $\pm 0.16$ , the post test mean of skill based exercises with tabata training three days per week group was 2.30 with standard deviation  $\pm 0.15$ , and the post test mean of control group was 2.02 with standard deviation  $\pm 0.19$ . The obtained 'F' ratio of 11.11 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on explosive power of experimental group I was 2.14, experimental group II was 2.23, for experimental group III was 2.30 and control group was 2.04. The obtained 'F' value on adjusted means was 86.97. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on explosive power of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table VIII.

**TABLE VIII**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc Analysis on**  
**Explosive Power**

SWT3DG EXP III	SWT2DG EXP II	SWT1DG EXP I	CG	MD	CI
2.30	2.23	-	-	0.07*	0.05
2.30	-	2.14	-	0.16*	
2.30	-	-	2.04	0.26*	
-	2.23	2.14	-	0.09*	
-	2.23	-	2.04	0.19*	
-	-	2.14	2.04	0.10*	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 0.04. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD:0.07).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.16).

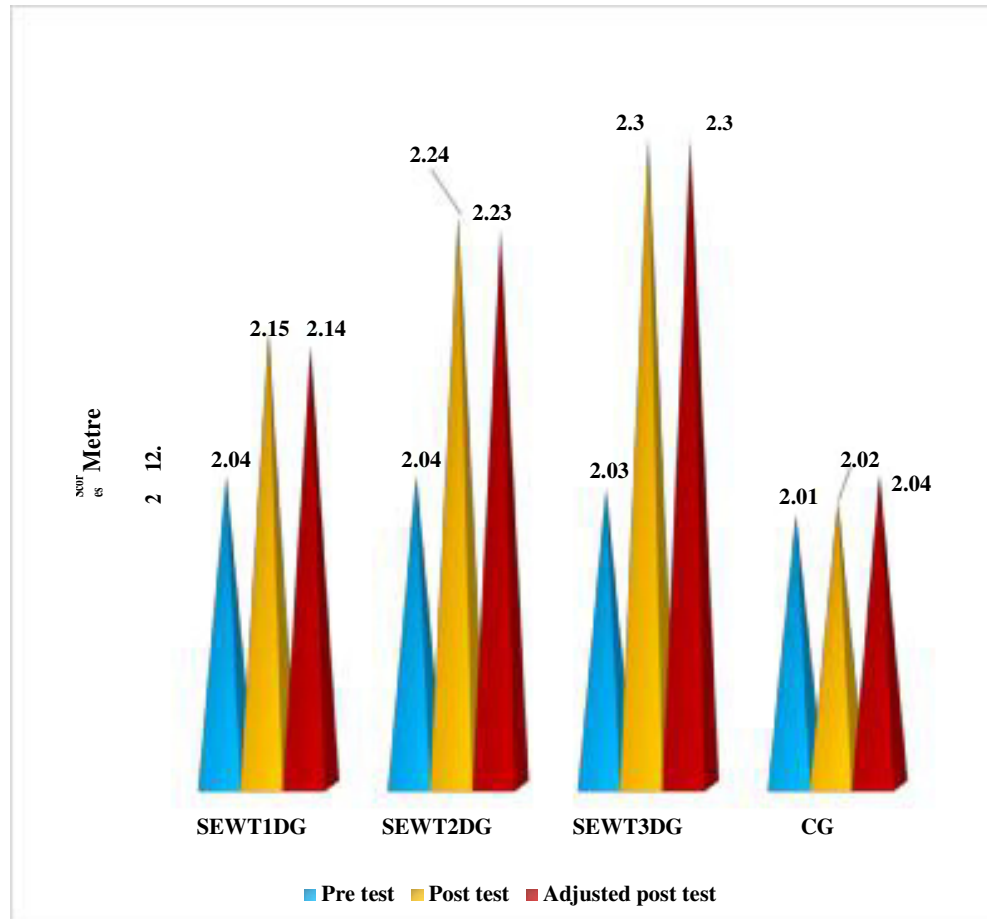
Skill based exercises with three days per week tabata training group Vs control group (MD: 0.26).

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.09).

Skill based exercises with two days per week tabata training group Vs control group (MD: 0.19).

Skill based exercises with one day per week tabata training group Vs control group (MD: 0.10).

The initial, final and adjusted post test means values of experimental and control group are presented on explosive power are presented through a diagram for better understanding of the results of the study in figure 8.



**Figure 8. Graphical Representation of Pre Post and Adjusted Post Test Mean on Explosive Power. (Scores in Metre).**

#### 4.4.2.1 DISCUSSION ON THE FINDINGS OF EXPLOSIVE POWER

The results presented in Table VII proved significant improvement on explosive power, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table VIII proved that where compared to control group, skill based exercises with varied frequencies of tabata training group significantly improved in explosive power among handball players. The post hoc results further proved that where compared between treatment groups, it was found that skill based exercises with three days per week tabata training was significantly better than skill based exercises with two days per week tabata training and skill based exercises with one day per week tabata training on explosive power among handball players.

Due to skill based exercises with high intensity training explosive power improved handball players significantly. The physiological changes refers for the explosive power are stimulus increases, the muscle size is given by imbalance in break down and synthesis of ATP and other muscle protein. The muscle made to contract in tabata training which as against resistance which are 80-90% of the maximum and the work phase lasted twenty seconds. In order to show significant reduction to muscle ATP. There was extreme exhaustion with in the recorded duration for load phase. (Singh, 1991).

The findings of present study were in agreement with the findings of Hermassi et al (2015) who identified that high intensity interval training improved explosive power significantly. The study conducted by Osawaet et al (2014) is also with the agreement with the present study. Cherif et al (2012) identified that aerobic and muscle strength changes due to high intensity interval training protocol and resulted significant

improvement on explosive power. The findings of the study proved that there was significant improvement on leg strength, and is in the agreement with the previous findings of Wong et al (2012).

Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on explosive power. The findings of the present study proved that, explosive power significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.



### 4.4.3 RESULTS ON AGILITY

The statistical analysis comparing the initial and final means of agility due to skill based exercises with varied frequencies of tabata training groups and control group among handball players is presented in table IX.

**TABLE IX**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON AGILITY**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	11.87	11.91	11.85	11.88	B	0.46	3	0.25	0.55
SD	0.15	0.16	0.19	0.16	W	3.96	76	0.03	
Post test	11.64	11.62	11.46	11.89	B	1.83	3	0.61	7.40*
SD	0.39	0.22	0.30	0.16	W	6.25	76	0.08	
Adjusted post test	11.65	11.60	11.49	11.88	B	1.65	3	0.548	8.23*
					W	5.01	75	0.057	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table IX, the pre test mean on agility of skill based exercises with tabata training one day per week group was 11.87 with standard deviation  $\pm 0.15$ , pre test means of skill based exercises with tabata training two days per week group was 11.91 with standard deviation  $\pm 0.16$ , the pre test mean of skill based exercises with tabata training three days per week group was 11.85 with standard deviation  $\pm 0.19$  and pre test mean of control group was 11.88 with standard deviation  $\pm 0.16$ . The obtained 'F' ratio 0.55 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table IX, the post test mean on agility of skill based exercises with tabata training one day per week group was 11.64 with standard deviation  $\pm 0.39$ , the post test mean of skill based exercises with tabata training two days per week group was 11.62 with standard deviation  $\pm 0.22$ , the post test mean of skill based exercises with tabata training three days per week group was 11.46 with standard deviation  $\pm 0.30$ , and the post test mean of control group was 11.89 with standard deviation  $\pm 0.16$ . The obtained 'F' ratio of 7.40 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on agility of experimental group I was 11.65, experimental group II was 11.60, for experimental Group III was 11.49 and control group was 11.88. The obtained 'F' value on adjusted means was 8.23. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on explosive power of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table X.

**TABLE X**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc Analysis on Agility**

SWT3DG EXP III	SWT2DG EXP II	SWT1DG EXP I	CG	MD	CI
11.49	11.60	-	-	0.11	0.21
11.49	-	11.65	-	0.16	
11.49	-	-	11.88	0.39*	
-	11.60	11.65	-	0.05	
-	11.60	-	11.88	0.28*	
-	-	11.65	11.88	0.23*	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 0.03. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs control group (MD: 0.39).

Skill based exercises with two days per week tabata training group Vs control group (MD: 0.28).

Skill based exercises with one day per week tabata training group Vs control group (MD: 0.23).

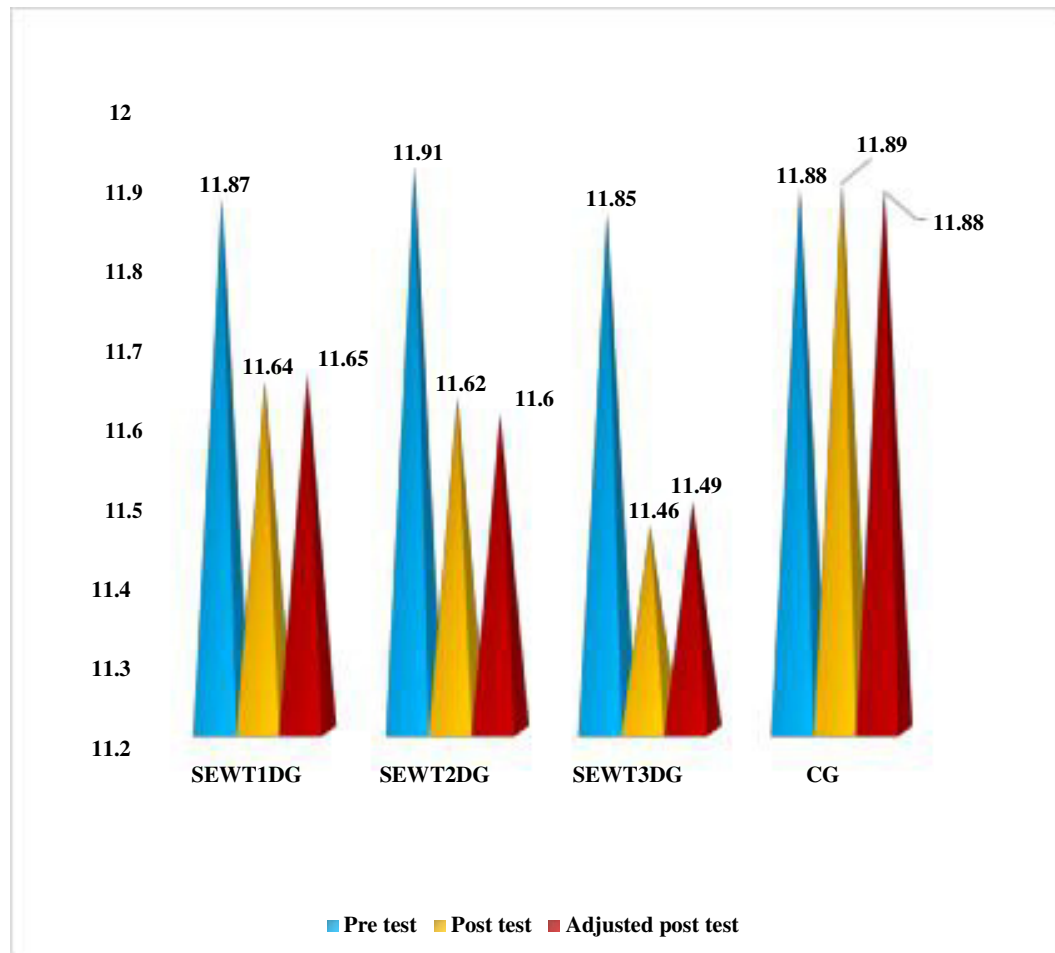
The following paired mean comparison were less than the required confidence interval and were not found significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD:0.11).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.16).

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.05).

The initial, final and adjusted post test means value of experimental and control group on agility are presented through a diagram for better understanding of the results of the study in figure 9.



**Figure 9. Graphical Representation of Pre Post and Adjusted Post Test Mean on Agility (Scores in Seconds).**

#### **4.4.3.1 DISCUSSION ON THE FINDINGS OF AGILITY**

The result presented in Table IX proved significant improvement on agility, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table X proved that where compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved in agility among handball players. The post hoc analysis further proved that where compared between treatment groups, it was found that there was no significant differences on agility among handball players.

The findings of present study were in agreement with the findings of Delextrat et al (2014) who identified that small sided games vs high intensity interval training improved agility significantly. The study conducted by Vaczi et al (2013) is also with the agreement with the present study. The findings of the study proved that there was significant improvement in agility, and is in the agreement with the previous findings of Trakovic et al (2012).

Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to improvement on agility. The findings of the present study proved that agility significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.4 RESULTS ON MEAN ARTERIAL BLOOD PRESSURE

The statistical analysis comparing the initial and final means of mean arterial blood pressure due to skill based exercises with varied frequencies of tabata training groups and control group among handball players is presented in table XI.

**TABLE XI**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON**  
**MEAN ARTERIAL BLOOD PRESSURE**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	93.90	93.50	94.25	93.80	B	5.65	3	1.88	0.55
SD	1.55	1.93	2.10	1.75	W	259.10	76	3.41	
Post test	94.00	93.70	94.85	94.35	B	14.65	3	4.88	2.00
SD	1.22	1.69	1.75	1.52	W	185.30	76	2.44	
Adjusted post test	93.99	93.90	93.85	94.36	B	7.15	3	2.38	1.60
					W	112.01	75	1.49	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table XI, the pre test mean on mean arterial blood pressure of skill based exercises with tabata training one day per week group was 93.90 with standard deviation  $\pm 1.55$ , pre test mean of skill based exercises with tabata training two days per week group was 93.50 with standard deviation  $\pm 1.93$ , the pre test mean of skill based exercises with tabata training three days per week group was 94.25 with standard deviation  $\pm 2.10$  and pre test mean of control group was 93.80 with standard deviation  $\pm 1.75$ . The obtained 'F' ratio 0.55 on pre test mean of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to

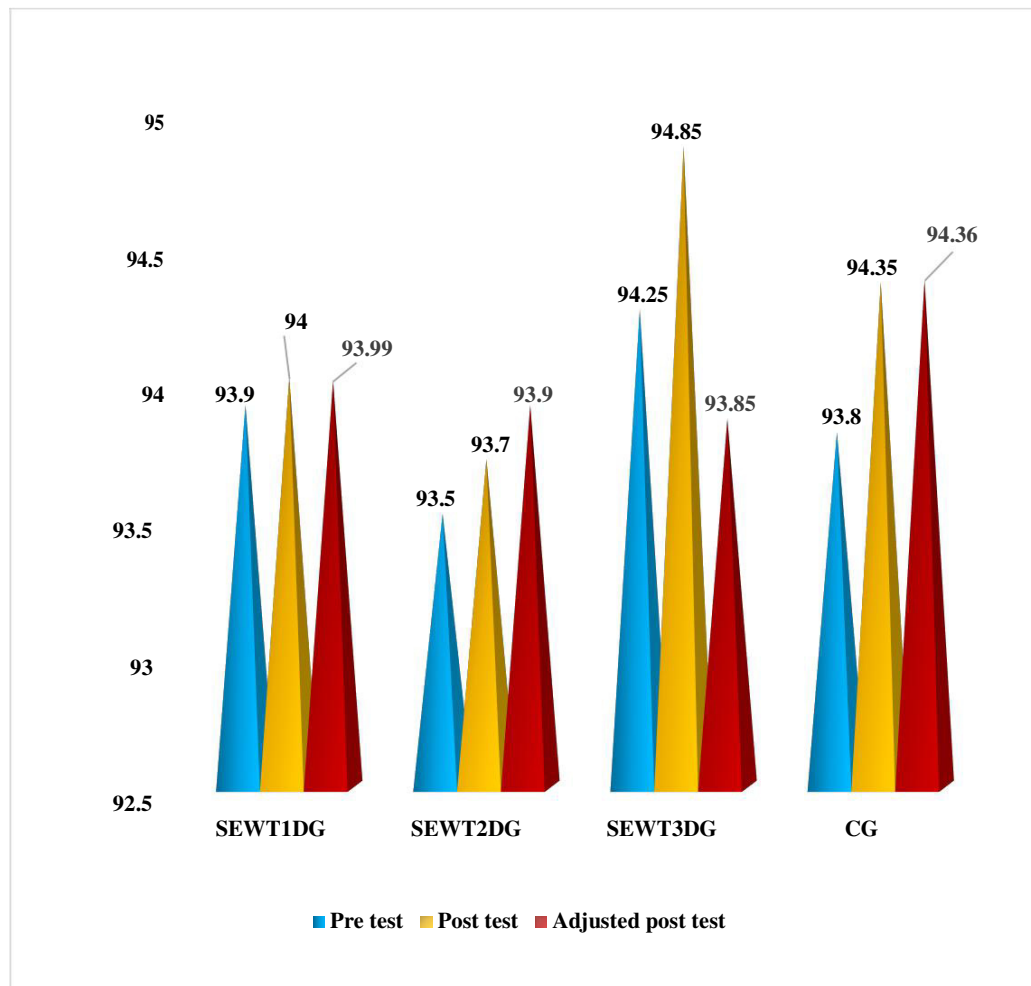
be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XI, the post test mean on mean arterial blood pressure of skill based exercises with tabata training one day per week group was 94.00 with standard deviation  $\pm 1.22$ , the post test mean of skill based exercises with tabata training two days per week group was 93.70 with standard deviation  $\pm 1.69$ , the post test mean of skill based exercises with tabata training three days per week group was 94.85 with standard deviation  $\pm 1.75$ , and the post test mean of control group was 94.35 with standard deviation  $\pm 1.52$ . The obtained 'F' ratio of 2.00 on post test means of the groups was no significant at 0.05 level as the obtained F value was lesser than the required table F value of 2.73 to be significant at 0.05 level. This shows that there no was significant difference in means of the groups among post test means.

Taking in to consideration of the pre and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on mean arterial blood pressure of experimental group I was 93.99, experimental group II was 93.90, for experimental group III was 93.85 and control group was 94.36. The obtained 'F' value on adjusted means was 1.60. The obtained F value was lesser than the table F value of 2.73 and hence it was proved that there was no significant differences among the adjusted post test means on the mean arterial blood pressure of the subjects.

The initial, final and adjusted post test means value of experimental and control group on mean arterial blood pressure were presented through a diagram for better understanding of the results of the study in figure 10.





**Figure 10. Graphical Representation of Pre Post and Adjusted Post Test Mean on Mean Arterial Blood Pressure (Scores In Mm Hg).**

#### **4.4.4.1 DISCUSSION ON THE FINDINGS OF MEAN ARTERIAL BLOOD PRESSURE**

The result presented in Table XI proved that there was no significant improvement on mean arterial blood pressure, as the obtained F value was lesser than the required table value to be significant at 0.05 level.

In young healthy athletes at rest, the systolic blood pressure averages approximately 120 mmHg and the diastolic pressure is 80 mmHg because the heart remains in diastolic longer than it goes in systole. The average or mean arterial pressure is slightly less than simply the average of the systolic and diastolic pressure and, at rest, average approximately 93 mm Hg. The mean arterial blood pressure represents the average for exerted by the blood against the wall of the arteries during the entire cardiac cycle. This could be reason that the handball players trained by the scholar did not show any significant differences in the mean arterial blood pressure due to skill based exercises with varied frequencies of tabata training.

The study conducted by Cornelissen et al (2015), Fagard, R. H. (2006) and Olea et al (2017) is also with the agreement with the present study. The findings of the study proved that arterial mean arterial blood pressure maintained at normal range and is in the agreement with the previous findings.

Thus, the theoretical findings based on previous researches proved that skill based exercises and tabata training (high intensity interval training) contributed no improvement on mean arterial blood pressure. The findings of the present study proved that mean arterial blood pressure maintained due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.5 RESULTS ON VITAL CAPACITY

The statistical analysis comparing the initial and final means on vital capacity due to skill based exercises with varied frequencies of tabata training groups and control group among college level handball players is presented in XII.

**TABLE XII**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON VITAL CAPACITY**

Means	SWT1DG EX 1	SWT2DG EX 2	SWT3DG EX 3	CG	SV	SS	DF	MS	'F' ratio
Pre test	4.53	4.52	4.55	4.53	B	0.01	3	0.004	0.06
SD	0.26	0.28	0.26	0.27	W	5.43	76	0.071	
Post test	4.64	4.66	4.73	4.54	B	0.34	3	0.113	1.40
SD	0.26	0.30	0.29	0.28	W	6.09	76	0.080	
Adjusted post test	4.65	4.68	4.71	4.54	B	0.297	3	0.099	31.09*
					W	0.238	75	0.003	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table XII, the pre test mean on vital capacity of skill based exercises with tabata training one day per week group was 4.53 with standard deviation  $\pm 0.26$ , pre test mean of skill based exercises with tabata training two days per week group was 4.52 with standard deviation  $\pm 0.28$ , the pre test mean of skill based exercises with tabata training three days per week group was 4.55 with standard deviation  $\pm 0.26$  and pre test mean of control group was 4.53 with standard deviation  $\pm 0.27$ . The obtained 'F' ratio 0.06 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XII, the post test mean on vital capacity of skill based exercises with tabata training one day per week group was 4.64 with standard deviation  $\pm 0.26$ , the post test mean of skill based exercises with tabata training two days per week group was 4.66 with standard deviation  $\pm 0.30$ , the post test mean of skill based exercises with tabata training three days per week group was 4.73 with standard deviation  $\pm 0.29$ , and the post test mean of control group was 4.54 with standard deviation  $\pm 0.28$ . The obtained 'F' ratio of 1.40 on post test means of the groups was no significant at 0.05 level as the obtained F value was lesser than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on vital capacity of experimental group I was 4.65, experimental group II was 4.68, for experimental Group III was 4.71 and control group was 4.54. The obtained 'F' value on adjusted post test means was 31.09. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on vital capacity of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table XIII.

**TABLE XIII**  
**Multiple Comparison between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc**  
**Analysis on Vital Capacity**

SWT3DG EX 3	SWT2DG EXP II	SWT1DG EXPI	CG	MD	CI
4.71	4.68	-	-	0.03	0.05
4.71	-	4.65	-	0.06*	
4.71	-	-	4.54	0.17*	
-	4.68	4.65	-	0.03	
-	4.68	-	4.54	0.14*	
-	-	4.65	4.54	0.11*	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 0.05. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD:0.06).

Skill based exercises with three days per week tabata training group Vs control group (MD: 0.17).

Skill based exercises with two days per week tabata training group Vs control group (MD: 0.14).

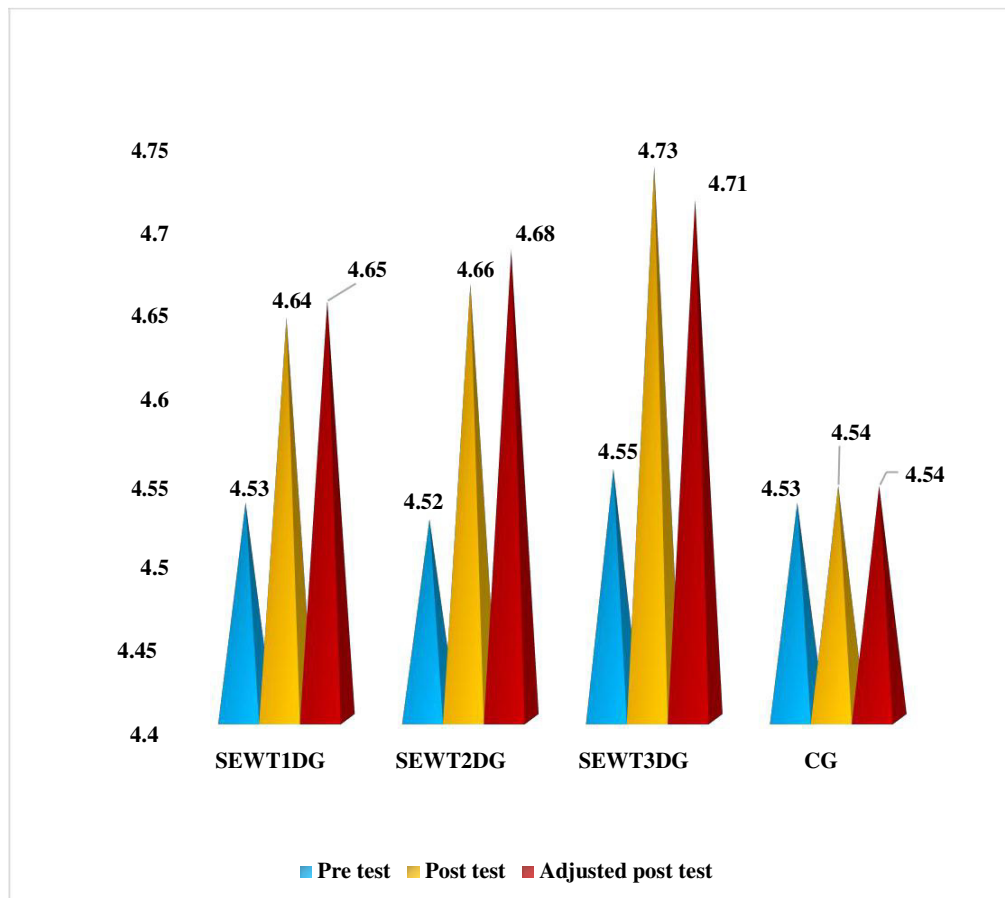
Skill based exercises with one day per week tabata training group Vs control group (MD: 0.11).

The following paired mean comparison were less than the required confidence interval and were found not significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD: 0.03).

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.03).

The initial, final and adjusted post test means value of experimental and control group on vital capacity are presented through a diagram for better understanding of the results of the study in figure 11.



**Figure 11. Graphical Representation of Pre Post and Adjusted Post Test Mean on Vital Capacity (Scores In Litre).**

#### 4.4.5.1 DISCUSSION ON THE FINDINGS OF VITAL CAPACITY

The result presented in Table XII proved significant improvement on vital capacity, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table XIII proved that where compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved in vital capacity of the handball players. The post hoc results further proved that, where compared between treatment groups, it was found that the skill based exercises with three days per week tabata training was significantly better than skill based exercises with one day per week tabata training on vital capacity among handball players. There was no significant differences between skill based exercises with three days per week tabata training and skill based exercises with two days per a week tabata training, skill based exercises with two days per week tabata training and skill based exercises with one day per a week tabata training on vital capacity among handball players.

Due to skill based exercises with high intensity training vital capacity improved handball players significantly. The physiological changes refers for the vital capacity are improved the stability of the body's internal milieu during the standard period of submaximal exercises consequently there is less disruption in whole body normal and acid base balance, which might negatively impact the functions of the inspiratory musculature. Also the ventilatory muscles benefit directly from exercises training. This enhanced function and may be due to the documented increase in aerobic enzyme levels and oxidative capacity of the ventilatory muscles with training. (William et al, 1996).

The findings of present study were in agreement with the findings of Fernandez et al (2017) who identified that combining high intensity interval training and sports



specific drills improved vital capacity significantly. The study conducted by Emberts et al (2013) is also with the agreement with the present study. The findings of the study proved that there was significant improvement in vital capacity and is in the agreement with the previous findings of Follador et al (2018).

Thus the theoretical findings based on previous researchers proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on vital capacity. The findings of the present study proved that vital capacity significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.6 RESULTS ON ANAEROBIC POWER

The statistical analysis comparing the initial and final means of anaerobic power due to skill based exercises with varied frequencies of tabata training groups and control group among handball players is presented in table XIV.

**TABLE XIV**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON**  
**ANAEROBIC POWER**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	139.17	138.62	140.62	140.56	B	60.79	3	20.26	0.88
SD	4.52	5.36	5.23	3.83	W	1735.80	76	22.84	
Post test	141.39	142.59	146.80	140.85	B	434.85	3	144.95	7.72*
SD	4.67	5.36	5.23	3.76	W	1425.51	76	18.75	
Adjusted post test	141.89	143.85	146.04	140.15	B	1284.71	3	144.95	67.09*
					W	1425.51	3	1.87	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table XIV, the pre test mean on anaerobic power of skill based exercises with tabata training one day per week group was 139.17 with standard deviation  $\pm$  4.52, pre test mean of skill based exercises with tabata training two days per week group was 138.62 with standard deviation  $\pm$  5.36, the pre test mean of skill based exercises with tabata training three days per week group was 140.62 with standard deviation  $\pm$  5.23 and pretest mean of control group was 140.56 with standard deviation  $\pm$  3.83. The obtained 'F' ratio 0.88 on pre test mean of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value

of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XIV, the post test mean on anaerobic power of skill based exercises with tabata training one day per week group was 141.39 with standard deviation  $\pm 4.67$ , the post test mean of skill based exercises with tabata training two days per week group was 142.59 with standard deviation  $\pm 5.36$ , the post test mean of skill based exercises with tabata training three days per week group was 146.80 with standard deviation  $\pm 5.23$  and the post test mean of control group was 140.85 with standard deviation  $\pm 3.76$ . The obtained 'F' ratio of 7.72 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on anaerobic power of experimental group I was 141.89, experimental group II was 143.85, for Experimental Group III was 146.04 and control group was 140.15. The obtained 'F' value on adjusted means was 80.93. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on anaerobic power of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table XV.

**Table XV**  
**Multiple Comparison between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc**  
**Analysis on Anaerobic Power**

SWT3DG EX 1II	SWT2DG EX 1I	SWT1DG EX 1	CG	MD	CI
146.04	143.85	-	-	2.19*	1.23
146.04	-	141.89	-	4.15*	
146.04	-	-	140.15	5.89*	
-	143.85	141.89	-	1.96*	
-	143.85	-	140.15	3.70	
-	-	141.89	140.15	1.74	
-	-	-	-	-	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 1.03. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD:2.19).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 4.15).

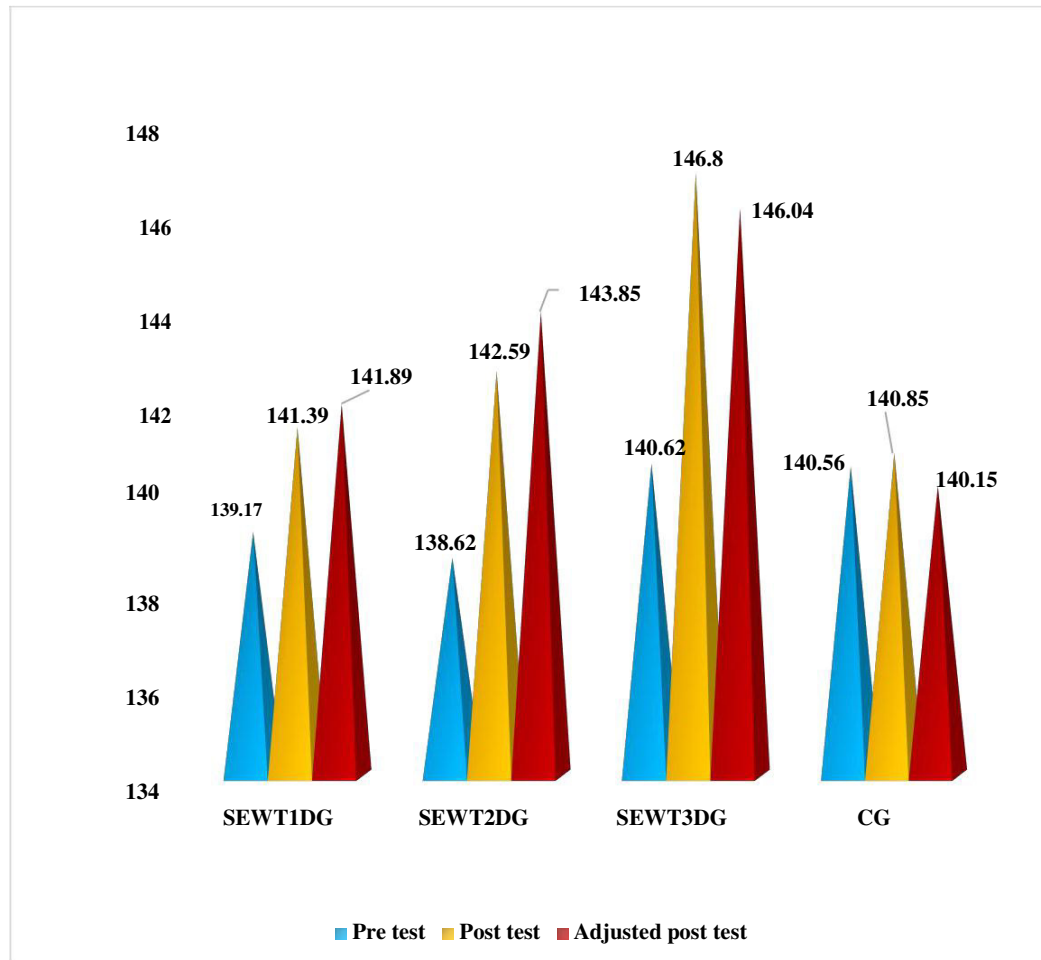
Skill based exercises with three days per week tabata training group Vs control group (MD: 5.89).

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 1.96).

Skill based exercises with two days per week tabata training group Vs control group (MD: 3.70).

Skill based exercises with one day per week tabata training group Vs control group (MD: 1.74).

The initial, final and adjusted post test means value of experimental and control group on aerobic power are presented through a diagram for better understanding of the results of the study in figure 12.



**Figure 12. Graphical Representation of Pre Post and Adjusted Post Test Mean on Anaerobic Power (Scores in Kilogram./Meter/Seconds).**

#### **4.4.6.1 DISCUSSION ON THE FINDINGS OF ANAEROBIC POWER**

The result presented in Table XIV proved significant improvement on anaerobic power, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table XV proved that compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved in anaerobic power among handball players. The post hoc results further proved that, where compared between treatment groups, it was found that the skill based exercises with three days per week tabata training was significantly better than skill based exercises with two days per week tabata training and skill based exercises with one day per week tabata training on anaerobic power among handball players.

This significant improvement could be due to the physiological reasons that anaerobic power improved among handball players due to skill based exercises with varied frequencies of tabata training significantly. The amount of phosphagens stores in the muscles less limited can supply oxygen for high intensity activities lasting for 8-10 seconds, since tabata training produce alactacid mechanism which support continuous high speed activity. The player improves to tolerate high concentration of lactic acid in the blood and muscles.

The findings of present study were in agreement with the findings of Tabata et al (1996) who identified that effects of moderate intensity endurance and high intensity intermittent training improve anaerobic capacity and  $VO_2$  max significantly. The study conducted by Karahan (2012) is also with the agreement with the present study. The findings of the study proved that there was significant improvement in anaerobic power, is in the agreement with the previous findings of Tabata et al (1990).

Thus the theoretical findings based on previous researchers proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on anaerobic power. The findings of the present study proved that anaerobic power significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.



#### 4.4.7 RESULTS ON PASSING

The statistical analysis comparing the initial and final means of passing due to skill based exercises with varied frequencies of tabata training groups and control group among college level handball players is presented in XVI.

**TABLE XVI**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON PASSING**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	15.00	15.10	14.95	14.90	B	.437	3	.145	0.08
SD	1.45	1.28	1.28	1.29	W	134.550	76	1.770	
Post test	18.00	18.10	18.15	15.10	B	133.738	3	44.579	24.17*
SD	1.30	1.33	1.35	1.45	W	140.150	76	1.844	
Adjusted post test	17.99	18.00	18.18	15.18	B	124.509	3	41.503	106.39*
					W	29.257	75	.390	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table XVI, the pre test mean on passing of skill based exercises with tabata training one day per group week group was 15.00 with standard deviation  $\pm 1.45$ , pre test mean of skill based exercises with tabata training two days per week group was 15.10 with standard deviation  $\pm 1.28$ , the pre test mean of skill based exercises with tabata training three days per week group was 14.95 with standard deviation  $\pm 1.28$  and pre test mean of control group was 14.90 with standard deviation  $\pm 1.29$ . The obtained 'F' ratio 0.08 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XVI, the post test mean on passing of skill based exercises with tabata training one day per week group was 18.00 with standard deviation  $\pm 1.30$ , the post test mean of skill based exercises with tabata training two days per week group was 18.10 with standard deviation  $\pm 1.33$ , the post test mean of skill based exercises with tabata training three days per week group was 18.15 with standard deviation  $\pm 1.35$ , and the post test mean of control group was 15.10 with standard deviation  $\pm 1.45$ . The obtained 'F' ratio of 24.17 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pretest means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean passing of experimental group I was 17.99, experimental group II was 18.00, for experimental group III was 18.18 and control group was 15.18. The obtained 'F' value on adjusted post test means was 106.39. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on passing of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence interval test. The results are presented on Table XVII.

**Table XVII**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies of**  
**Tabata Training Groups and Scheffe's Post Hoc**  
**Analysis on Passing**

SWT3DG EX III	SWT2DG EX II	SWT1DG EX I	CG	MD	CI
18.18	18.00	-	-	0.18	0.57
18.18	-	17.99	-	0.19	
18.18	-	-	15.18	3*	
-	18.00	17.99	-	0.01	
-	18.00	-	15.18	2.82*	
-	-	17.99	15.18	2.81*	
-	-	-	-	-	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 0.57. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs control group (MD: 3).

Skill based exercises with two days per week tabata training group Vs control group (MD: 2.82).

Skill based exercises with one day per week tabata training group Vs control group (MD: 2.81).

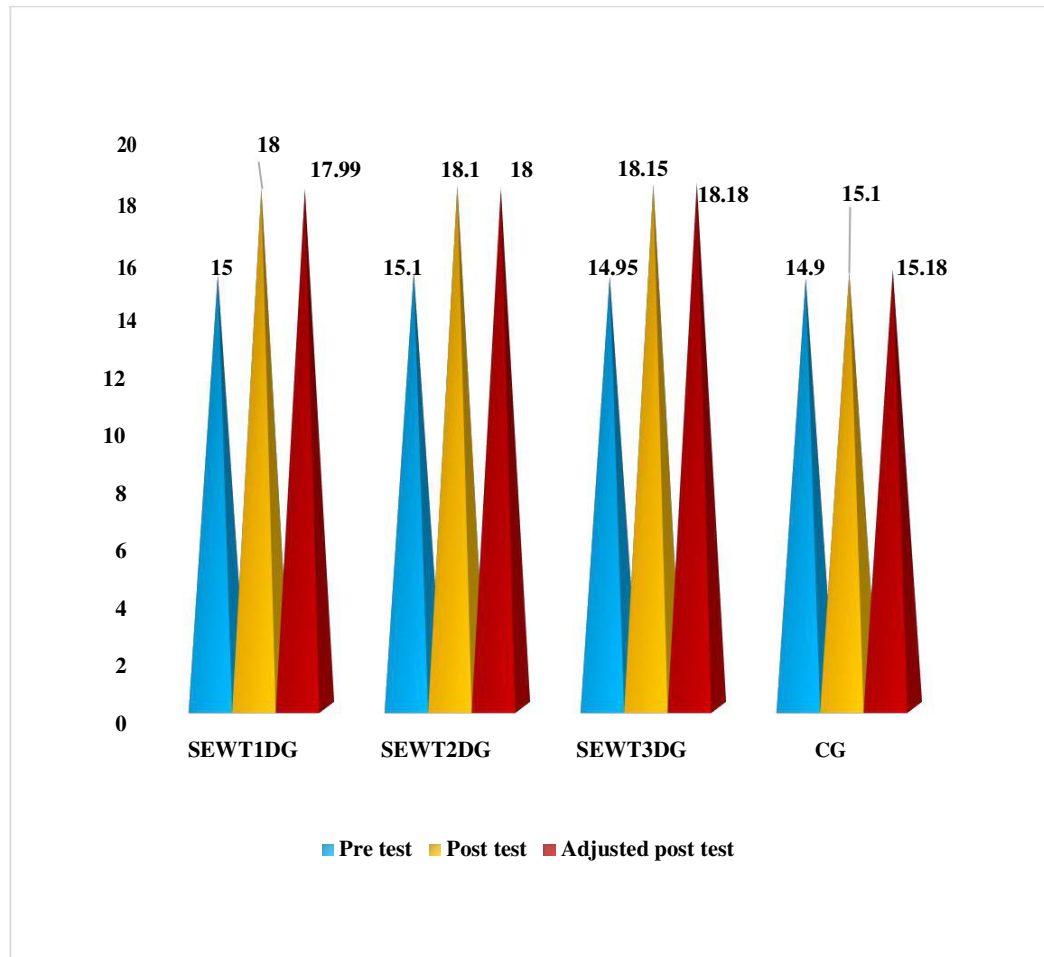
The following paired mean comparison were less than the required confidence interval and were not found significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD: 0.18).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.19)

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.01).

The initial, final and adjusted post test means value of experimental and control group on passing are presented through bar diagram for better understanding of the results of the study in figure 13.



**Figure 13. Graphical Representation of Pre Post and Adjusted Post Test Mean on Passing (Scores In Points).**

#### **4.4.7.1 DISCUSSION ON THE FINDINGS OF PASSING**

The result presented in Table XVI proved that significant improvement on passing, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table XVII proved that where compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved in passing among handball players. The post hoc analysis further proved that where compared between treatment groups, it was found that there was no significant differences on passing among handball players.

The skill based exercises with varied frequencies of tabata training improved accurate passing, ensured the pace and continuously of team play and kept pressure on defense by allowing each attacker to the opportunity to be scoring threat. (Clanton, 2015).

The findings of present study were in agreement with the findings of Hermassi et al (2017) who identified Short term effects of combined high intensity strength and sprint interval training on improved performance of the handball players significantly. The findings of the study proved that there was significant improvement in performance, which is in the agreement with the previous findings of Iacono (2016).

Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on passing. The findings of the present study proved that passing significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.8 RESULTS ON SHOOTING

The statistical analysis comparing the initial and final means of shooting due to skill based exercises with varied frequencies of tabata training groups and control group among handball players is presented in XVIII.

**TABLE XVIII**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON SHOOTING**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	18.00	18.05	18.15	17.95	B	0.437	3	0.146	0.09
SD	1.30	1.23	1.22	1.23	W	118.45	76	1.56	
Post test	21.75	21.90	22.10	18.15	B	214.05	3	71.350	38.21*
SD	1.33	1.37	1.29	1.46	W	141.90	76	1.867	
Adjusted post test	21.79	21.89	21.97	18.24	B	199.69	2	66.56	244.35*
					W	20.43	75	0.272	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) = 2.73; F (0.05), (df 3, 75) = 2.73.

As shown in Table XVIII the pre test mean on shooting of skill based exercises with tabata training one day per week group was 18.00 with standard deviation  $\pm 1.30$ , pre test mean of skill based exercises with tabata training two days per week group was 18.05 with standard deviation  $\pm 1.23$ , the pre test mean of skill based exercises with tabata training three days per week group was 18.15 with standard deviation  $\pm 1.22$  and pre test means control group was 17.95 with standard deviation  $\pm 1.23$ . The obtained 'F' ratio 0.09 on pre test means of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XVIII, the post test mean on shooting of skill based exercises with tabata training one day per week group was 21.75 with standard deviation  $\pm 1.33$ , the post test mean of skill based exercises with tabata training two days per week group was 21.90 with standard deviation  $\pm 1.37$ , the post test mean of skill based exercises with tabata training three days per week group was 22.10 with standard deviation  $\pm 1.29$ , and the post test mean of control group was 18.15 with standard deviation  $\pm 1.46$ . The obtained 'F' ratio of 38.21 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on shooting of experimental group I was 21.79, experimental group II was 21.89, for experimental group III was 21.97 and control group was 18.24. The obtained 'F' value on adjusted means was 244.35. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on shooting of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's confidence interval test. The results are presented on Table XIX.



**Table XIX**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies**  
**of Tabata Training Groups and Scheffe's Post Hoc**  
**Analysis on Shooting**

SWT3DG EX III	SWT2DG EX II	SWT1DG EX I	CG	MD	CI
21.97	21.89	-	-	0.08	0.47
21.97	-	21.79	-	0.18	
21.97	-	-	18.24	3.73*	
-	21.89	21.79	-	0.10	
-	21.89	-	18.24	3.65*	
-	-	21.79	18.24	3.55*	

\*Significant at 0.05 level.

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 0.47. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs control group (MD: 3.73).

Skill based exercises with two days per week tabata training group Vs control group (MD: 3.65).

Skill based exercises with one day per week tabata training group Vs control group (MD: 3.55).

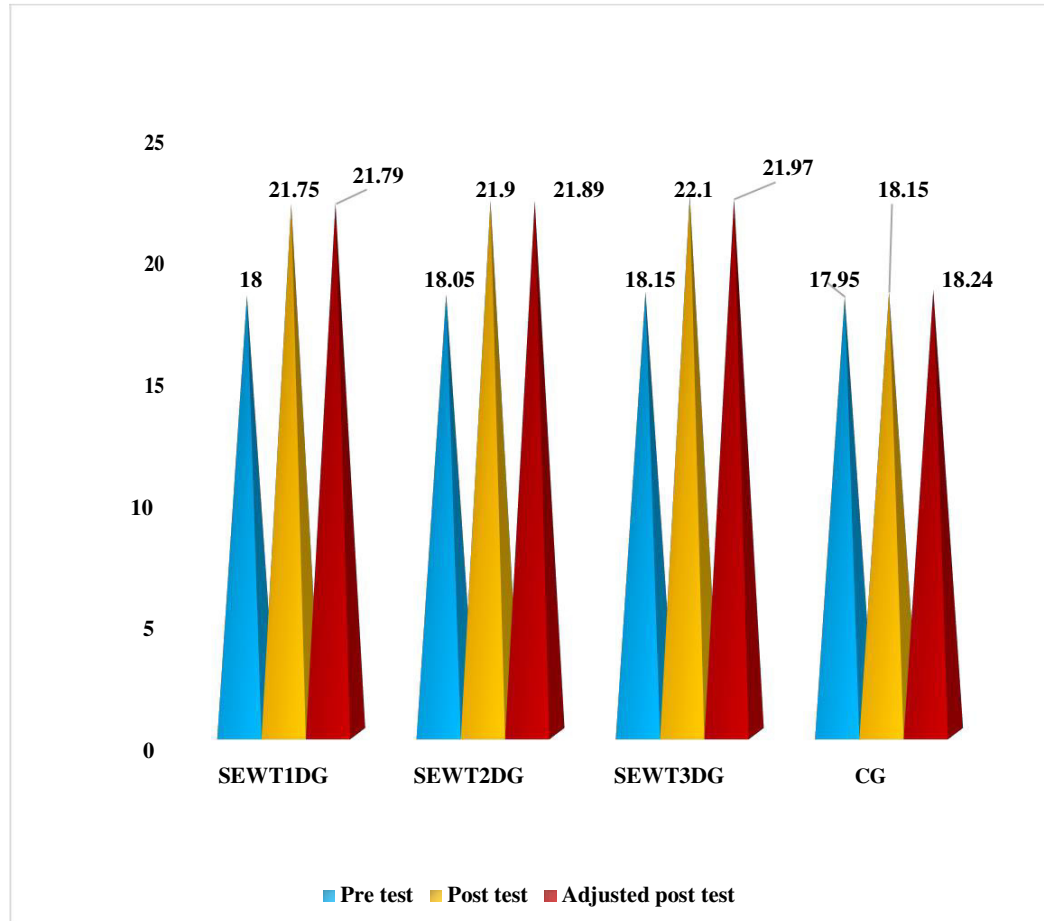
The following paired mean comparison were less than the required confidence interval and were not found significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD: 0.08).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.18)

Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 0.10).

The initial, final and adjusted post test means value of experimental and control group on shooting are presented through a diagram for better understanding of the results of the study in figure 14.



**Figure 14. Graphical Representation of Pre Post and Adjusted Post Test Mean on Shooting (Scores in Points).**

#### 4.4.8.1 DISCUSSION ON THE FINDINGS OF SHOOTING

The result presented in Table XVIII proved that significant improvement on shooting, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table XIX proved that where compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved in shooting of the handball players. The post hoc analysis further proved that where compared between treatment groups, it was found that there was no significant differences on shooting among handball players.

This could be due to the muscles of lower and upper limbs, pelvic region and trunk while extremely engaged in the skill based exercises with varied frequencies of tabata training with a stronger action of the trunk and upper limbs. (Janusz, 1997).

The findings of present study were in agreement with the findings of Hermassi et al (2011) who identified effects of eight week in season upper and lower limb heavy resistance training on improve peak power, throwing velocity, and sprint performance among handball players significantly. The findings of the study proved that there was significant improvement is in the agreement with the previous findings of Buchheit, (2009).

Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on shooting. The findings of the present study proved that shooting significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### 4.4.9 RESULTS ON PLAYING ABILITY

The statistical analysis comparing the initial and final means of playing ability due to skill based exercises with varied frequencies of tabata training groups and control group among college level handball players is presented in XX.

**TABLE XX**  
**COMPUTATION OF ANALYSIS OF COVARIANCE ON PLAYING ABILITY**

Means	SWT1DG EX I	SWT2DG EX II	SWT3DG EX III	CG	SV	SS	DF	MS	'F' ratio
Pre test	34.45	35.05	34.80	34.65	B	3.84	3	1.28	0.17
SD	2.84	2.76	2.50	2.89	W	575.65	76	7.57	
Post test	41.15	43.10	44.35	34.85	B	1068.04	3	356.01	51.49*
SD	2.94	2.61	2.21	2.71	W	525.45	76	6.914	
Adjusted post test	41.37	42.87	44.30	34.92	B	1027.09	3	342.36	143.85*
					W	178.50	75	2.38	

\*Significant at 0.05 level. SV: Source of Variance; B: Between W: Within, Required F (0.05), (df 3, 76) =2.73; F (0.05), (df 3, 75) =2.73.

As shown in Table XX, the pre test mean on playing ability of skill based exercises with tabata training one day per week group was 34.45 with standard deviation  $\pm 2.84$ , pre test mean of skill based exercises with tabata training two days per week group was 35.05 with standard deviation  $\pm 2.76$ , the pre test mean of skill based exercises with tabata training three days per week group was 34.80 with standard deviation  $\pm 2.50$  and pre test mean of control group was 34.65 with standard deviation  $\pm 2.89$ . The obtained 'F' ratio 0.17 on pre test mean of the groups was not significant at 0.05 level as the obtained F value was less than the require table F value of 2.73 to be significant at 0.05 level. This shows that there was no significant difference in means of the groups at initial stage.

The results presented in Table XX, the post test mean on playing ability of skill based exercises with tabata training one day per week group was 41.15 with standard deviation  $\pm 2.94$ , the post test mean of skill based exercises with tabata training two days per week group was 43.10 with standard deviation  $\pm 2.61$ , the post test mean of skill based exercises with tabata training three days per week group was 44.35 with standard deviation  $\pm 2.21$  and the post test mean of control group was 34.85 with standard deviation  $\pm 2.71$ . The obtained 'F' ratio of 51.49 on post test means of the groups was significant at 0.05 level as the obtained F value was greater than the required table F value of 2.73 to be significant at 0.05 level. This shows that there was significant difference in means of the groups among post test means.

Taking in to consideration of the pre test means and post test means, adjusted post test means were determined and analysis of covariance was done. The adjusted mean on playing ability of experimental group I was 41.37, experimental group II was 42.87, for experimental group III was 44.30 and control group was 34.92. The obtained 'F' value on adjusted means was 143.85. The obtained F value was greater than the table F value of 2.73 and hence it was proved that there was significant differences among the adjusted post test means on playing ability of the subjects.

Since significant improvement were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented on Table XXI.

**Table XXI**  
**Multiple Comparison Between Skill Based Exercises with Varied Frequencies**  
**of Tabata Training Groups and Scheffe's Post Hoc**  
**Analysis on Playing Ability**

SWT3DG EX III	SWT2DG EX II	SWT1DG EX I	CG	MD	CI
44.30	42.87	-	-	1.43*	1.39
44.30	-	41.37	-	2.93*	
44.30	-	-	34.92	9.38*	
-	42.87	41.37	-	1.50*	
-	42.87	-	34.92	7.95*	
-	-	41.37	34.92	6.45*	
-	-	-	-	-	

\*Significant at 0.05 level

The post hoc analysis of obtained ordered adjusted means proved that to be significant at 0.05 level of confidence the required confidence interval was 1.39. The following paired mean comparison were greater than the required confidence interval and were significant at 0.05 level.

Skill based exercises with three days per week tabata training group Vs skill based exercises with two days per week tabata training group (MD:1.43).

Skill based exercises with three days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 2.93).

Skill based exercises with three days per week tabata training group Vs control group (MD: 9.38).

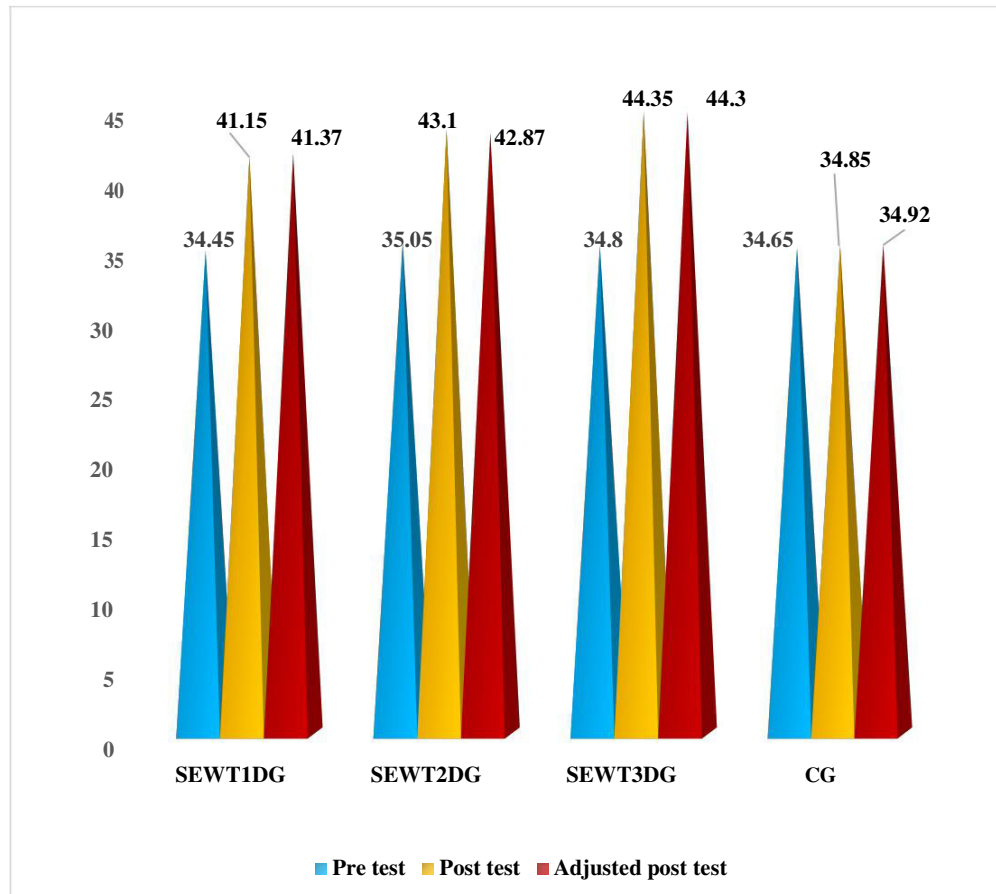
Skill based exercises with two days per week tabata training group Vs skill based exercises with one day per week tabata training group (MD: 1.50).

Skill based exercises with two days per week tabata training group Vs control group  
(MD: 7.95).

Skill based exercises with one day per week tabata training group Vs control group  
(MD: 6.45).

The initial, final and adjusted post test means value of experimental and control groups on playing ability are presented through a diagram for better understanding of the results of the study in figure 15.





**Figure 15. Graphical Representation of Pre Post and Adjusted Post Test Mean on Playing Ability (Scores in Points).**

#### **4.4.9.1 DISCUSSION ON THE FINDINGS OF PLAYING ABILITY**

The result presented in Table XX proved significant improvement on playing ability, as the obtained F value was greater than the required table value to be significant at 0.05 level. The post hoc analysis result presented in Table XXI proved where compared to control group, skill based exercises with varied frequencies of tabata training groups significantly improved playing ability among handball players. The post hoc results further proved that where compared between treatment groups, it was found that there skill based exercises with three days per week tabata training was significantly better than skill based exercises with two days per week tabata training and skill based exercises with one day per week tabata training on playing ability among handball players.

Due to sixteen weeks of skill based exercises with varied frequencies of tabata training significantly improved playing ability of the handball players.

The findings of present study were in agreement with the findings of Hermassi et al (2011) who identified effects of eight week in season upper and lower limb heavy resistance training on improve peak power, throwing velocity, and sprint performance among handball players significantly. The findings of the study proved that there was significant improvement in playing ability, is in the agreement with the previous findings of Luteberget et al (2017).

Thus, the theoretical findings based on previous research proved that skill based exercises and tabata training (high intensity interval training) contributed to the improvement on playing ability. The findings of the present study proved that playing ability significantly improved due to skill based exercises with varied frequencies of tabata training which is in the agreement to the previous researches.

#### **4.5 DISCUSSION ON HYPOTHESES**

The first hypothesis stated that there would be a significant improvement on selected bio motor, physiological and performance related variables due to skill based exercises with one day per week tabata training among handball players. The results of this study proved that skill based exercises with one day per week tabata training group had significantly improved cardiovascular endurance, explosive power, agility, anaerobic power, vital capacity, passing, shooting and playing ability among handball players. However there was no significant improvement in mean arterial blood pressure. Hence, the first hypothesis was accepted with partial rejection.

The second hypothesis stated that there would be a significant improvement on selected bio motor, physiological and performance related variables due to skill based exercises with tabata training two days per week among handball players. The results of this study proved that skill based exercises with two days per week tabata training group significantly improved cardiovascular endurance, explosive power, agility, anaerobic power, vital capacity, passing, shooting and playing ability among handball. However there was no significant improvement in mean arterial blood pressure. Hence, the second hypothesis was accepted with partial rejection.

The third hypothesis stated that there would be a significant improvement on selected bio motor, physiological and performance related variables due to skill based exercises with tabata training three days per week among handball players. The results presented in this study proved that skill based exercises with three days per week tabata training group significantly improved cardiovascular endurance, explosive power, agility, anaerobic power, vital capacity, passing, shooting and playing ability among

handball players. However there was no significant improvement in mean arterial blood pressure. Hence, the third hypothesis was accepted with partial rejection.

The fourth hypothesis stated there would be a significant differences among experimental groups in improving selected bio motor, physiological and performance related variables namely, cardiovascular endurance, agility, explosive power, mean arterial blood pressure, vital capacity, anaerobic power, passing, shooting and playing ability among handball players.

The post hoc analysis results presented in this study proved that there was significant differences among the experimental protocols, namely, skill based exercises with one day per week tabata training group, skill based exercises with two days per week tabata training group and skill based exercises with three days per week tabata training group on cardiovascular endurance, explosive power, anaerobic power, playing ability and to this extend the hypothesis was accepted at 0.05 level.

However, as for agility, passing and shooting, it was found no significant differences between skill based exercises with one day per week tabata training group and skill based exercises with two days per week tabata training group, skill based exercises with one day per week tabata training group and skill based exercises with three days per week tabata training group, skill based exercises with two days per week tabata training group and skill based exercises with three days week tabata training group. Hence, the hypothesis was rejected at 0.05 level.

In the case of vital capacity, it was found significant differences between skills based exercises with three days per week tabata training group and skill based exercises with one day per week tabata training group. Hence, the fourth hypothesis was accepted at 0.05 level. And also the results proved there was no significant differences between

skills based exercises with three days per week tabata training group and skill based exercises with two days per week tabata training group, skills based exercises with two days per week tabata training group and skill based exercises with one day per week tabata training group. Hence, fourth hypothesis was rejected at 0.05 level.