
RESULTS AND DISCUSSION

The results of the present investigation titled “**Effect of Interventions on Nutritional Status and Work Performance of Thang - Ta Athletes in Manipur**” are presented and discussed under the following headings:

A. Socio Economic Status of the Athletes

B. Nutritional Status and Physical Performance of the Athletes

1. Anthropometric Parameters

2. Biochemical, Clinical examination and Medical history

3. Dietary and Life Style Pattern

4. Physical Performance of the Athletes

C. Effect of interventions

1. Effect of Supplementation on Athletes.

2. Effect of Nutrition Education on Athletes

A. SOCIO ECONOMIC STATUS OF ATHLETES

Table IV provides the Socio Economic Background information such as age, sex, type of family, types of religion, type of residence, occupation of the head of the family, income of the head of the family and educational status of the Thang-Ta athletes.

TABLE IV

DETAILS OF SOCIO ECONOMIC BACKGROUND OF THE ATHLETES

(N=364)

Parameters	Criteria	Thang- Ta athletes			
		Male (n=280)		Female (84)	
		Number	Percent	Number	Percent
Age(years)	15-19	198	70.7	45	53.6
	20-25	82	29.3	39	46.4
Type of family	Nuclear	185	66.1	66	78.6
	Joint	95	33.9	18	21.4
Religion	Hindu	273	97.5	84	100
	Muslim	7	2.5	-	-
Areas of Residence	Rural	203	72.5	67	79.7
	Urban	77	27.5	17	20.3
Occupation of the Heads of the Families	Government employee	35	12.5	13	15.5
	Shopkeeper	27	9.7	5	5.9
	Driver	22	7.8	4	4.7
	Chaukidar	29	10.4	-	-
	Farmer	105	37.5	38	45.2
	Carpenter	62	22.1	24	28.5
* Family Income	Rs.5000(EWS)	97	34.6	31	36.9
	Rs.5001-Rs.10000 (LIG)	183	65.4	53	63.1
Educational Qualification of Athletes	Illiterate	12	4.3	-	-
	Dropout	35	12.5	-	-
	High school	123	43.9	44	52.4
	Higher secondary	50	17.8	26	31
	Graduate	42	15	9	10.7
	Post graduate	18	6.5	5	5.9

*HUDCO 2010, EWS-Economically Weaker Section, LIG-Low Income Group

Out of 280 male and 84 female Thang –Ta athletes , 70.7 per cent male and 53.6 per cent female athletes were in the age group of 15-19 years and 29.3 per cent male and 46.4 percent female Thang- Ta athletes were in the age group of 20-25 years. The present data revealed that more number of budding athletes in the age group of 15-19 years participated in Thang- Ta. It is encouraging to know that Thang-Ta is catching up with young athletes. However, considering the male: female ratio of 1000:987(Census, 2011) in Manipur, the representation of female athletes in Thang -

Ta is poor (98.7 per cent as against 30 per cent in the present study). This finding calls for policy makers and stakeholders to provide incentives to lure more women / girls in the state to practice and excel in Thang –Ta.

A majority (66.1 per cent of male and 78.6 per cent of female) of Thang - Ta athletes belonged to nuclear family system when compared to 33.9 per cent male and 21.4 per cent female Thang -Ta athletes who were from joint family system; 97.5 per cent male and all the female Thang -Ta athletes were Hindus and only 2.5 per cent male Thang-Ta were Muslims. According to Manipur Religion Census (2011), 41.39 per cent are Hindus, 41.29 per cent are Christians, 8.40 per cent are Muslims and 8.92 per cent belong to other religions.

Thang -Ta is an indigenous martial Art of Rural Manipur (Green, 2010). This is revealed in the results of the present study that majority (72.5 per cent of male and 79.7 per cent female) of Thang-Ta athletes were from rural areas. Only 27.5 per cent male and 20.3 per cent female Thang -Ta athletes were from urban areas. This finding conforms to the data of Census (2011) where in 70.79 per cent of the general population are from the rural and 29.1 per cent are from urban background. Most of the Thang- Ta athletes were from agriculture families (37.5 per cent of male and 45.2 per cent female).

On the basis of the HUDCO income classification (2010), majority of (65.4 per cent male and 63.1 per cent) female Thang -Ta athletes were from Low Income Group, while 34.6 per cent male and 36.9 per cent female Thang-Ta athletes were from Economically Weaker Sections.

This finding was supported by Devi and Singh (2007) who report that most of the players are from families of larger size and most of them belong to lowest income group.

Most of the athletes (43.9 per cent of male and 52.4 per cent female) had high school level of education. Remaining 4.3, 12.5, 17.8, 15 and 6.6 per cent of male Thang-Ta were illiterate, dropout, higher secondary, graduate and post graduate respectively. Of the female athletes, 31, 10.7, and 5.9 per cent were educated up to higher secondary, graduate and post graduation respectively. None of the female athletes was illiterate. As per the data of census (2011) where total literacy rate of the state is 79.85 per cent (Male literacy rate is 86.49 % and female literacy is 73.15

%). Manipur ranks fifth in literacy among the North Eastern States of India as per the final figures of the 2011 census. The literacy level of the Thang-Ta athletes in the present study is much higher than the values reported for the state of Manipur.

B. NUTRITIONAL STATUS AND PHYSICAL PERFORMANCE OF THE ATHLETES

Nutritional anthropometry, biochemical, clinical, dietary intake patterns were assessed to understand the nutritional profile of the athletes.

1. ANTHROPOMETRIC PARAMETERS

a. Standing Height and Body Weight of Thang-Ta Athletes

Mean height, weight and distribution according to height and weight of the male and female Thang- Ta athletes (of the two age groups 15-19 and 20-25 years) are given in Tables V and VI.

TABLE V
MEAN HEIGHT (cm) AND WEIGHT (kg) OF THE ATHLETES (15- 19 YEARS)
(N=243)

Height (cm)	Thang -Ta athletes									
	Male (n=198)					Female (n=45)				
	No. a	% b	Mean c	ICMR (2010) d	t-value c vs d	No. e	% f	Mean g	ICMR (2010) h	t-value g vs h
144-154	33	16.7	161.6 ± 6.73	168.2	2.18*	21	46.7	155± 5.29	159.6	2.42*
155-166	118	59.6				23	51.1			
167-177	45	22.7				1	2.2			
178-188	2	1.0				-	-			
Weight			52.5 ± 6.89	51.5	0.37 ^{NS}	12	26.7	51.5± 7.32	49.4	0.79 ^{NS}
36-46	38	19.2				26	57.8			
47-57	121	61.1				6	13.3			
58-68	35	17.7				1	2.2			
69-79	4	2.0								

*- significant at 5% level;NS- Not significant.

Majority (59.6 per cent male and 51.1 per cent female) of the Thang –Ta athletes were in the height range of 155-166 cm. Remaining 16.7 percent male and 46.7 per cent female; 22.7 per cent and 2.2 per cent athletes were in the height category of 144-154 cm, 167-177cm and respectively. Only one per cent of male and none of the female athletes were in the height category of 178-188 cm. It was found that the mean height of male and female Thang -Ta athletes in the age group of 15-19 years was 161.6 ± 6.73 cm and 155 ± 5.29 cm respectively. Majority (61.1 per cent male and 57.8 per cent) of the female Thang-Ta athletes were in the weight range of 47-57 kg. Rest of the male Thang- Ta athletes (19.2 per cent, 17.7 per cent and 2.0 per cent) were in the weight range of 36-46kg, 58-68 kg and 69-79 kg respectively. Similarly rest of the female athletes 26.7 per cent, 13.3 per cent and 2.2 percent were in the weight range of 36-46kg, 58-68 kg, and 69-79 kg respectively. The mean body weights of male and female Thang -Ta athletes were found to be 52.5 ± 6.89 kg and 51.5 ± 7.32 kg respectively.

Both male and female athletes in the age group 15-19 years were significantly shorter ($P < 0.05$) than their respective ICMR standard counter parts. But no significant difference was observed in the body weight of both the genders when compared with ICMR (2010). This finding shows that the Thang-Ta athletes of Manipur were 'fit' in terms of body weight though shorter than ICMR counterparts.

Earlier findings by Anel and Subapriya (2014) revealed that mean height of male Thang -Ta athletes in the age group of 15-19 years from two different training centers were found to be 160.3 ± 8.30 cm and 157 ± 4.88 cm respectively and their mean weight was 53.50 ± 6.81 kg and 49.22 ± 5.35 kg respectively.

Tsolakis and Vagenas (2010) reported that the Greek fencers (mean age $19.78 \text{ years} \pm 3.78$ years) had mean height of 173.84 ± 8.00 cm and body weight of 66.1 ± 9.1 . Franchini *et., al*, (2011) reported that male (mean of age of 18.9 ± 0.5 years) and female (18.6 ± 0.5 years) Junior judoka athletes had mean height of 176.7 ± 2.0 cm and 165.6 ± 1.9 cm respectively. Similarly mean body weight was 82.5 kg and 70.7 kg respectively. Thus it is seen that Thang- Ta athletes in the present study were much shorter and lighter than their Greek fencing and Spanish Judoka counter parts.

TABLE VI
MEAN HEIGHT (cm) AND WEIGHT (kg) OF THANG –TA ATHLETE
(20-25 YEARS)

(N=243)

Height	Thang -Ta athletes									
	Male (n=198)					Female (n=45)				
	No.	%	Mean	ICMR (2010)	t-value	No.	%	Mean	ICMR (2010)	t-value
144-154	5	6.1	164.6±	172	2.67*	12	30.7	156.8±	160.9	2.04*
155-166	47	57.3	6.10			26	66.7	5.54		
167-177	30	36.6				1	2.6			
178-188	-	-				-	-			
Weight	1	1.2	60.5±	60	0.15 ^{NS}	11	28.2	52.5±	55	0.90 ^{NS}
36-46			8.14					7.50		
47-57	30	36.6				19	48.7			
58-68	35	42.7				9	23.1			
69-79	16	19.5				-	-			

*- significant at 5% level;NS- Not significant.

The mean height of male and female Thang -Ta athletes in the age group of 20-25 years was 164.6±6.10 cm and 156.8±5.45 cm respectively. Majority 57.3 per cent male and 66.7 per cent female Thang -Ta were in the height range of 155-166 cm. Remaining 6.1 per cent male and 30.7 per cent female; 36.6 per cent male and 2.6 per cent female athletes were in the height category of 144-154 cm and 167-177 cm respectively. The mean weight of male and female Thang -Ta athletes were found to be 60.5±8.14kg and 52.5±7.50 kg respectively. Around 42.7 per cent male and 48.7 per cent female Thang-Ta athletes were in the weight range of 58-68 kg and 47-57 kg respectively. Among male athletes, the remaining 1.2 per cent, 36.6 per cent, 19.5 per cent male athletes were in the weight category of 36-46 kg, 47-57 kg and 69-79 kg respectively. Among female athletes, 28.2 per cent and 23.1 per cent were in the weight category of 36-46kg and 58-68 kg respectively.

Both male and female Thang- Ta in the age group 20-25 years were significantly shorter ($P<0.05$) than their respective ICMR standard counter parts. But no significance difference was observed in the body weight of both the genders when compared with ICMR (2010) standard.

Ghloum and Hajj (2011) reported that Kuwaiti male fencers with mean age of 21.5 ± 2.6 years had an average height and weight of 175.2 ± 6.1cm and 71.1 ± 15.0kg respectively. The present study Thang -Ta athletes with mean age of 21.48±1.45 had shorter height and lighter weight than Kuwaiti male fencers.

b. Distribution of Thang -Ta athletes according to Body Mass Index

Body Mass Index of male and female Thang -Ta athletes in the age group of 15-19 years and 20-25 years were computed and compared with the BMI of WHO (2007) and cut of levels for Asians of WHO (2004) and presented in Tables VII and VIII and Figures 3 and 4 respectively.

TABLE VII
BODY MASS INDEX OF THANG -TA ATHLETES (15-19 YEARS)

(N=243)

*BMI age /Sex Centiles	Nutritional grade	Male (n=198)			Female (n=45)		
		Mean	Number	Percent	Mean	Number	Percent
<5 th Centile	Under nutrition	20.08± 1.19	9	4.5	21.42± 2.84	-	-
5 th Centile to 85 th Centile	Normal		174	87.9		36	80
85 th – 95 th centile	Overweight		12	6.1		6	13.3
≥95 th Centile	Obesity		3	1.5		3	6.7
Total			198	100		45	100

*WHO (2007)

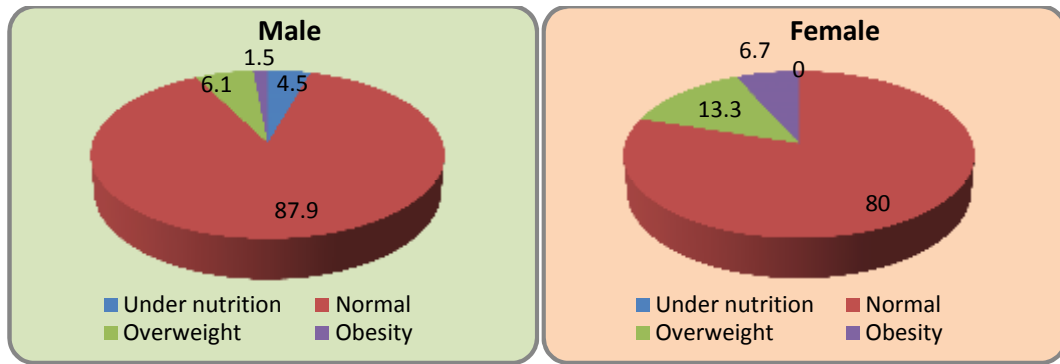


Figure 3 Distribution According To Body Mass Index (15-19 yrs)

The mean BMI of male and female Thang –Ta athletes in the age group of 15-19 years were 20.08 ± 1.19 and 21.42 ± 2.84 respectively. Compared with the BMI values of WHO (2007), majority 87.9 per cent male and 80 per cent female Thang-Ta athletes had normal BMI. Among male athletes, 4.5 per cent showed under nutrition, 6.1 per cent were overweight and 1.5 per cent was obese. Among female athletes, 13.3 per cent and 6.7 per cent were overweight and obese respectively. None of the female athletes in this age group were in the undernourished category.

TABLE VIII

BODY MASS INDEX OF THANG -TA ATHLETES (20-25 YEARS) (N=121)

^BMI	Nutritional grade	Male			Female		
		Mean	Number	Percent	Mean	Number	Percent
<18.5	Low	22.09 ± 2.56	1	1.2	21.32 ± 2.78	4	10.3
≥18.5 - <20.0	Low Normal		12	14.6		7	17.9
≥20.0 - <23.0	Normal		39	47.6		19	48.7
≥23.0 - <25.0	Over weight		28	34.2		8	20.5
≥ 25.0 - <27.5							
≥ 27.5 - <30.0	Obesity		2	2.4		1	2.6
≥ 30.0 - <32.5							
≥32.5 - <37.5							
≥37.5- <40.5							
≥40.0							
Total			82	100	39	100	

^WHO (2004)

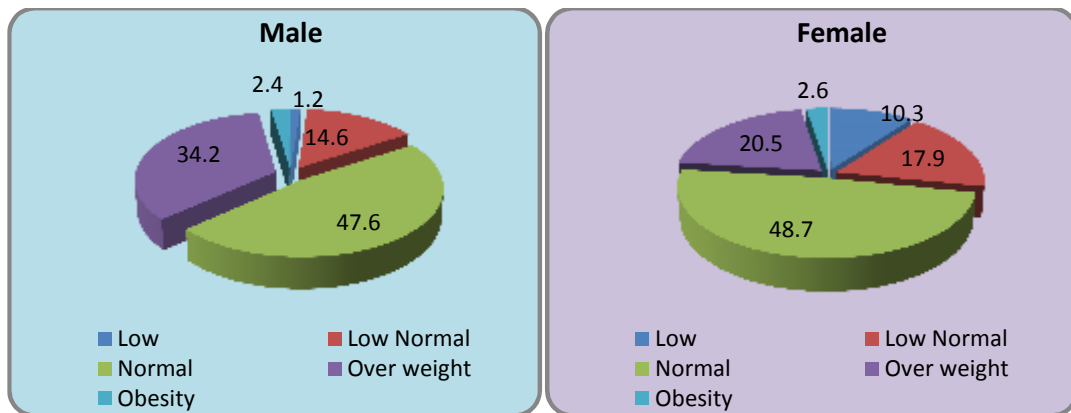


Figure 4. Distribution of athletes according to Body Mass Index (20-25 yrs)

Around 47.6 per cent male and 48.7 per cent female Thang- Ta athletes had normal BMI in this age group; 1.2 percent male and 10.3 per cent female were in low BMI category; 14.6 per cent male and 17.9 per cent female Thang -Ta athletes had low normal BMI; 34.2 percent male and 20.5 per cent female Thang -Ta athletes were in the overweight category. Only 2.4 per cent male and 2.6 per cent female were obese. Obesity among the athletes could be due to heredity in the family. More number of female athletes were underweight (10.3 per cent) highlighting poor nutritional status among female athletes. Rolls *et al.*, (1991) reported that underweight among women could be due to the consumption of fewer calories than men; sex differences in eating style in women who are more socialized to eat in famine manner and pressure to be thin in early adulthood. This brings out the need for nutritional education to enhance nutritional status of female athletes per se in the entire state.

The mean BMI of Thang- Ta athlete in the present study was almost similar to the BMI of elite (21.72 ± 1.45) and sub elite (20.78 ± 2.60) fencers studied by Tsolakis and Vagenas (2010) and also comparable to the mean BMI (20.9 ± 1.7) of Shorinji Kempo athletes of Japan studied by Sumida *et al.*, (2012).

c. Distribution of Thang-Ta athletes according to Waist –Hip ratio

Table IX presents the waist –hip ratio of the Thang - Ta athletes as per the normal and obese grades.

TABLE IX
WAIST–HIP RATIO OF ATHLETES (20-25 YEARS)

(N=121)

*WHR Classification (male)	Mean	Number (n=82)	Per cent
<0.95 Normal	0.74±	81	98.8
≥0.95 Obesity	0.04	1	1.2
*WHR Classification (female)	Mean	Number (n=39)	Per cent
>0.80	0.73±	37	94.8
≥0.80	0.04	2	5.2

*Brahmam *et al.*, (2005).

A Majority (98.8 per cent male and 94.8 percent female) of Thang-Ta athletes had normal waist –hip ratio when compared to the cut off by Brahmam *et al.*, (2005). A meager 1.2 per cent and 5.2 per cent showed obesity.

d. Mean Skinfold Thickness of Athletes

The mean skinfold thickness of male and female Thang-Ta athletes (at various sites) in the age group of 15-19 years and 20 -25 years is presented in Tables X and XI.

The mean triceps, biceps, subscapular, suprailliac, supraspinale, abdominal, thigh and calf skinfold values of male Thang -Ta athletes in the age group of 15-19 years was found to be 10.19±1.17mm, 8.04±1.14mm, 13.15±1.75mm, 14.00±2.12mm, 10.27±1.58mm, 19.04±2.32mm, 22.39±2.10mm and 15.28±1.72 mm respectively and for those in the age group of 20-25 years were 9.91±0.97mm, 8.00±0.89mm, 13.96±1.46mm, 14.69±2.04mm, 10.26±1.86mm, 16.07±2.01mm, 17.46±2.58mm and 14.12±1.49 mm respectively.

TABLE X
MEAN SKINFOLD THICKNESS OF MALE THANG -TA ATHLETES
(N=280)

Skin fold (mm)	Thang- Ta male athletes			♦Elite fencers (20.14 ±4.01 years) (c) (b vs c)	♦Sub elite fencers 19.78 ±3.15 years(d) (a vs d)
	(15-19 years) n=198 (a)	(20-25 years) n=82 (b)	t – value (a vs b)		
Triceps	10.19±1.17	9.91±0.97	1.91 *	9.65±3.08 2.44**	12.27±4.57 24.83**
Biceps	8.04±1.14	8.00±0.89	0.26 ^{NS}	4.58±1.70 24.63**	5.52±2.03 31.08
Subscapular	13.15±1.75	13.96±1.46	3.66 **	9.00±1.59 30.61**	10.63±5.99 20.21**
Supra iliac	14.00±2.12	14.69±2.04	2.52 **	8.53±2.31 27.37**	10.51±5.97 23.17**
Supraspinale	10.27±1.58	10.26±1.86	0.03 ^{NS}	-	-
Abdominal	19.04±2.32	16.07±2.01	10.11 **	-	-
Thigh	22.39±2.10	17.46±2.58	16.63 **	13.38±3.93 55.78**	17.09±6.45 35.07**
Calf	15.28±1.72	14.12±1.49	5.32 **	11.00±4.30 17.07**	12.67±4.48 21.30**

♦Tsolakis and Vagenas, (2010);

*-significant at 5% level;** - significant at 1%level;NS- Not significant.

Skinfold value of triceps among male Thang –Ta athletes of 15-19 years were significantly higher ($p < 0.05$) than the 20-25 years male Thang -Ta athletes. Biceps and supraspinale skinfold were not significantly different between both the age groups. But subscapular, suprailliac, abdomen, thigh and calf of 15-19 years male athletes were significantly higher ($P < 0.01$) than the 20-25 years male athletes. This could be due to the higher fat deposits in the younger age group and more intensive and longer duration training in the older age group.

This finding is further substantiated by the earlier study of Tsolakis and Vagenas, (2010). When compared with skinfold value of elite and sub elite Greek fencers, the triceps, biceps, subscapular, suprailliac, thigh and calf skinfold of male Thang -Ta athletes in both age group (15-19 years and 20-25 years) were higher (at $p < 0.01$) than the elite and Greek sub elite fencers of similar age.

TABLE XI
MEAN SKINFOLD THICKNESS OF FEMALE THANG -TA ATHLETES (N=84)

Skin fold (mm)	Thang- Ta athletes		♠Judoka athletes (18.6 ±0.5 yrs) (c) (a vs c)	♠Judoka athletes (24.1±0.4 yrs) (d) (b vs d)	♠Judoka athletes 18.2±2.7 (f) (a vs f)	♠Judoka athletes (22.6±3.4 yrs) (e) (b vs e)	♠ Sub elite fencers (19.78±3.15 yrs) (h) (a vs h)	♠ Elite fencers (20.14 ±4.01yrs) (g) (b vs g)
	15-19 years(n=45) (a)	20-25 years(n=39) (b) (a vs b)						
Triceps	10.36±1.35	11.39±1.26 3.60**	16.4±1.9 21.97**	14.6±1.5 15.79**	17.7±6.3 36.43**	13.9±3.9 13.34**	12.47±4.57 10.46**	9.65±3.08 8.61**
Biceps	8.09±1.02	8.59±0.92 2.34*	8.7±1.2 4.04**	6.3±1.0 15.50**	7.5±4.4 3.88**	6.5±2.2 14.14**	5.52 ±2.03 16.90**	4.58±1.70 27.14**
Subscapular	13.78±1.61	14.12±1.40 1.03 ^{NS}	17.7±2.9 16.28**	15.0±2.4 4.01**	15.6±7.5 7.55**	13.4±4.4 3.30**	10.63±5.99 13.09**	9.00±1.57 23.43**
Supra iliac	16.62±1.77	17.89±2.10 2.99**	-	-	-	-	10.51 ±5.97 23.07**	8.53±3.21 27.82**
Supraspinale	10.24±1.85	10.42±1.58 0.45 ^{NS}	15.5±3.0 19.03**	9.6±2.4 3.27**	15.0±7.4 17.22**	13.3±5.6 11.36**	-	-
Abdominal	20.57±2.02	20.45±1.82 0.27 ^{NS}	19.7±3.4 2.89**	15.8±2.8 18.39**	20.47.9 0.34**	21.7±8.3 4.25**	-	-
Thigh	23.79±1.77	23.39±1.50 1.09 ^{NS}	34.5±3.5 **40.52	27.5±2.9 31.61**	26.6±7.7 10.62**	22.2±5.0 4.96**	17.09±6.45 25.48**	13.38±3.93 41.49**
Calf	15.61±2.03	15.35±1.35 0.68 ^{NS}	26.1±2.6 34.56**	19.0±2.1 116.83**	23.7±5.2 26.64**	16.1±4.3 3.4**	12.67±4.48 9.71**	11.00±4.30 20.10**

♠Franchini *et al.*,(2011); ♠ Elipkhanov and Nemtsev (2013); ♠ Tsolakis and Vagenas (2010).

*-significant at 5% level; **-signiicant at 1% level; NS- Not significant

The mean triceps, biceps, subscapular, suprailiac, supraspinale, abdominal, thigh and calf skin fold of female Thang-Ta athletes in the age group of 15-19 years were found to be 10.36 ± 1.35 mm, 8.09 ± 1.02 mm, 13.78 ± 1.61 mm, 16.62 ± 1.77 mm, 10.24 ± 1.85 mm, 20.57 ± 2.02 mm, 23.79 ± 1.77 mm, and 15.61 ± 2.03 mm respectively. The mean triceps, biceps, subscapular, suprailiac, supraspinale, abdominal, thigh and calf skin fold of female Thang -Ta athletes in the age group of 20-25 years were found to be 11.39 ± 1.26 mm, 8.59 ± 0.92 mm, 14.12 ± 1.40 mm, 17.89 ± 2.10 mm, 10.42 ± 1.58 , 20.45 ± 1.82 mm, 23.39 ± 1.50 mm, 15.35 ± 1.35 respectively. It was also found that triceps and suprailiac value of 15-19 year age group were significantly lower ($p < 0.01$) than the respective values in the 19-20 year age group. Biceps value of 15-19 year old athletes were significantly lower ($p < 0.05$) than in the 20-25 year age group.

When compared with the skinfold value of Spanish Judoka athletes, Franchini *et al.*, 2011), the triceps, biceps, subscapular, supraspinale, skinfold values of female Thang- Ta in the age group of 15-19 years were significantly lower ($p < 0.01$); skinfolds at abdomen and calf region were higher than the Judoka athletes of similar age. Similarly among 20-25 years groups, the triceps, subscapular, and thigh skinfold value of female Thang –Ta athletes was significantly lower ($p < 0.01$); biceps and supraspinale were higher than the Judoka athletes.

Similarly, when compared with the skinfold thickness of international class female judo athletes (Elipkhanov and Nemtse, 2013). The mean triceps, supraspinale, abdomen and medial calf values of Thang- Ta female athletes in the age group of 15-19 years were significantly lower ($p < 0.01$). Biceps and subscapular skinfold value were significantly higher ($p < 0.01$) than the respective values for similar age. Similarly, among 20-25 year athletes, the triceps, subscapular, supraspinal, thigh and calf skinfold value were statistically lower ($p < 0.01$) except for biceps and abdomen skinfold value which were higher than the respective values of Judo athletes of similar age.

Contrast to the above previous studies findings, the skinfold value of Thang-Ta athletes were higher at $p < 0.01$ level than the skinfold values of elite and sub elite fencers reported by Tsolakis and Vagenas (2010).

Table XII and XIII compares the mean skinfold between the genders for the 15 -19 year age group.

TABLE XII
MEAN SKINFOLD (mm) OF MALE AND FEMALE ATHLETES (15-19 YEARS)

(N=243)

Sites of Skinfold	Mean Skinfold (mm)		a vs b t-value
	Male (n=198)	Female (n=45)	
	a	b	
Triceps	10.19±1.17	10.36±1.35	0.84 ^{NS}
Biceps	8.04±1.14	8.09±1.02	0.27 ^{NS}
Subscapular	13.15±1.75	13.78±1.61	0.02 ^{**}
Supra iliac	14.00±2.12	16.62±1.77	7.69 ^{**}
Supraspinale	10.27±1.58	10.24±1.85	0.09 ^{NS}
Abdominal	19.04±2.32	20.57±2.02	4.05 ^{**}
Thigh	22.39±2.10	23.79±1.77	4.15 ^{NS}
Calf	15.28±1.72	15.61±2.03	1.12 ^{NS}

There was no significant difference in triceps, biceps, supraspinale, thigh and calf skinfolds between male and female Thang -Ta athletes whereas, subscapular, suprailiac and abdomen skinfold of male Thang- Ta athletes of 15-19 years were significantly less ($p<0.01$) than female athletes of the same age group. This is in accordance with the fact that women have higher body fat percentage than men, deposited in the subscapular, suprailiac and abdominal regions (Blaak, 2001).

TABLE XIII
MEAN SKINFOLD THICKNESS (mm) OF MALE AND FEMALE ATHLETES (20-25 YEARS)

(N=121)

Sites of Skinfold	Mean Skinfold (mm)		t-value a vs b
	Male (n=82)	Female (n=39)	
	a	b	
Triceps	9.91±0.97	11.39±1.26	7.10 ^{**}
Biceps	8.00±0.89	8.59±0.92	3.35 ^{**}
Subscapular	13.96±1.46	14.12±1.40	0.57 ^{NS}
Supra iliac	14.69±2.04	17.89±2.10	7.97 ^{**}
Supraspinale	10.26±1.86	10.42±1.58	0.44 ^{NS}
Abdominal	16.07±2.01	20.45±1.82	11.49 ^{**}
Thigh	17.46±2.58	23.39±1.50	13.27 ^{**}
Calf	14.12±1.49	15.35±1.35	4.34 ^{**}

Skinfold values at triceps, biceps, supra iliac, abdomen, thigh and calf of female Thang - Ta athletes were significantly higher ($p<0.01$) than their male counterparts. However, no statistically significant difference was observed in subscapular and supraspinale skinfolds. This is accordance to the fact that, women generally have a higher percentage of body fat than men. Also, women store more fat in the gluteal-femoral region (Blaak, 2001).

e. Mean Body Composition Parameters

Mean body composition and BMR values of male and female Thang -Ta athletes and comparison with other combat athletes are presented in Tables XIV and XV respectively.

TABLEXIV
BODY COMPOSITION AND BMR OF THANG -TA ATHLETES
(N=280)

Body Composition Parameters	Thang -Ta athletes					
	Male			Female		
	15-19 yrs (n=198) a	20-25 yrs (n=82) b	t-value a vs b	15-19 yrs (n=45) c	20-25 yrs (n=39) d	t-value c vs d
Fat %	8.29±3.96	8.57±3.48	0.55 ^{NS}	20.97±6.33	18.93±5.98	1.50 ^{NS}
Fat free mass(kg)	48.05±6.35	55.18±6.12	8.64 ^{**}	40.29±3.34	42.22±3.57	0.79 ^{NS}
Total body water(kg)	35.00±4.70	40.36±4.47	8.78 ^{**}	29.48±2.44	30.89±2.62	2.55 ^{**}
Fat mass(kg)	4.41±2.34	5.39±2.78	2.99 ^{**}	11.17±5.09	10.33±4.60	2.55 ^{**}
Lean body mass(kg)	48.04±6.22	55.30±6.38	8.80 ^{**}	40.45±3.38	42.21±3.57	2.31 [*]
BMR (kcal)	1537.7±10 3.1	1555.0±13 5.69	1.15 ^{NS}	1353.9±75 .44	1347.77±7 7.17	0.37 ^{NS}

*-significant at 1% level;**-significant at 5 % level;NS-notsignificant

The mean score of body fat per cent, fat free mass, total body water, fat mass, lean body mass and BMR of male Thang -Ta athletes in the age group of 15-19 years were found to be 8.29±3.96 per cent, 48.05±6.35kg, 35.00±4.7kg, 4.41±2.34kg, 48.04±6.22kg, 1537±103.1 kcal respectively and those of male Thang-

Ta athletes in the age group of 20-25 years were to be 8.57 ± 3.48 per cent, 55.18 ± 6.12 kg, 40.86 ± 4.47 kg, 5.39 ± 2.78 kg, 55.30 ± 6.38 kg, 1555.00 ± 135.69 kcal respectively.

It was found that body fat percent and BMR of male athletes in both age groups were statistically similar. But fat free mass, total body water, fat mass and lean body mass of male athletes in the age group of 15-19 years were significantly lower at ($P<0.01$) than male athletes of 20-25 years.

Among female athletes, mean fat per cent, fat free mass, fat mass, total body water, Lean body Mass and BMR in the age group of 15-19 years was found to be 20.97 ± 6.38 per cent, 40.29 ± 3.34 kg, 29.48 ± 2.44 kg, 11.17 ± 5.09 kg, 40.45 ± 3.38 kg, and 1357.9 ± 75.44 kcal respectively. Similarly, Body Fat per cent, fat free mass, fat mass, total body water, lean body mass and BMR of female Thang -Ta athletes in the age group of 20-25 years was found to be 18.93 ± 5.98 per cent, 42.22 ± 3.57 kg, 30.89 ± 2.62 kg, 10.33 ± 4.60 kg, 42.21 ± 3.57 kg, 1347 ± 77.37 kcal respectively.

Fat percent, fat free mass and BMR of female Thang -Ta athletes of the two age groups were statistically similar. But fat mass of 15-19 years group female athletes was significantly higher ($p<0.01$) than the fat mass of 20-25 years group female athletes. Total body water and lean body mass of female Thang -Ta athletes in the age group of 15-19 years were significantly lower ($p<0.01$ and $p<0.05$ respectively) than the older age group.

The mean body composition parameters such as body fat percent, fat mass, total body water, lean body mass and BMR of male Thang- Ta athletes in the age group of 15-19 years were significantly lower ($p<0.01$) than the female Thang -Ta athletes of same age group. Other mean parameters (fat free mass, total body water and lean body mass and BMR were significantly ($p<0.01$) higher than among the female athletes.

Body fat per cent and fat free mass of male Thang –Ta athletes in the age group of 20-25 years were significantly less ($p<0.01$) than those female athletes 15-19 years of age. However, fat free mass, total body water, lean body mass and BMR value of male were higher ($p<0.01$) than the female counterparts, confirming the established finding that men have higher muscle and fat free mass.

TABLE XV

COMPARISON OF BODY FAT PER CENT OF THANG- TA ATHLETES WITH OTHER MARTIAL ART ATHLETES

Male Athletes						Female Athletes					
Age in years (15-19)			Age in years (20-25)			Age in years (15-19)			Age in years (20-25)		
Thang-Ta athletes a	Other combat athletes b	t- value a vs b	Thang-Ta athletes c	Other combat athletes d	t value c vs d	Thang -Ta athletes e	Other combat athletes f	t- value e vs f	Thang- Ta athletes g	Other combat athletes h	t- value g vs h
8.29±3.96	§ 9.62±4.26 (martial arts)	4.70**	8.57±3.48	●11.7±4.0	8.12**	20.97±6.38	▪22.7±5.2 Judoka)	1.83 ^{NS}	18.93±5.98	▪19.64±4.4 Judoka athletes	0.69NS
	◆10.6±1.9 Judo athletes	8.12**		□11.9±5.6 judo athletes	8.12**		◆24.0±2.1 Judo athletes)	3.20**		◆19.9±1.7 Judo athletes	1.00NS
				◆8.0±2.6 Judo athletes	1.48 ^{NS}						

§ Kayihan (2014); ◆Franchini *et.al.* ,(2011); ●Schik *et.al.* ,(2010); □Katralli *et al.*,2011; ◆Franchini *et.al.*, (2011);

•Elipkhanov & Nemtsev (2013);*-significant at 1% level;** at 5 % level;Ns-Not Significant

According to Guidelines for Exercise Testing and Prescription (American College of Sports Medicine, 2008) the ideal percentage of body fat for a non-athlete is around 15-18% for men and for athletes (depending on the type of sport) it is less than 10 per cent (good category). A typical fencer should have on average of 8-12 per cent body fat where the recommended value for healthy individuals is 15-18 per cent according to Thompson *et.al.*, (2010). In the present study, it was found that the mean Body Fat percent of Thang-Ta male athletes were in the recommended range (8-12 per cent) as per guidelines of ACSM. However, Thang-Ta athletes in the age group of 15 to 19 years had significantly lower values (at $p < 0.01$) than the standard. Body fat per cent of 20-25 year old Thang -Ta athletes showed no significant difference when compared with ACSM counterparts, 20-29 year of age.

Studies conducted by Kayihan, (2014), on physical fitness levels of Turkey's adolescent martial arts athletes revealed that the fat per cent was 9.62 ± 4.26 . Franchini *et al.*, (2011) studied the anthropometric profile of Spanish Judoka, where body Fat percent found to be 10.6 ± 1.9 (junior) and 8.0 ± 2.6 (senior) respectively. Schik *et.al.*, (2010) reported the fat percent of mixed martial artist of USA to be 11.7 ± 4.0 . Fat per cent of Indian judo athletes was 11.9 ± 5.6 (Katralli *et al.*, (2011).

The mean Body fat percent of Manipuri Thang -Ta was in the 'good' category (ACSM, 2008) but significantly lower than the other combat athletes of different regions. This could probably due to differences in ethnicity race, food habits, fat intake, life style pattern and different geographical environment.

The fat percentage of female Thang -Ta athletes in the age group of 15-19 years were in the good fitness scale when compared with the norms given by Neiman, (1995). Similarly when compared with the ACSM's classification of fat percent, the fat percent of female Thang- Ta athletes in the age group of 20-25 years were in the good fitness category which falls in the of range of 17.1 - 20.5 percent. Tsolakis and Vagenas (2010) studied the fat percentage of elite and sub elite fencers .The value were found as 13.74 ± 3.93 per cent) and (16.67 ± 4.37 per cent) respectively which were lower than the fat percent of female Thang -Ta athletes. This may be because the fencers were elite maximum of eight years training in particular field whereas the Thang -Ta athletes were beginners participating with a minimum of six months of indigenous training with no particular scientific training methods. But contrast to these results, the body fat percent of Thang -Ta female athletes in the age group of 15-19 years were higher than the body fat per cent of Judoka athletes

studied by Franchini *et al.*, (2011). No statistically significant differences were observed in body fat per cent in both the age groups when compared with fat per cent of Judoka athletes studied by Elipkhanov and Nemtsev (2013).

f. Other Anthropometric measurements of male and female Thang -Ta Athletes

The mean measurement values at various anthropometric sites of male and female Thang -Ta athletes in the age groups of 15-19 years and 20-25 years is presented in Tables XVI.

The mean values of measurements at various sites such as chest, waist, abdomen, hip, upper arm relaxed, upper arm flexed, fore arm girth, thigh girth, Calf girth, wrist girth and ankle girth circumference of male Thang- Ta athletes in the age group of 15-19 years were found to be 78.35±4.30 cm, 65.94±4.13 cm, 70.53±4.57 cm, 79.24±4.03 cm, 24.59±1.39 cm, 27.63±1.36 cm, 24.23±1.28 cm, 42.69±3.30 cm, 33.63±2.93 cm, 16.00±0.74 cm, 22.21±0.92 cm respectively. Length such as upper arm length, fore arm length, hand length, hand breath, tibial medial –sphyrion length, thigh length and foot length were found to be 29.04±2.32 cm, 24.50±1.96 cm, 16.63±0.86 cm, 7.91±0.59 cm, 33.84±2.42 cm, 37.94±2.60 cm, 24.03±1.73 cm respectively. The mean value of body diameter such as biacromial distance, biiliocrystal, tranverse chest breadth, femur breadth and humerus breadth were found to be 35.59±3.12 cm, 26.42±1.78 cm, 25.12±0.80 cm, 8.90±0.50 cm, 5.94±0.42cm respectively. In the age group of 20-25 years, the mean value of various circumference sites such as chest, waist, abdomen, hip, upper arm relaxed, upper arm flexed, fore arm girth, thigh girth, calf girth, wrist girth, ankle girth circumference of male Thang- Ta athletes in the age group of 15-19 years were found to be 81.03±4.05 cm, 66.48±2.86cm, 71.73±4.01cm, 78.60±4.03cm, 26.46±1.02cm, 29.14±1.32 cm, 24.55±1.25cm, 47.16±3.39cm, 34.22±2.20cm, 16.12±0.69cm, 23.21±0.76 cm respectively. Length such as upper arm lengths, fore arm length), hand length, hand breath, tibial medial –sphyrion length, thigh length and foot length were found 29.33±2.06 cm, 24.64±1.61 cm, 16.68±0.87 cm, 7.81±0.51cm, 34.51±2.09 cm, 39.24±2.82 cm, 24.08±1.33cm respectively. The mean value of body measurements such as biacromial distance, biiliocrystal, tranverse chest breadth, femur breadth and humerus breadth were found to be 36.30±2.28cm, 27.15±1.31cm, 26.02±1.18 cm, 8.94±0.51cm, 6.02±0.38 cm respectively.

TABLE XVI
OTHER ANTHROPOMETRIC PARAMETERS (cm) OF THANG -TA ATHLETES
(15-19 YEARS) (N=280)

Parameters	Male Athletes			Female athletes			t-value a vs c	t-value b vs d
	(n=198) 15-19 years a	(n=82) 20-25 years b	t-value a vs b	(n=45) 15-19 years c	(n=39) 20-25 years d	t-value c vs d		
Chest circumference	78.35±4.30	81.03±4.05	4.82**	74.41±2.48	75.28±3.22	1.39 ^{NS}	5.90**	7.76**
Waist circumference	65.94±4.13	66.48±2.86	1.08**	64.30±2.82	65.00±3.57	1.00 ^{NS}	2.52**	2.44**
Abdomen circumference	70.53±4.57	71.73±4.01	2.06*	72.31±4.01	70.52±3.88	2.06*	2.40**	1.56 ^{NS}
Hip circumference	79.24±4.03	78.60±4.03	1.19 ^{NS}	85.74±3.53	88.24±2.60	3.64**	9.96**	13.60**
Upper arm relaxed circumference	24.59±1.39	26.46±1.02	11.00**	24.22±0.99	24.35±1.01	0.60 ^{NS}	7.62**	10.61 ^{NS}
Upper arm flexed circumference	27.63±1.36	29.14±1.32	8.32**	26.28±1.12	26.66±1.08	1.56 ^{NS}	6.18**	10.17 ^{NS}
Fore arm girth	24.23±1.28	24.55±1.25	1.91*	22.86±0.86	23.58±0.90	3.72**	6.76**	4.29**
Thigh girth	42.69±3.30	47.16±3.39	10.22**	44.73±2.85	46.61±3.01	2.93**	3.38**	0.86 ^{NS}
Calf girth	33.48±2.73	34.22±2.20	3.73 ^{NS}	32.48±2.63	32.65±2.22	0.32 ^{NS}	2.42**	3.66**
Wrist girth	16.00±0.74	16.12±0.69	1.21 ^{NS}	15.90±0.57	15.62±0.66	2.03*	0.87 ^{NS}	3.70**
Ankle girth	22.21±0.92	23.21±0.76	8.69**	20.85±1.09	20.96±1.26	0.42 ^{NS}	8.59**	12.10**
Upper arm length	29.04±2.32	29.33±2.06	0.96 ^{NS}	27.54±1.80	27.49±1.91	0.12 ^{NS}	4.04**	4.68**
Fore arm length	24.50±1.96	24.64±1.61	0.56 ^{NS}	25.05±1.74	24.98±1.77	0.19 ^{NS}	1.74 ^{NS}	1.05 ^{NS}
Hand length	16.63±0.86	16.68±0.87	0.41 ^{NS}	16.67±0.86	16.51±0.80	0.85 ^{NS}	0.23 ^{NS}	1.02 ^{NS}
Tibiale mediale – sphyron length	33.84±2.42	34.51±2.09	2.17*	32.51±2.32	32.74±2.53	0.43 ^{NS}	3.35**	4.05**
Thigh length	37.94±2.60	39.24±2.82	3.70**	36.03±2.74	36.07±2.58	0.07 ^{NS}	4.39**	5.92**
Foot length	24.03±1.73	24.08±1.33	0.25 ^{NS}	22.15±1.66	22.51±1.63	0.99 ^{NS}	6.60**	5.62**
Hand breadth	7.91±0.59	7.81±0.51	1.40 ^{NS}	7.13±0.71	7.46±0.78	2.03*	7.70**	2.89**
Biacromial	35.59±3.12	36.30±2.28	1.86 ^{NS}	33.17±2.74	33.56±3.79	0.53 ^{NS}	4.78**	4.93**
Biiliocrystal	26.42±1.78	27.15±1.31	3.35**	25.86±1.06	26.34±1.34	1.83 ^{NS}	2.05*	3.17**
Transverse chest breadth	25.12±0.80	26.02±1.18	7.39**	24.81±0.90	24.96±0.93	0.76 ^{NS}	2.22*	4.88**
Femur breadth	8.90±0.50	8.94±0.51	0.46 ^{NS}	8.44±0.59	8.35±0.59	0.71 ^{NS}	5.35**	5.57**
Humerus breadth	5.94±0.42	6.02±0.38	1.44 ^{NS}	5.86±0.34	5.90±0.38	0.51 ^{NS}	1.21 ^{NS}	1.59 ^{NS}

Chest circumference, waist circumference upper arm relaxed circumference, upper arm flexed circumference and thigh girth value of male Thang -Ta athletes in the age group of 15-19 years were significantly lower ($p<0.01$) than the 20-25 years male Thang -Ta athletes. Abdomen and fore arm circumference were also significantly lower ($p<0.05$) than the 20-25 years male athletes. Hip circumference, calf and wrist girth, upper arm length, forearm length hand length, hand breadth and foot showed no statistically significant difference between both the age groups. But, tibial medial –sphyron length was lower at $p<0.05$ and thigh length at ($p<0.01$) than 20-25 years. Biiliocrystal and transverse chest value of 15-19 years male

Thang -Ta athletes were lower at $p < 0.01$ than male Thang -Ta of 20-25 years athletes. Femur breadth and humerus breadth was not significantly different in both the age groups.

Among female athletes, the mean values of various circumference such as chest, waist, abdomen, hip, upper arm relaxed, upper arm flexed, fore arm girth, thigh girth, calf girth, wrist girth and ankle girth of male Thang- Ta athletes in the age group of 15-19 years were found to be 74.41 ± 2.48 cm, 64.30 ± 2.82 cm, 72.31 ± 4.01 cm, 85.74 ± 3.53 cm, 24.22 ± 0.99 cm, 26.28 ± 1.12 cm, 22.86 ± 0.86 cm, 44.73 ± 2.85 cm, 32.48 ± 2.63 cm, 15.90 ± 0.57 cm, 20.85 ± 1.09 cm respectively. Length such as upper arm length, fore arm length, hand length, hand breadth, tibial medial –sphyrion length, thigh length) and foot length were to be 27.54 ± 1.80 cm, 25.05 ± 1.74 cm, 16.67 ± 0.86 cm, 7.13 ± 0.71 cm, 32.51 ± 2.32 cm, 36.03 ± 2.74 cm, 22.15 ± 1.66 cm respectively. The mean value of body diameter such as biacromial distance,biiliocrystal, tranverse chest breadth, femur breadth and humerus breadth were found to be 33.17 ± 2.74 cm, 25.86 ± 1.06 cm, 24.81 ± 0.90 cm, 8.44 ± 0.59 cm, 5.86 ± 0.34 cm respectively. In the age group of 20-25 years, the mean value of various circumference sites such as chest, waist, abdomen, hip, upper arm relaxed, upper arm flexed, fore arm girth, thigh girth, calf girth, wrist girth, ankle girth circumference of male Thang- Ta athletes in the age group of 15-19 years were found to be 75.28 ± 3.22 cm, 65.00 ± 3.57 cm, 70.52 ± 3.88 cm, 88.24 ± 2.60 cm, 24.35 ± 1.01 cm, 26.66 ± 1.08 cm, 23.58 ± 0.90 cm, 46.61 ± 3.01 , 32.65 ± 2.22 cm, 15.62 ± 0.66 cm 20.96 ± 1.26 cm respectively. Length such as upper arm length, fore arm length,hand length, hand breadth, tibiale mediale – sphyrion length, thigh length and foot length were found to be 27.49 ± 1.91 cm, 24.98 ± 1.77 cm, 16.51 ± 0.80 cm, 7.46 ± 0.78 cm, 32.74 ± 2.53 cm, 36.07 ± 2.58 cm, 22.51 ± 1.63 cm, 33.56 ± 3.79 cm respectively. The mean value of body measurements such as biacromial distance,biiliocrystal, tranverse chest breadth, femur breadth and humerus breadth were found to be 33.56 ± 3.79 cm, 26.34 ± 1.34 cm, 24.96 ± 0.93 cm, 8.35 ± 0.59 cm, 5.90 ± 0.38 cm respectively.

Comparison of between female Thang- Ta athletes in the age group of 15-19 years and 20-25 years showed that the abdominal circumference, wrist girth and hand breadth of female Thang- Ta athletes in the age group of 20-25 years were

significantly higher ($p < 0.05$) whereas, hip circumference, forearm circumference and thigh girth of 20-25 years were significantly higher ($P < 0.01$) than the 15-19 years age group of female athletes.

Comparison between male and female Thang -Ta athletes in the age group of 15-19 years revealed that the anthropometric variables such as chest circumference, waist circumference, upper arm relaxed circumference, upper arm flexed circumference, fore arm girth, calf girth, ankle girth, upper arm length, hand breadth, tibiale mediale –sphyrion length, thigh length, foot length, biacromial, of male Thang-Ta athletes were significantly higher ($p < 0.01$) and biliocristal, transverse chest breadth, femur breadth, were statistically significant higher ($p < 0.05$) than female athletes. No statistically significant difference was observed for wrist girth, fore arm length, hand length and humerus breadth. Abdominal circumference, hip circumference and thigh girth was significantly higher ($p < 0.01$) for the female athletes.

It was found that chest circumference, waist circumference, fore arm length, calf girth, wrist girth, ankle girth, upper arm length, hand breadth, tibiale mediale – sphyrion length, thigh length, biacromial, biliocristal, transverse chest breadth, femur breadth of male Thang -Ta athletes in the age of 20-25 years were significantly higher at $p < 0.01$ than the female counterparts. But, hip circumference was significantly lower ($p < 0.01$) than female athletes. No statistically significance differences were observed for abdominal circumference, upper arm flexed circumference, fore arm girth, thigh girth, fore arm length, hand length, humerus breadth.

2. Biochemical, Clinical Examination and Medical History

a. Categorization of Thang- Ta Athletes according Haemoglobin level

Table XVII presents the Categorization of male athletes according to mean hemoglobin level.

TABLE XVII
CATEGORY OF ANAEMIA AND HAEMOGLOBIN LEVEL

(N=108)

Category of Anaemia and Haemoglobin level (WHO, 2002)	Male Athletes						Female athletes					
	15-19 years (n=33)			20-25 years (n=24)			15-19 years (n=27)			20-25 years (n=24)		
	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%
Normal >12g/dl	14.55 ± 1.22	33	100	13.68 ± 1.12	24	100	12.34 ± 1.71	18	66.7	12.21 ± 0.87	17	70.8
Mild 9-11g/dl		-	-		-	-		9	33.3		7	29.2
Total	33	100	24	100	27	100	24	100				

When compared with WHO (2002) Categorization of Anaemia and Haemoglobin level, all the male Thang - Ta athletes in both age groups had normal haemoglobin level. Among female, majority 66.7 per cent in the age group of 15-19 years and 70.8 per cent in the age group of 20-25 years had normal haemoglobin level. Remaining 33.3 per cent female in the age group of 15-19 years and 29.2 per cent in the age group of 20-25 years had mild degree of anaemia. This mild degree of anaemia could be due to menstrual losses in women. According to (Malczewska *et al.*, (2000), anaemia among female athletes could be the result of menstrual losses in women and low iron content in their diet.

Distribution of Thang –Ta athletes according to blood pressure is presented in Table XVIII and XIX.

TABLE XVIII
DISTRIBUTION OF BLOOD PRESSURE OF MALE AND FEMALE THANG - TA
ATHLETES IN THE AGE GROUP OF 15-19 YEARS

(N=243)

Category of blood pressure (mmHg)	Level	Male			Female		
		15-19 years			15-19 years		
		Mean	No.	%	Mean	No.	%
Systolic	<90 th percentile (Normal)	113.02± 4.79	198	100	112.69± 3.62	45	100
	90 th to < 95th percentile or ≥ 120/80 (Prehypertension)		-	-		-	-
	95th to < 99th percentile plus 5 mm Hg(Stage1 Hypertension)		-	-		-	-
	> 99th percentile plus 5 mm Hg (Stage Hypertension)		-	-		-	-
Diastolic	<90 th percentile (Normal)	75.49± 2.90	198	100	76.06± 1.52	45	100
	90 th to < 95th percentile or ≥ 120/80 (Prehypertension)		-	-		-	-
	95th to < 99th percentile plus 5 mm Hg(Stage1 Hypertension)		-	-		-	-
	> 99th percentile plus 5 mm Hg (Stage Hypertension)		-	-		-	-

Chobanian *et al.*, 2003

The mean systolic and diastolic pressure of the male Thang-Ta athletes in the age group of 15-19 years was found to be 113.02±4.79mmHg and 75.49±2.90mmHg mmHg respectively. Similarly the mean systolic and diastolic value of the female Thang-Ta athletes in the age group of 15-16 was found to be 112.69±3.62mmHg and 76.06±1.52 mmHg respectively. When compared with the Classification of Prehypertension and Hypertension in Children and Adolescents) Chobanian *et al.*, (2003) , blood pressure of male and female Thang- Ta athletes in both the gender showed normal blood pressure level.

TABLE XIX
DISTRIBUTION OF BLOOD PRESSURE OF MALE AND FEMALE THANG - TA
ATHLETES IN THE AGE GROUP 20-25 YEARS

N=121

Category of blood pressure mmHg	Level	Athletes					
		Male			Female		
		20-25 years			20-25 years		
		Mean	NO.	%	Mean	No.	%
Systolic	90-119-Normal	112.98±4.79	82	100	112.00±5.01	39	100
	120-139 Prehypertension		-	-		-	-
	140-159 Stage1 Hypertension		-	-		-	-
	≥160 Stage Hypertension		-	-		-	-
Diastolic	<60-79-Normal	74.53±2.19	82	100	77.10±1.60	34	87.2
	80-89 Prehypertension		-	-		5	12.8
	90-99 Stage 1 Hypertension		-	-		-	-
	≥100 Stage 2 Hypertension		-	-		-	-

Chobanian *et al.*, 2003

The mean systolic and diastolic blood pressure of male Thang- Ta athletes in the age group of 20-25 years was found as 112.98±4.79 mmHg and 74.53±2.19 mmHg respectively. Similarly, the mean systolic and diastolic blood pressure of female Thang- Ta athletes in the age group of 20-25 was found as 112.00±5.01 mmHg and 77.10±1.60 mmHg respectively. When compared with Classification of Hypertension (Chobanian *et al.*, 2003), the blood pressure (systolic and diastolic) of male and female Thang-Ta athletes were normal. Only 12.8 per cen of female Thang -Ta athletes had diastolic blood pressure in the range of 80-89 mmHg which was in the pre hypertension stage.

b. Clinical signs and Symptoms among Male and Female Thang- Ta Athletes

Figure 5 presents the clinical signs prevalent among the athletes

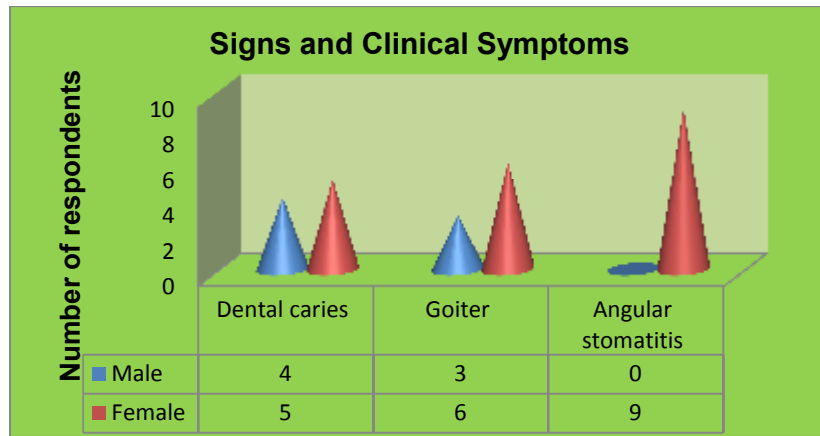


Figure 5

Clinical Signs and Symptoms seen among Athletes

Of the 280 male Thang -Ta athletes, only 1.42 percent (n=4) and 1.07 per cent (n=3) male athletes had dental caries and goiter respectively. Among female, out of 84 athletes, 5.9 Per cent (n=5) and 7.1 per cent (n=6) and 10.71 (per cent n=9) female had dental caries, goiter and angular stomatitis respectively. Two hundred and seventy three male athletes and 64 female athletes showed no clinical signs and symptoms of deficiency.

c. Medical History of the Athletes

(i) Family History of the Thang -Ta Athletes

History of disease prevalence in the families of the athletes is presented in Figure 6

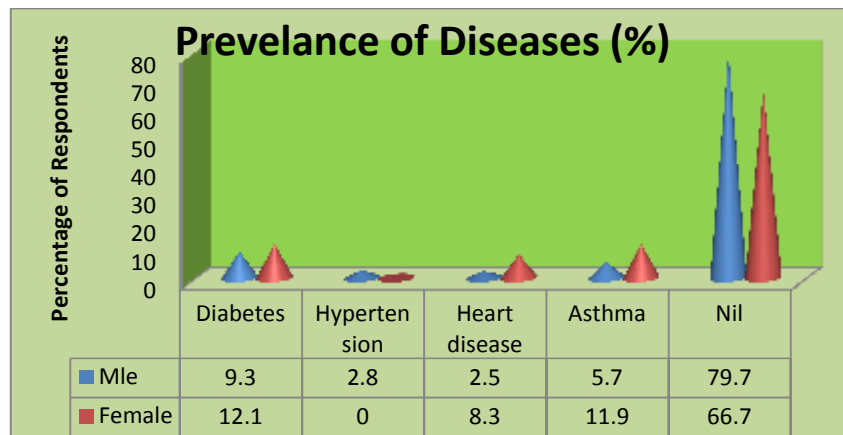


Figure 6

Family history of the Thang-Ta Athletes

It was found that out of 280 families of male athletes, 9.3 per cent, 2.8 percent, 2.5 per cent and 5.7 per cent reported diabetes, hypertension, heart disease and asthma respectively among their family members. Similarly among 84 families of female athletes, 13.1 per cent, 8.3 per cent 11.9 per cent reported cases of diabetes, hypertension and asthma respectively. None of the family members of female athletes reported hypertension; 79.7 per cent of the families of male athletes and 66.7 per cent of female athletes reported no disease prevalence in their families.

(ii) Morbidity among Thang –Ta Athletes

Details on ailment/morbidity among the athletes are presented in Table XX.

TABLE XX

DETAILS OF AILMENTS / MORBIDITY AMONG THANG –TA ATHLETES (N=364)

Ailments/Morbidity	Male (n=280)		Female (n=84)	
	No.	%	No.	%
Jaundice	17	6.1	8	9.5
Chest pain during exercise	9	3.2	4	4.8
Fracture	11	3.9	-	-
Allergy	12	4.3	-	-
Asthma	11	3.9	-	-
No Ailment	220	78.6	72	85.7

Out of the 280 male Thang -Ta athletes, only 6.1 percent, 3.2 per cent and 3.9 per cent had jaundice, chest pain during exercise and fracture in the past respectively. Among female, 9.5 per cent and 4.8 per cent had jaundice and chest pain respectively. While 4.3 per cent and 3.9 per cent of men had allergy and asthma respectively, none of the women athletes reported allergy or asthma. No ailment in the past six months reported by 78.6 per cent of male and 85.7 per cent of female athletes.

3. Dietary and Life Style Pattern

a. Dietary Pattern

Details of dietary pattern of Thang –Ta Athletes are presented in Table XXI.

TABLE XXI
DETAILS OF DIETARY PATTERN OF THANG- TA ATHLETES

Details	Thang -Ta –Athletes			
	Male (n=280)		Female (N= 84)	
	No.	%	No.	%
Non vegetarian	280	100	84	100
On rising				
Tea	86	30.7	43	51.2
Milk	11	3.9	6	7.1
Water	183	65.4	35	41.7
Frequency of Meals/day				
2 times	88	31.5	27	32.2
3 times	192	68.5	57	67.8
Skipping				
No	280	100	84	100
Variety in diet				
Every day	159	56.7	73	86.9
Sometimes during a week	99	35.5	11	13.1
During the weekend days	22	7.8	-	-
Food Allergy				
Yes	12	4.3	-	-
No	268	95.7	84	100
Type of Food before Competition				
Semisolid	199	71.1	77	91.7
Liquid	81	28.9	7	8.3

z

All the athletes were non vegetarian. Majority 65.4 per cent male athletes drank water in the morning. Only 30.7 per cent and a meager 3.9 per cent male Thang –Ta athletes consumed tea and milk respectively in the morning. Among female athletes majority 51.2 per cent athletes consumed tea in the morning. Remaining 7.1 per cent and 41.7 per cent consumed milk and water respectively. It was found that Thang -Ta athletes had very little intake of milk. Majority 68.5 per cent male and 67.8 per cent of female Thang -Ta athletes consumed three meals daily. Remaining 31.5 per cent male and 32.2 per cent female consumed two meals daily. It was also found that all the athletes did not skip meals. Majority 56.7 per cent male and 86.9 per cent female had variety in their diet every day. 35.5 per cent male and 13.1 per cent female athletes consumed variety of diet, sometimes during a

week and only 7.5 per cent male athletes had variety in diet during the weekend. A meager 4.3 per cent male athlete had food allergy and none of the female athletes had food allergy. Majority 71.1 percent male and 91.7 per cent female Thang-Ta athletes consumed semisolid food before competition. Remaining 28.9 per cent male and 8.3 per cent female athletes consumed liquid food before competition.

b. Fluid Intake Pattern

Distribution of athletes according to fluid intake and mean fluid intake is presented in Figures 7 and 8 respectively.

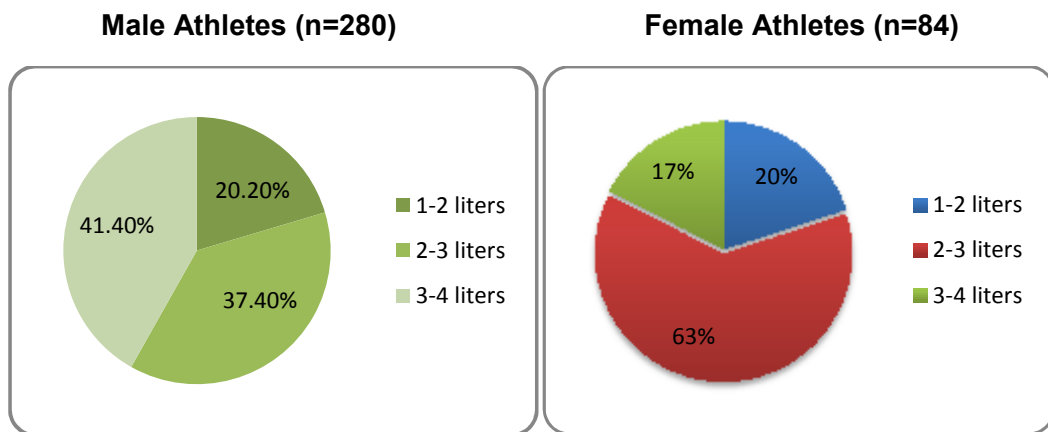


Figure 7

Distribution of athletes according to fluid intake pattern

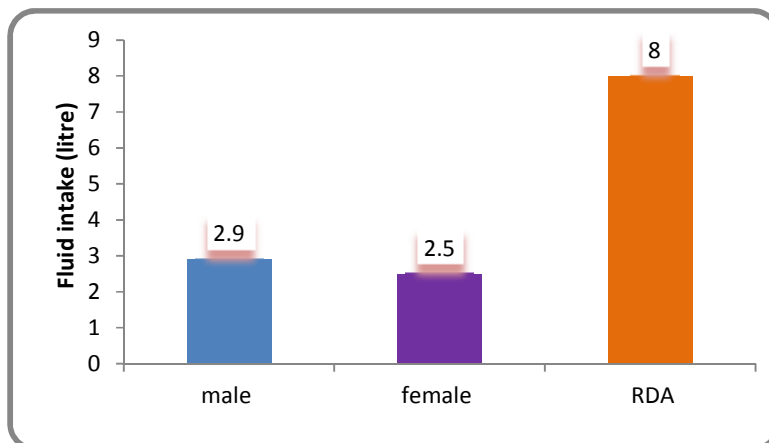


Figure 8

Comparison of Mean Fluid Intake with Suggested Intake

Majority, 41.4 per cent male and 63 per cent female consumed 2-3 liters of fluid /day. 37.4 per cent per cent male and 17 percent female consumed 3-4 l/day. The remaining 21.2 per cent male and 20 per cent female consumed 1-2 l /day. From the data, it was observed female consumed less water intake than male athletes. The mean fluid intake of male and female Thang -Ta athletes was 2.9 ± 0.72 l/day and 2.57 ± 0.66 l/day respectively and it was very less than the suggested intake (8 liters /day) given by Venkataramana (2010)

c. Life style Pattern

The life style pattern of athletes is given in Table XXII

TABLE XXII
LIFE STYLE PATTERN OF THE ATHLETES

(N=364)

Life style Pattern	Male (n=280)		Female (n=84)	
	No.	%	No.	%
Duration of Exercise (hours)				
<1/2	69	24.7	20	23.8
>1/2	211	75.3	64	76.2
Alcohol /smoking				
No	280	100	84	100
Stress Placebo				
Yoga	9	3.21	-	-
Sports	188	67.2	72	85.7
Music (listening)	40	14.3	12	14.3
Book (reading)	43	15.4	-	-

A majority (75.3 per cent male and 76.2 per cent female) of Thang- Ta athletes performed exercise for more than ½ hour, while 24.7 and 23.8 per cent of male and female athletes respectively performed exercise for less than 30 minutes. None of the athletes were alcoholics or smokers. A majority (67.2 per cent male and 85.7 per cent) female indulged in sports to placebo stress. While listening to music was adopted as a stress control method by 14.3 per cent of male and 4.3 per cent of female athletes, 15.4 per cent of male athletes and none of the female athletes read books to alleviate mental stress.

d. Food Frequency of the athletes

The frequency of consumption of different foods by male Thang-Ta athletes is given in Table XXIII.

TABLE XXIII
FOOD FREQUENCY AMONG MALE THANG- TA ATHLETES
(N=280)

Food Item	Daily	Weekly	Twice/ week	Thrice /week	Fort nightly	Monthly	Occasionally	Never
	Cereals							
Rice	100	-	-	-	-	-	-	-
Wheat	-	51.7	30	18.3	-	-	-	-
Maize	-	-	-	-	-	18.5	81.5	-
Pulses								
Peas	1.8	65	30	3.2	-	-	-	-
Black gram	-	72.8	16.1	-	-	11.1	-	-
Green gram	-	19.7	14.2	-	-	35	31.1	-
Red gram	-	63.6	-	-	-	17.8	18.6	-
Soybean	-	36.5	7.1	-	-	35.7	20.7	-
Rajmah	-	14.3	-	-	10	53.5	22.2	-
Vegetables								
Amaranthus	-	24.3	25.7	-	14.3	19.6	7.2	8.9
Cauliflower leaves	-	23.2	30.5	14.7	15.6	7.2	8.8	-
Broad beans leaves	8.9	21.1	24.3	25	4.3	16.4	-	-
Pumpkin leaves	14.3	24.6	17.1	10	14.3	16.1	3.6	-
Colocasia leaves	-	29.3	14.3	-	15	20.7	20.7	-
Cabbage	-	24.3	21.1	31.4	14.3	8.9	-	-
Coriander leaves	100	-	-	-	-	-	-	-
Spinach leaves	-	51.8	24.5	7.5	5.5	10.7	-	-
Cow pea tendril	14.3	21.1	24.3	31.4	8.9	-	-	-
Knol-knol greens	-	25.7	14.2	-	25.6	27.3	7.2	-
Mustard leaves	5.6	24.6	51.8	7.4	10.6	-	-	-

Food Item	Daily	Weekly	Twice/ week	Thrice /week	Fort nightly	Monthly	Occasionally	Never
	Cereals							
Other Vegetables								
Potato	100	-	-	-	-	-	-	-
Onion	100		-	-	-	-	-	-
Snake gourd	-	20.7	21.1	14.3	10.4	17.8	15.7	-
Bottle gourd	-	36.4	17.8	8.9	-	21.5	15.4	
Cauliflower	3.6	24.6	17.1	14.3	14.3	16.1	10	-
Plantain	25.7	17.7	24.4	20.6	11.6	-	-	-
Cluster beans	-	20.7	20.1	14.3	11.4	17.8	15.7	-
Ladies finger		14.3	21.1	24.3	31.4	8.9	-	-
Papaya green	5.6	51.8	24.6	7.4	10.6	-	-	-
Bamboo shoot	-	23.4	21.3	15	8.9	31.4	-	-
Condiments and Spices								
Garlic	100	-	-	-	-	-	-	-
Ginger	100	-	-	-	-	-	-	-
Turmeric	100	-	-	-	-	-	-	-
Fruits								
Amla	-	14.3	10	-	-	59.3	16.4	-
Banana	-	17.8	17.2	-	10	35	20	-
Orange	-	-	-	-	-	35.4	64.6	-
Guava	-	7.1	10.4	14.3	-	29.3	38.9	-
Tomato	-	14.3	-	-	7.8	54.3	23.6	-
Meat, Fish and Poultry								
Fish	100	-	-	-	-	-	-	-
Chicken	-	17.2	12.8	-	-	56.8	13.2	-
Snail	-	24.6	15.7	-	-	46.1	13.6	-
Pork	-	17.5	-	-	-	63.9	18.6	-
Egg	10	8.2	10.7	-	-	30.4	40.7	-
Milk and Milk products								
Milk	10	11.5	10.7	-	9.3	30.3	28.2	-
Curd	-	-	-	-	-	31.8	55.7	12.5
Paneer	-	-	-	-	-	3.5	71.5	25
Fats and Oils								
Mustard oil	100	-	-	-	-	-	-	-
Sugar and Jaggery								
Sugar	100	-	-	-	-	-	-	-

All the male Thang -Ta athletes consumed rice daily. Majority 51.7 per cent consumed wheat once in a week and remaining 30 per cent and 18.2 per cent consumed twice and thrice in a week respectively; maize consumption was very low; 14.3 -72 per cent athletes consumed pulses once in a week, 7.1-30 per cent (twice in a week); 3.2 per cent thrice in a week. Amaranthus, cauliflower leaves, broad bean leaves, pumpkin leaves, colocasia leaves, coriander leaves, spinach beans leaves, cow pea tendrils, knol-khol greens and mustard leaves were very frequently consumed among vegetables; 21.1 -51.8 per cent consumed vegetables once a week; 14.3 -51.8 per cent athletes consumed twice a week and 7.4-31.4 per cent consumed thrice in a week. Among other vegetables potato onion were consumed daily. Snake gourd, bottle gourd, cauliflower, bean, papaya green and bamboo shoot were frequently consumed; 14.3-36.5 per cent, 17.1-24.6 per cent, 7.4-24.3 per cent, 8.9 -31.4 per cent athletes consumed other vegetables once in a week, twice in a week, thrice in a week and fortnightly respectively; 8.9 per cent - 39.4 per cent athletes consumed other vegetables on monthly basis and occasionally. Among spices and condiments, ginger, garlic and turmeric were consumed daily. Fruits consumption was very less. 29.3- 59.3 per cent and 20-64.6 percent male athletes consumed fruits monthly and occasionally. All the male athletes consumed fish daily. While 17.2 per cent, 12.8 per cent, 56.8 per cent, 13.2 per cent consumed chicken once a week, twice a week, monthly and occasionally; 24.6 per cent consumed snail once in week; 15.7 per cent consumed twice in week, 46.1 per cent consumed monthly and 13.6 occasionally. Majority (63.9 per cent) male athletes consumed pork monthly. Only 10 per cent athletes consumed egg daily, 8.2 per cent consumed weekly, 10.7 per cent twice a week, 30.4 per cent once a month and 40.7 per cent occasionally. Only 10 per cent consumed milk daily, 11.5 per cent weekly, 10.7 per cent consumed milk twice a week, 9.3 per cent fortnightly, 30.3 per cent monthly and 28.2 per cent occasionally. 31.8 per cent consumed curd monthly, 55.7 per cent consumed occasionally while 12.5 per cent never consumed curd. Consumption of curd and paneer were very poor among the athletes. Only 3.5 per cent consumed paneer monthly, 71.5 per cent consumed occasionally and 25 per cent never consumed paneer. Mustard oil and sugar jaggery were consumed by all the athletes.

The frequency of consumption of different foods by female Thang- Ta athletes is given in Table XXIV

TABLE XXIV
FOOD FREQUENCY AMONG FEMALE THANG- TA ATHLETES (N =84)

Food Item	Daily	Weekly	Twice/w eek	Thrice /week	Fortnightly	Monthly	Occasionally	Never
Cereals								
Rice	100	-	-	-	-	-	-	-
Wheat	10.8	23.8	41.6	23.8	-	-	-	-
Maize	10.7	13.1	-			25	51.2	
Pulses								
Peas	-	23.8	14.3	10.7	-	34.6	16.6	-
Black gram	11.9	15.5	-	-	-	47.6	25	-
Green gram	16.6	11.9	-	19.1	-	14.3	38.1	-
Red gram	-	23.8	13.1	13.1	-	33.3	16.7	-
Soybean	-	10.7	-	13.1	-	51.2	25	-
Rajmah	-	21.4	13.1	11.9	-	34.6	19	-
Vegetables								
Amaranthus	-	14.3	9.6	-	7.2	32.1	36.8	-
Cauliflower leaves	14.3	11.9	38.1	35.7	-	-	-	-
Broadbeans leaves	-	21.4	26.2	-	19.1	-	33.3	-
Pumpkin leaves	13.1	38.1	35.7	-	13.1	-	-	-
Colocasia leaves	-	14.3	-	38.1	-	35.7	11.9	-
Cabbage	-	19.1	34.6	21.4	11.9	13	-	-
Coriander leaves	100	-	-	-	-	-	-	-
Spinach leaves	-	21.4	13.1	-	-	34.6	19	11.9
Cow pea tendrils	26.2	23.8	17.9	11.9	-	20.2	-	-
Knol-khol greens	-	26.2	17.9	13.1	-	11.9	17.8	13.1
Mustard leaves	11.9	25	15.5	47.6	-	-	-	-

Food Item	Daily	Weekly	Twice/w eek	Thrice /week	Fortnightly	Monthly	Occasionally	Never
Potato	Other Vegetables							
	100	-	-	-	-	-	-	-
Onion	100							
Snake gourd	11.9	26.2	17.9	-	-	20.2	23.8	-
Bottle gourd	-	21.4	11.9	-	-	27.4	39.3	-
Cauliflower	-	16.6	13.1	22.7	-	33.3	14.3	-
Plantain	24.3	21.1	14.3	31.4	8.9	-	-	-
Cluster beans	13.1	17.9	26.2	13.1	-	11.9	17.8	-
Ladies finger	-	44.1	32.1	23.8	-	-	-	-
Papaya green	100	-	-	-	-	-	-	-
Bamboo shoot	-	24.3	21.1	14.3	8.9	31.4	-	-
Garlic	Condiments and Spices							
	100	-	-	-	-	-	-	-
Ginger	100	-	-	-	-	-	-	-
Turmeric	100	-	-	-	-	-	-	-
	Fruits							
Amla	14.3	11.9	20.2	9.6	-	19	25	-
Banana	-	26.2	-	-	-	27.4	46.4	-
Orange	-	21.4	-	-	-	38.1	40.5	-
Guava	20.2	26.2	16.7	-	10.7	26.2	-	-
Tomato	27.4	20.2	13.1	11.9	-	14.3	13.1	-
	Meat, Fish and Poultry							
Fish	100	-	-	-	-	-	-	-
Chicken	-	41.7	13.1	-	-	45.2	-	-
Snail	-	28.5	32.2	-	-	27.4	11.9	-
Pork	-	14.3	-	-	-	16.7	26.2	42.8
Egg	-	29.7	15.5	-	-	40.5	14.3	-
	Milk and Milk products							
Milk	-	19	14.3	-	-	54.8	11.9	-
Paneer	-	-	-	-	-	11.9	79.8	8.3
	Fats and oils							
Mustard oil	100	-	-	-	-	-	-	-
	Sugar and Jaggery							
Sugar	100	-	-	-	-	-	-	-

All the female athletes consumed rice daily; 23.8 per cent athletes consume wheat thrice a week and maize consumption was very less. Pulses consumption was also low among female athletes. Only 11.9-16.6 and 10.7-19.1 per cent female athletes consumed pulses daily and thrice a week respectively; Among vegetables, cauliflower leaves, broad bean leaves, pumpkin leaves, colocasia leaves, cabbage, coriander leaves, cow pea tendrils, knol- khol greens, mustard leaves were frequently consumed by female Manipuri athletes; 11.9 -100 per cent female athletes consumed vegetables daily 11.9-47.6 per cent athletes consumed thrice a week. Potato, onion, green papayas were consumed daily; Plantain and ladies finger were more frequently consumed. Banana, orange, guava and tomato were frequently consumed; 20.2- 27.4 per cent athletes consumed fruits daily; all the athletes consumed fish daily; 41.7 per cent, 13.1 per cent and 45.2 per cent consumed chicken weekly once, weekly twice and monthly respectively; 14.3,16.7, 26.2 per cent consumed pork weekly once, monthly and occasionally. Most of the female athletes did not consumed pork. Higher percentage (32.2 per cent) female athletes consumed snail twice in week and the remaining athletes consumed once in week (28.5 per cent), monthly 27.4 per cent and occasionally 11.9 per cent. 14.3 per cent consumed pork once in week. 14.3 per cent consumed milk twice in week. And the remaining consumed once in a week, monthly and occasionally. Curd and paneer consumption was very poor. Mustard oil and sugar were used by all the athletes, daily.

Apart from common vegetables, Thang -Ta athletes consumed different varieties of locally available indigenous food i.e. herbs, shrubs, aquatic plants, tree (leaves, flowers, pods and tendrils), edible fungi and indigenous fermented foods products. Among the herbs, Maroi napakpi, Maroi nakupi, Hangam yela, Tokningkhok, Phakpai, Yellang, Yaipal, Namara, Yaipal, Yendem were frequently consumed.

The frequency of consumption of locally available indigenous foods by the athletes is given in Table XXV. Figures on top represent frequency of consumption by male athletes and figures at the bottom represent frequency of consumption by female athletes.

TABLE XXV
CONSUMPTION OF LOCALLY AVAILABLE INDIGENOUS FOODS BY THE ATHLETES (N=280)

Food Item/ Scientific Name	Frequency							
	Daily	Once/ week	Twice/ week	Thrice /week	Fort nightly	Monthly	Occasionally	Never
Herbs								
Maroinapakpi/ <i>Allium hookerii</i>	100 100	-	-	-	-	-	-	-
Maroinakupi/ <i>Allium odorosum</i>	100 100	-	-	-	-	-	-	-
Hangamyela/ <i>Brassica juncea</i> (L.) Czern	12.26 38.1	16.07 13.1	35.6 13.1	28.57 35.7	7.5 -	- -	- -	- -
Tokningkhok/ <i>Houttuyniacordata</i> Thunb.	100 100	- -	- -	- -	- -	- -	- -	- -
Phakpai/ <i>Persicariacapitata</i> (Buch.-Ham. ex D.Don)H.Gross.	7.8 24.3	31.8 14.3	34 21.1	21.4 31.4	- 8.9	- -	5 -	- -
Yellang / <i>Polygonumorientale</i> Linn.	11.9 13.1	20.2 19.1	13.1 34.6	27.4 21.4	- 11.8	14.3 -	13.1 -	-
Yaipal / <i>Curcumaangustifolia</i> Roxb.	20.2 26.2	26.2 16.7	16.7 26.2	26.2 20.2	10.7 10.7	- -	- -	- -
Namara / <i>Amomumaromaticum</i> Roxb.	20.7 28.6	18.9 16.1	19.3 17.8	23.6 21.4	17.5 14.3	- -	- 1.8	- -
Yaipal / <i>Curcumaangustifolia</i> Roxb.	20.2 26.2	26.2 16.7	16.7 26.2	26.2 20.2	10.7 10.7	- -	- -	- -
Yendem/ <i>Alocasiaindica</i> (Roxb.) Schott.	28.5 17.2	16.5 13.2	35 12.8	12.5 56.8	7.5 -	- -	- -	-
Shrubs								
U- Hawaimaton / <i>Crotalariajuncea</i> Linn.	10.7 25	14.3 19.3	28.6 23.3	32.2 22.8	- -	8.9 -	5.3 9.6	- -
Mayang ton / <i>Ocimumcanum</i> Sims	17.8	16.1	28.6	21.4	14.3	1.8	-	-

Food Item/ Scientific Name	Frequency							
	Daily	Once/ week	Twice/ week	Thrice /week	Fort nightly	Monthly	Occasionally	Never
	11.9	15.5	47.6	25	-	-	-	-
Pheija / <i>Wendlandiainctoria</i> (Roxb.)DC	16.7 21.4	26.2 16.1	26.2 17.8	20.2 28.6	- -	- 1.8	10.7 14.3	- -
Nongmangkhamapal / <i>Phlagocanthesthysiformis</i> Nees	- 16.1	21.1 28.6	24.3 17.8	25 21.4	- -	16.4 1.8	8.9 14.3	4.3 -
Sougri/ <i>Hibiscus</i>	- 10.7	20.7 26.2	23.6 26.2	19.3 20.2	- 16.7	18.9 -	17.5 -	- -
Shillo-Sougri/ <i>Hibiscus sabdariffa</i>	- -	23.6 25	17.5 15.5	18.9 11.9	- -	19.3 -	20.7 47.6	- -
Aquatic vegetables								
Kolamni / <i>Ipomoea aquatica</i> Forsk.	17.8 16.6	21.4 14.3	32.2 22.7	14.3 33.3	14.3 -	- -	- 13.1	- -
Komprek / <i>Oenanthejavanica</i> (Blume) DC.	32.2 42.8	14.3 14.3	17.8 16.7	21.4 26.2	14.3 -	- -	- -	- -
Heikakyelli/ <i>Trapanatans</i> Linn.	26.2 21.4	20.2 16.1	26.2 28.6	16.7 17.8	10.7 -	- 1.8	- 14.3	- -
Tharo / <i>Nymphaeapubescence</i> Willd.	19.3 28.6	17.5 16.1	20.7 17.8	23.6 21.4	18.9 -	- 1.8	- 14.3	- -
Thambou / <i>Nelumbonucifera</i> (Gaertn.)	26.2 22.1	20.2 19.3	17.9 23	23.8 25	- -	- -	11.9 9.6	- -
Thangjing / <i>Euryale ferox</i> Salisb.	38.1 28.2	11.9 25.5	14.3 11.9	35.7 25.4	- -	- -	- 9	- -
EshingKambong / <i>Zizania latifolia</i> Turcz.ex	- -	25 26.2	11.9 16.7	15.5 10.7	- -	- 26.2	47.6 20.2	- -
Loklei / <i>Hedychium coronarium</i> Koening.	24.3 25	16.4 16.4	21.1 21.1	25 24.3	8.9 8.9	- -	4.3 4.3	- -
Pullei / <i>Alpinianigra</i> (Gaertn.) Burt.)	28.6 23.8	16.1 20.2	17.8 17.9	21.4 26.2	- 11.9	1.8 -	14.3 -	- -

Food Item/ Scientific Name	Frequency							
	Daily	Once/ week	Twice/ week	Thrice /week	Fort nightly	Monthly	Occasionally	Never
Tree								
Mukthruhi / <i>Zanthoxylumacanthopodium</i> (Flower and leaves)	11.9 16.7	28.5 6.2	32.2 26.2	27.4 20.2	- 20.7	- -	- -	- -
Laphu / <i>Musa paradisiaca</i> Linn.(Stem)	- 9.6	24.3 23	31.8 25	14.3 19.6	- -	14.9 -	14.7 22.8	- -
Yongchak / <i>ParkiaTimoriana</i> (A.DC.) Merr.Syn,P.roxburghiiG.Don (Beans and pods)	26.2 25	20.2 16.4	17.9 21.1	23.8 24.3	11.9 8.9	- -	- -	- 4.3
Yendang / <i>Cycaspectinata</i> Hanilton. (Tendrils)	- 17.2	11.9 13.2	32.2 12.8	27.4 56.8	- -	- -	28.5 -	- -
Edible fungi								
Uchina (Black Slimy Mushroom or Wood Ear Mushroom)/ <i>Auricularia delicate</i> (Fr.)P. Henn	- 19.9	21.1 17.1	14.3 -	8.9 19	- 17.8	31.4 26.2	24.3 -	- -
Uyen / <i>Pleurotusostreatus</i> (Jacquin ex. Fr) Kummer.	- 12.2	- 24.3	35 19.6	11.8 18.2	7.8 -	5.7 -	28.6 25.7	11.1 -
Chengum/ <i>Agaricuscampestris</i>	- -	12.8 21.4	21.4 17.8	- 14.3	- 16.1	34 -	31.8 12.6	- 17.8
Kanglayen (fungus)/ <i>Schizophyllum commune</i>	- -	17.2 17.8	12.8 14.3	- 21.4	- 16.1	56.8 18.4	13.2 12	- -
Fermented Products								
Fermented fish (ngari)/ <i>Puntiussophore</i>	100 100	- -	- -	- -	- -	- -	- -	- -
Fermented soyabean (Hawaijar)/ <i>Glycine max</i> (L.) Merr.	21.4 22.7	34.6 33.3	19.1 16.6	13 14.3	11.9 13.1	- -	- -	- -
Fermented bamboo shoot (Soibum)/ <i>Bambusasp.</i>	14.2 -	26.2 26.2	17.9 23.8	17.8 10.1	23.9 19.8	- 20.1	- -	- -

Top value -Male; Bottom value –Female

All the athletes consumed Maroi napakpi, Maroi nakupi daily as a part of their diet .11.9 -28.5 percent,16-31.8 per cent, 13.1-35.6 per cent,12.5-28.57 per cent, 7.5-17.5 per cent ,4.3 and 5-13.1 per cent male athletes consumed Hangam yela, Phakpai, Yellang, Yaipal, Namara, Yaipal, Yendem daily, weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally respectively.

Among shrubs, 10.7 -17.8 per cent, 14.3-26.2 per cent, 17.5-28.6 per cent,18.9-32.2 per cent,14.3 per cent ,1.8-19.3 per cent, 5.3-17.5 per cent and 4.3 per cent of male athletes consumed U- Hawaimaton, Mayang ton, Pheija, Nongmangkha mapal, Sougri, Shillo-Sougri daily, weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally respectively.

Among aquatic vegetables,17.8-38.1 per cent, 11.9-25 per cent, 11.9-32.2 per cent 14.3-35.7 per cent , 8.9-18.9 per cent ,1.8 per cent, 4.3-47.6 Per cent male athletes consumed Kolamni, Komprek, Heikak yelli, Tharo, Thambou, Thangjing, Eshing Kambong, Loklei, Pullei daily, Weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally respectively.

Of products from trees, 11.9 -26.2 percent, 11.9-28.5 per cent, 17.9-32.2 per cent, 14.3-27.4 per cent, 11.9 per cent, 14.9 per cent, 14.7-28.5 per cent male athletes consumed Mukthrubi (leaves and flowers), laphu (stem), Yongchak (beans and pods) and Yendang (tendrils) daily, weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally respectively.

Among edible Fungi, Uchina (Black Slimy Mushroom or Wood Ear Mushroom), Uyen, Chengum, Kanglayen were frequently consumed; 7.8-21 per cent, 12.8-35 per cent, 8.9-11.8 per cent, 7.8 per cent, 5.7-56.8 per cent, 13.2-31.8 per cent and 7.1 per cent of male athletes consumed the above edible fungi daily, weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally and never respectively.

Among the fermented food products, Ngari (fermented fish) was consumed daily. 21.4, 34.6, 19.1, 13 and 11.9 per cent of male athletes daily weekly once, weekly twice, weekly thrice and fortnightly respectively. 14.2, 26.2,17.9,17.8, 23.9 per cent male athletes consumed fermented bamboo shoot daily weekly once, weekly twice, weekly thrice and fortnightly respectively

Female athletes consumed herb varieties such as Maroi napakpi, Maroi nakupi, Hangam yela, Tokningkhok, Phakpai, Yellang, Yaipal, Namara, Yaipal, Yendem frequently. Among them, Maroi napakpi, Maroi nakupi daily as a part of their daily diet. 13.1-38.1 per cent, 13.1-19.1 per cent, 13.1-26.2 per cent, 20.2-56.8 per cent, 8.9-14.3 per cent, 1.8 per cent female athletes consumed Hangam yela, Phakpai, Yellang, Yaipal, Namara, Yaipal, Yendem daily, weekly once, weekly twice, weekly thrice, forthrightly and occasionally respectively.

Among shrub vegetables, 10.7-25 per cent, 15.5-28.6 per cent, 15.5-47.6 per cent, 11.9-28.6 per cent, 16.7 per cent, 1.8 per cent and 9.6-47.6 per cent athletes consumed U- Hawaimaton, Mayang ton, Pheija, Nongmangkha mapal, Sougri, Shillo-Sougri daily, week once, weekly twice, weekly thrice, forthrightly, monthly and occasionally respectively.

Among aquatic vegetables, Kolamni, Komprek, Heikak yelli, Tharo, Thambou, Thangjing, Eshing Kambong, Loklei, Pullei were frequently consumed. 16.6- 42.8 per cent, 14.3-26.2 per cent, 11.9-28.6 per cent 17.8-33.3 per cent, 8.9-11.9 per cent, 1.8-26.2 per cent, 4.3-14.3 per cent female athletes consumed aquatic vegetables daily, weekly once, weekly twice, weekly thrice, forthrightly, monthly and occasionally respectively.

Among tree products, Mukthubi (flowers and leaves), Laphu (stem), Yongchak (beans and pods) and Yendang (tendrils) were frequently consumed among the Manipuri athletes. 9.6-25 percent, 13.2-23 per cent, 12.8-26.2 per cent, 19.6-56.8 per cent, 8.9 per cent, 22.8 per cent female athletes consumed Mukthubi, laphu, Yongchak and Yendang daily, weekly once, weekly twice, weekly thrice, fortnightly, monthly and occasionally respectively.

Uchina (Black Slimy Mushroom or Wood Ear Mushroom), Uyen, Chengum, Kanglayan were frequently consumed edible Fungi. 12.2-19.9 per cent, 17.1-24.3 per cent, 14.3-19.6 per cent, 16.1-17.8 per cent, 18.4-26.2 per cent and 17.8 per cent female athletes consumed edible fungi daily, weekly once, weekly twice, weekly thrice, forthrightly, monthly, occasionally and never respectively.

Among the fermented food products, Ngari (fermented fish) was consumed daily. 22.7 per cent, 33.3 per cent, 16.6, per cent, 14.3 per cent and 13.1 per cent

female athletes consumed fermented soya bean daily weekly once, weekly twice, weekly thrice and fortnightly respectively. 26.2 per cent, 23.8 per cent, 10.1 per cent, 19.8 per cent and 20.1 per cent female athletes consumed and fermented bamboo shoot weekly once, weekly twice, weekly thrice and fortnightly respectively.

e. Food Intake of the Athletes.

i. Mean Food and Nutrient Intake of male athletes.

The Mean Food and nutrient intake of male Thang -Ta athletes is depicted in Tables XXVI to XXVIII.

TABLE XXVI

FOOD INTAKE OF MALE THANG -TA ATHLETES IN THE AGE GROUP OF 15-19 AND 20-25 YEARS

(N=280)

Food	*Suggested Allowances	Male Thang -Ta athletes			
		15-19 years		20-25 years	
		Actual intake	Per cent excess /deficit	Actual intake	Per cent excess / deficit
Cereal and millets (g)	400 550[~]	504.02±69 .32	23.36 8.32 [~]	559.37± 58.70	39.84 1.70 [~]
Pulses (g)	40	12.60±3.4	-68.5	13.25± 3.77	-66.87
Vegetables (g)	350	330.82± 38.14	-5.48	336.01± 26.37	-3.99
Root and tubers(g)	150 -[~]	40.10± 12.81	-73.26	39.65± 11.80	-73.56
Fruits (g)	150	45.05± 23.67	-69.96	43.55± 11.35	-70.96
Milk and milk products (ml)	750	53.06± 38.68	-92.92	52.85± 31.62	-92.95
Meat (g)	250 -[~]	61.04± 20.01	-75.58	68.99± 16.70	-72.40
Egg(g)	50 -[~]	8.93± 4.52	-82.14	7.53± 4.58	-84.94
Fats and oil (g)	50	25.19±5.7 6	-49.62	24.32± 5.32	-51.36
Sugar (g)	80	35.87± 22.83	-55.16	33.64± 6.55	-57.95

[~]Satyanarayana *et.,al* 1985 ; *-ILSI,NIN and SAI (2007)

When compared with the suggested food allowance of food stuff by ILSI, NIN and SAI (2007) for specific event, the mean intake of cereal and millets of male Thang –Ta athletes was in excess (23.6 per cent) in the age group of 15- 19 years and 39.84 per cent excess for 20-25 years. All the other food stuffs such as pulses, vegetables, roots and tubers, fruits, milk products, meat, egg, fats, oils and sugar were consumed at levels less than the suggested allowances (68.5 and 66.87 %, 5.48 and 3.99 %, 73.26 and 73.56%, 69.96 and 70.96 % and 92.92 and 92.95 %, 75.58 and 72.40%, 82.14 and 84.94%, 49.62 and 51.36 % and 55.16 and 57.95 % respectively by athletes in the two age groups).

When compared with suggested allowances of food stuffs by Satyanaryana *et al.*, (1985), cereal intake of male –Thang Ta athletes was less (8.32 percent among 15-19 year old athletes). But among 20-25 years group, there was a small excess of 1.70 per cent in cereal intake.

TABLE XXVII
MACRO NUTRIENT INTAKE OF THE MALE THANG -TA ATHLETES
(N=280)

Nutrients	Male Thang -Ta athletes					
	Age group 15-19 years			Age group 20-25 years		
	Recommended Allowance (ILSI,NIN and SAI, 2007)	Actual intake	% excess/deficit	Recommended Allowance (ILSI,NIN and SAI, 2007)	Actual intake	% excess/deficit
Energy (kcal)	3147.6 (60)	2669.3± 217.68 (50.8)	-15.2	3630.6 (60)	2871.5± 359.71	-20.9
Carbohydrate (g)	435.4 (8.2)	570.5± 94.88 (10.8)	31.1	502.2 (8.2)	593.8± 92.11 (9.8)	18.2
Protein (g)	131.2 (2.5)	63.7± 8.02 (1.2)	-51.4	151.3 (2.5)	68.2± 8.01 (1.1)	-54.9
Fat(g)	110.2 (2.1)	55.9± 12.74 (1.1)	-49.3	127.1 (2.2)	59.4± 11.42 (0.9)	-53.3
Energy Contribution Ratio (C:P:F)	55:16:31	85:9:18	-	55:16:31	82:9:18	-

Intake per kg body weight is given in parentheses; C:P:F- Carbohydrate :Protein :Fat

The mean energy, carbohydrate, protein and fat intake of male Thang- Ta athletes in the age group of 15-19 years was found to be 2669.3±217.68 kcal, 570.5±94.88 g, 63.7±8.02 g, 55.9±12.74 g respectively. When compared to the Recommended Allowance ILSI, NIN and SAI (2007), the intake was disproportionate; energy intake was 15.2 per cent deficit, carbohydrate 31.1 per cent in excess, and protein 51.4 per cent deficit and fat 49.3 per cent deficits. Therefore the energy contribution was disproportionate.

The energy contribution of carbohydrate, protein and fat in the diet of male Thang -Ta athletes is depicted in Figure 9.

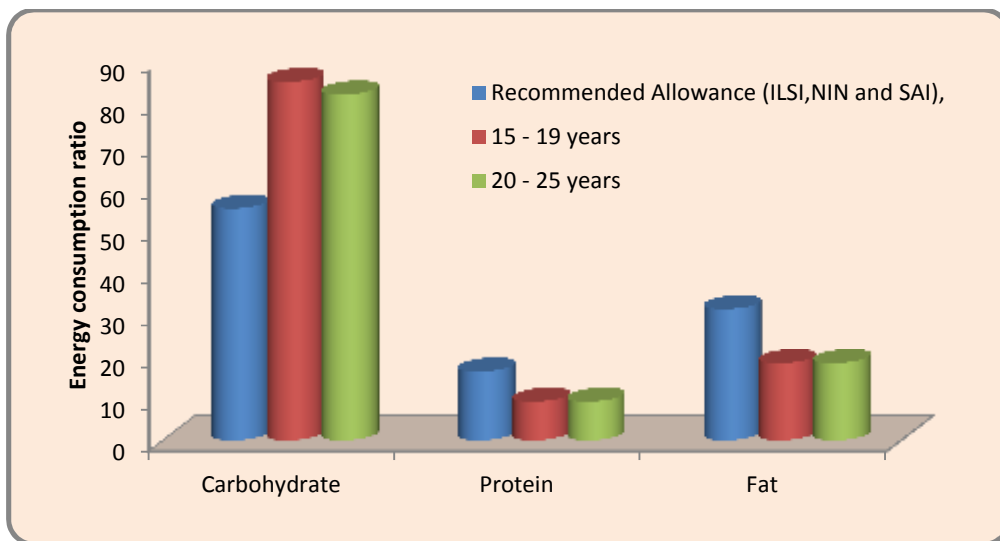


Figure 9

Energy Contribution Ratio of Carbohydrates, Protein and Fat of Male Thang -Ta Athletes

The energy contribution ratio of Carbohydrate: Protein: Fat intake was 85:9:18, as against the suggested energy contribution ratio of Carbohydrate: Protein: Fat (55:16:31) for specific event. Similarly, the mean energy, carbohydrate, protein and fat intake of male athletes in the age group of 20-25 years were found as 2871.5±359.71 kcal, 593.8±92.11 g, 68.2±8.01 g, 59.4±11.42 g respectively. The energy intake was 20.1per cent deficit, carbohydrate18.2% excess, protein 54.9% deficit and fat 53.3 % deficit. The energy contribution of carbohydrate: protein: Fat in the diet of Thang-Ta athletes was 82:9:18 as against the suggested energy contribution ratio carbohydrate: protein: Fat (55:16:31).

Artoli *et al.*, (2009), studied the nutritional profile of the Brazilian Olympic Wushu (Kung- Fu) athletes. It was found that male athletes consumed high fat, low carbohydrate diet whereas women consumed moderate fat and high carbohydrate diet but protein consumption was adequate. The findings of Rossi *et al.*, (2010) on dietary intake of male mountain bikers were normocaloric and the intake of carbohydrate was 54.4 ± 7.9 per cent, protein 17.3 ± 3.6 per cent, lipids $28.3 \pm .34$ per cent. Micro nutrients intake were adequate. The findings of the Ghloom and Hajj, (2011) on diet consumption on Kuwaiti fencers showed that they consumed less carbohydrate $47.8\% \pm 1.7$ of total calories a day and had more saturated fat $16.5\% \pm .84$ and more total protein $16.6\% \pm .80$ than recommended percentages.

TABLE XXVIII
MICRO NUTRIENT INTAKE OF THE MALE ATHLETES

(N=280)

Nutrients	Male Thang- Ta athletes					
	15-19 years			20-25 years		
	Suggested allowance ICMR 2010	Actual intake	% excess/ deficit	Suggested allowance ICMR 2010	Actual intake	% excess/ deficit
Thiamine (mg)	1.5	0.68 ± 0.38	-54.66	1.4	0.74 ± 0.34	-47.14
Riboflavin (mg)	1.8	0.87 ± 0.40	-51.66	2.1	0.91 ± 0.40	-56.66
Niacin (mg)	17	11.15 ± 2.13	-34.41	21	12.49 ± 2.27	-40.52
Ascorbic acid (mg)	40	24.36 ± 8.57	-31.1	40	25.08 ± 7.02	-37.3
Iron (mg)	28	22.09 ± 5.35	-21.10	17	18.67 ± 2.58	9.2
Calcium (mg)	800	452.40 ± 127.09	-43.45	600	471.97 ± 127.18	-21.33
Beta carotene (mcg)	4800 $\mu\text{g}/\text{dl}$	2400.70 ± 912.84	-49.98	4800	2782.03 ± 638.85	-48.92

When compared with the suggested micro nutrient requirement given by ICMR (2010), the mean intake of thiamine, riboflavin, niacin, ascorbic acid, iron,

calcium and beta carotene intake of male Thang- Ta athletes in the age group of 15-19 years were deficient at 54.66 per cent, 51.66 per cent, 34.41 per cent, 31.1 per cent, 21.10 per cent, 43.45 per cent, 49.98 per cent respectively. Similarly, the mean intake of thiamine, riboflavin, niacin, ascorbic acid, calcium and beta carotene intake of male Thang- Ta athletes in the age group of 20-25 years were deficient at 47.14 per cent, 56.66 per cent, 40.52 per cent, 37.3 per cent, 21.33 per cent, 48.92 per cent respectively, except of Iron, the mean intake was excess at 9.2 per cent.

ii) Mean Food and Nutrient Intake of Female Athletes

The Mean Food and Nutrient Intake of Female Athletes is presented in Tables XXIX to XXXI.

TABLE XXIX

FOOD INTAKE OF FEMALE THANG -TA ATHLETES (15-19 AND 20-25 YEARS)

(N=84)

Foods	±Suggested allowance	Female Thang -Ta athletes			
		15-19 years		20-25 years	
		Actual intake	Per cent excess/deficit	Actual intake	Per cent excess/deficit
Cereal and millets (g)	400 550	481.07± 44.53	20.26 -12.53	508.96± 52.09	27 -7.46
Pulses (g)	40	12.41± 3.35	-68.97	13.06± 3.44	-67.35
Vegetables (g)	350	329.65± 22.56	-5.8	340.01± 24.69	-2.85
Root and tubers(g)	150 -	39.49± 13.97	-73.67	42.41± 12.17	-71.72
Fruits (g)	150	44.99± 15.31	-70	40.92± 11.38	-72.72
Milk and milk products (ml)	750	51.70± 44.26	-93.10	45.72± 12.62	-93.90
Meat (g)	250 -	44.72± 11.69	-82.11	45.18± 14.31	-81.92
Egg	50 -	12.18±4.39	-75.64	9.73± 3.01	-80.54
Fats and oil (g)	50	26.34± 5.24	-47.32	27.05± 2.62	-45.88
Sugar (g)	80	30.33± 5.82	-62.08	32.61± 5.28	-59.23

▪ Satyanarayana *et al.*, 1985 ; ±ILSI NIN, and SAI (2007)

When compared with the suggested food allowance (ILSI, NIN and SAI 2007) for specific event, the mean intake of cereals and millets of female Thang –Ta athletes was in excess (20.26 per cent) in the age group of 15- 19 years and 27 per cent excess in 20-25 years. All the food stuffs such as pulses, vegetables, roots and tubers, fruits, milk product, meat, egg, fats, oils, sugar were consumed at (68.97 per cent, 5.8 per cent, 73.67 per cent, 70 per cent, 93.10 per cent, 82.11 per cent, 75.64 per cent per cent , 47.32 per cent , 62.08% respectively) levels less than the suggested allowance. Similarly, all the food stuffs such as pulses, vegetables, roots and tubers, fruits, milk product, meat, egg, fats, oils, sugar consumed by 20-25 years were deficient at (67.35 per cent, 2.85 per cent, 71.72 per cent, 72.72 per cent, 93.90 per cent, 81.92 per cent, 80.54 per cent, 45.88per cent, 59.23per cent respectively. Deficits were less in vegetable intake among Manipuri Thang -Ta athletes, probably because of the intake of indigenous herbs and shrubs as revealed in the food frequency table. It was found that the consumption of milk and milk product and low intake of high quality milk protein and specifically, of highly bioavailable calcium among Thang -Ta athletes. Milk and dairy products consumption is essential for the formation of bones and maintenance of bone mineral density in female athletes, and inadequate calcium intake increases the risk of osteoporosis as they age (Maughan and Shirreffs, 2007)

When compared with suggested allowance of food stuff by Satyanarayana *et.,al* (1985), cereal intake of female Thang-Ta athletes were less (12.53 per cent) among 15-19 years athletes. But among 20-25 years group female Thang-Ta athletes, there was an excess of excess of 7.46 per cent was found in cereal intake.

Aerenhouts *et al.*, (2011) reported that dietary habits in adolescent sprint athletes as measured over a three -year period were far from optimal, especially with regard to fluid intake, sources of fat, and fruit and vegetable consumption. To achieve significant improvements in an athlete's diet, regular monitoring with greater intervention in the diet may be needed. Santos *et al.*, (2016) reported that the dietary patterns of female football players were both quantitatively and qualitatively inappropriate. A nutritional intervention is indicated to improve diet quality, with the inclusion of various foods, such as whole grains, fruits, vegetables, dairy products, and better protein quality, along with a reduction in saturated fat, sodium, and added sugar.

TABLE XXX
MACRO NUTRIENT INTAKE OF FEMALE ATHLETES

(N=84)

Nutrients	Female Thang -Ta athletes					
	15-19 years (n=45)			20-25 years (n=39)		
	Suggested allowance ILSI, NIN and SAI, (2007)	Actual intake	% excess/ deficit	Suggested allowance ILSI, NIN and SAI, (2007)	Actual intake	% excess/ deficit
Energy (kcal)	3087.6 (60)	2497.4±186.38	-19.2	3153 (60)	2638.30±221.72 (50.20)	-16.3
Carbohydrate (g)	427.2 (8.3)	532.80±67.85 (10.4)	24.7	436.2 (8.3)	579.10±65.89 (11.01)	32.7
Protein (g)	128.6 (2.4)	56.31±8.77 (1.1)	-56.3	131.4 (2.5)	64.70±13.68 (1.2)	-50
Fat (g)	108.06 (2.1)	53.70±9.22 (1.1)	-50.4	110.4 (2.1)	57.48±5.94 (1.1)	-48.1
Ratio (C:F:P)	55:16:31	85:9:19	-	55:16:31	73:8:16	-

Per kg body weight parenthesis; C: P: F=Carbohydrate: Protein: Fat

Figure 10 depicts the energy contribution of carbohydrate, fat and protein of female athletes in the age group of 15-19 and 20-25 years.

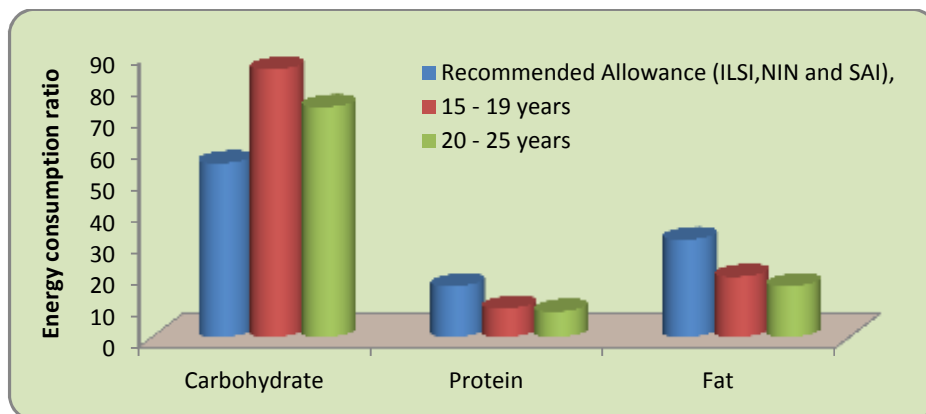


Figure 10

Energy contribution of Carbohydrate, Fat and Protein of female athletes in the age group of 15-19 and 20-25 years

The mean energy, carbohydrate, protein and fat intake of male Thang- Ta athletes in the age group of 15-19 years were found as 2497.4±186.38kcal, 532.80±67.85 (g), 56.31±8.77 (g), 53.70±9.22 (g) respectively. When compared to the suggested Allowance by ILSI, NIN, and SAI, (2007) for specific event, the intake was disproportionate; energy intake was 19.2 per cent deficient, carbohydrate 24.7 per cent excess, protein 56.3 per cent deficient and fat 50.4 per cent deficient. Therefore the energy contribution was disproportionate. The mean per cent energy contribution ratio of Carbohydrate :Protein : Fat intake was 85:9:19, it was against the suggested energy contribution ratio of Carbohydrate :Protein : Fat (55:16:31) for specific event. Similarly, the mean energy, carbohydrate, protein and fat intake of male athletes in the age group of 20-25 years were found as 2638.30±221.72 kcal, 579.10±65.89 (g), 64.70±13.68 (g), 57.48±5.94 (g) respectively. The energy intake was 16.3per cent deficient, carbohydrate 32.7 per cent excess, protein 50 percent deficient and fat 48.1per cent deficient. Therefore the energy contribution was of carbohydrate: protein: Fat was 73:8:16 which was against the suggested energy contribution ratio carbohydrate: protein: Fat (55:16:31).

In the present study protein intake was less 1.1g /day among both male and female athletes 15-19 years of age and 2.2g/day among male athletes 20-25 years of age and 1.2 g/day among female athletes 20-25 years of age. This is contradictory to the study by Lemon (2000), wherein, protein intake for athletes was between 4.0 and 6.0 g/kg/day, which clearly represents an excess. For the general population, protein of intake of greater than 1.6 g/kg/day could be considered high and 2.4 g/kg/day, extremely high (Rossi et al., 2004). According to Lemon (2000), for strength athletes, protein intake should be between 1.4 and 1.8, possibly reaching 2.0, and above 2.4 g/kg/day the oxidation of amino acids increase, without additional lean mass gain (Rossi and Tirapegui, 2000). Among Japanese karate athletes, protein intake was 89.8 ± 24.5 g /day or 1.38 ± 0.46 g/kg/day due to their low ingestion of red meat, milk and by products (Teshima *et al.*, 2002).

TABLE XXXI
MICRO NUTRIENT INTAKE OF THE FEMALE ATHLETES

(N=84)

Nutrient	Female Thang -Ta athletes					
	Age group 15-19			Age group 20-25		
	Suggested allowance ICMR (2010)	Actual intake	% excess/ deficit	Suggested allowance ICMR (2010)	Actual intake	% excess/ deficit
Thiamine (mg)	1.0	0.78± 0.35	-22	1.4	0.89± 0.31	-33.42
Riboflavin (mg)	1.2	0.73± 0.43	-39.16	1.7	0.82± 0.32	-51.76
Niacin (mg)	14	10.53± 1.84	-24.78	16	10.95± 2.05	-31.56
Ascorbic acid (mg)	40	24.09± 6.12	-39.77	40	26.16± 5.43	-34.6
Iron (mg)	26	23.00± 4.47	-11.53	21	22.09± 3.02	5.1
Calcium (mg)	800	440.52± 130.50	-44.93	600	446.76± 93.53	-25.54
Beta carotene (mcg)	4800	2100.83± 784.48	-56.23	4800	2117.73 ± 807.01	-55.88

When compare with the suggested micro nutrient allowance given by ICMR (2010), the mean intake of thiamine, riboflavin, niacin, ascorbic acid, iron, calcium and beta carotene intake of female Thang- Ta athletes in the age group of 15-19 years were less (at levels 22 per cent, 39.16 per cent, 24.78 per cent, 11.53 per cent, 44. 93 per cent, 56.23 per cent respectively) than the suggested requirement. Similarly, the mean intake of thiamine, riboflavin, niacin, ascorbic acid, calcium and beta carotene intake of female Thang- Ta athletes in the age group of 20-25 years were less (at levels 33.42 per cent, 51.76 per cent, 31.56 per cent, 34.6 per cent, 25.54 per cent, 55.88 per cent respectively) than the suggested requirements, except mean Iron intake was slight excess at 5.1 percent levels.

iii. Energy intake and expenditure of the athletes

The energy intake and expenditure of the athletes is given in Table XXXII.

TABLE XXXII
ENERGY INTAKE AND EXPENDITURE OF MALE AND FEMALE ATHLETES
(N=364)

Thang -Ta athletes							
15-19 years				20-25 years			
Gender	Actual intake	Energy expenditure	% excess /deficit	Gender	Actual intake	Energy expenditure	%excess /deficit
Male (n=198)	2669.3± 217.68	3231.53± 486.14	21.1	Male (n=82)	2871.5± 359.71	3290.43± 468.89	14.59
Female (n=45)	2497.4± 186.38	3029.53± 295.91	21.30	Female (n=39)	2638.30± 221.72	3245.53± 292.73	23.02

The mean energy expenditure of male Thang -Ta athletes in the age group of 15-19 years was 3231.53 kcal /day with excess energy expenditure of 21.1 per cent against the actual intake 2669.3 kcal /day. Similarly the mean energy expenditure of male Thang -Ta athletes in the age group of 20-25 years was 3290.43± 468.89 kcal /day with excess energy expenditure of 14.59 per cent against the actual intake 2871.5±359.71 kcal /day.

On the other hand, the mean energy expenditure of female Thang Ta athletes in the age group of 15-19 years was 3029.53 ± 295.91 kcal /day with excess energy expenditure of 21.30 per cent against the actual intake 2497.4±186.38 kcal /day. Similarly the mean energy expenditure of female Thang -Ta athletes in the age group of 20-25 years was 3245.53±292.73 kcal /day with excess energy expenditure of 23.02 per cent against the actual intake 2638.30±221.72kcal /day.

The findings of the present study were entirely different from those reported by Martin *et al.*, (2006) who studied the nutritional practices and activity of elite England female soccer players. The energy expenditure (2153±5906.2 kcal) was not significantly different ($p>0.05$) from intake suggesting that energy balance was achieved.

Both male and female athletes were practicing at energy deficit levels ranging from 14.59 to 23.02 per cent, the deficit being higher in the older age group of athletes.

Souza and Williams (2004) warn that reduced caloric intake and strenuous exercise leads to hypoestrogenism and is associated with clinical manifestations that include disordered eating, stress fractures, osteoporosis, and, as recently reported, a potential increase in the risk of premature cardiovascular disease. The etiology of menstrual disturbances among female is causally linked to energy deficiency.

The Mean performance parameters of male and female athletes is presented in Table XXXIII.

4. PHYSICAL PERFORMANCE OF THE ATHLETES

TABLE XXXIII

MEAN PERFORMANCE PARAMETERS OF MALE AND FEMALE ATHLETES

N=364

Parameters	Thang- Ta Athletes				b vs d	a vs c
	15-19 years		20-25 years			
	Male (n=198) (a)	Female n =45 (b) (a) vs (b)	Male (n =82) (c)	Female (n =39) (d) (c) vs (d)		
Vertical jump (cm)	51.05± 6.30	43.00± 6.19 7.75**	50.08± 6.20	41.35± 6.86 6.94**	1.14 ^{NS}	1.17 ^{NS}
Standing broad Jump(cm)	160.14± 10.68	131.5± 11.90 15.86**	156.50± 11.44	136.77± 13.05 8.46**	1.92*	2.5**
Sit -ups (count per minute)	25.17± 4.11	17.55± 4.96 10.77**	23.40± 3.80	17.64± 3.48 8.00**	0.09 ^{NS}	3.35**
Push -ups (count per minute)	21.22± 3.98	14.26±3.54 10.78**	19.65± 4.00	13.07± 2.52 9.39**	1.74 ^{NS}	2.98**
30 m flying start(sec)	3.71± 0.31	4.68± 0.57 15.64**	3.91± 0.45	4.78± 0.44 9.86**	0.8 ^{NS}	4.31**
6x10m shuttle run (sec)	16.66± 1.25	18.30± 1.41 7.78**	16.92± 0.01	19.31± 2.63 7.17**	2.19*	1.64 ^{NS}
VO ₂ max (ml/kg/min)	41.03± 6.5	32.43±1.95 8.70**	40.58± 5.49	30.25± 3.20 10.34**	3.70**	0.54 ^{NS}

** - Significant at 1% level; NS – Not Significant

The mean score value of Vertical Jump, Standing Broad Jump, Sit ups, Push- ups, 30 m flying start test, 6X 10 m shuttle run and VO₂ max of 15-19 years male athletes were 51.05± 6.30 cm, 160.14± 10.68 cm, 25.17± 4.11 count/minute, 21.22± 3.98 count/minute, 3.71± 0.31 sec, 16.66± 1.25 sec and 41.03± 6.5 (ml/kg/min) respectively. Among female athletes 15-19 years of age, the mean score value of Vertical Jump, Standing Broad Jump, Sit ups, Push- ups, 30 m flying start test, 6X10 m shuttle run and VO₂ max were 43.00±6.19cm, 131.5 ±11.90 cm, 17.55±4.96 count/minute, 14.26±3.54 count/minute, 4.68±0.57 sec, 18.30±1.41 sec, 32.43±1.95 ml/kg/min respectively. Performance scores were significantly better for the male athletes (at p<0.01) than their female counterparts.

Similarly, among male athletes in the age group of 20-25 years, the mean score value of vertical jump, standing broad jump, sit ups, push- ups, 30 m flying start, 6X 10 m shuttle run and VO₂ max were 50.08±6.20 cm, 156.50±11.44 cm, 23.40±3.80 count/minute, 19.65 ±4.00 count/minute, 3.91±0.45 sec, 16.92±0.01 sec, 40.58±5.49 ml/kg/min respectively. Among female athletes of respective age, the mean score value of vertical jump, standing broad jump, sit ups, push- ups, 30 m flying start test, 6X 10 m shuttle run and VO₂ max were 41.35±6.86 cm, 136.77±13.05 cm, 17.64±3.48 counts, 13.07±2.52 counts, 4.78 ±0.44 sec, 19.31±2.63 sec, 30.25 ±3.20 ml/kg/min respectively. The performance scores of male athletes were significantly better (at p<0.01) than the female athletes.

Comparison between the two age group of female athletes (b vs d), there was no statistically significant difference between the two groups except for Standing broad Jump, 6 x 10 m Shuttle run, and VO₂ max where in the older age group performed significantly better (p<0.01) than the younger age group of girls.

Performance of male athletes in the (two age groups) in vertical jump, 6X10 meter shuttle run and VO₂ max was on par with each other while the older age group fared better (p<0.01) than the younger age group of athletes in standing broad jump, sit –ups, push -ups and 30 meter flying start.

Grading of male and female athletes is presented in Table XXXIV to XXXVII.

TABLE XXXIV
GRADING OF MALE ATHLETES ACCORDING TO VERTICAL JUMP, STANDING BROAD JUMP, SIT UPS AND PUSH-UPS
(N=260)

Parameters	Male Thang -Ta athletes							
	15-19 years (n=198)				20-25 years (n=82)			
	Mean	Category	No.	%	Mean	Category	No.	%
Vertical jump (cm)	51.05±6.30	∅Excellence >65	38	19.2	50.08±6.20	μAbove average - 56.70	16	19.5
		∅Above average 50-65 (57) 14.39**	71	35.8				
		∅Average 40-49 (44.5) 14.62**	81	40.9		μAverage-41-55(48) 3.04**	63	76.8
		∅Below average 30-39	8	4.1		μBelow average -31-40(35.5) 21.58**	3	3.7
Standing broad jump (cm)	160.14±10.68	≠Poor category 0-10 th percentile (106.6-180.34) 143.46 21.97**	198	100	156.50 ± 11.44	≠Poor 0 th -10 th percentile (127 -188.97) 1.17 ^{NS}	82	100
Sit- ups (count / minute)	25.17±4.11	≠Low average 0 th -10 th percentile (12-30) (21) 14.27**	198	100	23.40±3.80	≠Poor 0 th , 10 th percentile (0- 26) 13 24.78*	8	9.8
						Low average (29-34)	72	90.2
Push- ups (count/ minute)	21.22±3.98	∅Average -19-34 (26.5) 18.65**	140	70.7	19.65±4.00	□Fair (20-34) 1.59**	39	47.6
		∅Fair 11-16	58	29.3		Poor <20 0.77 ^{NS}	43	52.4

[∅]Devis *et al.*, 2000; ^μArkinstall 2010≠AAHPHRD, 1976; [□]Mc Ardle, *et al.*, 2000;

[∅]Golding *et al.*, (1986)

The mean value for vertical jump for male Thang -Ta athletes 15-19 years of age was 51.05 ± 6.30 cm. When compared with norms given by *Devis et al.* (2000), 40.9 per cent were in the Average (40-49) category. Only 19.2, 35.8 and 4.1 per cent athletes were in the excellent (>65), above average (50-65) and below average (30-39) categories respectively. The mean value for vertical jump among male Thang-20-25 years of age was 50.08 ± 6.20 cm. A majority (76.8 per cent athletes) was in the average category when compared with the classification by *Arkininstall* (2010) and the remaining 19.5 and 3.7 per cent were in the above average and low average categories respectively. Taking 57.0 cm as the mean of the above average category (*Devis et al.*, 2000), the mean vertical jump score of male Thang -Ta athletes (51.05 cm) was significantly higher ($p < 0.01$). Among 20 to 25 year old male athletes, considering 48 cm as mean of average *Arkininstall* (2010). The mean vertical jump value of 50.08 was significantly higher ($p < 0.01$).

The average score of standing broad jump was 160.14 ± 10.68 cm and 156.50 ± 11.44 cm for the two age groups respectively. The mean sit ups values were 25.17 ± 4.11 and 23.40 ± 3.80 count per minute. All the athletes were in the poor category in terms of standing broad jump and sit ups according to *AAHPARD* (1976).

The average push-ups were 21.22 ± 3.98 count per minute for 15-19 years and 19.65 ± 4.00 count per minute for 20-25 years. When compared to *Golding et al.*, (1986), majority (70.7 per cent) of male athletes were in the average category and the remaining 29.3 per cent athlete in the fair category in terms of push-ups. Similarly, among 20-25 male athletes, majority 52.4 per cent were in the poor category and the remaining 47.6 per cent in the fair category when compared to *Mc Ardle, et al.*, 2000. When 26.5 was consider as the average, it the mean score of push ups of male athlete in the age group of 15-19 years was lower at $p < 0.01$ level. Even though the mean score of push ups for 20-25 years were in the fair category range but significantly lower than the fair category when taking 27 as the average.

TABLE XXXV

GRADING OF MALE ATHLETES ACCORDING TO 30 METER FLYING START, 6X10 METER SHUTTLE RUN AND VO₂ MAX

N=260

Parameters	Male Thang -Ta athletes							
	15-19 years (n=198)				20-25 years (n=82)			
	Mean	Categories/Grades	No.	%	Mean	Categories/Grades	No.	%
30 m flying start (sec)	3.71± 0.31	∪Excellence (<4) 12.69**	172	86.9	3.91± 0.45	□ low average (>3.7)	39	47.6
		∪Above average (4-4.2)	18	9.1		□Average (3.5-3.7) 6.36**	43	52.4
		∪Average(4.3-4.4)	4	2.0				
		∪Below average (4.5-4.6)	1	0.5				
		∪Poor (>4.6)	3	1.5				
6x10m shuttle run (sec)	16.66±1.2 6	Below satisfactory (>16.3)	100	50.5	16.92±0.01	Below satisfactory (>16.3)	59	71.9
		[∞] Satisfactory (16.3-15.8) (16.05) 6.95**	19	9.6		[∞] Satisfactory (16.3-5.8) (16.05) 7.81**	10	12.2
		[∞] Good (15.7-15) (15.35) 14.80**	79	39.9		[∞] Good (15.7-15) (15.35) 14.06**	13	15.9
VO ₂ max ml/kg/min	41.03± 6.5	□Fair (38.4-45.1) (41.57) 1.53 ^{NS}	170	85.95	40.58±5.49	□Average (42.48) 7.27**	36	43.9
		□Poor (35-38.3)	28	14.1		□Fair (39-41) 0.97 ^{NS}	31	37.8
						□Poor (<39)	15	18.3

□ACSM (2008); □Heyward(1998); ∪ *Devis et al.*, (2000); ∪ *Ray et al.*, (2007) ; [∞] Norms given in the physical Education Scheme , Pune University(2015). *-Significant at 5% level,**-Significant at 1% level; NS-Not significant.

When compared with the grade given by *Devis et al.*, (2000). Majority (86.9 per cent) of male athletes in the age group of 15-19 were in the excellent category and the remaining 9.1, 2.0, 0.5 and 1.5 per cent male athletes were in the above average, average, below average and poor category respectively in terms of 30 meter flying start test. But the score was lower at $p < 0.01$ than the excellent (< 4), which means athletes in the age group of 15-19 years had better performance in terms of speed. Among 20-25 year old male athletes, majority 52.4 per cent were in the average category and remaining 47.6 per cent were in the low average category in terms of 30 meter flying according to *Ray et al.*, (2007) with the mean of 3.91 ± 0.45 sec. However the mean score was slightly higher at $p < 0.01$ level than the average.

When compared to norms given by the physical Education Scheme, Pune University, 2015, on 6X10 meter shuttle run, majority 50.5 per cent athletes male Thang- Ta athletes were below satisfactory and the remaining 9.6 and 39.9 per cent male athletes in the age group of 15-19 years were in the satisfactory and good category respectively. Similarly among male athletes, majority (71.9 per cent) were below satisfactory and remaining 12.2 and 15.9 per cent were in the satisfactory and good category in terms of 6X10 meter shuttle run according to norms given in the Physical Education Scheme, Pune University, (2015) with the mean of 16.92 ± 0.01 sec

In terms of Heyward (1998), majority 85.9 per cent male athletes in the age group of 15-19 years were in the fair category and the remaining 14.1 per cent were in the poor category in terms of VO_2 max score. Similarly, in the age group of 20-25 male athletes, most of the male athletes (43.9 per cent) were average category. The remaining 37.8 per cent and 18.3 per cent athletes were in the fair and poor category when compared to American College of Sport Medicine (ACSM, 2008).

The overall picture of the male athletes (15-19 years of age) in the 30 meter flying start test according to the grade of *Davis et al.*, (2000) was excellent with the mean of 3.71 ± 0.31 sec, below satisfactory in 6X10 meter shuttle run (Norms given in the physical Education Scheme, Pune University, 2015) with a mean of 16.66 sec, fair in terms of VO_2 max (according to Heyward, 1998) with the mean of 41.03 ml/kg/min.

Male athletes (20-25 years) were in the average category in terms of 30 meter flying according to *Ray et al.*, (2007) with the mean of 3.91 ± 0.45 sec. Below satisfactory category in terms of 6X10 meter shuttle run according to norms given in the Physical Education Scheme, Pune University, (2015) with the mean of 16.92 ± 0.01 sec. Average category in terms of VO_2 max according to ACSM (2008).

TABLE XXXVI
GRADING OF FEMALE ATHLETES ACCORDING TO VERTICAL JUMP, STANDING BROAD JUMP, SIT- UPS AND PUSH UPS

N=84

Parameter	Female Thang-Ta athletes							
	(15-19 years) n =45				(20-25 years) n=39			
	Mean	Grades	No.	%	Mean	Grades	No.	%
Vertical jump (cm)	43.00± 6.19	∪Above average 47-58(52.5) 10.28**	14	31.1	41.35± 6.86	∪ Above average -46-60	13	33.4
		∪Average 36-46(41.4) 1.73 ^{NS}	29	64.4		∪ Average (31-45) (38) 3.01**	23	58.9
		∪Below average- 30-39	2	4.4		∪Below average(21-30)	3	7.7
Standing broad Jump(cm)	131.5± 11.90	∩Poor category 0 th to 10 th percentile 81.28-132.08	27	60	136.77 ± 13.05	∩Poor category 0 th to 10 th percentile 68.58-121.42	7	17.9
		∩Low average 15 th to 25 th 137.16-144.78	8	17.7		∩Low average 15 th to 25 th 139.7-147.32	20	51.3
		∩Average 30 th to 40 th 147.32-157.14	10	22.2		∩Average 30 th to 40 th 149.86-157.32	12	30.8
Sit- ups (count/minute)	17.55± 4.96	∩Average (30 th -40 th) (25-27)	2	4.4	17.64± 3.48	∩Very good (60 th -70 th)22-25	8	20.6
		∩low average(15 th -25 th) (20-24)	17	37.8		∩Good (45 th -55 th) 19-21	10	25.6
		∩Poor (0-10 th) (0-17)	26	57.8		∩Average (30 th -40 th) 15-18	14	35.9
						∩Low average (15 th -25 th)11-14	7	17.9
Push- ups (count/minute)	14.26± 3.54	∩Average 11-29 (20) 10.85**	38	84.4	13.07± 2.52	∩ Average -17-33	1	2.6
		∩Below average -6-10	7	15.6		∩ Fair - 6-16(11) 5.13**	38	97.4

[∪] Davis *et al.*, (2000); [∪] Arkinstall (2010); [∩] AAHPERD (1976); [∩] Golding *et al.*, (1986); [∩] McArdle *et al.*, (2000). ** - Significant at 1% level; NS – Significant.

Vertical jump result showed that, majority 64.4 per cent female athletes in the age group of 15-19 years were in the average category (47-58) and the remaining 31.1 and 4.4 per cent athletes were in the were above average and poor category respectively when compared to norms given by *Devis et al.*, (2000). The mean score of 43 cm was not significantly greater than the average score of 41cm. Compared to score specified by Arkininstall, 2010, majority 58.9 per cent of 20-25 year old athletes were in the average category (31-45) and remaining 34.4 and 7.7 per cent were belong to above average and below average category respectively. The mean score of 41.35 cm reached by the female athletes in the present study was significantly higher ($p < 0.05$) than the standard average of 38cm given by Arkininstall, 2010.

When compare to AAHPERD (1976) norms, majority of 60 per cent of female Thang -Ta athletes were in the poor category in terms of standing broad jump. The remaining 17.7 and 22.2 per cent female athletes were in the low average and average category respectively. The mean score of standing broad jump of both the age group were in the poor category. Similarly, among 20-25 years female athletes, majority 51.3 per cent were belong to low average and the remaining 17.9 and 30.8 per cent were in the poor and average category respectively.

Sit up result shows that majority, 57.8 per cent female athlete in the age group of 15-19 years were belong to poor category and remaining 37.8 per cent and 4.4 percent were in the average and low average category respectively when compared to AAHPERD (1976). Similarly among 20-25 years female athlete, majority 35.9 per cent were belongs to average category and the remaining 20.6, 25.6 and 17.9 per cent were belongs to very good , good and low average category respectively.

When compared to *Golding et al.*, (1996), majority 84.4 per cent athlete were belong to average and 15.6 per cent were in the below average category in terms of push ups . Similarly, when compared to *McArdle et al.*, (2000), majority 97.4 per cent female athletes in the age of 20-25 years were in the fair category and the remaining 2.6 per cent were in the average category. The mean push up score of 15-19 years athletes were in the average category. But when consider 20 as the average standard, it was lower at $p < 0.01$ level. Similarly, among 20-25 years when we consider 11 as the average standard, the mean score was significantly higher at $p < 0.01$ than the average score.

TABLE XXXVII
GRADING OF FEMALE ATHLETES ACCORDING TO 30 METER FLYING START, 6X10 METER SHUTTLE
RUN AND VO₂ MAX

N=84

Parameters	Female Thang-Ta athletes							
	15-19 years (n=198)				20-25 years (n=82)			
	Mean	Grades	No.	%	Mean	Grades	No.	%
30 m flying start(sec)	4.68± 0.57	^υ Excellent- <4.5	22	48.9	4.78± 0.44	<input type="checkbox"/> Below average(>4.5)	29	74.4
		^υ Above average (4.5-4.6 (4.5) 2.20*	7	15.6		<input type="checkbox"/> Average (4- 4.5)(4.2) 8.26**	10	25.6
		^υ Average (4.7-4.8)(4.7) 0.13 ^{NS}	4	8.9				
		^υ Below average (4.9-5.0)	1	2.2				
		^υ Poor (>5)	11	24.4				
6x10m shuttle run (sec)	18.30± 1.41	[∞] Below Satisfactory	41	91.1	19.31± 2.63	[∞] Below Satisfactory(>16.3)	39	100
		[∞] Satisfactory (16.3-15.8)(16.05) 7.72**	4	8.8		[∞] Satisfactory (16.3-15.8) 10.82**	-	-
VO ₂ max (ml/kg/min)	32.43±1.95	[®] Good 35-38.9	4	8.8	30.25±2 .20	[°] Average 33-39	4	10.2
		[®] Fair -31.34.9(32.92) 1.57 ^{NS}	37	82.2		[°] Fair (30-32) 0.45 ^{NS}	29	74.4
		[®] Poor(25-30.9)	4	8.8		[°] Poor <30	6	15.4

^υDevis *et al.*, (2000); ^υRay *et al.*, (2007); [∞] Norms given in the Physical Education Scheme, Pune University, (2015); [°]ACSM,(2008); [®]Heyward,(1998).; ** - Significant at 1% level; * - Significant at 5% level; ; NS - Significant

Of female athletes in the age group of 15-19 years, 48.9 per cent were in the excellent category in terms of 30 meter flying start test and the remaining 15.6, 8.9, 2.2 and 24.4 per cent were in the above average, average, below average and poor category respectively when compared to grades by Davis *et al.*, (2000). The mean score of 4.68 sec in 30 meter flying start test was significantly higher ($p < 0.05$) than above average category at $p < 0.05$ but not statistically significant with the average norm. A majority 74.4 per cent and 25.6 per cent female athletes in the age group of 20-25 years were in the below average and average category respectively according to Ray *et al.*, (2007) for 30 meter flying start. The mean score of 4.78 sec was significantly higher at $p < 0.01$ than the average (4.2 sec) which indicates that 20-25 years female athletes had low performance in terms of speed.

In terms of 6X10 meter shuttle run, 91.1 per cent and 8.8 per cent of athletes in the age group of 15-19 years were in the below satisfactory and satisfactory category respectively. All the female athletes (100%) in the age group of 20-25 years were in the below satisfactory range. When compared to standard norms of norms given in the Physical Education Scheme, Pune University, (2015); the mean score of 18.3 sec was significantly ($p < 0.01$) higher than the “satisfactory” mean of 16.05 sec, indicating that the female athletes were less agile in terms of fitness. This could be because the Thang- Ta athletes did not follow regular standard fitness training and practice only they have cultural shows or demonstrations.

VO₂ max values showed that a majority, (82.2 per cent) female athletes in the age group of 15-20 years were in the fair category, and the remaining 8.8 per cent were in the good and poor category respectively according to Heyward, (1998). Similarly, among 20-25 years athletes, majority, 74.4 per cent were in the fair category and remaining 10.2 and 15.4 per cent belonged to average and poor category when compared to ACSM, (2008). Average and poor category scores were observed in the present study. Therefore adequate nutrition, hydration, nutrition awareness regarding basic nutrition and right ways of choosing food, energy balance etc. in terms of nutrition education is the need of the hour. Specific standard fitness protocol and training of Thang -Ta coaches regarding specific training methods so that they can impart standard fitness training along with the traditional methods to raise budding athletes in the national as well as international arena.

The overall fitness status of athletes in terms of performance parameters is presented in Table XXXVIII.

TABLE XXXVIII

OVERALL FITNESS STATUS OF ATHLETES ACCORDING TO GRADING OF PHYSICAL PERFORMANCE PARAMETERS

Parameters	Gender			
	Male		Female	
	15-19 years	20-25 years	15-19 years	20-25 years
Vertical jump(cm)	Average (40.9)	Average (76.8)	Average (64.4)	Average (58.9)
Standing Broad Jump(cm)	Poor (100)	Poor (100)	Poor (60)	Low Average (51.3)
Sit –ups(count/minute)	Low average (100)	Low average (90.2)	Poor (57.8)	Average (35.9)
Push- ups (count/minute)	Average (70.7)	Poor (52.4)	Average (84.4)	Fair (97.4)
30 meter flying start test (sec)	Excellent (86.9)	Average (52.4)	Excellent (48.9)	Below Average (100)
6X10 meter shuttle run (sec)	Below Satisfactory (50.5)	Below Satisfactory (71.9)	Below satisfactory (91.1)	Below Satisfactory (100)
VO₂ max (ml/kg/min)	Fair (85.9)	Average (43.9)	Fair (82.2)	Fair (74.4)

Figures in parentheses indicate the percentage of athletes

The overall fitness status of most of the athletes, in terms of the seven performance parameters is in a very dismal condition. While most of the athletes were in the average category for vertical jump, all the male athletes and female athletes (15-19 years of age) were poor in standing broad jump. Female athletes in the 20-25 year group were in the low average category. Most of the athletes of both genders in the younger age group were average in terms of push -ups. They were excellent in 30m flying start indicating greater agility and stamina. While male athletes were average in 30m flying start, women athletes were below average indicating less speed and agility among athletes in the older age group. A majority of the athletes, irrespective of age and gender performed below satisfactory in 6x10m shuttle run. VO₂ max of male athletes (15-19years) and female athletes were fair while that of male athletes (20-25years) was average. The above findings and the huge deficits in food and nutrient intakes indicate the need for an intensive and multifaceted nutrition intervention in terms of food supplementation (providing wholesome and balanced diet) and nutrition education for sustained enhancement of

nutritional status. The situation also calls for an equally intensive training regimen which will help to improve the performance calibre of the athletes.

C. EFFECT OF INTERVENTION

1. Effect of Supplementation on Athletes

a. On performance

Table XXXIX to XLV presents the effect of supplementation of Hibisa drink on performance parameters of male athletes.

TABLE XXXIX
EFFECT ON SUPPLEMENTATION ON MEAN PERFORMANCE
PARAMETERS OF MALE ATHLETES

n=10/ group

Parameters	0day ±SD	30 th day ±SD	60 th day ±SD	90 th day ±SD	ANOVA (f value)
Vertical jump (cm)					
Experimental	49.90±4.59	50.00±5.27	49.50±3.69	48.00±4.81	1.12 ^{NS}
Placebo	49.00±4.45	49.20±3.61	49.50±4.06	49.60±3.30	0.56 ^{NS}
Standing Broad Jump (cm)					
Experimental	212.00±14.38	212.50±13.79	212.80±17.75	212.50±14.39	0.015 ^{NS}
Placebo	208.80±31.76	208.90±32.63	209.80±32.73	209.80±32.46	1.264 ^{NS}
Sit - ups(count/minute)					
Experimental	20.40±2.72	21.10±1.91	21.30±1.25	21.40±1.84	0.58 ^{NS}
Placebo	20.10±1.66	20.60±1.58	21.30±2.11	21.90±1.91	5.882 ^{**}
Push -ups(count/minute)					
Experimental	18.30±2.50	18.90±1.20	19.10±1.52	19.30±2.36	0.77 ^{NS}
Placebo	18.90±2.16	18.20±2.15	19.50±2.07	20.00±1.83	7.800 ^{**}
30 meter flying start test(sec)					
Experimental	3.99±0.32	3.79±0.23	3.69±0.09	3.91±0.27	3.11 [*]
Placebo	4.01±0.45	3.92±0.45	3.73±0.47	3.65±0.52	6.776 ^{**}
6X10 meter shuttle run(sec)					
Experimental	15.57±0.61	15.28±0.55	15.11±0.71	15.05±0.58	2.60 ^{NS}
Placebo	16.09±0.99	15.95±0.83	15.70±0.57	15.63±0.79	2.96 [*]
Vo₂ max(ml/kg/min)					
Experimental	43.48±5.20	46.17±4.48	48.91±3.16	50.19±2.26	8.09 ^{**}
Placebo	44.25±5.95	44.42±4.81	45.63±4.08	45.44±4.12	1.03 ^{NS}

The mean value for Vertical jump score of male experimental group on 0th day is 49.80 ± 5.59 cm and on 30th 60th and 90th day, the values were increased to 50.00 ± 5.27 cm, 49.50 ± 3.69 cm and 48.00 ± 4.81 cm respectively. To test whether the Vertical jump level differs significantly among the four periods, repeated measures ANOVA was conducted. The F-ratio value comparing the four periods is 1.12 was found to be not significant. That is there is no significant difference in the mean Vertical jump levels among the four periods.

In the placebo group, the mean Vertical jump score of male athletes on 0th day is 49.00 ± 4.45 cm and on 30th 60th and 90th day, the values were increased to 49.20 ± 3.61 cm, 49.50 ± 0.46 cm and 49.60 ± 3.30 cm respectively. To test whether the Vertical jump level differs significantly among the four periods, repeated measures ANOVA was conducted. The F-ratio value comparing the four periods is 0.56 which is found to be not significant. That is there is no significant difference in the mean Vertical jump levels among the four periods.

The mean Vertical jump score for experiment and placebo group on 0th day male was 49.80 ± 4.59 cm and 49.00 ± 4.45 cm. To verify whether the initial assessment of Vertical jumps score differ between experiment and placebo, t- test was conducted. The calculated t-value was 0.39, which means no significant difference was observed.

The mean Vertical jump values for experimental and placebo on 90th day was 48.00 ± 4.81 cm and 49.60 ± 4.30 cm respectively. When compared with the initial value 49.80 ± 4.59 cm and 49.00 ± 4.45 cm for experimental and placebo group respectively, slight differences were observed. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result showed that the covariate, i.e initial assessment of Vertical jump (0th day) was significant at ($p < 0.05$) level. The F -ratio comparing the final value between male experimental and placebo group after adjusting the initial assessment was 3.50, which indicates no significant differences in the final values of experiment and placebo group.

The mean Standing Broad Jump score of experimental group on 0th day was 212.00 ± 14.38 cm and on 30th, 60th, and 90th day the values were 212.50 ± 13.79 cm, 212.80 ± 17.75 cm and 212.50 ± 14.39 cm respectively. To test whether the Standing Broad Jump score differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.01 which is found to be not significant. That is there is no significant difference in the mean Standing Broad Jump among the four periods.

Among the placebo group, the mean Standing Broad Jump value for male placebo group on 0th day was 208.80±31.76 cm and on 30th, 60th, and 90th day, the value were 208.90 ± 32.67 cm, 209.80 ± 32.73 cm and 209.80 ± 32.46 cm respectively. To test whether the Standing Broad Jump level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 1.264. That is, there is no significant difference in the mean Standing Broad Jump score among the four periods.

The mean Standing Broad jump for male experiment and placebo group on 0th day was 212.00±14.38cm and 208.80±31.76cm respectively. To verify whether the initial assessment of Vertical jump differs between experiment and placebo group, t- test was conducted. The calculated t-value was 0.29, i.e. no significant difference was observed.

The mean Standing Broad Jump scores for male experimental and placebo group on 90th day was 212.50± 14.39 cm and 209.80± 32.46 cm respectively. When compared to the initial values of experimental (212.00± 14.38 cm) and placebo group score (208.80±31.76 cm), slight differences were observed. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result showed that the covariate, i.e initial assessment of Standing Broad Jump (0th day) was significant (at p<0.01) . The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment is 0.36. That is, no significant differences in the final values of experiment and placebo group.

The mean Sit ups score of male experimental group on 0th day were 20.40 ± 2.72 count/minute and on 30th, 60th and 90th day, it has slightly increased with to 21.10 ± 1.91 count/minute and 21.30 ± 1.25 count/ minute and 21.40 ± 1.84 count/ minute respectively. To test whether the Sit ups level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.585 which is found to be not significant. That is there is no significant difference in the mean Sit ups value among the four periods.

In the placebo group, the mean Sit ups value on 0th day was 20.10±1.66 count/minute and on 30th, 60th and 90th day, the values were 20.60 ±1.58 count/minute and 21.30±2.11 count/minute and 21.90±1.91 count/minute respectively. To test whether the Sit ups level differs significantly among the four periods, repeated measures ANOVA were conducted to test the above hypothesis. The F-ratio value comparing the four periods was 5.88 which is found to be significant at (p<0.01) level. That is there is significant difference in the mean Sit ups levels among the four periods. Since the F-ratio was significant, Student Newman – Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XL
S-N-K TEST (PLACEBO MALE ATHLETES FOR SIT UPS)

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		20.10	20.60	21.30	21.90		
0 day	20.10		0.50 ^{NS}	1.80 ^{NS}	1.80*	4	1.259
30th day	20.60		0.70 ^{NS}	1.30 ^{NS}	1.30*	3	1.141
60th day	21.30				1.60*	2	0.944
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			0.944	1.141	1.259		

The S-N-K table of placebo group shows that the difference between 0th day and 30th day mean was 0.50 which is less than their Range Critical (RCV) value of 0.944 .Hence the difference is not significant .However, the difference between 0th day and 60th day and 90th day were 1.20 and 1.80.The corresponding RCV were 1.14 and 1.25.This shows that there is significant difference (at p<0.05) level between 0th

day and 90th day. No significant difference between 30th and 60th day was found since the difference is less than the RCV. The difference between 30th and 90th; 60th day and 90th day were 1.30 and 1.60 which was greater than the RCV value 1.25 that is significant at p<0.05 level.

The mean Sit ups level for experiment group on 0th day male was 20.40±2.72 count/minute and for placebo is 20.10±1.66 count/minute. To verify whether the initial assessment of sit ups scores differ between experiment and placebo group, t- test was conducted. The calculated t-value was 0.298, that is, no significant difference was observed.

ANACOVA was applied. The result shows that the covariate, i.e. initial assessment of Sit ups (90th day) are significant at (p<0.01) level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment is 0.464 which is not significant. That is, there exist no significant differences in the final values of experiment and placebo group.

The mean Push up score of male experimental group on 0th day is 18.30±2.50 count/minute and on 30th, 60th and 90th day was slightly increased with to 18.90 ±1.20 count/minute and 19.10±1.52 count/minute and 19.30±2.36 count/minute respectively. To test whether the push up level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.77, which is found to be not significant .That is there is no significant difference in the mean push- ups score among the four periods.

TABLE XLI

S-N-K TEST (PLACEBO MALE ATHLETES FOR PUSH UPS)

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		18.00	18.20	19.50	20.00		
0 day	18.00		0.20 ^{NS}	1.508*	2.00*	4	1.355
30 th day	18.20			1.30*	1.80*	3	1.228
60 th day	19.50				0.50 ^{NS}	2	1.016
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			1.016	1.228	1.355		

Whereas the mean Push up score of male placebo group on 0th day was 18.90 ± 2.16 count/minute and on 30th, 60th and 90th days the values were 18.20 ± 2.15 count/minute and 19.50 ± 2.07 count/minute and 20.00 ± 1.83 count/minute. This shows that there is a very slight difference in the Push ups score for placebo male. To test whether the push-ups level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 7.803 which is found to be significant (at $p < 0.01$). That is there is significant difference in the mean push up levels among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

The S-N-K table of male placebo group on push up test shows that the difference between 0th day and 30th day mean is 0.20 which is less than their Range Critical (RCV) value of 1.016. Hence the difference is not significant. However, the difference between 0th day, 60th day and 90th day were 1.508 and 2.00 respectively. The corresponding RCV are 1.228 and 1.355. This shows that there is significant difference at ($p < 0.05$) level between 0th day, 60th day and 90th day. There is also significant difference between 30th and 60th day since the difference (1.30) is greater than the RCV (1.22). The difference between 30th and 90th day (1.80) also greater than the RCV value 1.355 that is significant at $p < 0.05$ level. No significant difference between 60th and 90th day was found.

The mean push ups level for male experiment group and placebo group on 0th day was 18.30 ± 2.50 count/minute and 18.00 ± 2.16 count/ minute respectively. To verify whether the initial assessment of push ups differs between placebo and experiment and placebo group, t- test was conducted to test for significant difference between placebo and experiment show that the calculated t-value is 0.28 and no significant differences was observed.

The mean push ups values for experimental and placebo on 90th day was 19.30 ± 2.36 count/minute and 20.00 ± 1.83 count/minute respectively, which has increased from the initial values of 18.30 ± 2.50 count/minute and 18.00 ± 2.16 count/minute respectively. This shows that there is an increased in the both the group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial

assessment from the final value, Analysis for covariance (ANACOVA) was applied to test the above hypothesis. The result shows that the covariate, i.e initial assessment of push- ups (0th day) is not significant. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment was 0.73, that is, no significant difference in the final values of experiment and placebo group.

The mean 30 meter flying start of male experimental group on 0th day was 3.99 ± 0.32 sec and on 30th, 60th and 90th day, the values were 3.79 ± 0.23 sec, 3.69 ± 0.09 sec and 3.91 ± 0.27 sec respectively. To test whether the 30 m flying level differs significantly among the four periods; repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 3.11 which is found to be significant (at $p < 0.05$) level. That is there is significant difference in the mean 30 meter flying start test value among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XLII

S-N-K TEST EXPERIMENTAL MALE for 30 METER FLYING

Treatment	Mean	0 day	30 day	60 day	90 day	R	RCV
		3.99	3.79	3.69	3.71		
0 day	3.99		0.20 ^{NS}	0.30*	0.28*	4	0.297
30 day	3.79			0.10 ^{NS}	0.08 ^{NS}	3	0.269
60 day	3.69				0.02 ^{NS}	2	0.223
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			0.223	0.269	0.297		

The above SNK table of male experimental group on 30 meter flying start test on the difference between 0th day and 30th day mean is 0.20 which is less than their Range Critical (RCV) value of 0.223. Hence the difference is not significant. However, the difference between 0th day, 60th and 90th day were 0.30 and 0.28 respectively. The corresponding RCV are 0.269 and 0.297 respectively. This shows that there significant difference at ($p < 0.05$) level was observed between 0th day and 60th day and 90th day. No significant difference between 30th, 60th day and 60th, 90th day; since the difference is less than the RCV.

Whereas among male placebo group, the mean 30 meter flying start male placebo group on 0th day was 4.01 ± 0.45 sec and on 30th, 60th and 90th day, the values were 3.92 ± 0.45 sec, 3.73 ± 0.47 sec and 3.65 ± 0.52 sec respectively. To test whether the 30 meter flying start differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 6.77 which is found to be significant at (p<0.01). That is, there is significant difference in the mean 30 meter flying start test level among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XLIII

S-N-K TEST (PLACEBO MALE ATHLETES FOR 30 METER FLYING)

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		4.01	3.92	3.37	3.65		
0 day	4.01		0.09 ^{NS}	0.28*	0.36*	4	0.248
30th day	3.92			0.19 ^{NS}	0.27*	3	0.225
60th day	3.37				0.20 ^{NS}	2	0.186
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			0.186	0.225	0.258		

The above S-N-K table of male placebo group on 30 meter flying start test shows that the difference between 0th day and 30th day mean is 0.09 which is less than their Range Critical (RCV) value of 0.186. Hence the difference is not significant. However, the difference between 0th day and 60th day and 90th day is 0.28 and 0.36. The corresponding RCV are 0.225 and 0.258. This shows that only there is 5% level significant difference between 0th day and 60 and 90th day. There is significant difference between 30th and 60th and 30th to 90th day since the difference is higher than the RCV.

The mean 30 meter flying start score for male experiment and placebo group on 0th day was 3.99 ± 0.32 sec and 4.01 ± 0.45 sec respectively. To verify whether the initial assessment of 30 meter flying start test differ between experiment and

placebo, t- test was conducted. The calculated t-value is 0.13 which means, no significant difference was observed.

The mean 30 meter flying values for experimental and placebo on 90th day was 3.71 ± 0.27 sec and 3.65 ± 0.52 sec respectively. This has slightly reduced to 3.99 ± 0.32 sec for experimental and placebo group for 4.01 ± 0.45 sec. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied to test the above hypothesis. The result shows that the covariate, i.e initial assessment of 30 meter flying start (0th day) was significant at ($p < 0.05$). The F -ratio comparing the final value between male experimental and placebo after adjusting the initial assessment is 0.21, That is, there no significant differences in the final values of experiment and placebo group.

The mean 6X10 meter shuttle run test score on male experimental group on 0th day was 15.57 ± 0.61 sec and on 30th 60th and 90th day, the values were 15.28 ± 0.55 sec, 15.11 ± 0.71 sec and 15.05 ± 0.58 sec respectively. To test whether the 6X10 meter shuttle run level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 2.60. That is, there is no significant difference in the mean 6X10 meter shuttle run value among the four periods.

Whereas among male placebo group, the mean 6X10 meter shuttle run level male placebo group on 0th day is 16.09 ± 0.99 sec and on 30th, 60th and 90th day, the values were slightly decrease with to 15.95 ± 0.83 sec, 15.70 ± 0.75 sec and 15.63 ± 0.79 sec respectively. To test whether the 6X10 meter shuttle run level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 2.96 which is found to be significant (at $p < 0.05$) level. That is, there is significant difference in the mean 6X10 meter shuttle run level among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

The difference between 0th day and 30th; 0th 60th day mean is 1.14 and 0.39 which was lower than the corresponding RCV value 0.357 and 0.431 respectively, which indicated no significance difference. However, the difference between 0th day and 90th day was 0.46 which was higher than the corresponding RCV of 0.456. This shows that there is significant difference at (p<0.05) level between 0th and 90th day. There is no significant difference between 30th and 60th; 30th day and 90th; day; 60th and 90th day since the difference is less than the RCV.

TABLE XLIV

S-N-K TEST FOR MALE PLACEBO GROUP FOR 6X 10 METER SHUTTLE RUN

Treatment		0 day	30 th day	60 th day	90 th day	R	RCV
Mean		16.09	15.95	15.70	15.63		
0 day	16.09		0.14	0.39 ^{NS}	0.46*	4	0.456
30 day	15.95			0.25 ^{NS}	0.32 ^{NS}	3	0.431
60 day	15.70				0.07 ^{NS}	2	0.357
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			0.357	0.431	0.456		

*-significant at 1 % level; NS- Not significant

The mean 6X10 meter shuttle run score for experiment and placebo group on 0th day male was 15.57 ±0.61 sec and 16.09±0.99 sec respectively. To verify whether the initial assessment of 6X10 meter shuttle run score differs between experiment and placebo group, t- test was conducted. The calculated t-value was 1.41. That is no significant difference was observed.

The mean 6X10 meter shuttle -run values for male experimental and placebo on 90th day is 15.05± 0.58 sec and 15.63±0.79 sec respectively, which reduces with the initial value (15.57 ±0.58 sec) for experiment and placebo group (16.09±0.99 sec). Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis ANACOVA was applied. The result shows that the covariate, i.e initial assessment of 6X10 meter shuttle run score (0th day) is significant (at p<0.05) level. The F – ratio comparing the final value of 6x10 meter shuttle run score of male experimental and placebo after adjusting the initial

assessment was 1.59 that is no significant differences. Therefore, no significant difference in the final values of experiment and placebo group was found.

However, the mean difference of 0th and 90th days of 6X10 meter shuttle run score of male experimental group (0.52) and mean difference of 0th to 90th day placebo group (0.46) was less difference. Therefore, there is no significant change in both the placebo and experimental group after supplementation.

The mean VO₂ max of male experimental group on 0th day was 43.48±5.20 ml/kg/min and on 30th 60th and 90th day, the values were 46.17±4.48 ml/kg/min, 49.91±3.16 ml/kg/min and 50.19±2.26 ml/kg/min respectively. To test whether the VO₂ max level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 8.090 which is found to be significant at (p<0.01) level .That is there is significant difference in the mean VO₂ max value between the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XLV

S-N-K TEST (EXPERIMENTAL MALE ATHLETES FOR VO₂ MAX)

Treatment		0 day	30 th day	60 th day	90 th day	R	RCV
Mean		43.48	46.17	48.91	50.19		
0 day	43.48		2.69 ^{NS}	5.43*	6.71*	4	4.066
30 th day	46.17			2.74 ^{NS}	4.02*	3	3.684
60 th day	48.91				1.28 ^{NS}	2	3.048
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			3.048	3.684	4.066		

*-significant at 1% level;NS- Not significant

The above S-N-K of table of male experimental group on VO₂ shows that the difference between 0th day and 30th day mean is 2.69 which is less than their Range Critical (RCV) value of 3.04. Hence the difference is not significant .However, the difference between 0th day and 60th day and 90th day is 5.43 and 6.71.The corresponding RCV are 3.684 and 4.006.This shows that there is significant

difference at ($p < 0.05$) level between 0th day and 60th day and 90th day. There is no significant difference between 30th and 60th day since the difference (2.74) is less than the RCV (3.68) but difference between 30th and 90th day is 4.02 which is greater than the RCV value 3.68 that is significant at ($p < 0.05$). No significant difference between 60th and 90th day was observed.

Whereas among male placebo group, the mean VO_2 max level of male placebo group on 0th day was 44.25 ± 5.95 ml/kg/min and on 30th, 60th and 90th day, the values were 44.42 ± 5.81 ml/kg/min, 45.63 ± 4.08 ml/kg/min and 45.44 ± 4.12 respectively. To test whether the VO_2 max level differs significantly among the four periods, repeated measures ANOVA were conducted to test the above hypothesis. The F-ratio value comparing the four periods was 1.01 which is found to be not significant. That is, there is no significant difference in the mean VO_2 max level among the four periods.

The mean VO_2 max level for male experiment and placebo group on 0th day male was 43.48 ± 5.20 ml/kg/min and 44.25 ± 5.95 ml/kg/min respectively. To verify whether the initial assessment of VO_2 max differ between experiment and placebo, t-test was conducted. The calculated t-value was 0.30, hence no significant difference was observed.

The mean VO_2 max values for experimental and placebo on 90th day was 50.19 ± 2.26 ml/kg/min and 45.44 ± 4.12 ml/kg/min respectively, which increased from the initial value (43.48 ± 5.20 ml/kg/min) for experiment and placebo group (44.25 ± 5.95 ml/kg/min). Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied. The result showed that the covariate, i.e initial assessment of VO_2 max (0th day) was significant at $p < 0.01$ level. The F –ratio comparing the final value between male experimental and placebo after adjusting the initial assessment was 11.00 which was found to be significant at $p < 0.01$ level. That is, there is a significant difference in the final values of experiment and placebo group.

The mean difference of VO_2 max value of 0th day to 90th day among experiment group was higher than the 0th day and 90th day among placebo group. This indicated that supplemented group had better improvement on VO_2 max score than placebo group.

This improvement in the VO_2 max in the present study is supported by the findings of Bock *et al.*, (2004) that acute supplementation of 4-weeks with *Rhodiola rosea* increased ($p < .05$) time to exhaustion and VO_2 peak ($p < .05$) and VCO_2 peak ($p < .05$) also increased

Improvement of VO_2 max level after supplementation of Hibiscus drink was supported by Hupponen *et al.*, (2007), reported that a seven-day administration of N-acetyl cysteine could prevent the decrease of total antioxidant capacity as well as causing improvement of maximal oxygen uptake (VO_2 max) and muscle fatigue. The reason for improvement could be the rich antioxidant properties of *Hibiscus sabdariffa* and the Hibiscus drink contain multiple transportable carbohydrates. Various researchers reported that *Hibiscus sabdariffa* Linn contain antioxidant and many nutrients. Hibiscus juice is rich in vitamin B₆, calcium, potassium (Ogbeche, 2002). The presence of β -carotene and lycopene at respectively concentrations of 1.9 mg.100 g⁻¹ and 164.3 mg.100 g⁻¹ of fresh material has been reported in the calyx of *Hibiscus sabdariffa* (Wong *et al.*, 2002). Antioxidant rich supplementation enhance the reduction of free radicals, this was supported by Mc Anulty *et al.*, (2004), that administration of 150 g/d blueberries, rich sources of polyphenols, significantly decreased serum levels of free radicals in athletes in a hot environment.

Effect of supplementation on performance parameters of female athletes is presented in Table XLVI to XLIX.

TABLE XLVI
EFFECT ON SUPPLEMENTATION ON MEAN PERFORMANCE PARAMETERS
OF FEMALE ATHLETES

n=5/ group

Parameters	0day ±SD	30 th day ±SD	60 th day ±SD	90 th day ±SD	F-test
Vertical jump (cm)					
Experimental	41.82±5.58	41.90±6.13	42.80±4.97	43.46±5.13	1.033 ^{NS}
Placebo	42.60±4.56	41.60±5.50	43.60±6.07	42.80±7.92	0.67 ^{NS}
Standing Broad Jump(cm)					
Experimental	128.80±12.24	129.20±9.52	130.20±11.65	131.30±11.30	1.58 ^{NS}
Placebo	123.20±15.35	122.00±18.23	125.00±18.37	126.00±15.40	2.11 ^{NS}
Sit ups(count/minute)					
Experimental	14.60±3.85	15.00±3.32	15.60±3.44	15.20±3.90	1.31 ^{NS}
Placebo	19.00±4.24	20.20±2.17	20.00±1.41	19.20±1.92	0.41 ^{NS}
Push ups(count/minute)					
Experimental	15.20±3.03	15.40±2.61	15.60±3.51	15.80±3.42	0.61 ^{NS}
Placebo	15.60±1.34	15.20±.10	16.00±1.22	15.80±1.92	0.51 ^{NS}
30 meter flying start test (sec)					
Experimental	5.12±0.25	4.99±0.33	4.71±0.09	4.68±0.12	6.707**
Placebo	4.40±0.11	4.25±0.22	3.77±0.37	3.68±0.37	12.59**
6X10 meter shuttle run(sec)					
Experimental	16.33±0.41	16.09±0.25	15.77±0.47	15.64±0.50	6.37**
Placebo	15.94±1.15	15.73±0.81	16.11±1.19	15.93±0.88	1.36 ^{NS}
Vo₂ max ml/kg/min					
Experimental	33.46±0.81	35.04±1.85	36.00±0.67	36.56±1.31	6.49**
Placebo	34.04±1.15	34.18±1.52	35.08±1.13	35.22±1.55	1.94 ^{NS}

**-significant at 1 % level; NS-not significant

The mean Vertical jump score of female experimental group on 0th day was 41.82±5.58 cm and on 30th 60th and 90th day, the values were increased to 41.90 ±6.13 cm, 42.80±4.97cm and 43.46±5.13 cm respectively. To test whether the Vertical jump level differs significantly among the four periods, repeated measures ANOVA were conducted to test the above hypothesis. The F-ratio value comparing the four periods was 1.033 which is found to be not significant. That is there is no significant difference in the mean Vertical jump score of female experimental group among the four periods.

Similarly among female placebo group, the mean Vertical jump score on 0th day is 42.60 ± 4.56cm and on 30th, 60th and 90th days it has increased with to 41.60 ±5.50cm, 43.60±6.07 cm and 42.80±7.92cm respectively. To test whether the

Vertical jump level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.67 which is found to be not significant. That is, there is no significant difference in the mean vertical jump score of female placebo group among the four periods.

The mean Vertical jump level for female experiment and placebo group was 41.82 ± 5.58 cm and 42.62 ± 4.56 cm respectively. To verify whether the initial assessment of Vertical jump differ between experiment and placebo, t- test was conducted. The calculated t-value was 0.242 and no significant difference was observed.

The final 90th day vertical jump score for experimental group 43.46 ± 5.13 cm and placebo 42.80 ± 7.92 cm were increased from the initial values 41.82 ± 5.58 cm and 42.60 ± 4.56 cm respectively, this shows that there is only a slight increased in both the group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of vertical jump score on (90th day) was significant (at $p < 0.05$). The F-ratio comparing the final value between female placebo and experiment after adjusting the initial assessment was 0.250 which mean no significant.

The mean Standing Broad Jump score of female experimental group on 0th day was 128.80 ± 12.24 and on 30th, 60th, and 90th day, the values were 129.20 ± 9.52 cm, 130.20 ± 11.65 cm and 131.20 ± 11.30 cm respectively. To test whether the Standing Broad Jump level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 1.58, which is found to be not significant. That is there is no significant difference in the mean Standing Broad Jump of female experimental group among the four periods.

Similarly among female placebo group, the mean Standing Broad Jump score on 0th day was 123.20 ± 15.35 cm and on 30th, 60th, and 90th day, the values were increased with to 122.00 ± 18.23 cm, 125.00 ± 18.37 cm and 226.00 ± 15.40 cm respectively. To test whether the Standing Broad Jump level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio

value comparing the four periods is 2.11 which is found to be not significant. That is there is no significant difference in the mean Standing Broad Jump level among the four periods.

The mean Standing broad jump score for experiment and placebo group were 128.80 ± 12.24 cm and 123.20 ± 15.35 cm respectively. To verify whether the initial assessment of Vertical jump differs between experiment and placebo group, t- test was conducted. The calculated t-value was 0.638, and found to be not significant.

The mean Standing broad Jump score for experimental and placebo on 90th day is 131.20 ± 11.30 cm and 126.00 ± 15.40 cm respectively which have increased from the initial values 128.80 ± 12.24 cm of and 123.20 ± 15.35 cm respectively. The mean values shows that there is slight increased in the both group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of Standing Broad Jump (0th day) is significant at $p < 0.05$ level. The F -ratio comparing the final value between placebo and experiment after adjusting the initial assessment is 0.173. That is, no significant differences in the final values of experiment and placebo group

The mean Sit ups score of female experiment group on 0th day was 14.60 ± 3.85 count/minute and on 30th, 60th and 90th day it has increased with to 15.00 ± 3.32 count/minute and 15.60 ± 3.44 count/minute and 15.20 ± 3.90 cont/minute respectively. To test whether the Sit ups level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 1.31, which is found to be not significant. That is, no significant difference in the mean Sit ups score of female experimental group among the four periods.

Similarly among female placebo group, the mean Sit ups score on 0th day was 19.00 ± 4.24 and on 30th, 60th and 90th day the values were 20.20 ± 2.17 and 20.00 ± 1.41 and 19.20 ± 1.92 respectively. To test whether the Sit ups level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 0.418 which is found to be not

significant .That is, no significant difference in the mean Sit ups levels among the four periods.

The mean sit ups score for female experiment and placebo group on 0th day was 14.60 ± 3.85 count/minute and 19.00 ± 4.24 count/minute respectively. To verify whether the initial assessment of sit -ups scores differ between experiment and placebo group, t- test was conducted. The calculated t-value was 1.718 and found to be not significant.

The mean Sit- ups score for experimental and placebo on 90th day were 15.20 ± 3.90 count/minute and 19.20 ± 1.92 count/minute respectively. It was observed that for the experimental group, it has reduced from the initial values (14.60 ± 3.85 count/minute) and for placebo less differenced was observed when compared to initial value (19.00 ± 4.24 count/minute). The mean values show that there are some differences in the experiment as well as placebo group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of Sit ups (90th day) is significant at $p < 0.01$ level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment is 0.835. That is, no significant differences in the final values of experiment and placebo group.

The mean Push up score of female experiment group on 0th day is 15.20 ± 3.03 count/minute and on 30th, 60th and 90th day; the values were 15.40 ± 2.61 count/minute and 15.60 ± 3.51 count/minute and 15.80 ± 3.42 count/ minute respectively. To test whether the push up score differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.61 which is found to be not significant .That is, no significant difference in the mean push- ups score of female experimental group among the four periods

Similarly among female placebo group, the mean Push up score on 0th day was 15.60 ± 1.34 and on 30th, 60th and 90th day, the values were 15.20 ± 1.10 count/minute, 16.00 ± 1.22 count/minute and 15.80 ± 1.92 count/minute respectively.

To test whether the push-ups level differs significantly among the four periods; repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 0.51, which is found to be not significant. That is, no significant difference in the mean push-ups score of female placebo group among the four periods.

The mean push-ups level for experiment and placebo group is 15.20 ± 3.03 count/minute and 15.60 ± 1.34 count/minute respectively. To verify whether the initial assessment of push-ups differs between placebo and experiment and placebo group, t-test was conducted. The calculated t-value was 0.270 and found to be not significant.

The mean push up values for female experimental and placebo on 90th day was 15.80 ± 3.42 count/minute and 15.80 ± 1.92 count/minute respectively. Less difference was observed from the initial values of 15.20 ± 3.03 count/minute (experimental) and 15.60 ± 1.34 count/minute (placebo). Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value for this; analysis of covariance, ANACOVA was applied. The result show that the covariate that is the initial assessment of push-ups is significant at ($p < 0.05$), the F-ratio comparing the final value between experimental and placebo after adjusting the initial assessment was 0.26, which means no significant difference were found in the final value of experimental and placebo group.

.The mean 30 m flying start test score of female experiment group on 0th day was 5.12 ± 0.25 and on 30th 60th and 90th day, the values were 4.99 ± 0.33 sec, 4.71 ± 0.09 sec and 4.68 ± 0.12 sec respectively. To test whether the 30 meter flying start test level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 6.70 which is found to be significant at ($p < 0.05$). That is there is significant difference in the mean 30 meter flying start test score of female experimental group among the four periods. Since the F-ratio was significant, Student Newman-Kuels (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XLVII
SNK TEST OFFEMALE EXPERIMENTAL GROUP OF 30 METER FLYING

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		5.12	4.99	4.71	4.68		
0 day	5.12		0.13 ^{NS}	0.41*	0.44*	4	0.351
30 th day	4.99			0.28 ^{NS}	0.31 ^{NS}	3	0.316
60 th day	4.71				0.03 ^{NS}	2	0.258
R			2	3	4		
Value at 0.05 level			3.083	3.775	4.2		
RCV			0.258	0.316	0.351		

*-significant at 5% level; NS- not significant

The mean difference between 0th day and 30th day was 0.13, which is less than their Range Critical (RCV) value of 0.258. Hence the difference is not significant. However, the difference between 0th day, 60th day and 90th day were 0.41 and 0.44 respectively which is greater than their corresponding RCV 0.316 and 0.351 respectively. This shows that significant difference (at $p < 0.05$). The difference between 30th and 60th day; 30th and 90th day; 60th and 90th day were less than the RCV. Hence no significant were observed.

Similarly, mean 30 meter flying start test of female placebo group on 0th day was 4.40 ± 0.11 sec and on 30th, 60th and 90th days were 4.25 ± 0.22 sec and 3.77 ± 0.37 sec respectively. To test whether the 30 meter flying start test level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods 12.59 which is found to be significant at ($p < 0.01$). That is, there is significant difference in the mean 30 meter flying start test score of female placebo group among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLEXLVIII
S-N-K PLACEBO FEMALE FOR 30 METER FLYING

Treatment		0 day	30 th day	60 th day	90 th day	R	RCV
Mean		4.40	4.25	3.77	3.69		
0 day	4.40		0.15 ^{NS}	0.63*	0.71*	4	0.416
30 th day	4.25			0.48*	0.56*	3	0.374
60 th day	3.77				0.08	2	0.305
R			2	3	4		
Value at 0.05 level			3.083	3.775	4.2		
RCV			0.305	0.374	0.416		

*- significant at 5% level; NS-Not significant

The mean difference between 0th day and 30th day mean was 0.15 which is less than their Range Critical (RCV) value of 0.30. Hence the difference is not significant. However, the difference between 0th day and 60th day and 90th day were 0.63 and 0.71 respectively. This was higher than their corresponding RCV of 0.37 and 0.416. Hence significant difference at $p < p.05$ were found. A significant difference between 30th and 60th; 30th and 90th day was also seen since the difference is higher than the RCV. But no significant changes were seen on 60th to 90th day.

The mean 30meter flying start score for experiment and placebo group were 5.12 ± 0.25 sec and 4.40 ± 0.11 sec respectively. To verify whether the initial assessment of 30 meter flying start test differ between experiment and placebo group, t- test was conducted to test for significant difference between experiment and placebo group. The calculated t-value was 5.76 and found to be not significant.

The mean 30 meter flying start test values for female experimental and placebo on 90th day is 4.68 ± 0.12 sec and 3.69 ± 0.37 sec respectively, which slightly decreased from initial 5.12 ± 0.25 sec (experimental) and 4.40 ± 0.45 sec (placebo), this shows that there is only a slight decreased in the placebo group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, ANACOVA was applied. The result shows that the covariate, i.e initial assessment of 30 meter flying start test (90th day) is

significant at ($p < 0.01$) level. The F-ratio comparing the final value between female placebo and experiment after adjusting the initial assessment was 8.068 which mean significant at ($p < 0.05$).

The mean 6X10 meter shuttle run score of female experimental group on 0th day was 16.33 ± 0.41 and on 30th, 60th and 90th day; the values were 16.09 ± 0.25 , 15.77 ± 0.47 and 15.64 ± 0.50 respectively. To test whether the 6X10 meter shuttle run level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 6.376 and found to be significant at ($p < 0.05$). That is there is significant difference in the mean 6X10 meter shuttle run levels among the four periods.

Similarly, the mean 6X10 meter shuttle run score of female placebo group on 0th day is 15.94 ± 1.15 sec and on 30th, 60th and 90th days, the score were 15.73 ± 0.81 sec, 16.11 ± 1.19 sec and 15.93 ± 0.88 sec respectively. To test whether the 6X10 meter shuttle run score differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 1.360 which is found to be not significant. Hence there is no significant difference in the mean 6X10 meter shuttle run score of female placebo group among the four periods.

The mean 6X10 meter shuttle run score for experiment and placebo group is 16.33 ± 0.41 sec and 15.94 ± 1.15 sec respectively. To verify whether the initial assessments of 6X10 meter shuttle run score differ between experiment and placebo group, t- test was conducted. The calculated t-value is for male was 1.412 and for female was 0.718 and both are not significant.

The final value for experimental group 15.64 ± 0.50 sec and placebo 15.93 ± 0.88 sec were decreased from the initial values 16.33 ± 0.41 sec (experimental) and 15.94 ± 1.15 sec (placebo group). Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of hemoglobin (90th day) is significant at ($p < 0.05$) level The F-ratio comparing the final value between female placebo and experiment after adjusting the initial assessment is 3.426 which mean no significant.

However, However, the mean difference of 0th and 90th days of 6X10 meter shuttle run score of female experimental group was 0.69 which was slightly higher than the mean difference of 0th to 90day placebo group (0.01).Therefore experimental group had better improvement than placebo group.

The mean VO₂ max score of female experiment group on 0th day was 33.46± 0.81 and on 30th 60thand 90th day, the values were 35.04 ±1.85 ml/kg/min, 36.00±0.67 ml/kg/minand 36.56 ±1.31 respectively. To test whether the VO₂ max score differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 6.49 which is found to be significant at p<0.01 level. That is, there is significant difference in the mean VO₂ max levels among the four periods.

Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE XLIX
S-N-K TEST EXPERIMENTAL FEMALE ATHLETES FOR VO₂MAX

Treatment	Mean	0 day	30 day	60 day	90 day	r	RCV
		33.46	35.04	36.00	36.56		
0 day	33.46		1.58 ^{NS}	2.54*	3.10*	4	2.237
30 day	35.04			0.96 ^{NS}	1.52 ^{NS}	3	2.010
60 day	36.00				0.56 ^{NS}	2	1.642
R			2	3	4		
Value at 0.05 level			3.083	3.775	4.2		
RCV			1.642	2.010	2.237		

*-significant at 5% level;NS-Not significant

The above table shows that the difference between 0th day and 30th day mean was 1.58 which is less than their Range Critical (RCV) value of 1.642. Hence the difference is not significant. However, the difference between 0th day and 60th day and 90th day was 2.54 and 3.10 respectively which were higher than their corresponding RCV of 2.01 and 2.23.This shows that statistically significant difference at (p<0.05) level. The difference between 30th and 60th; 30th and 90th; 60th

and 90th were less than their corresponding RCV. Therefore no significant different were found.

Similarly, the mean VO₂ max level of female placebo group on 0th day was 34.04±1.15ml/kg/min and on 30th, 60th and 90th days the values were 34.18 ±1.52 ml/kg/min, 35.08±1.13 ml/kg/min and 35.22±1.55 ml/kg/min respectively. This shows that there is minimal change in the VO₂ max level for placebo female athletes. To test whether the VO₂ max level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 1.941 which is found to be not significant. Therefore, the mean VO₂ level of female placebo group among the four periods was not significant.

The mean VO₂ max level for experiment and placebo group was 33.46±0.81 ml/kg/min and 34.04±1.15 ml/kg/min respectively. This shows that there is minimal increased in both groups. To verify whether the initial assessment of VO₂ max differs between experiment and placebo group, t- test was conducted. The calculated t-value was 0.920 and found to be not significant.

The mean VO₂ max values for female experimental and placebo on 90th day was 36.56 ± 1.31 ml/kg/min and 35.22±1.55 ml/kg/min respectively, which were increased from the initial values 33.46±0.81 ml/kg/min (experimental) and increased from 34.04±1.15 (placebo group) respectively, this shows that there is significantly increased in both the group. Since the difference in the initial values was carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment has from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of VO₂ (0th day) is not significant. The F-ratio comparing the final value between female placebo and experiment after adjusting the initial assessment is 3.920 which mean no significant. However, the mean difference of 0th and 90th days of VO₂ max score of female experimental group was 3.1 which were slightly higher than the mean difference of 0th to 90day placebo group (1.18). Therefore experimental group has better improvement than placebo group.

The overall effect of supplementation on fitness parameters is presented in Table L.

TABLE L
EFFECT OF SUPPLEMENTATION ON FITNESS PARAMETERS

Parameters	Male						Female					
	30 th day		60 th day		90 th day		30 th day		60 th day		90 th day	
	E	P	E	P	E	P	E	P	E	P	E	P
Vertical jump	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS	NS	NS
Standing broad jump	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS	NS	NS
Sit ups	NS	NS	NS	NS	NS	0-90 th day* 30 th -90 th day* 60 th -90 th day*	NS	NS	NS	NS	NS	NS
Push ups	NS	NS	NS	30 th -60 th day* 0 th -60 th day*	NS	30 th -90 th day* 0-90 th day*	NS	NS	NS	NS	NS	NS
30 meter flying			0-60 th *		0-90 th *	0-90 th day*		0-60 th day *	30 th -60 th *	0 th -90 th day *		30 th -90 th day* 0-90 th day *
6X10 meter shuttle run	NS	NS	NS	NS	NS	0-90 th day*						
VO ₂ max	NS	NS	0 th -60 th *	NS	30 th -90 th * 0 th -90 th *	NS	NS	NS	0-60 th day *	NS	0-90 th day*	NS

Figures in parentheses indicate the percentage of athletes in each category

E-Experimental ;P-Placebo ;*-significant at 5 % level;NS-Not significant.

The supplementation study involved administration of Hibisa drink (with dried and powdered calyces of *Hibiscus sabdariffa* Linn, MTC and salt in potable water) to the experimental group and MTC and salt in potable water to the placebo group for 90 days.

On the whole, neither Hibisa drink nor the placebo had any effect on vertical jump and standing broad jump of both male and female athletes, during the entire period. Among the experimental group of male athletes, there was statistically significant improvement ($p < 0.05$) between 0 and 60 and 0 and 90 days of supplementation for 30m flying start. VO_2 max improved significantly ($p < 0.05$) between 0 and 60, 0 and 90 and 30 to 90 days. In female athletes there was statistically significant ($p < 0.05$) improvement in 30m fly between 0 and 60 and 0 and 90 days of supplementation. VO_2 max was significantly ($p < 0.05$) during 0-60 and 0-90 days. Thus it can be inferred that Hibisa had beneficial effect on 30m fly (speed) and VO_2 max (cardio respiratory endurance) of athletes (both genders)

In the placebo group of male athletes, sit ups improved significantly ($p < 0.05$) at 0-90, 30-90 and 60-90 days; push ups significantly improved ($p < 0.05$) between 0-60, 0-90, 30-60 and 30-90 days; 30m fly improved significantly ($P < 0.05$) during 0-60 and 0-90 days; 6x10m shuttle run improved at 5% level after 90 days. Among female athletes, only 30m fly improved significantly ($p < 0.05$) during 30-60 and 0-90 days of intervention. The placebo was more beneficial to male athletes (sit ups – flexibility; push ups - strength; 30mfly – speed; 6x10m shuttle run - agility) than female athletes (30mfly - speed).

b. On Biochemical parameters

Tables LI to LIV presents the effect of supplementation Hibisa drink on biochemical parameters of male athletes.

TABLE LI
EFFECT OF SUPPLEMENTATION ON BIOCHEMICAL PARAMETERS
OF MALE ATHLETES

Parameters	0day ± SD	30 th day ±SD	60 th day ±SD	90 th day ±SD	F-value
Haemoglobin(g/dl)	14.45±	14.76±	14.87±	15.15±	4.42*
Experimental	1.24	1.13	1.09	1.03	
Placebo	14.45± 1.08	14.41± 1.09	14.42± 1.04	14.44± 1.04	0.23 ^{NS}
Serum ferritin (ng/ml)	40.37±	40.97±	42.07±	43.51±	5.17**
Experimental	18.91	19.17	19.14	20.11	
Placebo	39.83± 18.24	39.71± 18.35	39.86± 18.57	40.35± 18.77	1.35 ^{NS}
Blood glucose (mg/dl)	76.36±	76.54±	76.20±	75.97±	0.86 ^{NS}
Experimental	10.84	10.01	10.10	9.17	
Placebo	76.26± 5.77	76.58± 5.74	76.90± 6.09	77.03± 6.32	2.60 ^{NS}
Serum lactate dehydrogenase (U/L)	289.20±	283.10±	266.40±	249.40±	7.17**
Experimental	44.37	50.26	52.65	62.84	
Placebo	275.20± 49.75	274.00± 49.25	273.10± 48.72	272.50± 48.37	2.49 ^{NS}

*- significant at 5% level;** - significant at 1 % level; NS-Not significant

The mean blood haemoglobin level of male experimental group on 0th day was 14.45±1.24 and on 30th, 60th and 90th day, the values were 14.76±1.13 g/dl, 14.87±1.09 g/dl and 15.15±1.03g/dl respectively. To test whether the haemoglobin level differs significantly among the four periods, repeated measures ANOVA were conducted to test the above hypothesis. The F-ratio value comparing the four periods was 4.42 which is found to be significant at p<0.05 level. That is, there is significant difference in the mean haemoglobin levels among the four periods.

Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE LII
S-N-K TEST EXPERIMENTAL MALE ATHLETES ON
HAEMOGLOBIN LEVEL

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		14.45	14.76	14.87	15.15		
0 day	14.45		0.31 ^{NS}	0.42 ^{NS}	0.70*	4	0.532
30 th day	14.76			0.11 ^{NS}	0.39 ^{NS}	3	0.482
60 th day	14.87				0.28 ^{NS}	2	0.399
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			0.399	0.482	0.532		

*-significant at 5 % level;NS- Not significant.

The mean difference between 0th day and 30th day was 0.31 which is lower than the corresponding RCV (Range Critical Value) 0.399. Which indicate no significant differences. Similarly, the differences between 0th and 60; 30th and 60; 30 and 90th were 0.42, 0.11 and 0.39 respectively which was lower than the corresponding RCV 0.482, 0.482 and 0.532 respectively indicates no significant differences. However, the difference between 0th day and 90th days was 0.70 which is higher than the corresponding RCV 0.532, which indicates that significant difference (at $p < 0.05$) was found in 0th and 90th day supplementation.

Similarly, the mean blood haemoglobin level of male placebo group on 0th day was 14.45 ± 1.08 g/dl and on 30th 60th and 90th day, the values were 14.41 ± 1.09 g/dl, 14.42 ± 1.04 g/dl and 14.445 ± 1.04 g/dl respectively. To test whether the haemoglobin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.23 which is found to be not significant. That is, there is no significant difference in the mean haemoglobin levels among the four periods.

The mean haemoglobin level for male experiment group on 0th day male was 14.45 ± 1.24 g/dl and for placebo was 14.45 ± 1.08 g/dl. To verify whether the initial assessment of haemoglobin differ between placebo and experiment and placebo group, t- test was conducted. The calculated t-value was 0.00 and no significant difference was found.

The mean haemoglobin level of male experimental and placebo group on 90th day was 15.15± 1.03 g/dl and 14.44±1.04 g/dl respectively. When compared with the initial value (14.45 ±1.24 g/dl), it was observed that there is an increase for experimental group but no changes in the final value for placebo group when compared to initial value (14.45±1.08g/dl). Since the difference in the initial values will also be carried over before testing for testing for difference between experiment and placebo group. The effect of initial assessment has to be removed from the final value. For this, analysis of covariance, ANACOVA was applied to test the above hypothesis. The result shows that the covariate, i.e initial assessment of haemoglobin (90th day) is significant at p<0.01 level. The F –ratio comparing the final value between male experimental and placebo group after adjusting the initial assessment was 8.208 which is significant at p<0.05 level. That is, there exist significant differences in the final values of experiment and placebo group.

The mean serum ferritin level of male experimental group on 0th day was 40.37±18.91 ng/ml and on 30th, 60th and 90th day, the values were 40.97±19.17 ng/ml, 42.07±19.14 ng/ml and 43.51±20.11 ng/ml respectively. To test whether the serum ferritin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 5.17 which is found to be significant at p<0.01 level. That is, there is significant difference in the mean serum ferritin levels among the four periods.

Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means

TABLE LIII
S-N-K TEST for EXPERIMENTAL MALE (SERUM FERRITIN LEVEL)

Treatment	Mean	0 day	30 th day	60 th day	90 th day	r	RCV
		40.37	40.97	42.07	43.51		
0 day	40.37		0.60 ^{NS}	1.70 ^{NS}	3.14*	4	2.349
30 th day	40.97			1.10 ^{NS}	2.54*	3	2.128
60 th day	42.07				1.44 ^{NS}	2	1.761
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			1.761	2.128	2.349		

*-significant at 5 % level;NS- Not significant.

The mean difference serum ferritin level between 0th day and 30th day was 0.60 which is lower than the corresponding RCV (Range Critical Value) 1.76, which indicates no significant differences. Similarly, the differences between 0th and 60; 30th and 60; 60 and 90th were 0.70, 1.10 and 1.44 respectively which was lower than the corresponding RCV 2.12, 2.12 and 2.34 respectively indicates that no significant differences. However, the difference between 0th day and 90th; 30th and 90th days was 3.14 and 2.54 respectively which was higher than the corresponding RCV 2.34, which indicates that significant difference (at $p < 0.05$). This shows that improvement of ferritin was seen on 90th day of supplementation of Hibisa drink.

The mean serum ferritin level of male placebo group on 0th day was 39.83 ± 18.24 ng/ml and on 30th, 60th and 90th day, the values were 39.71 ± 18.35 ng/ml, 39.86 ± 18.5 ng/ml and 40.35 ± 18.77 ng/ml respectively. To test whether the serum ferritin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 1.35 which is found to be not significant. That is, there is no significant difference in the mean serum ferritin levels among the four periods.

The mean ferritin level of male experiment and placebo group on 0th day male was 40.37 ± 18.91 ng/ml and 39.83 ± 18.24 ng/ml respectively. To verify whether the initial assessment of serum ferritin level differs between placebo and experiment and placebo group, t- test was conducted to test for significant difference between experiment and placebo. The calculated t-value was 0.06 and found to be not significant.

The mean serum ferritin level of male experimental and placebo on 90th day was 43.51 ± 20.11 ng/ml and 40.35 ± 18.77 ng/ml respectively which were increased when compared with the initial 40.37 ± 18.91 ng/ml (experimental) and placebo group (39.83 ± 18.24 ng/ml). The mean value shows that there are some differences in experiment and placebo group. Since the difference in the initial values was also be carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, ANACOVA was applied. The result shows that the covariate, i.e initial assessment of serum ferritin (90th day) is significant at $p < 0.01$ level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment

was 3.82. That is, there exist no significant differences in the final values of experiment and placebo group.

The mean blood glucose level of male experimental group on 0th day was 76.36±10.84 mg/dl and on 30th, 60th and 90th day, the values were 76.54±10.01 mg/dl, 76.20±10.10 mg/dl and 75.97±9.17 mg/dl respectively. To test whether the blood glucose level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 0.86 which is found to be not significant. That is, there is no significant difference in the mean blood glucose levels among the four periods.

Similarly, the mean blood glucose level of male placebo group on 0th day was 76.26±5.77 mg/dl and on 30th, 60th and 90th day, the values were 76.58±5.74 mg/dl, 76.90±6.09 mg/dl and 77.03±6.32 mg/dl respectively. To test whether the blood glucose level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 2.60 which is found to be not significant. That is, there is no significant difference in the mean blood glucose levels among the four periods.

The improvement in haemoglobin level in the present study is supported by Kelker *et al.*, (2008) where the effect of antioxidant supplementation remarkably reduced serum MDA (Malondialdehyde) level ($p = 0.003$) after supplementation also improve hematological status

The mean blood glucose level for experiment group on 0th day male was 76.36±10.84 mg/dl and for placebo was 76.26±5.77 mg/dl. To verify whether the initial assessment of blood glucose differs between experimental and placebo group, t- test was conducted. The calculated t-value was 0.026, hence no significant difference was found.

The mean blood glucose values for experimental and placebo on 90th day was 75.97± 9.17 mg/dl and 77.03 ± 6.32 mg/dl respectively. Compared with the initial 76.36 ± 10.84 mg/dl (experimental) it was almost similar but slight increased was observed on placebo group when compared with initial value 76.26±5.77 mg/dl. The mean values show that there is less change in experiment group but slightly increased in the placebo group. Since the difference in the initial values was also be carried over before testing the difference between experiment and placebo group. To

remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of blood glucose (0th day) is significant at p<0.01 level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment was 3.56. That is, there exist no significant differences in the final values of experiment and placebo group.

Parisi *et al.*, (2010)also supported that the Chronic Rhodiola Rosea supplementation of 4 weeks on 14 trained male athletes had no effect on blood sugar level. Similar findings are reported in the present study also.

The mean LDH level (serum lactate dehydrogenase) of male experimental group on 0thday was 289.20±44.37 U/L and on 30th 60thand 90th day, the values were 283.10±50.26 U/L, 266.40±52.65 U/L and 249.40±62.84 U/L respectively. To test whether the LDH level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 7.17 which is found to be significant at p<0.01 level. That is, there is significant difference in the mean LDH level among the four periods. Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE LIV
S-N-K TEST MALE EXPERIMENTAL GROUP ON LDH LEVEL

Treatment	Mean	0 day	30 th day	60 th day	90 th day	R	RCV
		289.20	283.10	266.40	249.40		
0 day	289.20		6.10 ^{NS}	22.80 ^{NS}	39.80*	4	25.883
30 th day	283.10			16.70 ^{NS}	33.70*	3	23.450
60 th day	266.40				17.00 ^{NS}	2	19.405
R			2	3	4		
Value at 0.05 level			2.903	3.508	3.872		
RCV			19.405	23.450	25.883		

*- significant at 5% level ;NS- Not significant.

The mean difference LDH level between 0th day and 30th day was 6.10 which is lower than the corresponding RCV (Range Critical Value) 19.40, which indicate no significant differences. Similarly, the differences between 0th and 60; 30th and 60; 60 and 90th were 22.80, 16.70 and 17.00 respectively which was lower than the

corresponding RCV 23.45, 23.45 25.88 respectively indicates that no significant differences. However, the difference between 0th day and 90th; 30th and 90th days was 39.80 and 33.70 respectively which was higher than the corresponding RCV 25.88, which indicates that significant difference (at $p < 0.05$) was found in 0th and 90th day of supplementation.

Similarly the mean LDH level (serum lactate dehydrogenase) of male placebo group on 0th day was 275.20 ± 49.75 U/L and on 30th 60th and 90th day, the values were 274.00 ± 49.25 U/L, 273.10 ± 48.72 U/L and 272.50 ± 48.37 U/L respectively. To test whether the LDH level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 2.49 which is found to be not significant. That is, there is no significant difference in the mean LDH levels among the four periods.

The mean LDH level of male experiment and placebo group on 0th day male was 289.20 ± 44.37 U/L and 275.20 ± 49.75 U/L respectively. To verify whether the initial assessment of LDH differ between placebo and experiment and placebo group, t- test was conducted .The calculated t-value was 0.664, hence significant difference was observed.

The mean LDH values for experimental and placebo on 90th day was 249.40 ± 62.84 U/L and 272.50 ± 48.37 U/L respectively which have reduced from the initial values of 289.20 ± 44.37 U/L and 275.20 ± 49.75 U/L respectively. This shows that there is a significant reduction in the experiment group. Since the difference in the initial values was carried over before testing for testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied. The result showed that the covariate, i.e initial assessment of LDH (90th day) is significant at $p < 0.01$ level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment was 5.95. That is, there no significant differences in the final values of experiment and placebo group.

The lowering value of Blood lactate dehydrogenase level in present study is supported by Aguilo *et al.*, (2007) that antioxidant diet supplement lower maximal blood lactate concentration supplements than in the placebo group. Parisi *et al.*, (2010) also supported that the Chronic Rhodiola Rosea supplementation of 4 weeks on 14 trained male athletes reduce both lactate levels ($P < 0.05$) and parameters of skeletal muscle

damage after an exhaustive exercise session. Bharati *et al.*, (2015) also supported that the effect of Aloe vera on cell damage in male athletes significantly reduced LDH (P=.006) during aerobic exercise when compared to placebo group.

Tables LV to LVIII presents the effect of supplementation Hibisa drink on biochemical parameters of female athletes.

The mean blood haemoglobin g/dl level of female experimental group on 0th day was 10.80±1.55 g/dl, and on 30th 60th and 90th day, the values were 11.30±1.69 g/dl, 11.36±1.72 g/dl and 12.30±2.36 g/dl respectively. To test whether the haemoglobin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 1.41 which is found to be not significant. That is, there is no significant difference in the mean haemoglobin levels among the four periods.

TABLE LV
EFFECT OF SUPPLEMENTATION ON BIOCHEMICAL PARAMETERS
AMONG FEMALE ATHLETES

N=5/group

Parameters	0 th day ±SD	30 th day ±SD	60 th day ±SD	90 th day ±SD	F-test
Haemoglobin (g/dl)	10.80±	11.30±	11.36±	12.30±	1.41 ^{NS}
Experimental	1.55	1.69	1.72	2.36	
Placebo	12.64±	12.70±	12.66±	12.62±	0.25 ^{NS}
	1.17	1.13	1.27	1.36	
Serum ferritin (ng/ml)	24.90±	25.84±	27.04±	27.46±	5.17 ^{**}
Experimental	12.54	11.03	11.30	11.55	
Placebo	32.06±	31.96±	32.00±	32.08±	0.07 ^{NS}
	15.40	15.67	15.21	14.72	
Blood glucose (mg/dl)	79.46±	79.12±	78.48±	78.84±	0.24 ^{NS}
Experimental	8.52	7.44	6.25	5.79	
Placebo	73.38±	74.42±	75.94±	77.36±	2.61 ^{NS}
	6.84	6.62	4.79	2.87	
Serum lactate dehydrogenase(U/L)	284.80±	280.40±	257.80±	272.40±	2.86 ^{NS}
Experimental	57.98	57.68	52.76	52.06	
Placebo	275.80±	274.80±	265.00±	254.60±	1.20 ^{NS}
	25.59	24.95	15.41	26.71	

** - Significant at 1% level; NS – Not significant

Similarly, the mean blood haemoglobin level of female placebo group on 0th day was 12.64±1.17 g/dl and on 30th 60th and 90th day, the values were 12.70±1.13 g/dl, 12.66±1.27 g/dl and 12.62±1.36 g/dl respectively. To test whether the

haemoglobin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.25 which is found to be not significant. That is, there is no significant difference in the mean haemoglobin levels among the four periods.

The mean haemoglobin level for female experiment group on 0th day male was 10.80 ± 1.55 g/dl and for placebo was 12.64 ± 1.77 g/dl. To verify whether the initial assessment of haemoglobin differ between placebo and experiment and placebo group, t- test was conducted. The calculated t-value was 2.11 and no significant difference was found.

The mean haemoglobin level of female experimental and placebo group on 90th day was 12.30 ± 12.36 g/dl and 12.62 ± 1.36 g/dl respectively. When compared with the initial value (10.80 ± 1.55 g/dl), it was observed that there is an increased for experimental group but no changes in the final value for placebo group when compared to initial value (12.64 ± 1.17 g/dl). Since the difference in the initial values will also be carried over before testing for testing for difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of haemoglobin (90th day) is not significant. The F – ratio comparing the final value between male experimental and placebo group after adjusting the initial assessment was 0.36. That is, there exist no significant differences in the final values of experiment and placebo group.

However, the mean differences of hemoglobin level for experimental female group on 0th to 90th day was 1.5, which was higher than the mean differences of haemoglobin level for placebo group (0.02). This shows that experimental group has better improvement than placebo group after supplementation. This could be the reason of rich iron content of *Hibiscus sabdariffa* Linn. Maregesi *et al.*, (2013) reported that *Hibiscus sabdariffa* Linn was found to contain a higher amount of iron content (164.78 mg/kg). Presence of iron justifies the nutraceutical use as haemoglobin enhancer.

Ghislain *et al.*, (2011) studied the effect of the consumption of *Hibiscus sabdariffa* Linn juice extracted from the dried calyx of *Hibiscus sabdariffa* Lin on some biochemical parameters in humans. The findings suggest that Hibiscus juice

can safely be used in the prevention and management of anaemia and cardiovascular diseases and may also have some level of hepatoprotective effects as far as transaminases are concerned.

Aguilo *et al.*, (2004) that antioxidant supplementation (vitamins E and C, and β-carotene) prevent the decrease of serum iron and the iron saturation index, and a link between iron metabolism and oxidative stress

The mean serum ferritin level of female experimental group on 0th day was 24.90±12.54 ng/ml and on 30th 60th and 90th day, the values were 25.84±11.03 ng/ml, 27.04±11.30 ng/ml and 27.46±11.55 ng/ml respectively. To test whether the serum ferritin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 4.40 which is found to be significant at p<0.05 level. That is, there is significant difference in the mean serum ferritin level among the four periods.

Since the F-ratio was significant, Student Newman –Kouls (S-N-K) Post hoc test was conducted to find which two periods differ significantly in their ordered means.

TABLE LVI

S-N-K TEST FOR EXPERIMENTAL FEMALE (SERUM FERRITIN LEVEL)

Treatment	Mean	0 day	30 th day	60 th day	90 th day	r	RCV
		24.90	25.84	27.04	27.46		
0 day	24.90		0.94	2.14*	2.56*	4	2.329
30 th day	25.84			1.20 ^{NS}	1.62 ^{NS}	3	2.094
60 th day	27.04				0.42 ^{NS}	2	1.710
R			2	3	4		
Value at 0.05 level			3.083	3.775	4.2		
RCV			1.710	2.094	2.329		

*-significant at 5 % level;NS-Not significant.

The mean difference serum ferritin level between 0th day and 30th day was 0.94 which is lower than the corresponding RCV (Range Critical Value) 1.71, which indicates no significant differences. Similarly, the differences between 0th and 60; 0th and 90th were 2.14, and 2, 56 respectively which was higher than the corresponding

RCV 2.09 and 2.32 respectively indicates that significant differences at $p < 0.05$ level was observed. However, the difference between 30th day and 60th; 30th and 90th days; 60th and 90th day was 1.20, 1.62 and 0.42 respectively which was lower than the corresponding RCV 2.09, 2.09 and 2.23 respectively which indicates that no significant difference were observed. However, it was observed that significant improvement on serum ferritin was seen on 0th to 60th and 90th day of supplementation.

Similarly, mean serum ferritin level of female placebo group on 0th day was 32.06 ± 15.40 ng/ml and on 30th 60th and 90th day, the values were 31.96 ± 15.67 ng/ml, 32.00 ± 15.21 ng/ml and 32.08 ± 14.72 ng/ml respectively. To test whether the serum ferritin level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 0.75 which is found to be not significant. That is, there is no significant difference in the mean serum ferritin level among the four periods.

The mean ferritin level of female experiment and placebo group on 0th day female was 24.90 ± 12.54 ng/ml and 32.06 ± 15.40 ng/ml. The following hypothesis was frame to verify whether the initial assessment of serum ferritin level differs between placebo and experiment and placebo group, t- test was conducted. The calculated t-value was 0.80 and found to be not significant.

The mean serum ferritin value of female experimental and placebo on 90th day were 27.46 ± 11.55 ng/ml and 32.08 ± 14.72 ng/ml respectively, which was increase when compared with the initial 24.90 ± 12.54 ng/ml (experimental) and for placebo no changes were observed. Since the difference in the initial values was also be carried over before testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of serum ferritin on (90th day) is significant at $p < 0.01$ level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment was 3.61 which means no significant. That is, there exist no significant differences in the final values of experiment and placebo group.

However, the mean difference of serum ferritin value of female experimental group on 0th day and 90th day was 2.45 which is higher than the mean difference of serum ferritin of placebo group on 0th day and 90th day (0.02). This shows that experimental group had better improvement than placebo group.

The mean blood glucose level of female experimental group on 0th day was 79.46±8.52 mg/dl and on 30th, 60th and 90th day, the values were 79.12±7.44mg/dl, 78.48±6.25mg/dl and 78.84±5.79mg/dl respectively. To test whether the blood glucose level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 0.24 which is found to be not significant. That is, there is no significant difference in the mean blood glucose levels among the four periods.

Similarly, the mean blood glucose level of female placebo group on 0th day was 73.38±6.84mg/dl and on 30th, 60th and 90th day, the values were 74.42±6.62mg/dl, 75.94±4.79mg/dl and 77.36±2.87mg/dl respectively. To test whether the blood glucose level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 2.61 which is found to be not significant. That is, there is no significant difference in the mean blood glucose levels among the four periods.

The mean blood glucose level of female experimental and placebo group on 0th day was 76.46±0.82mg/dl and 73.38±6.84 mg/dl respectively. To verify whether the initial assessment of blood glucose differs between experimental and placebo group, t- test was conducted. The calculated t-value was 1.24, no significant difference was found.

The mean blood glucose values for experimental and placebo on 90th day was 78.84± 5.79 mg/dl and 77.36±2.87mg/dl respectively. Slight differences were observed when compared to the initial value of experimental (79.46 ± 8.52mg/dl) and placebo (73.38±6.84mg/dl). Since the difference in the initial values was also carried over before testing the difference between experimental and placebo group. To remove the effect of initial assessment from the final, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of blood glucose (90th day) is significant at p<0.01 level. The F –ratio comparing the final value between placebo and experiment after adjusting the initial assessment is

0.688 which is not significant. That is, there exist no significant differences in the final values of experiment and placebo group.

The mean LDH level (Serum Lactate Dehydrogenase) of female experimental group on 0th day was 284.80 ± 57.98 U/L and on 30th, 60th and 90th day, the values were 280.40 ± 57.68 U/L, 257.80 ± 52.76 U/L and 272.40 ± 52.06 U/L respectively. To test whether the LDH level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods is 2.86 which is found to be not significant. That is, there is no significant difference in the mean LDH levels among the four periods.

Similarly the mean LDH level (serum lactate dehydrogenase) of female placebo group on 0th day was 275.80 ± 25.59 U/L and on 30th, 60th and 90th day, the values were 274.80 ± 24.95 U/L, 265.00 ± 15.41 U/L and 254.60 ± 26.71 U/L respectively. To test whether the LDH level differs significantly among the four periods, repeated measures ANOVA were conducted. The F-ratio value comparing the four periods was 1.20 which is found to be not significant. That is, there is no significant difference in the mean LDH levels among the four periods.

The mean LDH level of experiment and placebo group on 0th day female was 284.80 ± 57.98 U/L and 275.80 ± 25.59 U/L respectively. To verify whether the initial assessment of LDH differs between placebo and experiment and placebo group, t-test was conducted. The calculated t-value was 0.31 and no significant difference was observed.

The mean LDH values of female experimental and placebo on 90th day was 272.40 ± 52.06 U/L and 254.60 ± 26.71 U/L respectively which have reduced from the initial values of 284.80 ± 57.98 U/L and 275.80 ± 25.59 U/L respectively. This shows that there is a significant reduction in the experiment group. Since the difference in the initial values was carried over before testing for testing the difference between experiment and placebo group. To remove the effect of initial assessment from the final value, Analysis of covariance, (ANACOVA) was applied. The result shows that the covariate, i.e initial assessment of LDH (90th day) is significant at $p < 0.05$ level. The F –ratio comparing the final value between female experiment and placebo after adjusting the initial assessment was 0.375. That is, there no significant differences in the final values of experiment and placebo group.

The overall effect of supplementation on biochemical parameters of athletes is presented in Table LVII.

TABLE LVII
EFFECT OF SUPPLEMENTATION ON BIOCHEMICAL
PARAMETERS OF ATHLETES

Parameters	Male Athletes						Female Athletes						
	30 th day		60 th day		90 th day		30 th day		60 th day		90 th day		
	E	P	E	P	E	P	E	P	E	P	E	P	
Blood Haemoglobin (g/dl)	NS	NS	NS	NS	0-90 th day*	NS	NS	NS	NS	NS	NS	NS	NS
Serum Ferritin (ng/ml)	NS	NS	NS	NS	0-90 th day* 30-90 th day*	NS	NS	NS	0-60 th day*	NS	0-90 th *	NS	NS
Blood Glucose (mg/dl)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Serum lactate Dehydrogenase (U/L)	NS	NS	NS	NS	0-90 th day* 30-90 th day*	NS	NS	NS	NS	NS	NS	NS	NS

*- significant at 5 % level; NS-Not significant .

Statistical analysis of the data on the effect of supplementation on biochemical parameters revealed the edge of Hibisa drink over the placebo as a food supplement. Hibisa improved blood haemoglobin of male athletes significantly ($p < 0.05$) on 90 days of supplementation, serum ferritin levels between 0 and 90 days and 30 and 90 days ($p < 0.05$). Serum lactate dehydrogenase decreased significantly ($p < 0.05$) on 90 days and between 30 and 60 days of supplementation. Among female athletes serum ferritin levels alone improved at 5% level on 60 and 90 days of supplementation. The placebo did not evince any improvement in any of the biochemical parameters, whatsoever. These findings drive home the fact that *Hibiscus sabdariffa* Linn has commendable potentials to improve the physical performance as well as blood/serum parameters. Supplementation for a longer duration on a larger group of athletes can further substantiate the benefits of the shrub as an ergogenic aid. Hence it can be used as/incorporated into any sports drink to benefit Thang -Ta athletes of Manipur.

c. Effect on Micro nutrient intake

Effect of supplementation on micronutrient intake is presented in Table LVIII

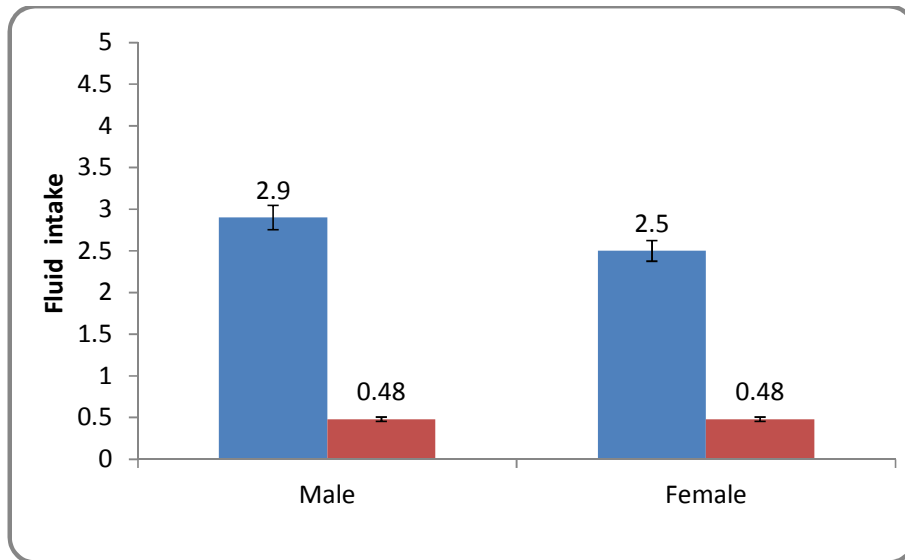
TABLELVIII
EFFECT OF SUPPLEMENTATION ON MICRONUTRIENT INTAKE

Micro nutrients	Intake			
	Male experimental group		Female experimental group	
	Before	After	Before	After
Iron (mg/g)	24.52 ±5.96	57.72	25.24±5.89	58.44
Vitamin C (mg/g)	24.67±3.26	149.67	24.58±5.26	149.38

It was observed that after supplementation of Hibisa drink, iron intake was increased to 57.72 mg/g from the initial 24.52 ±25.5.96 mg/g among male experimental group. Among experimental female, the iron intake increased to 58.44 mg/g from the initial 25.24±5.89. Similarly, vitamin C intake among male and female athletes increased to 149.67 mg/g from the initial (24.67±3.26 mg/g) and 149.38 mg/g from the initial (24.58±5.26 mg/g) respectively respectively. Therefore, it can be concluded that Hibisa drink has a potential of alleviating some of the micronutrient deficiency in economically poorer section. Improvement in micro nutrient intake was supported by Agte *et al.*, (2006) that effect of Green leafy vegetable as natural fortificant improve micro nutrient intake of iron, folic acid, vitamin C, riboflavin, zinc, B carotene and thiamine. Gallagher *et al.*, (2014) also reported that Food supplement rich in micro nutrient help to correct the micro nutrient imbalance by increasing the consumption

d. On Fluid Intake

The Effect of supplementation on fluid intake is depicted in figure 11.

**Figure11****Effect of Supplementation on Fluid Intake**

After supplementation of Hibisa drink, it was observed that the mean fluid intake was increased by 0.48 liter (480 ml) in both male and female. This shows that fluid intake was somewhat improved after supplementation. But it is highly needed to increase the fluid intake to reach the recommended allowance of athlete 8 l/day by (Venkataramana, 2009).

Volpe *et al.*, (2009) reported that athletes were hypo hydrated at different levels that is consumption of fluid intake is low than the recommended intake. A greater percentage of men than women were hypo hydrated. A proper hydration schedule should be encouraged.

E. EFFECT OF NUTRITION EDUCATION AMONG ATHLETES

The effect of nutrition education in terms of knowledge, attitude and practice were given in table LIX and LX.

TABLE LIX
EFFECT OF NUTRITION EDUCATION ON KNOWLEDGE,
(N=364)

Group	Male Thang Ta athletes						Female Thang –Ta athletes					
	15-19 years (n=198)		Z – Statistics	20-25 years (n=82)		Z Statistics	15-19 years (n=45)		Z – Statis tics	20-25 years (n=39)		Z Stati stics
	Proportion			Proportion			Proportion			Proportion		
	Before	After		Before	After		Before	After		Before	After	
Knowledge regarding on General Nutrition	0.29	0.82	25.98**	0.41	0.85	12.01**	0.32	0.84	11.38	.3410	.84	10.24**
Knowledge regarding on Food intake	0.36	0.74	13.49**	0.40	0.82	9.17**	0.36	0.74	13.4980**	0.40	0.82	9.17*
Knowledge regarding to Sports Nutrition and Hydration	0.36	0.83	25.74**	0.36	0.84	16.77**	0.36	0.83	25.74*	0.36	0.84	16.77**

**-significant at 1% level

It was observed that the proportion of male athlete (15 -19 years and 20-25 years) with the correct knowledge regarding general nutrition, knowledge regarding on food intake, knowledge regarding sports nutrition and hydration were significantly improved at $p < 0.01$ level after the education. Among female athletes, knowledge regarding general nutrition, food intake, Sports Nutrition and hydration among 15 -19 years and 20-25 years significantly improved at $p < 0.01$ level after the education.

TABLE LX
EFFECT OF NUTRITION EDUCATION ON ATTITUDE AND PRACTICE
ON MALE ATHLETES

N= 380

Group	Male Thang Ta athletes						Female Thang Ta athletes					
	Age group 15-19 years n=(198)		Z – Statistics	20-25 years (n=82)		Z Statistics	Age group 15-19 years n=(45)		Z – Statistics	20-25 years (n=39)		Z – Statistics
	Mean			Mean			Mean			Mean		
	Before	After	Before	After	Before	After	Before	After				
Attitude	39.09±6.25	60.34±2.21	45.34**	44.20±4.37	58.80±3.36	21.57**	41.68±5.10	58.44±2.84	19.07**	41.05±4.72	58.53±3.08	19.38**
Practice	2.17±0.20	3.36±0.19	67.876**	2.13±0.23	3.31±0.23	36.02**	2.25±0.17	3.45±0.159	34.00**	2.11±0.18	3.16±0.18	29.817**

**-significant at 1 % level.

The mean attitude score of 15-19 years male athletes before nutrition education was 39.09 ± 6.25 and after education it increased to 60.34 ± 2.21 which means after education the score significantly increased at $p < 0.01$ level. Similarly among 20-25 years athletes, the mean attitude score before nutrition education was 44.20 ± 4.37 and after education it increased to 58.80 ± 3.36 . This shows that after education the attitude score significantly increased at $p < 0.01$ level. The mean practice score of male athletes in the age group of 15-19 years before education was 2.17 ± 0.20 and it increased to 3.36 ± 0.19 after the education which significantly increased at $p < 0.01$ level. Similarly among female 20-25 years, the mean score of practice before education was 2.13 ± 0.23 and after education it increased to 3.31 ± 0.23 which indicate the practice score significantly increased at $p < 0.01$ level after education.

This findings was supported by Sangeetha *et al.*, (2014) that nutrition education improved nutrition knowledge of the selected sports person. Chaudhary and Sukhwal

(2016) also supported that Nutrition education improved mean awareness score among the athletes. Rossi *et al.*, 2017 also reported that sports nutrition education on nutritional status improve nutritional status, body composition and shuttle run performance

Similarly, the mean attitude score of 15-19 years female athletes before nutrition education was 41.68 ± 5.10 and after education it was increased to 58.44 ± 2.84 which means after education the score was significantly increased at $p < 0.01$ level. Similarly among 20-25 years athletes ,the mean attitude score before nutrition education was 41.05 ± 4.72 and after education it was increased to 58.53 ± 3.08 , which indicates the attitude score was significantly increased at $p < 0.01$ level. The mean practice score of male athletes in the age group of 15-19 years before education was 2.25 ± 0.17 and it increased to 3.45 ± 0.159 after the education which was significantly increased at $p < 0.01$ level. Similarly among female 20-25 years, the mean score of practice before education was 2.11 ± 0.18 and after education it increased to 3.16 ± 0.18 which indicate the practice score was significantly increased at $p < 0.01$ level after education

This present study findings was supported by Subapriya and Shaijamol, 2010, that nutrition education could be imparted through conventional (booklet, poster, chart) and computerized assisted nutrition education materials and assessed through KAP of athletes, and there was significant overwhelming effect on KAP. Cholewa *et al.*, (2015) also reported that Sports Nutrition Education Interventions improved significantly at $p < 0.05$ on sport nutrition knowledge among baseball players.

Figure 12 depicts the effect of nutrition education on fluid intake

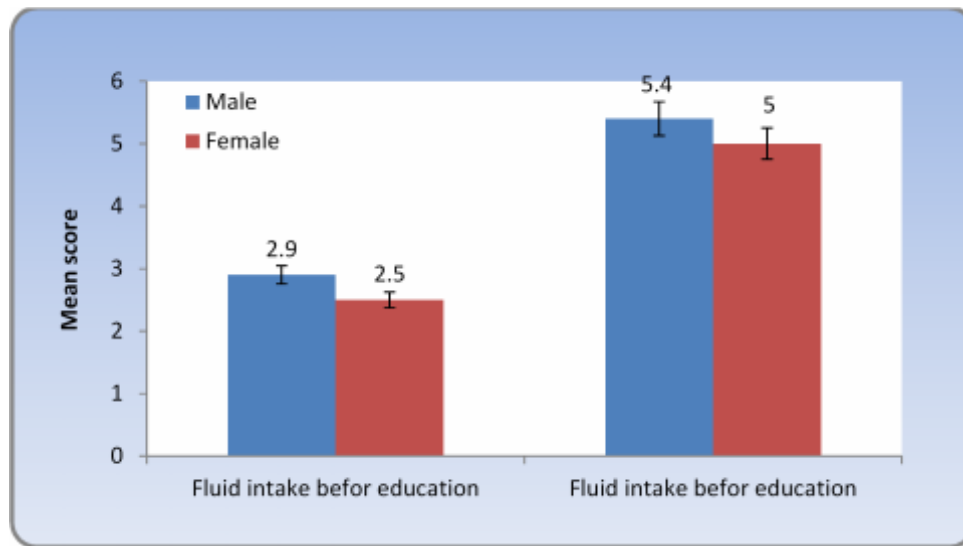


Figure 12

Effect of Nutrition Education on Fluid Intake

The mean fluid intake of male and female Thang -Ta athletes before education was 2.9 ± 0.72 and 2.57 ± 0.66 respectively. After the nutrition education the mean fluid increased to 5.43 ± 0.51 and 5.01 ± 5.5 respectively. However, fluid intake of Thang-Ta athletes could not reached the recommended allowance (8l/day) for athletes. This could be due to cold climate of Manipur. However, nutrition education improved fluid intake of Thang-Ta athletes to nearly double in the present study.

This findings are supported by McCotter *et al.*, (2012) that Educational intervention on water intake improved hydration status by ad libitum consumption of water and can enhance performance in young children exercising in the heat.

Cost Comparison of Hibisa with other Commercial Sports Drinks

Cost Comparison of Hibisa with other Commercial Sports Drinks is given in Figure 13