

## SUMMARY AND CONCLUSION

Since traditional athletes is most often neglected and there is a dearth on data of their nutritional profile. However these athletes have the potential to rise up to national or international standard. Traditional Athletics are often pushed to the back seat and nutritional status of traditional athletes in general and those practicing Thang-Ta in particular is often neglected. Manipur contribute significantly to the medal tally of the country. However, nutritional problems are rampant among athletes here, as elsewhere in the country. There is a dearth for data on nutritional and physical performance of Thang-Ta athletes in Manipur.

Consumers are looking for variety in their diets and are aware of the health benefits of food rich in micronutrients. Regular consumption of plant foods are associated with numerous health benefits rooted in their various physiological effects as a result of their phytochemical and nutritional constituents (Hunter and Fletcher, 2002). Studies had proved that natural fruit drinks such as young coconut water (Saat *et al.*, 2002) and Ismail *et al.*,(2007) honey Earnest *et al.*,(2004 ) and milk (Watson *et al.*, (2008) and Shirreffs *et al.*, (2007) been shown to be effective hydration drinks. *Hibiscus sabdariffa* Linn popularly known as Silog Sougri in Manipur is one of the common food consumed in Manipur. It is also reported that *Hibiscus sabdariffa* drink can safely be used in the prevention and management of anaemia and cardiovascular disease (Ghislain *et al.*,2011).

Hence the study entitled “Effect of Intervention on Nutritional Status and Work Performance of Thang - Ta Athletes in Manipur” was undertaken with the objectives:To

1. determine the Socio Economic Status of Thang –Ta athletes in Manipur.
2. assess Nutritional Status and Body Composition and Physical Performance of Thang –Ta Athletes.
3. formulate Standardize, assess Acceptability and Nutrient content of a sports drink from *Hibiscus sabdariffa*Linn and assess its nutrient content

4. supplement the standardized drink and evaluate its effect on Thang- Ta athletes
5. imparting Nutrition Education and Assess its impact on KAP of Thang –Ta athletes

Three hundred and sixty four Thang Ta athletes participated in the study, of whom 198 were adolescentmales (15-19 years) and 82were young adult males (20-25 years), 45 were female athletes in the age group of 15-19 years and 39 were in the age group of 20-25 years.Socio economic status, nutritional anthropometry, clinical status, dietary survey (24 hour food recall) and physical fitness level were assessed for all the athletes. Blood haemoglobin levels were assessed on 108 willing athletes;30 athletes (20 male and 10 female) in the age group of 15-19 years were chosen for supplementation study.Fifteen each (10 male and five female athletes) were categorized into experimental and placebo groups. A food supplement in the form of a drink rich in micronutrients and antioxidants was formulated from an indigenous shrub, Hibiscus sabdariffa Linn, MTC and salt was standardized, organoleptically evaluated named 'Hibisa drink' and administered to the experimental group (for 90days). Sweetened salted Water (SSW) was administered to placebo group (for 90days). The effect of supplementation was evaluated on selected physical performance and biochemical parameters. Nutrition education was givento all the 364 athletes and their KAP was evaluated before and after the education.

**The Findings of the study are summarised below**

- The present data revealed that more number of budding athletes in the age group of 15-19 years participated in Thang- Ta. This shows 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 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. 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.

- When compared with 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.
- Most of the athletes (43.9 per cent of male and 52.4 per cent female) had high school level of education. Only 4.3, illiterate among male athletes. None of the female athletes was illiterate. This finding conforms to the data of per census (2011), where literacy rate total was 79.85per cent.
- 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. It was also found that Thang- Ta athletes in the present study were much shorter and lighter than their Greek fencing and Spanish Judoka counter parts.
- Similarly among male and female Thang- Ta in the age group 20-25 years were also 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) standard.
- 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
- Around 47.6 per cent male and 48.7 per cent female Thang- Ta athletes in the group of 20-25 had had normal BMI; 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. More number of female athletes were underweight (10.3 per cent) highlighting poor nutritional status among female athletes.
- 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.

- Skin fold 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 suprascapular skin fold 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.
- When compared with the skinfold value of Spanish Judoka athletes, Franchini *et.al*, 2011), the triceps, biceps, subscapular, suprascapular, 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 suprascapular were higher than the judoka athletes.
- When compared with the skin fold thickness of international class female judo athletes (Elipkhanov and Nemtse, 2013). The mean triceps, suprascapular, 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, suprascapular, 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.

- Skinfolds thickness was less in male than in female Thang –Ta athletes. 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).
- 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.
- 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.
- Body fat Per cent, 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. However fat free mass, total body water and lean body mass and BMR were significantly ( $p < 0.01$ ) higher than among the female athletes.
- Similarly , 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.
- 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.

- Among the anthropometric measurements, 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, Tibiale mediale –sphyrion 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 significant in both the age groups.
- Comparison of between female Thang- Ta athletes in the age group of 15-19 years and 20-25 years on various athropometric measurement 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, fore arm circumference and thigh girth of 20-25 years were significantly higher (at  $P<0.01$  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 a chest circumference, waist circumference, upper arm relaxed circumference, upper arm flexed circumference, fore arm girth, calf girth, ankle girth, upper arm length, hand breadth, tibial medial –sphyrion length, thigh length, foot length, biacromial, of male Thang-Ta athletes were significantly higher ( $p<0.01$ ) and biiliocrystal, transverse chest breadth, femur breadth, were statistically significant higher ( $p<0.05$ ) than female athletes. No statistically significant difference was observed on 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, waist circumference , fore arm length, calf girth, wrist girth, ankle girth, upper arm length, hand breadth, Ttibial medial – sphyrion length, thigh length, foot length, biacromial, biiliocrystal, 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 higher at ( $p<0.01$ ) 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.

- All the male Thang - Ta athletes in the age group of 15-19 and 20-25 years had normal haemoglobin level when compared with WHO (2002) Categorization of Anaemia and 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.
- 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.
- 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
- 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.
- 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 little intake of milk. Majority 68.5 per cent male and 67.8 per cent of female Thang -Ta athletes consumed three meals daily. None of the athletes skip meals. Majority 56.7 per cent male and 86.9 per cent female had different variety every day. 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.

- The mean fluid intake of male and female Thang –Ta athletes was  $2.9 \pm 0.72$  l/day and  $2.57 \pm 0.66$  l/day respectively and it was very less than the suggested intake (8 l /day) given by Venkataramana, (2009).
- Life style pattern showed that majority 75.3 per cent male and 76.2 per cent female Thang- Ta athletes performed exercise for more than ½ hour. 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 control stress.
- 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.pulses consumption among the athletes were very low. 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. Among other vegetables potato onion were consumed daily. Snake gourd, bottle gourd, cauliflower, bean, papaya green and bamboo shoot were also frequently consumed. Among spices and condiments, ginger, garlic and turmeric were consumed daily.
- Fruits consumption was very less. All the male athletes consumed fish daily. Most of the male athletes consumed chicken and pork monthly. Only 10 of 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. Milk and milk products consumption was very low among the male athletes. Mustard oil and sugar were consumed by all the athletes.
- Similarly, all the female athletes consumed rice daily. Pulses consumption was also low. 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. Plantain and ladies finger were more frequently consumed. Banana, orange guava tomato were frequently consumed among the fruits. Most of the female (42.8 per cent) did not consume pork. Higher percentage (32.2 per cent) female athletes consumed snail twice in week. Consumption of milk product was very low among female athletes too.

- 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 as a part of their diet.
- Among shrub vegetable consumption, U- Hawaimaton, Mayang ton, Pheija, Nongmangkha mapal, Sougri, Shillo-Sougri. Among aquatic vegetables, Kolamni, Komprek, Heikak yelli, Tharo, Thambou, Thangjing, Eshing Kambong, Loklei, Pullei were frequently consumed. Among the tree products, Mukthruhi (leaves and flower),laphu, Yongchak (beans and pod) and Yendang (tendrill) were frequently consumed among the Manipuri athletes.
- Among the edible fungi, Uchina (Black Slimy Mushroom or Wood Ear Mushroom), Uyen, Chengum, Kanglayen were frequently consumed. Ngari (fermented fish) was consumed daily among the entire athletes .Fermented soya bean and fermented bamboo shoot were also consumed.
- 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 of 39.84 percent. Pulse, vegetables, roots and tubers, fruits, milk product, meat, egg, fats, oils, sugar were consumed very low than the suggested allowances. But it was observed that less deficient intake in vegetable consumption was found among Manipuri Thang -Ta athletes. Milk and milk product consumption were very low.

- 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. When compare with the suggested micro nutrient requirement given by ICMR 2010, the mean intake of thiamine, riboflavin, niacin, ascorbic acid, calcium, iron and beta carotene intake of Thang-Ta athletes were deficient in both male and female athletes. But iron intake was slight excess in male (9.2 percent) and female athletes (5.1 per cent) in the age group of 20-25 years
- The mean energy, carbohydrate, protein and fat intake of male and female Thang- Ta athletes in both the age group was disproportionate when compared to the Recommended Allowance given by ILSI, NIN and SAI (2007); energy intake was less, protein and fat intake were low.
- 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. VO<sub>2</sub> 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.

- 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<sub>2</sub> 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<sub>2</sub> max was significantly ( $p < 0.05$ ) during 0-60 and 0-90days. Thus it can be inferred that Hibisa had beneficial effect on 30m fly (speed) and VO<sub>2</sub> 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 flying 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 flying 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; 30mflying – speed; 6x10m shuttle run - agility) than female athletes (30mflying - speed).

- 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 the 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.
- It was observed that after supplementation of Hibisa drink, iron intake increased to 57.72 mg/g from the initial  $24.52 \pm 5.5.96$  mg/g among male experimental group. Among experimental female group, the iron intake increased to 58.44 mg/g from the initial  $25.24 \pm 5.89$ . Similarly, vitamin C intake among male and female athletes was increased to 149.67 mg/g and 149.38 mg/g respectively from the initial  $24.67 \pm 3.26$  mg/g and  $24.58 \pm 5.26$  mg/g respectively. Therefore, it can be concluded that Hibisa drink has a potential of alleviating some of the micronutrient deficiencies among Thang Ta athletes.
- 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. But it is highly needed to increase the fluid intake to reach the recommended allowance of athlete 8l /day by (Venkataramana, 2009)
- After nutrition education, the general nutritional knowledge, knowledge regarding food intake, knowledge regarding sports nutrition and hydration of male athletes (15 -19 years and 20-25 years) improved significantly at  $p < 0.01$  level. Similarly, among female athletes, the initial knowledge regarding on general nutrition, knowledge regarding on food intake ,

knowledge regarding to Sports Nutrition and hydration among (15 -19 years and 20-25 years) improved significantly at  $p<0.01$  level.

- The mean attitude score of 15-19 years male athletes after nutrition education increased significantly at  $p<0.01$  level. Similarly among 20-25 years athletes, it significantly increased at  $p<0.01$  level after education. Similarly among female athletes in both the age groups, the mean practice score of male athletes in the age group of 15-19 years significantly increased at  $p<0.01$  level.
- The mean fluid intake of male and female Thang -Ta athletes before education was meagre. After the nutrition education the mean fluid intake increased to  $5.43\pm 0.51$  litres and  $5.01 \pm 0.5$  litres respectively when compared to initial value of  $2.9\pm 0.72$  liters and  $2.57 \pm 0.66$  liters respectively for male and female. However the fluid intake of Thang-Ta athletes could not reach the recommended allowance (8l/day) for athletes. This could be because of the cold climate of Manipur. However, nutrition education improved fluid intake of Thang-Ta athletes in the present study.

## **CONCLUSION**

The findings of the study reveal the low socioeconomic and nutritional status, among Thang Ta athletes of Manipur. Energy deficiency, disproportionate intake of macronutrients, inadequate intake of micro nutrients and prevalence of mild anaemia among female athletes were observed. However, majority of the athletes had normal haemoglobin level; this could probably be due the high intake of locally available green leafy vegetables of different varieties including herbs, aquatic vegetables, edible flowers and edible fungi. It also brings out the beneficial effects of utilizing low cost (Rs.23.80 per day/athlete) fluid replacement drink prepared from locally available low cost shrubs like *Hibiscus sabdariffa Linn* alleviating malnutrition and improving performance among athletes.

Consequently the following recommendation are made

1. Assessment of nutritional status of other traditional athletes in Manipur.
2. Study the effect of other locally available fruits on their nutritional status.

3. Assess the efficacy of traditional food ingredients and recipes of Manipur to enhance the nutritional status and physical performance of athletes.
4. Provide follow up nutritional education to both the athletes and coaches on dietary diversification/modification.
5. Assess hydration status of athletes in Manipur

**Limitations**

1. The sample size of athletes is small.
2. Female athletes represented a small proportion of the sample study sample.
3. Supplementation study was conducted in only one training center.
4. Hydration status should not measure.
5. Cost constraints in the inclusion of several biochemical parameters in the assessment of nutritional status.
6. Geographic terrain in Imphal and inclement weather conditions in Manipur