
RESULTS AND DISCUSSION

The results of the research entitled, ‘Health status and impact of pregame sports supplements on the performance capabilities of sports persons and athletes’ are presented and discussed under the following headings.

- A. Socio-economic and athletic profile of the selected subjects
- B. Health and nutritional status of the selected athletes
- C. Performance capabilities of the selected athletes
- D. Composition and acceptability of the formulated nutrimix powder and pregame supplements
- E. Efficacy of the pregame supplements formulated

A. Socio-economic and athletic profile of the subjects

1. Socio-economic profile

Utilizing the interview schedule developed the socio-economic and athletic profile of the subjects were collected and the results were consolidated and are given under the sub headings type and size of family of the subjects, education, occupation and income of parents of the selected subjects, athletic profile namely age, order of birth, type of sports activity, type of exercise performed, intensity of exercise, levels of achievements and benefits derived out of sports activity. The basic pattern of Interview schedule is given in Appendix I.

a. Type of family

Table 5 and figure 1 presents the type of family of the selected athletes.

Table 5
Type of family of the selected athletes

Type of family	Number of subjects	Percentage
Nuclear	410	77
Joint	81	15
Extended	39	8
Total	530	100

Data presented in Table 5 on the type of family of the selected subjects revealed domination of nuclear families over joint families. Out of the total number of 530 subjects 77 per cent belonged to nuclear families and 23 per cent were in joint families. When the reason for being in nuclear families was enquired 24 per cent indicated that they migrated from their native villages to city in search of jobs leaving their parents in the villages and 33 per cent migrated for the education of children. One of the reasons for development of more nuclear families in India was that the head of the family got an employment in urban areas far away from parental house. In joint families the grand parents also lived along with son or daughter. Totally thirty nine families (8%) were in extended families and these families had three generations namely parents, grand- parents and children along with uncle or aunt living in the same house. The joint family is characterized by large family size, common residence, common purse, common kitchen and common land and there is great degree of interdependence. It also provides social and economic security to all its members - working, non- working, old and young children, sick people, widows and handicapped or disabled.

Suganthi *et al.*, (2012) have pointed out the same trend of dominance of nuclear families over joint families in a study conducted in Chennai. Study done by Vasanthamani and Durgadevi (2009) had also pointed out the predominance of nuclear family system with two to four members in Coimbatore, Tamilnadu, India.

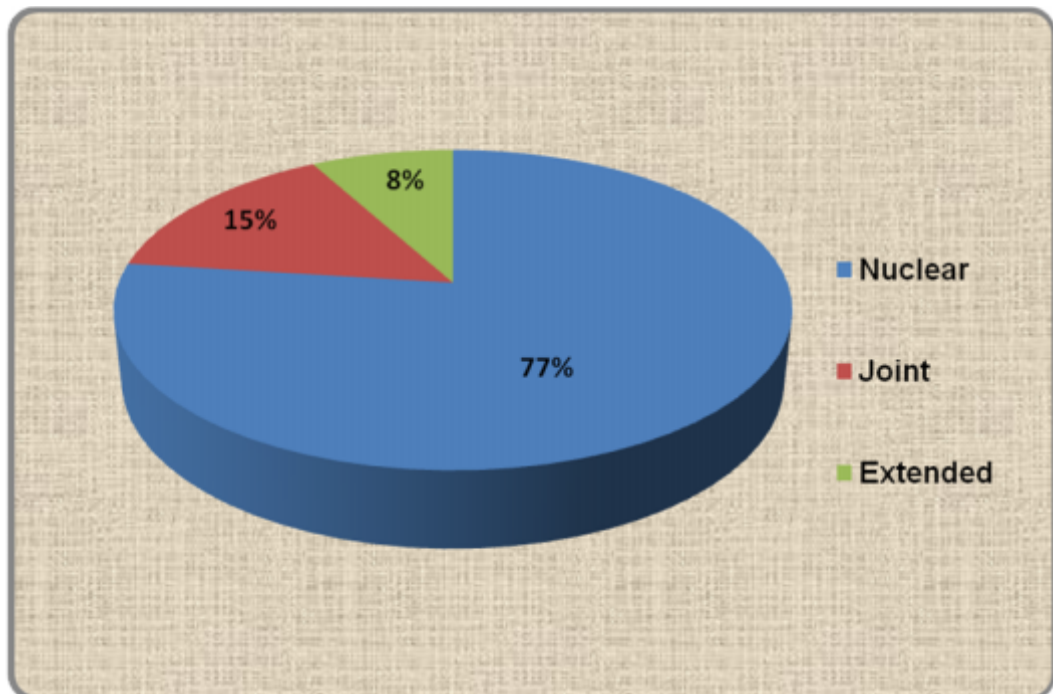


Figure-1
Type of family of the selected athletes

b. Size of family

Table 6 depicts distribution of selected athletes according to the size of the family. The data is depicted in figure 2 also.

Table 6
Size of family of the selected athletes

No. of members	Number of athletes	Percentage
3-5	332	63
6-8	158	30
9-11	39	7
Total	530	100

Size of the family of the selected subjects depicted in Table 6 indicates the same trend as that of data in Table 5. Sixty three per cent of families were small families with three to five members. There were 9 to 11 members in seven per cent of the families. This may be because of the presence of extended families. The results of the present study are in line with the results of Mini Joseph and Prema (2013) had shown predominance of nuclear families with four to six members.

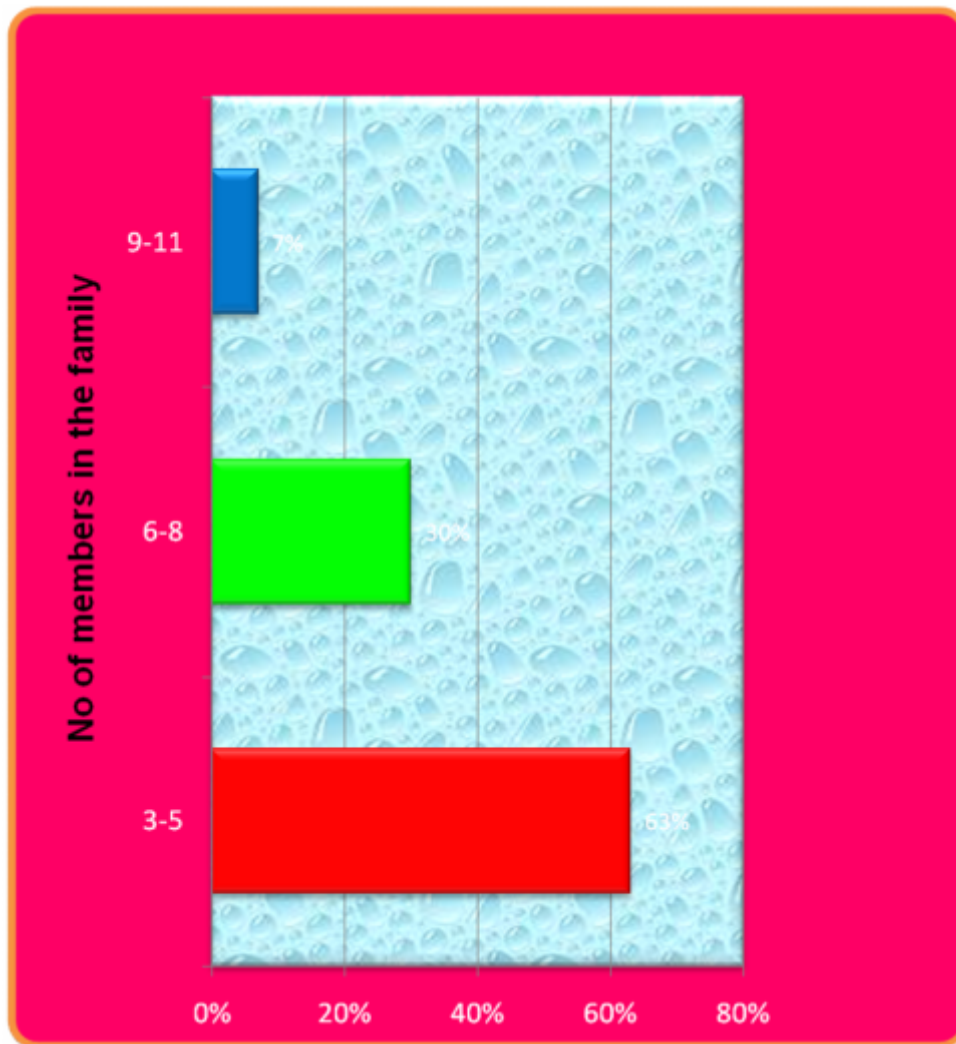


Figure 2

Size of family of the selected athletes

c. Educational status of the parents

Table 7 presents the educational status of the parents of the selected subjects.

Table 7**Educational status of the parents**

Level of education	Father		Mother		Total	
	No	%	No	%	No	%
Illiterates	220	42	295	57	515	50
Primary school	95	18	110	21	205	20
Middle school	90	17	57	11	147	14
High school	45	9	25	5	70	7
Higher Secondary	35	7	20	4	55	5
Graduates	35	7	8	2	43	4
Total	520	100	515	100	1035	100

The level of education of the parents of the selected subjects presented in Table 7 brings out the fact that the educational status of the parents was very low. Illiteracy was prevalent among 50 per cent of the parents. There were no post-graduates and the number of the graduates was also very less (4%). Mothers were less educated than fathers and hence illiteracy was high among the women compared to men. It is obvious that the fathers had better education than mothers. As they were less educated they were not able to go for white collar jobs. Poor educational status was an important barrier in getting government jobs. Education and economic status go hand in hand in most of the families. Among the selected athletes 10 did not have father and 15 did not have mother and hence they were

single parent families. It was heart-warming to notice that these parents had sent their siblings to college for completing graduations.

Study done by Vasanthamani and Julie Benita (2012) also revealed prevalence of illiteracy and poor educational status in the selected coastal villages of Ramnad district of Tamilnadu.

d. Occupational status of the parents

Table 8 brings out the occupational status of parents of the selected athletes.

Table 8
Occupational status of the parents of selected athletes

Type of occupation	Father		Mother		Total	
Daily wages/Coolies	285	55	240	46	525	50
Drivers/conductors	75	14	Nil	0	75	7
Labourers/Servant maids	50	9	140	26	190	18
Plumbers/Electricians/ Carpenters/Tailors	40	8	Nil	0	40	4
Street Vendors	35	7	30	6	65	6
Construction workers(Painter/Tile laying)	30	6	60	12	90	9
Peon/Civil Supervisor/Forester/Police/ Railways	5	1	Nil		5	1
Housewives	Nil	0	40	8	40	4
Teacher /Tailors	Nil	Nil	5	1	5	1
Total	520	100	515	100	1035	100

Data in Table 8 on occupational status of the parents of the selected athletes reveal that the parents were employed in unorganized sectors which fetched them a low income since their educational status was poor. Fifty per cent of them were coolies with daily wages on seasonal basis. Labourers (18 %) go for work only when they get work orders like household repair work or cleaning work. Women were working as servant maids since they had low educational status. Only one per cent had jobs in government offices as Peon/ civil supervisor/forester/police or headmaster with permanent income.

e. Family income

The classification of the families of the subjects according to income classification recommended by the National Council for Applied Economics Research (NCAER) is presented in Table 9.

Table 9
Classification of families according to income

Category	Family income per annum (Rs)	Number of athletes	Per cent
Low income(Bottom most quintile)	1000-33000	43	8
Low income	33001-55000	380	72
Lower middle class	55001-88800	82	15
Upper middle class	88801-150000	9	2
High income(Top most quintile)	Above 150000	17	3
TOTAL		530	100

It is evident from Table 9 that 72 per cent of the selected athletes belonged to low income group with the family income of Rs 33001 to 55000 per

annum followed by 15 per cent in the lower middle class with Rs 55001 to 88800 per annum. According to Planning Commission's guidelines a household earning of Rs 55000 and above annually is considered just above the urban poverty line for 2011-12 (Hindu dated 5.4.2014). According to this norm only 20 per cent of the families were above poverty line. Two and three per cent fell under upper middle class and high income category respectively. Eight per cent of the families fell under very poor income class with Rs 1000 to 33000 per annum. The selected colleges were Government of Tamilnadu state funded colleges and the fee structure was very low. Hence the low income families had admitted their wards in these colleges. The Government colleges are run for the benefit of the children of such low income families.

Nande *et al.*, (2009) had also recorded a mean monthly family income of minimum Rs 4000 and a maximum of Rs.25,000 for female athletes in their study at Nagpur, Maharashtra state.

2. Athletic Profile

a. Age of the selected athletes

Table 10 presents the distribution of the selected athletes according to age.

The data is also represented in figure 3.

Table 10
Distribution of athletes according to age

Age in years	Number of athletes	Per cent
18	189	36
19	142	27
20	109	20
21	57	11
22	18	3
23	11	2
24	4	1
TOTAL	530	100

As given in Table 10 a total number of 530 female athletes who were participating in sports and games were selected. These athletes were selected from under graduate and post graduate classes of the selected colleges. Hence they were in the age group of 18 to 24 years. Maximum numbers of 189 athletes (36%) were in the age group of 18 years followed by 27 per cent in 19 years and 20 per cent in 20 years. As the age increased number of athletes decreased because the total strength of the under graduate classes were more compared to the strength of postgraduate classes. Moreover the total strength of post graduate classes was less and as the age advanced, participation of students in sports and games decreased due to increased class work.

These results are in line with the results of Muthu *et al.*, (2011) who have pointed out that age can affect stamina in sports by gradually taking away an athlete's overall muscle fibres. In the present study also this could have been the reason for presence of less number of athletes in older age groups.

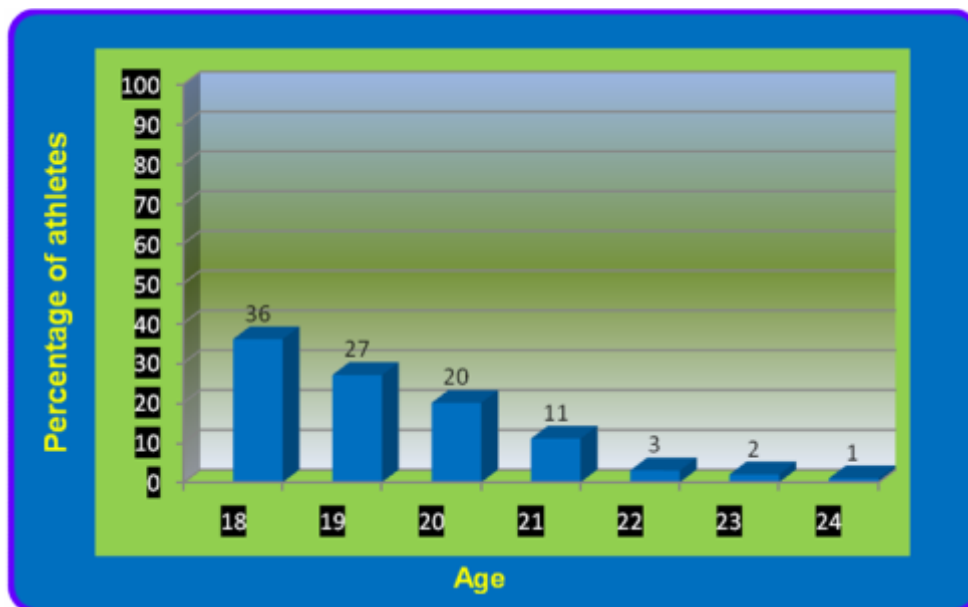


Figure - 3
Age in years of the selected athletes

b. Order of birth

Table 11 reveals the order of the birth of the selected athletes

Table 11
Order of birth of the selected athletes

Order of birth	Number of subjects	Per cent
I	200	38
II	235	44
III	80	15
IV	5	1
V	10	2
Total	530	100

From Table 11 it is evident that out of 530 athletes a total number of 44 per cent were II born, 38 per cent I born and 15 per cent were III born. Osama (2009) found that first-borns and only-children were demonstrated to have higher dependency on parents than later-borns and older borns served as role models for later-borns socialisation into sport in the family. Only three per cent were in the higher birth order. Type of family and size of family presented in the Tables I and II point out the predominance of nuclear families and small families and hence most of the athletes were either first or second born.

c. Types of sports activities

Table 12 gives data on event wise distribution of the selected athletes.

Table 12
Event wise distribution of the selected athletes

Sports/games	No. of athletes	Per cent
Team events	468	88
Track events	30	6
Both	32	6
Total	530	100

Details on the type of games played by the selected athletes in Table 12 reveal that greater participation was in team events than track events. Team events such as kabadi, football, kho-kho, volleyball, cricket, hockey, handball and basketball were the games played by the selected athletes. In government colleges the participation of athletes in more than one event is a common phenomenon. Only 12 per cent of the athletes played both track and team events. According to Adachi (2014) those who were participating in track events were more confident and independent. Event wise distribution of athletes is presented in figure 4 also.

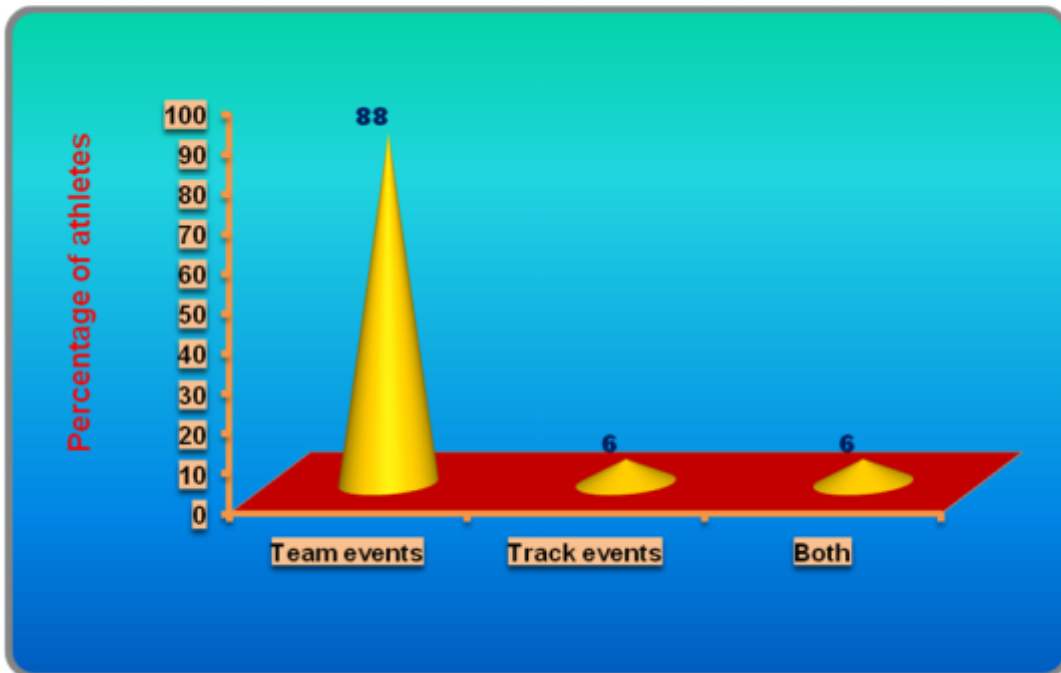


Figure 4

Event wise distributions of selected athletes

d. Physical activity category

Based on the duration of practice undertaken Wardlaw (1994) had suggested a categorization by levels of activities. The selected athletes were categorized according to that physical activity categorization. Table 13 depicts the distribution of selected athletes according to physical activity classification suggested by Wardlaw (1994).

Table 13
Distribution of selected athletes according to physical activity

Category	Duration of practice	Intensity (days/week)	Total	
			No. of athletes	%
Super active	1 hour of vigorous practice	5	391	74
Active	20 minutes sustained practice	5	120	23
Moderately active	20 minutes sustained practice	3	19	3
Mostly inactive	Sustained activity mostly walking	<3	Nil	Nil
Sedentary	Activities limited to sitting or minimal walking	Nil	Nil	Nil

From Table 13 it is obvious that 74 per cent of the selected athletes were super active since they had one hour of vigorous practice five days/week. These athletes practiced the whole day during tournament seasons. When there was a need for practicing and participating in sports they had the stamina for continuous vigorous practice. When tournament was over they come to class and prepared for tests and exams. During this period their activity slowed down.

e. Levels of achievement

Table 14 gives the details on the levels of achievement of the athletes.

Table 14**Levels of achievement of the athletes**

Levels of achievement	No. of subjects	Per cent
College	80	15
University	50	9
Zone	200	38
District	85	16
State	50	9
National	67	13
Total	530	100

As shown in Table 14 and figure 5 the selected athletes had achieved participation at different levels. A maximum number namely 38 per cent had participated at zone level followed by district and college level. Some athletes had gone up to national level tournaments also.

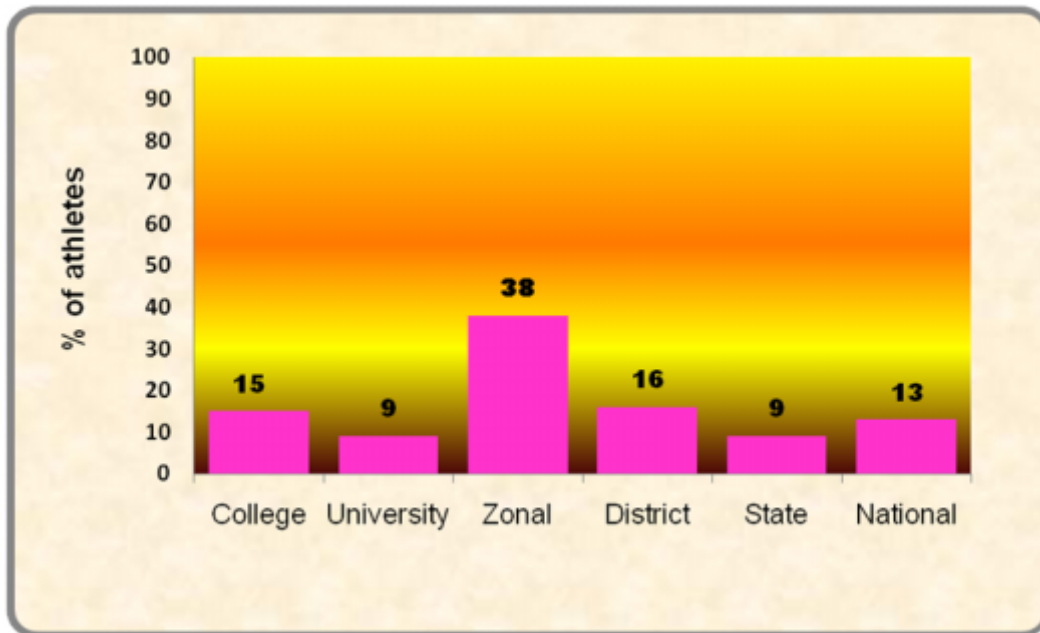


Figure 5
Levels of achievement by the athletes

B. Health and nutritional status of the selected athletes

Nutritional status of the selected athletes was assessed by studying the Anthropometric measurements, Biochemical status, Clinical examination and Dietary habits (ABCD).

Anthropometric measurements

The anthropometric measurements of all the 530 athletes were studied. This comprised of body weight, height, hip and waist circumference and body fat percentage. The results are presented in Tables 15 and 16.

a. Body weight

The mean body weight, height and the body mass indices are presented in Table 15. The individual values are presented in Appendix V

Table 15
Mean body weight, height and body mass index of the selected athletes

Parameters	Body weight (kg)		Height (cm)		BMI (kg/m ²)	
	Age					
	18-19	20-24	18-19	20-24	18-19	20-24
Standard values*	53.8	54.8	161.1	154.80	20.70	21.20
Mean values	50.0	52.7	160.7	155.20	17.65	24.08

***ICMR (2010)**

The mean weight of the selected athletes in Table 15 was less than the standard body weight expressed by ICMR (2010) for Indians. The mean body mass index of the selected athletes in 18 to 19 years was lower than the ICMR standard indicating underweight. In contrast for 20 to 24 years age group the body mass index of the selected athletes was greater than the ICMR standard values.

The selected athletes were involved in sports and games at least for 2 to 3 hours per day and thus had spent more calories. Their fat mass had been replaced by the muscle mass because of sports activity and this could have been the reason for higher mean body weight of the subjects.

According to ICMR (2010), the standard weight for reference women in the age group of 20 to 39 years is 50 kg. Athletes in the present study had registered a mean weight of 52.74kg for 20 to 24 years which was higher than the reference value for that age group. The weight, height, BMI of the athletes measured has been shown in the Appendix V. Figure 6 presents the mean body mass index of the selected athletes.



Figure 6
Mean Body Mass Index of the selected athletes

b. Body Mass Index(BMI)

Table 16 represents the distribution of the selected athletes according to BMI classification recommended for women by ICMR (2008). The Body Mass Index of the selected athletes is shown in Appendix V and VI.

Table 16**Body Mass Index classification of the selected athletes**

Category	BMI*	No. of subjects	Per cent
Underweight	<18.4	125	24
Normal	18.5-22.9	282	53
Overweight	23-24.9	81	15
Obese	>25	42	8

***ICMR, (2008)**

It is evident from Table 16 that more than 50 per cent (53%) of the selected athletes were in the normal range of Body Mass Index namely 18.5 to 22.9. Rest of the athletes were equally divided between underweight and overweight. Out of the 23 per cent of the athletes who had body mass index greater than 23, only eight per cent were in obese category. As observed in the previous Tables these athletes were from poor socio economic background and food and nutrient intake was also inadequate. They performed athletic activities for long hours and thus spent more calories. So prevalence of obesity was very low.

A study conducted by Vasanthamani and Uma Mageshwari (2009) among affluent university students of the same age had shown higher values for Body Mass Index and more prevalence of obesity.

Study done by Nikolaidis et al., (2015) on relationship of the body mass status with running and jumping performances in young basketball players revealed that the excess of body mass seemed to have the most detrimental effect on running and jumping performance. Figure 7 represents the body mass index of the selected athletes.

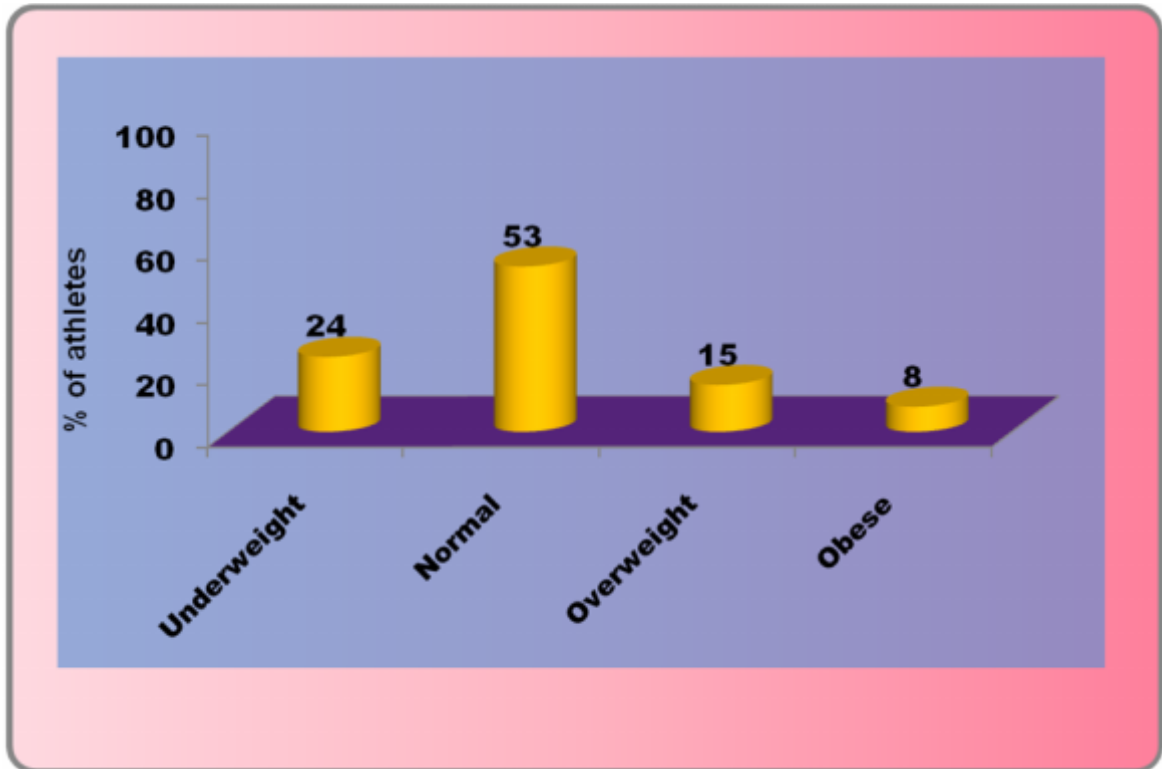


Figure 7

Body mass index of the selected athletes

c. Hip and Waist Circumference

The hip and waist circumferences of the selected athletes were measured and waist to hip ratio was calculated. Table 17 brings out the mean waist and hip circumferences and waist to hip ratio of the selected athletes. The individual values are presented in Appendix V and VI. Figure 8 also shows the waist and, hip circumferences and waist hip ratio.

Table 17
Mean waist and hip circumferences and waist hip ratio
of the selected athletes

Parameters	Mean \pm S.D
Waist circumference	63.25 \pm 23.2
Hip circumference	85.66 \pm 8.37
WHR	0.81 \pm 0.04

As seen in the Table 17 the mean waist hip ratio was in the normal range (< 0.8) suggested for women by WHO (2008b). There was no accumulation of fat in the hip or waist as these athletes had regular physical activity. There was no abdominal obesity.

Study done by Kaur *et al.*, (2011) among 21 to 30 year old women showed waist circumference range of 66 to 116.8cm at Ludhiyana. Waist Hip Ratio of the adult females (18 to 20 years) was 0.79 in a study by Trivedi *et al.*, (2004).

d. Body fat percentage

The body fat percentage of all the selected athletes was studied by using Omeran body fat analyzer. Nieman (1995) has given a fitness scale based on percentage body fat. The selected athletes were distributed according to this fitness scale and is shown in the Table 18. The individual values of the body fat percentage are presented in Appendix V and VI.

Table 18

Body fat percentage of the selected Athletes

Fitness scale*	Body fat percentage	18-20 years	21-23 years	>24 years	No of subjects	Per cent
Risky	<9	Nil	Nil	Nil	Nil	Nil
Excellent	9-18.9	81	8	2	91	17
Good	19-22.1	62	10	3	75	14
Fair	22.2-25	61	31	4	96	18
Poor	25.1-29.6	104	29	3	136	26
Very poor	>29.6	132	-	-	132	25
Total		440	78	12	530	100

*Niemen (1995) and Sen Ray *et al.*, (2011)

It is evident from Table 18 that 25 per cent of the subjects had more than 29.6 per cent body fat and thus were classified as very poor with high body fat content. Forty four per cent were classified as fair (18%) and poor (26%) in the fitness scale with more than 22.2 and less than 29.6 per cent body fat. Majority of the selected athletes had BMI and waist and hip circumferences near normal values. The body fat content showed slightly higher body fat percentage.

Excess body fat is related to injury, non-adherence to training and overall reduced athletic performance. A high body fat per cent remains as 'dead weight' reducing speed and efficiency of movement.([http:// www.sport.fitness-advisor.com/bodyfatpercentage.html](http://www.sport.fitness-advisor.com/bodyfatpercentage.html)).

Anjali *et al.*, (2014) had recorded a mean body fat percentage of 24.11 among athletes. Derbyshire (2011), in University of Texas collected pre and post season body composition measurements and showed that athletes had 22.3 per cent body fat at the beginning of their career. Vasanthamani and Anuradha (2011) registered body fat percentage of 19.29 among the female athletes of 18 to 23 years at Coimbatore, Tamilnadu, India. Figure 8 represents the fitness scale based on body fat percentage.

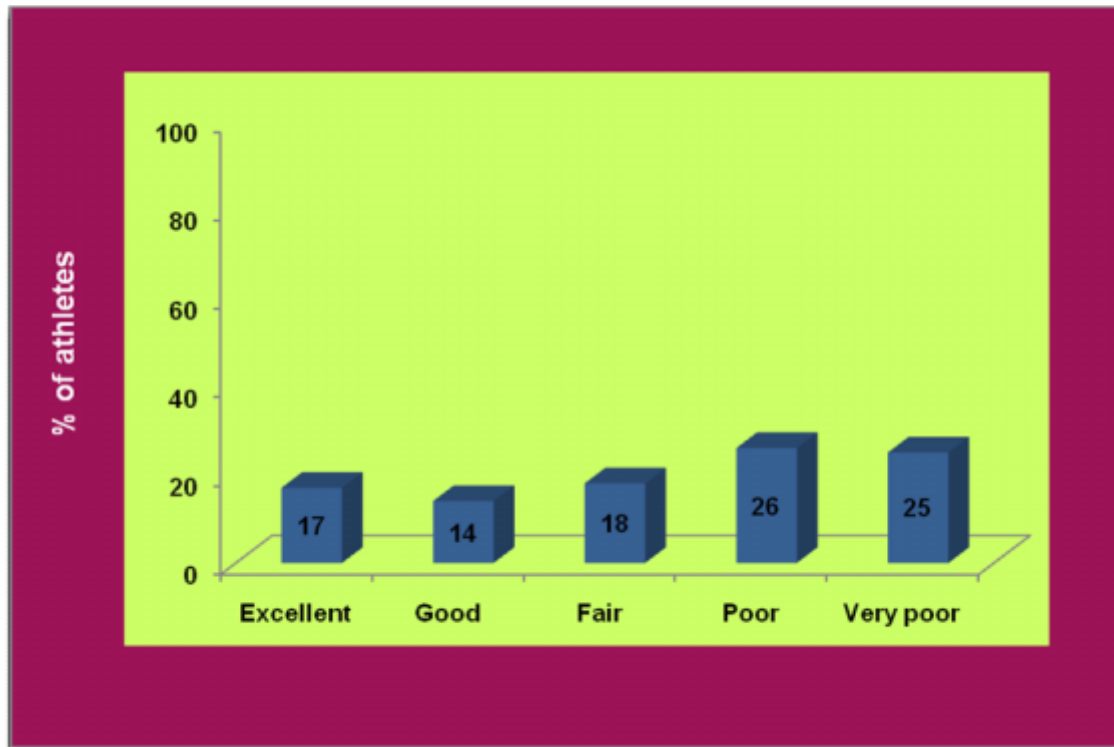


Figure 8

Fitness scale based on body fat percentage

e. Muscle mass, BMR and visceral fat

The mean muscle mass, BMR and visceral fat of selected athletes are given in Table 19.

Table 19
The Mean muscle mass, BMR and Visceral fat of the athletes

Parameters	Values recorded	Reference value
Muscle mass (%)	28.32 ± 7.82	26**
BMR (kcal)	1231 ± 166,80	1171*
Visceral fat (%)	17.14 ± 29.66	8**

* -ICMR (2010)

** -Omeran body fat composition analyser

It is obvious from Table 19 that the selected athletes had muscle mass greater than the standard prescribed by Omeran body fat composition analyser manual. The mean Basal Metabolic Rate recorded was higher than standard value given by ICMR (2010) indicating that the basal energy requirement was greater for the selected athletes. Since these athletes had more muscular tissue which were more active their BMR was high. Visceral fat content was higher than the standard values. Appendix V and VI reveals the individual muscle mass, visceral fat and BMR of the selected athletes.

f. Triceps skin fold measurements

The mean skin fold measurement value of the selected athletes was 11.78 mm which falls under adequate calorie reserve as compared to reference value of 11.5 to 16.5 per cent suggested for females by Douglas et al., (2008). This is in support of the fat mass percentage given in Table 19.

2. Biochemical estimation

a. Blood haemoglobin levels

Table 20 presents the distribution of selected athletes according to blood haemoglobin levels. Figure 9 also depicts the prevalence of anaemia among athletes. The individual values are presented in Appendix VII.

Table 20

Classification of athletes according to blood haemoglobin levels

Haemoglobin level (g/dl)	Classification of anaemia	Per cent
>12	Normal	54
11.0 to 11.9	Mild	17
8.0 to 10.9	Moderate	29
< 8.0	Severe	Nil

It is evident from the Table 20 that only 54 per cent of the selected athletes were normal without anaemia. Their haemoglobin levels were more than 12g/dl of blood. Mild to moderate anaemia was present in 17 and 29 per cent of the athletes respectively. It was alarming to note that nearly 30 per cent of the selected athletes had moderate anaemia. Poor dietary intake of iron, irregular menstruation, lack of knowledge on iron rich foods and poor purchasing power due to low family income could have been the causative factors. The present study is on par with the study done by Rajalakshmi et al., (2012) among female sports persons from Trichy, Tamilnadu.

The World Health Organization has reported that one in two women worldwide is iron deficient. High impact sports such as running causes blood cells in the foot to burst, Athletes may have unbalanced diets when they attempt to achieve a certain body weight or body composition and the inflammation caused

by constant exercise can also prevent efficient iron uptake from food. Women athletes are therefore at a higher risk of iron deficiency anaemia (Pasricha et al., 2014).

Totally 46 per cent of the selected athletes had mild to moderate anaemia according to the present research. Kumari and Singh (2003) have declared in their study that nearly 80 per cent of adolescent females suffered from iron deficiency anaemia.

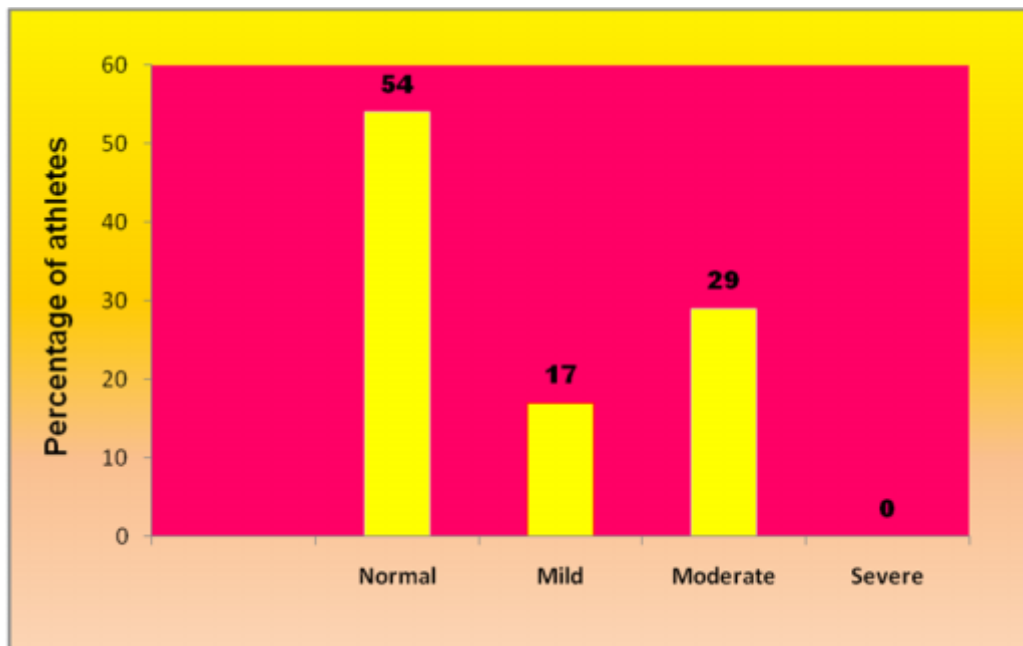


Figure 9
Prevalence of anaemia among athletes

b .Fasting Blood glucose values

The fasting blood glucose values of the selected athletes were within the normal range of ≤ 126 mg/dl suggested by WHO (2009).None of the athletes had diabetes mellitus or other blood glucose related disorders. In the present day situation, when India is turning into diabetic capital of the world and prevalence of Type I Diabetes mellitus is on the rise, is a heart warming result that none of the athletes had hyperglycemia. The procedure for blood glucose estimation of the athletes is shown in Appendix III.

3 .Clinical examination

Table 21 presents the results of the clinical examination of the selected athletes.

Table 21
Signs of malnutrition in the selected athletes

Category	Signs of malnutrition	Per cent
I	Healthy and free from any deficiency symptoms	48
II	a. Poor musculature	22
	b. Deficient subcutaneous fat	24
III	a. Nutritional oedema	Nil
	1. b. Poor musculature	18
	d. Xerosis of the cornea	4
	2. a. Tenderness of the calf	25
	b. Angular stomatitis	30
	d. Bleeding gums	30
3.	a. Xerosis or pigmentation of conjunctiva	12
	b. Bitot's spots	14
	c. Dental caries	30
	d. Dry / rough skin	32
	e Hyperkeratosis	26
	f. Discolored / Dry / Sparse / Brittle hair	13

Data on the clinical examination shown in Table 21 reveals that 48 per cent of the selected athletes had no nutritional deficiency symptoms indicating good nutritional status with all signs of good nutrition. They were very alert, body straight, good posture eyes bright, shiny and clean skin with lustrous hair.

Poor musculature and pale conjunctiva were observed among 22 per cent of the selected athletes. Tenderness of the calf (25%), angular stomatitis(30%), and bleeding gums(30%) were registered indicating vitamin B complex and vitamin C deficiency.

Dental caries was observed among 30 per cent of the athletes indicating calcium/vitamin D deficiency. Dry / rough skin was noticed among 32 per cent of the athletes. Hyperkeratosis was seen among 26 per cent, xerosis or pigmentation of conjunctiva (12%) and bitot's spots (14%) of the athletes indicating vitamin A deficiency. Poor food intake, inadequate consumption of essential nutrients and lack of consumption of fresh fruits and salads were noticed during diet survey.

4. Dietary habits

Young adulthood is a period of reproductive maturation and during which body composition is altered. Nutrient requirements are increased during sports and athletic performance. Good nutrition is essential as physical activity, athletic performance and recovery from exercise are enhanced by optimal nutrition. Hence the dietary habits of the selected athletes were assessed and the results are presented in the following Tables and discussed.

a. Type of diet

Types of diet consumed by the selected athletes are given in Table 22 and figure 10.

Table 22**Type of diet consumed by the selected athletes**

Type of diet	Number of subjects	Per cent
Vegetarian	117	22
Non vegetarian	371	70
Lacto-ova vegetarian	42	8
Total	530	100

From Table 22 it could be inferred that 78 per cent of the selected athletes were either non-vegetarians or lacto-ova vegetarians. Only 22 per cent consumed vegetarian diet. Development of muscle mass, increased endurance capacity, alertness in action is essential during physical exercise and performance. Good quality protein is essential to achieve this during athletic performance. Animal proteins supply proteins with high biological value and it was relevant that 78 per cent were non-vegetarians. Only 20 per cent were vegetarians. Twenty two per cent of the vegetarians were from families whose tradition and custom did not allow consumption of non- vegetarian foods.

Subangani (2008) has stressed the role of protein in the diets of athletes as an energy substrate especially during endurance activities and heavy training. It was also found out that 22 per cent of the vegetarians were involved in team events and they did not have the stamina to participate in track events.

A similar result has been obtained in the study by Vasanthamani and Uma Mageshwari (2009) among university students which revealed that 75 per cent of them were non-vegetarians, 14 per cent were vegetarians and 11 per cent ova-vegetarians. Type of diet consumed by the athletes are represented in figure 10

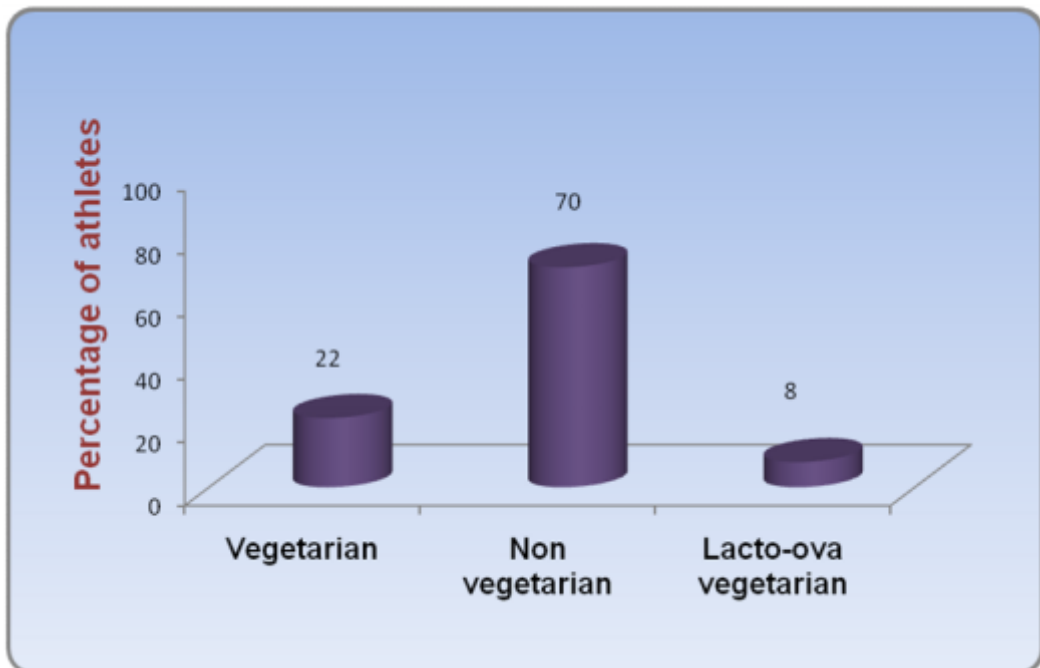


Figure 10

Type of Diet consumed

b. Number of meals consumed per day

Enquiry regarding the number of meals consumed per day by the athletes revealed that three meals per day was the normal practice among the selected athletes. All the three meals were rice based with occasionally one meal containing wheat. As the athletes started their practice early in the morning breakfast was consumed only after the practice was over. Normally breakfast consisted of tiffin items namely Idli or Dosai, which were prepared out of rice and black gram dhal batter.

Afternoon lunch and night dinner consisted of boiled rice with the vegetable sambar and one vegetable accompaniment. Some athletes consumed deep fried snacks in the evening along with coffee or tea which were purchased from nearby canteens.

c. Odd dietary habits

Some of the odd dietary habits prevailed among the selected athletes are presented in Table 23 and figure 11.

Table 23**Odd dietary habits of selected athletes**

Habits	No. of athletes	Per cent
Skipping of meals	399	75
Fasting	180	34
Eating away from home	330	62
Snacking habit	335	63

It is evident from Table 23 that skipping of meals namely either breakfast or lunch was rampant among 75 per cent of the athletes. Hurry in getting ready to catch the bus, busy morning schedule, early morning practice, dislike for the food were some of the reasons given for skipping of meals. These athletes were advised to follow correct eating habits and avoid unhealthy snacks and to follow right dietary habits. This was followed by another 62 per cent who had the habit of

eating food away from home. Unhealthy food items such as parotta and other fast foods which consisted of only maida were selected by the athletes while eating away from home. Thirty four per cent of the athletes were skipping their meals due to fasting.

Sixty three per cent of the athletes had the habit of consuming deep fried snacks often bought from outside eateries. Fried ground nuts, potato chips and processed snacks were some of the snacks preferred by the selected athletes. Drinking tea or cola drinks were also common among them which provided empty calories. But the quantity consumed was limited because of the financial constraints.

Study by Munira *et al.*, (2007) among adolescent female athletes in Indore, Madhya Pradesh also showed skipping of meals and consumption of two meals per day. Fink *et al.*, (2006) point out that college athletes consume too much of dietary fat due to an over reliance on fast foods. Omission of breakfast decreases maximal output with an increased risk of losing lean muscle mass, higher rates of injury, lowered concentration and motor control (Williams,2005). Figure 11 shows the odd dietary habits prevailed among the selected athletes.

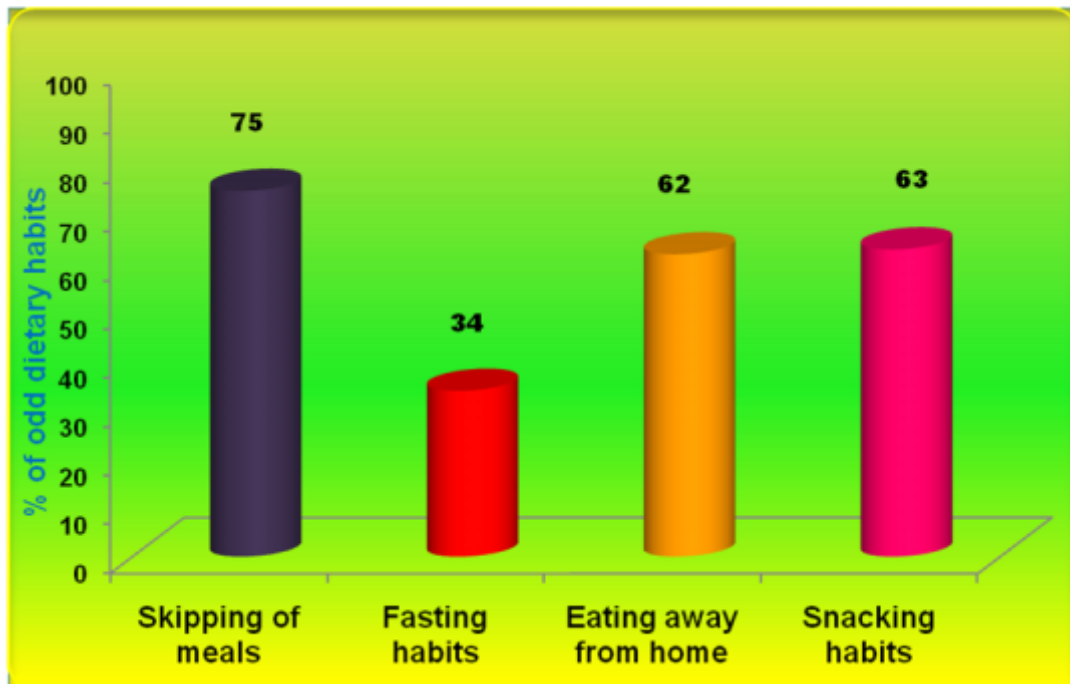


Figure 11

Odd dietary habits of athletes

d. Foods preferred and avoided during an event

Table 24 and 25 present the foods preferred and avoided during athletic events.

Table 24**Foods preferred by the selected athletes**

Foods	Before an event		During an event		After an event	
	No. of athletes	%	No. of athletes	%	No. of athletes	%
Biscuits	265	50	-	-	-	-
Idli-2	212	40	-	-	-	-
Banana(small)	201	38	100	20	-	-
Apple	198	37	-	-	-	-
Glucose water	180	34	148	28	-	-
Empty stomach	166	31	-	-	-	-
Lemon juice	159	30	-	-	-	-
Bread and jam	159	30	-	-		
Chocolates	132	25	-	-	79	15
Electrolytes	120	23	223	42	-	-
Tea/coffee	100	19	-	-	30	6
Carbonated/Malted beverages	79	15	-	-	-	-
Full meals	-	-	-	-	106	20
Milk shake	-	-	-	-	244	46

It is evident from the Table 24 that different types of foods were preferred by athletes before, during and after an event. It was obvious that preference of foods before starting an event was more than during and after an event. Athletes preferred to consume light and energy rich foods before an event. Liquids such as glucose water, electrolytes, carbonated or malted beverages, lemon juice, tea or coffee was preferred by the athletes. Biscuits were preferred by 50 per cent of the selected athletes. Other solid foods such as banana, idli, bread and jam which do not contain fat were preferred by 32 and 40 per cent of the selected athletes. It is evident from these results that low fat, liquid and energy dense foods were preferred before starting an event. Since no special pregame supplements were available these food items were preferred and consumed by the athletes. These results point out the necessity to develop pre game sports foods. If a tasty, energy rich, low cost supplement had been available they would have preferred to consume that.

Electrolytes and glucose water were consumed during the break in the middle of the game. Liquids were consumed for the purpose of hydration. Twenty per cent of the subjects preferred consuming a small banana.

Abian *et al.*, (2015) showed that the ingestion of a caffeinated energy drink improved jump performance and activity patterns in elite badminton players. Berardi (2009) suggested stocking with after game foods and drinks during tournaments and multiple events to ensure recovery and energy for the subsequent event.

e. Foods avoided during events

Table 25 presents the foods avoided by the athletes during athletic events.

Table 25**Foods avoided before and during events by the selected athletes**

Foods avoided	Before an event		During an event	
	No. of athletes	Per cent	No. of athletes	Per cent
Heavy meals	371	70	-	-
Spicy foods	344	65	-	-
Fried foods	318	60	-	-
Rice	212	40	-	-
Milk	40	8	-	-
Non vegetarian foods	60	11	-	-
Chilled water/beverages	-	-	212	40

As Table 25 points out heavy meals, spicy foods, fried foods and milk were avoided before starting an event. The athletes expressed that these foods produced heaviness and irritation in stomach and led to nausea, vomiting and dizziness during the event. In general, after an event their pattern of dietary intake gradually started from liquid and ended in solids. Forty per cent of athletes avoided chilled water or any other drinks during an event. They had a belief that sudden change in temperature will cause fever. These athletes need proper counseling about effect of different foods on health.

Study done by Lafata *et al.*, (2012) on the effect of a cold beverage during an exercise session revealed that drinking cold water can significantly mediate and delay the increase in core body temperature during an exercise session in a moderate climate with euhydrated subjects. The ingestion of cold water improved performance in 49 per cent of the participants in the broad jump.

Haakonssen *et al.*, (2014) found out that some athletes avoided dairy products in the meal consumed before exercise due to fear of gastrointestinal discomfort. Regular exclusion of dairy foods may unnecessarily reduce intake of high quality proteins and calcium with possible implications for body composition and bone health. They showed that dairy-based pre exercise meal does not affect gut comfort or time-trial performance in female cyclists. They recommended inclusion of substantial amounts of dairy foods in meals consumed before strenuous cycling without impairing either gut comfort or performance.

f. Pattern of water Intake

Pattern of water intake by the selected athletes during an event is presented in Table 26 and figure 12.

Table 26

Pattern of water intake during an event

Time	Water consumption				Quantity			
	No		Yes		250 to 500 ml		750 to 1000ml	
	No.	%	No.	%	No.	%	No.	%
Before an event	75	14	455	86	455	86	NIL	NIL
After an event	198	37	332	63	332	63	238	45
During events/break	484	91	46	9	46	9	NIL	NIL

The water intake of the selected athletes before an event was 250 to 500 ml (86%). After an event 63 per cent of the athletes drank 250 to 500 ml of water. Only 45 per cent drank 750 ml to 1000 ml of water after an event. During break, nine per cent of them sipped 100 ml of chilled water to cool down their body temperature. The athletes did not drink plenty of water before an event or during an event to avoid discomfort and heaviness. Chandrasekhar *et al.*, (2005)

have pointed out that an athlete's fluid intake is of critical concern. The thirst sensation comes when a person is already three per cent dehydrated resulting in poor endurance and poor performance.

Athletes lose fluid as sweat and this insensible loss occurs very rapidly, especially in hot and humid climates. This can cause a substantial decrease in performance in the very next bout of exercise and pose a risk of heat injuries among the athletes (Tan, 2015). Ramani (2009) points out that fluid loss of seven to ten per cent of body weight may result in heat stroke and death. Fluid intake of 1500ml to 3000ml above their normal intake, the day before the event and 500ml one to two hours prior to the event is advantageous (Pandey, 2013).

Fluid intake within one to two hours prior to exercise can enhance thermoregulation and lower heart rate during exercise. The ACSM, the NATA and American Dietetic Association recommend hydration schedule in the hours immediately prior to exercise namely 400 to 600 ml two to three hours prior to exercise and 200 to 300 ml, 10 to 20 minutes prior to exercise. This volume of fluid ensures proper hydration (Fink *et al.*, 2006).

Study done by Bardis *et al.*, (2013) revealed that mild dehydration decreased cycling performance during a five kilo meters outdoor hill course, probably due to greater heat strain and greater perceived intensity. Keishing *et al.*, (2012) studied the hydration pattern of athletes in the age group of 18 to 25 years at Gandhigram Rural Institute, Dindigul, Tamil Nadu. The results revealed that only nine per cent consumed one litre, 14 per cent consumed two litres, 52 per cent consumed three litres and 24 per cent had four litres of water daily.

Water intake by the athletes of the present study is very low compared to the study of Keishing *et al.*, (2012).

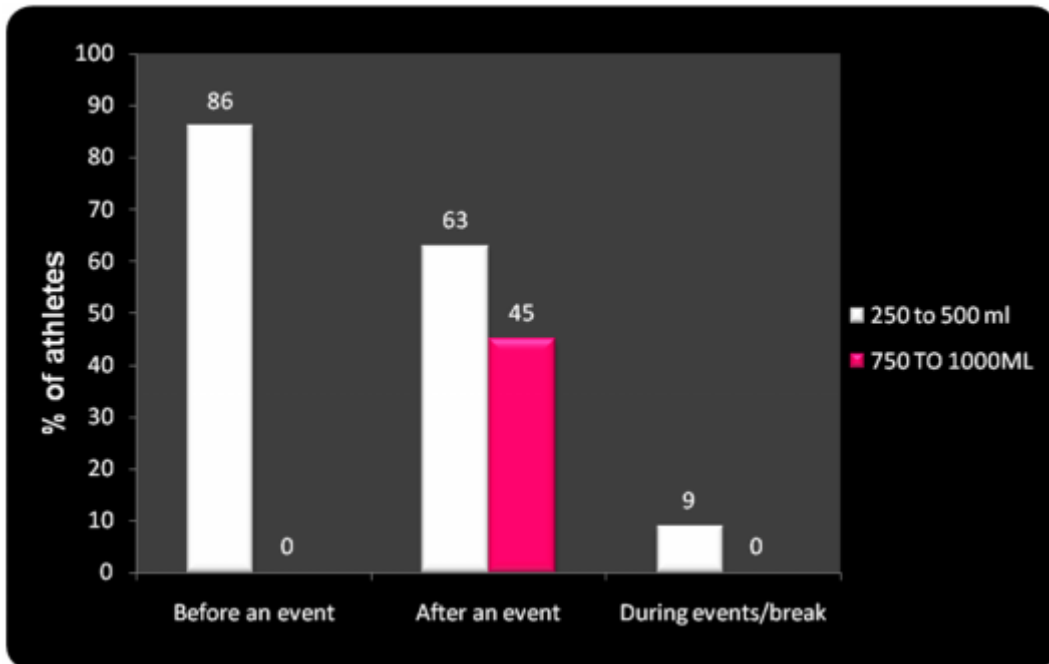


Figure 12

Pattern of water intake during an event

g. Mean food intake of the selected subjects

The fundamental principle of “sports excellence” is mainly dependent on athletes physique and dietary intake apart from physiological and training concepts. Table 27 depicts the mean food intake of the selected subjects.

Table 27
Mean food intake of the athletes

Foods (g)	SDA (g)	Mean intake (g)	Intake (%)
Cereals	550	510	93
Pulses	40	28	70
Green leafy vegetables	150	110	73
Other vegetables	200	20	10
Roots & Tubers	150	100	67
Fruits	150	30	20
Nuts & oil seeds	30*	40	133
Milk and its products	750ml	150	20
Fats and oils	50	60	120
Sugars	80	60	75
Egg	100	50	50
Animal foods	250	50	20

SDA - Suggested Dietary Allowances by Sathyanarayana et al.,(1985).

*Pasricha and Thimmayamma (2005).

Details on the mean food intake of the athletes presented in Table 27 reveal that the consumption of cereals(93 %), pulses(70%), green leafy vegetables (73%), roots and tubers(67%) and sugar(75%) were high compared to intake of

other vegetables(10%), fruits(20%), milk and milk products(20%), egg (50%)and animal foods(20%). These foods were deficient in the diet of the selected athletes. Consumption of nuts and oil seeds and fats and oils were found to be higher than the Suggested Dietary Allowances given by Sathyanarayana et al., (1985). Consumption of oily, deep fat fried snacks and other junk foods could have contributed to this high fat intake. The athletes preferred to have oily preparations such as biriyani /fried rice and/or /deep fried non-vegetarian preparations. It was noticed that processed ready to consume snacks were popular than homemade snacks.

Study done by Asha et al., (2009) among basketball players, at Dharwad city revealed that food intake was marginal and the adequacy was very less for green leafy vegetables and other vegetables, whereas it was comparatively high for pulses, fruits, fats and oils, sugars and egg. They emphasis the need for sound nutrition principles to optimize their body composition and to recover quickly after training. National health survey (2005-06) in India has reported that 60 per cent of women did not consume fruits even once a week. Study done by Narayanan and Sathishkumar (2013) among college students recorded inadequate intake of fruits. Shabiha (2007) has critically pointed out that many athletes have the false assumption that adequate training procedures are sufficient to optimize their athletic performance and neglect diet.

In the present study the selected athletes consumed inadequate quantities of all the nutrients. Poor educational status, low income and ignorance were the factors responsible for the poor nutrient intake. As these subjects were from low income families, their purchasing power was low and hence the availability of the food was also low in their families.

A study done by Vasanthamani and Anuradha (2011) among elite college female athletes showed deficient intake of green leafy vegetables and 10 per cent deficient intake of cereals, roots and tubers. The energy and iron intake were low but the milk consumption was excess by 20 per cent.

h. Mean nutrient intake of the selected subjects

Table 28 gives the mean nutrient intake of the selected athletes.

Table 28**Mean nutrient intake of the selected athletes**

Nutrients	RDA(SAI) *	Mean intake	Intake (%)
Energy(kcal)	4000	2340	58
Protein(g)	147	49	33
Fat (g)	145	100	69
Calcium (mg)	2000	989	49
Iron (mg)	21	15	71
Carotene (ug)	4800	2700	56
Riboflavin (mg)	1.1	08	72
Thiamine (mg)	0.9	0.8	88
Vitamin C (mg)	50	40	80

RDA suggested by *Sports Authority of India (2001)

Mean nutrient intake of the athletes revealed that intake of energy was only 58 per cent of the Recommended Dietary Allowance suggested by Sports Authority of India. The protein intake was very low (33%). Irregular meal timings, fasting habits and skipping meals could have been the reasons for inadequacy. The fat intake was 69 per cent. This is in line with the high fats and oil consumption in Table 27.

Intake of calcium was only 49 per cent. From Table 27 it is evident that intake of milk and milk products was also low. This was followed by β carotene which was only 56 per cent and iron 71 per cent.

A study by Zapolska *et al.*, (2015) among professional volleyball players showed alarmingly low intake of energy, carbohydrate, fiber, vitamins and minerals such as iron and calcium.

Mullick(2011) has said that poor food habits, choice of poor quality foods and consumption in improper quantities were the reasons for malnutrition. Study done among the soccer players and cyclists by Galanti *et al.*, (2014) revealed that daily food intake was similar between the two groups (2844 kcal/day for soccer players and 2630 kcal/day for cyclists), which was lower than recommended allowances. Calcium intake was low (soccer players 1120 ± 128.9 mg/day, cyclists 718 ± 309 mg/day) for both groups. The caloric intake of the selected adolescent athletes was lower than recommended.

4. Health profile

Health and sports are closely linked. Hence the health profile of the selected athletes was evaluated in terms of dimensions of wellness and prevalence of minor health ailments and over training syndrome. These are presented below.

a. The dimensions of wellness

Sport is a noble art which stimulates continuous improvement of oneself and has an artistic appeal to inspire everybody. An athlete will feel better, train harder and be in better position in games and sports by staying healthy. The five categories of wellness dimensions as classified by Charles *et al.*, (2009) presented in Table 29 expresses the emotional state and attitude of the athletes.

Table 29**The Dimensions of Wellness**

Category	Positive	Number	Per cent	Negative	Number	Per cent
Emotional	Happy	424	80	Depressed	185	35
Intellectual	Informed	413	78	Ignorant	127	24
Physical	Fit	318	60	Unfit	116	22
Social	Involved	191	36	Lonely	95	18
Spiritual	Fulfilled	222	42	Unfulfilled	64	12
Total outlook	Positive	360	68	Negative	233	44

It is evident from the Table 29 that 80 per cent of athletes had expressed that they were emotionally happy. Sixty eight per cent had expressed positive attitude about their involvement in sports and games, while 44 per cent had negative feelings. The athletes indicated that participating in sports and games made them physically fit and helped them to mingle with new people and friends. The selected athletes expressed that they were happy, enjoyed playing and were able to concentrate more on their studies when they play.

The negative feelings were mainly during the defeat, or if they did not get prize or trophies for their performance. They expressed that they were depressed. Twenty two per cent felt unfit because of their minor health problems.

b. Ailments confronted

Nutrition not only plays a role in performance but it can also help to prevent injuries, enhance recovery from exercise, help maintain bodyweight and improve overall health. Among the comparable athletes good eating habits can be a factor that determines the winner. Hence the ailments confronted by the selected athletes were studied and are listed in Table 30 and figure 13.

Table 30**Ailments confronted by the selected athletes**

Ailments	Number	Per cent
Leg pain	265	50
Menstrual problems	154	29
Pelvic pain	69	13
Pain in muscles and joints	53	10
Fatigue	42	8
Increased tiredness	42	8
Wheezing	39	7
Excess sweating	32	6
Insomnia	27	5
Joint dislocation/fractures	28	5
Muscle injuries	19	4
Heat strokes	15	3
Vomiting	7	1
Breathlessness	6	1

The ailments confronted by the selected athletes listed in Table 30 bring to light that leg pain was the main problem that affected 50 per cent of the athletes followed by menstrual problems in 29 per cent of the subjects. Out of the 30 per cent of athletes who had menstrual problems 60 per cent (92) had irregular menstruation, 30 per cent (46) suffered from Pre Menstrual Syndrome (PMS) and 16 per cent (25) suffered from amenorrhea. Other health problems such as pelvic pain, pain in muscles and joints, fatigue, increased tiredness, wheezing, excess sweating, insomnia, joint dislocation or fractures, muscle injuries, heat strokes and breathlessness were prevalent. Many of their ailments might be due to poor nutritional status. These problems can be controlled to a greater extent by regular intake of nutritious food which will prevent nutritional deficiencies and enhance the performance of the athletes.

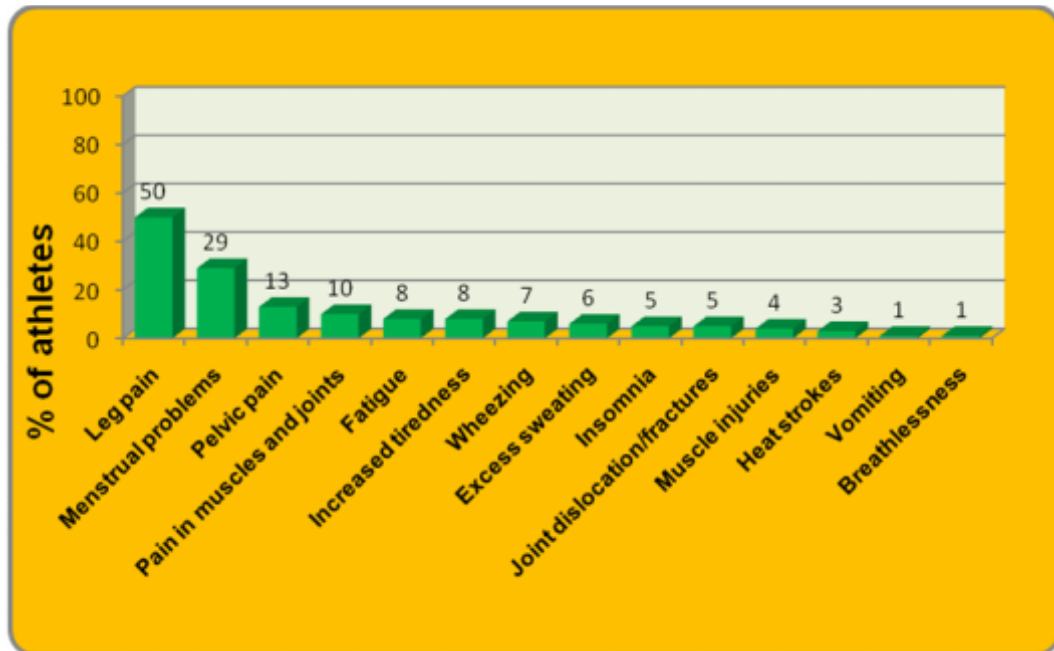


Figure 13

Health ailments of athletes

c. Overtraining syndrome

Table 31 depicts the over training syndromes of the selected athletes.

Table 31**Symptoms of over training syndrome of athletes**

Symptoms	No. of subjects	Per cent
Sudden drop in performance	106	20
Pain in muscle & joints	79	15
Menstrual problems	73	14
Headache	63	12
Fatigue	52	10
Breathlessness	26	5
Excess sweating	21	4
Insomnia	20	4
Depression	16	2
No symptoms	74	14
Total	530	100

As evident from the Table 31, twenty per cent of the selected athletes reported that they experienced sudden drop in their performance during stressful events. Fifteen per cent reported pain in muscle and joints during strenuous exercise and games. Menstrual problems in terms of irregular periods, amenorrhea and premenstrual syndrome were experienced by 14 per cent of the athletes. Menstrual irregularities were reported to be due to heavy exercise and practice. Headache and fatigue were reported by 10 per cent of athletes in each group.

The most dangerous risk associated with amenorrhea in female athlete is its impact on skeleton. A complication associated with amenorrhea includes compressed bone density and increased risk of stress fractures. To treat this an increase in nutritional intake and a decrease in the intensity of exercise will be effective.

Suganthi *et al.*, (2012) noted stomach pain related to menstrual problems and observed irregular meal pattern among adolescents (13-21 years). A longitudinal cohort study of healthy, physically active women in the US Military Academy (n=91; average age=18.4years) was carried out by Nieves *et al.*, (2015). Over four years, assessments of height, weight, calcium intake, physical fitness, menstrual function (annual number cycles), Oral Contraceptives (OC) or Depot-Medroxy Progesterone Acetate (DMPA) use, eating disorder inventory (EDI) and Bone Mineral Density(BMD) were done. Results indicated a modest increase in bone mineral density of college-aged women, in the absence of risk factors including subclinical eating disorders, weight loss, menstrual dysfunction and Depot Medroxy Progesterone Acetate use in healthy physically active women.

C. Performance capabilities of athletes

The performance capability of an individual can be assessed by measuring the performance related fitness attributes.

Performance capability or physical fitness comprises of two components namely health related components and skill related components. Individual values of the physical fitness tests are given in Appendix VIII.

1. Health related fitness tests

The results of the health related fitness namely cardio-respiratory endurance by Harvard step test, treadmill test, electronic bicycling, 2000 meters brisk walking and 1500 meters middle distance running, muscular endurance by floor push- ups test, flexibility by modified sit and reach test are presented and discussed in the following Tables.

A. Cardio-respiratory endurance tests

i. Harvard step test

Cardio- respiratory fitness level as evaluated by Harvard step test which is expressed as Physical Efficiency Index (PEI) is shown in Table 32.

Table 32**Physical efficiency index of the selected subjects
(Harvard step test)**

Category	PEI	Per cent
Excellent	90 and above	41
Good	80 to 89	38
High average	65 to79	21
Low average	55 to 64	Nil
Total		100

The physical efficiency index of the selected athletes shown in Table 32 reveal that 41 per cent of the subjects had secured scores above 90 and thus they were classified as excellent category. The heart is a powerful organ that pumps blood throughout the body. The results indicated that athletes in the “excellent” category had a strong and fit heart function and ability to pump adequate blood even during heavy performance. Thirty eight per cent of athletes had scored between 80 to 89 moving out of the high fitness zone to a low performance zone. Twenty one per cent of the selected athletes were in the high average zone indicating reduction in performance capability. None of the athletes were in low average category. Since the subjects were already in athletic training and practice, the cardiac endurance of these subjects were high. They had the stamina to withstand stress.

ii. Tread mill test

The results of the treadmill test conducted at a speed of 10km/hour with four per cent inclination for 12 minutes are given in Table 33.

Table 33**Distance covered by the athletes in treadmill test**

Distance (km)	Per cent
1.58-1.53	27
1.52-1.47	31
1.46-1.41	13
1.40-1.32	29
TOTAL	100

Treadmill is the most commonly used cardiovascular exercise machine. Treadmill and electronic bicycling tests utilize a series of rising exercise intensities. These tests are called as incremental or graded exercise tests whereby treadmill speed, gradient or load applied are increased every two to three minutes, depending upon the protocol chosen. The health status of the athletes determines the choice of the protocol chosen.

The data on treadmill test presented in Table 33 show maximum distance coverage of 1.58 km/12 minutes and a minimum distance of 1.32 km/12 minutes by the selected athletes. Data from Charles (2009) on the distance covered in 12 minutes by the athlete was less than 1.70km that would indicate low fitness zone, whereas the elite athletes covered greater than or equal to 2.20 km indicating a high performance fitness zone. In the present research the selected athletes fell under low fitness zone. This could be attributed to their low endurance level. Moreover the inclination (4%) provided in the treadmill produced stressful situation on the athletes cardiac and pulmonary system. This result brings to light the need for improving the health and stamina of the athletes, which is necessary for withholding normal cardiac function in stressful exercises.

iii. Electronic bicycling

Cardiac endurance capacity can be measured using an electronic bicycling also. The athletes were requested to do the pedalling for 15 minutes as fast as they can and the distance covered by each athlete was recorded from the monitor display and are presented in Table 34.

Table 34

Distance covered by the athletes in electronic bicycling test

Distance (km)	Per cent
1.20-1.50	17
1.51-1.75	23
1.76-2.00	24
2.01-2.25	15
2.26-2.50	17
2.51-2.68	4
TOTAL	100

Data on the distance covered in electronic bicycling test presented in Table 34 reveal that 21 per cent of the selected athletes were able to cover the distance of 2.26 km to 2.68 km in 15 minutes indicating a healthy cardio-respiratory endurance. Thirty nine per cent had covered 1.76kms to 2.25kms showing good cardio-respiratory endurance and stamina. Forty per cent had covered 1.20 km to 1.75 km which reveals comparatively poor fitness scale.

Iv. Two thousand meters brisk walking

Walking is a heel and toe sport. It is an aerobic exercise. Oxidative energy transfer takes place in the mitochondria of cells and utilizes a combination of muscle glycogen, intra cellular fatty acids and amino acids. Hence the breakdown products from both glycolysis and beta oxidation are utilized resulting in slower rate of transfer of energy(Berardi,2009).The results of the 2000m brisk walking by the selected subjects is depicted in the Table 35

Table 35

Time taken by the athletes to cover 2000 metres brisk walking

Time taken(minutes)	Per cent
12.0-13.59	15
14.0-15.59	30
16.0-16.59	32
17.0-17.59	23
Total	100

From Table 35 it is noted that 15 per cent had completed 2000m brisk walking in a very good pace to cover the distance in 12.0 to 13.59 seconds. This pace helps the athletes to pursue health benefits of walking. Thirty per cent covered the distance in a slightly lesser speed to complete the distance in 14.0 to 15.59 minutes. Thirty two per cent had taken 16.0 to 16.59 minutes to complete the 2000 meters brisk walking. Only 23 per cent had taken 17 to 17.59 minutes to complete 2000 meters brisk walking.

Renolds (2013) quotes a study by Williams, a statistician at Berkley National laboratory that the health benefits of walking can be obtained while walking at a faster pace. In his study he had concluded that females had faster pace than males.

According to the World Book of Encyclopedia, an expert walker can walk one mile (1.6kms)in 6.5 minutes. Notably one athlete had covered 2000 metres brisk walking in 6.47 minutes indicating a very good record among other athletes.

v. Thousand five hundred meters middle distance running

The 1500m middle distance running is referred as “The metric mile”. It requires endurance, quick speed, proper form and mental focus. The result of the 1500m middle distance running is presented in Table 36.

TABLE 36

Thousand five hundred metres middle distance running

Duration (minutes)	Per cent
5.0-5.9	11
6.0-6.9	78
7.0-8.9	11
TOTAL	100

Data in Table 36 reveal that 78 per cent of athletes had taken 6.0 to 6.9 minutes to complete the 1500m middle distance running followed by 11 per cent each completing in 5.0 to 5.9 and 7.0 to 8.9 minutes. It is a high intensity exercise involving longer than two minutes. According to Berardi et al.,(2009) 84 per cent of energy is obtained from aerobic and 16 per cent from anaerobic oxidation.

b. Flexibility test

The flexibility of the selected athletes was measured by modified sit and reach test. The readings of the flexibility test are given in the Table 37. Figure 14 also shows the results of the flexibility test by sit and reach test.

Table 37**Flexibility test of the selected athletes**

Category	Distance (cm)	Per cent
Super	>=30	46
Excellent	21-30	48
Good	11 – 20	6
Total		100

Data depicted in Table 37 on flexibility of the selected athletes shows the categorization of the selected athletes according to the distance reached in the sit and reach test. Well's and Dilson (1952) have categorized the results of flexibility test into super, excellent and good. Majority (94%) of the athletes have been categorised as super and excellent. The results show that the selected subjects had greater flexibility, good muscle length and better development of hip and back flexion. These subjects have good extension of the hamstring muscles of the legs. Majority of the selected subjects were lean and hence scored good results. The flexibility test had a highest score of 43(cm) and lowest score of 12(cm) in the present study. Ortego *et al.*, (2011), Joukesh *et al.*, (2011) have shown better performance by female athletes in sit and reach test compared to male athletes.

c. Muscular endurance by floor push-ups test

The muscular endurance of the selected athletes as assessed through floor push-ups test is presented in Table 38 and figure 15.

Table 38**Categorization of the subjects according to muscular endurance
by floor push-ups**

Category	No of push-ups	Per cent
Excellent	19 – 21	4
Very good	16 – 18	10
Good	13 – 15	32
Fair	7 – 12	42
Poor	<7	12

Tests for muscular endurance by floor push-ups revealed in Table 38 indicate that 46 per cent of the subjects had recorded good, very good and excellent results. The athletes had high capacity to repeat contractions and show evidence of having fast twitch muscle fibres. Rest of the 54 per cent were not able to show good results. Lack of regularity in exercising and poor muscular endurance due to poor diet could have been the causative factors. These results indicate the need for improving the diet. Twelve per cent had registered poor results.

2. Skill related performance tests

a. Speed test

Speed is the ability to perform a movement in a short period of time. The result of the speed fitness test is depicted in Table 39.

Table 39

Categorization of athletes according to speed in 100 metres dash

Hundred meters dash		
Category*	Time (seconds)	Per cent
Excellent	14-16	9
Very good	16-18	42
Good	18-20	31
Fair	20-22	18
Total		100

* (www.mtdruitt-h.schools.nsw.edu.au/.../Fitness%20Testing%20averages.d.)

The 100 meter dash is a sprint race in track events which is most popular and prestigious event

It is evident from the data presented in Table 39 that time taken in seconds to complete the 100m dash ranged from 14 seconds to 22 seconds. Accordingly the subjects were classified into excellent, very good, good and fair. The results indicate that nine per cent were classified as 'excellent' and they were the fastest with 14 to 16 seconds. A maximum number of athletes (42 per cent) were in the very good category. They took 16 to18 seconds to cover the distance of 100 m. Thirty one per cent of the subjects had taken 18 to 20 seconds and were ranked as good. At the same time 18 per cent were classified as fair. If adequate nutritious diet is provided regularly the stamina and speed of these athletes can be improved.

b. Agility test

Agility is tested by the ability of the body to rapidly and accurately change the direction of the movement of the entire body in space and can be measured by shuttle run. The results of the 4x10 meters shuttle run conducted to assess the agility of the athletes are given in Table 40.

Table 40**Time taken by the selected athletes in shuttle run**

Time (seconds)	Per cent
10-12	87
12-14	3
14-16	10
16-18	Nil
Total	100

The time taken to complete the shuttle run presented in Table 40 indicates that 87 per cent were able to cover the distance within 10 to 12 seconds. Three per cent had covered in 12 to 14 seconds. The rest 10 per cent had taken 14 to 16 seconds to cover the distance. Good health and stamina are essential to withstand the ability to change the direction of the movement of the entire body in space. The results indicate good stamina and agility. A study conducted by Devi and Kumari (2014) among female college athletes showed an average of 12.92 seconds for shuttle run. The subjects of the present research have registered better performance. The performance would be much better if the haemoglobin level of the subjects are improved, because the speed in these tests depends upon the oxygen carrying capacity of blood.

C. Salient features of the pregame supplements formulated

One of the most important factors in improving athletic performance could be providing a pregame nutritious supplement to the performers. The ultimate goal of the pregame supplement is to increase the performance by maximizing stamina, by increasing energy stores and delaying fatigue. Fink *et al.*, (2006) have pointed out that pregame or pre activity meal should include a combination of protein, carbohydrate and fats. The carbohydrate foods should predominate in the pre-event meal, whereas protein foods should serve as a complement. In order to allow time for digestion, the pre-event meal should be consumed one to three hours prior to the onset of exercise.

The results of Phase I and II brought out the fact that the socio-economic status of the selected subjects was very low and food and nutrient intake was also not satisfactory. The selected athletes did not have adequate resources for purchase of any pregame nutrition supplements. Hence a low cost pregame supplement namely nutrimix powder was developed by the investigator which could be incorporated into different recipes.

The salient features of the nutrimix powder namely, nutrient content, cost, shelf life, composition and acceptability were assessed and the results are presented and discussed in the following Tables.

1. Nutrient composition and cost of the nutrimix powder

Table 41 presents the nutrient composition and cost of the three variations of the nutrimix powder developed.

Table 41

Nutrient composition and cost of the nutrimix powder

Variations of nutrimix	Quantity (g)	Carbohydrate (g)	Energy (kcal)	Fibre (g)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Cost (Rs)
V ₁	100	65	441	3.7	17	13	221	15.4	8.77
V ₂	100	65	441	3.3	17	13	166	15.5	8.44
V ₃	100	65	441	3.3	17	13	166	14.8	8.77

As depicted in Table 41 all the three variations of the nutrimix powder contained 65 g of carbohydrate and 440 kcals. The protein, fat and iron contents were equal in all the three variations while calcium was much higher in nutrimix V₁. The cost of variations V₁ and V₃ were the same namely Rs.8.77 while the cost of V₂ was slightly lower.

The excess calcium level in V₁ variation was due to the presence of ragi. Ragi has 344 mg of calcium per 100 g. The cost of nutrimix V₂ was low because of the low cost of Jowar. But for these two factors all the other nutrients were equal in the three variations developed.

1. Acceptability scores of the Nutri mix powders

The mean acceptability scores of the nutrimix powders are presented in Table 1 in methodology. The results revealed that the variation V₁ with ragi had obtained maximum score of 20 out of 25 followed by V₃ with bajra (18) and V₂ with Jowar (17). The acceptability of the nutrimix powder developed using ragi was high. This indicates that the taste of ragi was more acceptable compared to bajra and jowar. At the same time this variation had higher amount of calcium, which would benefit the athletes. Hence variation V₁ was selected for incorporating into the pregame sports supplements.

2. Shelf life of the nutrimix powder

The most acceptable combination namely V₁ with ragi was analyzed microbiologically for its keeping quality. Table 42 presents the microbial content of the nutrimix powder (V₁) before and after a storage period of three months.

Table 42

Microbial content of the nutrimix powder

Criteria	Initial	After 3 months
Total bacterial count (cfu/g)	Nil	3000
Yeast	BDL	BDL
Mould	BDL	BDL

BDL - Below Detectable Limit

The results of the microbial analysis of the nutrimix powder conducted in the fresh sample as well as sample stored for three months are presented in the Table 42. This points out that there were no bacterial contamination in the fresh sample. Yeast and mould contents were below the detectable level. After a storage period of three months, yeast and mould counts were below detectable level and bacterial count was 3000 (cfu/g). This was within the safe limits and does not have deleterious impact on health. The PFA act (1954) has recommended a total bacterial count of not more than 40,000 per gram of the sample in cereal based food products. Hence the bacterial count of the nutrimix was within the recommended level for cereal products and therefore was found to be suitable for consumption.

3. Characteristics of nutrimix incorporated pregame supplements.

The V₁ variation of the nutrimix powder was incorporated into three recipes namely nutridrink, nutribar and nutriballs as pre game supplements for the athletes. Composition, nutrient content and acceptability of pregame supplements developed are given in Tables 43 and 44.

- a. Composition of the pregame supplements per 100g of the supplement.

Table 43

Composition of the pregame supplements per 100g

Composition (g)	Nutridrink	Nutribar	Nutriballs
Nutrimix powder	30	30	30
Milk	40	Nil	Nil
Jaggery	20	20	20
Glucose	10	10	10
Banana	Nil	30	Nil
Sago powder	Nil	Nil	25
Ground nuts	Nil	5	Nil
Niger seeds	Nil	5	5
Ghee	Nil	Nil	10
Total	100	100	100

From Table 43 it is observed that Nutrimix powder (30g), jaggery (20g) and glucose (10g) were the common ingredients added to all the three recipes. For nutridrink milk (40g) was added, for nutribar banana (30g) ground nuts (5g) and niger seeds (5g) were added and for nutriball sago, niger seeds and ghee were added. All the three recipes had equal weight of 100g. To bring the nutridrink to fluid consistency 150 ml water was added.

b) Mean acceptability scores of pregame supplements

Table 44
Mean acceptability scores of pregame supplements

Variations	Organoleptic criteria					Mean scores (Max=25)	Percentage scores
	Appearance (5)	Taste (5)	Mouth feel (5)	Consistency (5)	Flavour (5)		
Nutridrink	4	4	4	4	4	20	80
Nutribar	4	4	3.5	3.5	3	19	76
Nutriballs	4	3.5	3	3	3	16.5	66

It is evident from Table 44 that the maximum score of 20 was obtained by Nutridrink followed by Nutribar. Hence these two preparations were chosen for supplementation. Nutridrink was preferred due to its good flavour, colour, acceptable mouth feel and ease of consumption. Nutribar had attractive brown colour with appetizing banana flavour, soft mouth feel but took little more time to chew due to the content of nuts. Nutriballs scored less because of its sticky consistency and the flavour which was not acceptable.

Due to high acceptability scores nutridrink and nutribar were selected to supplement the selected athletes one hour before practice early in the morning.

c. Nutrient composition of pregame supplements

Table 45
Nutrient composition of pregame supplements

Nutrients	Nutridrink (200 ml)	Nutribar (1 bar)	Nutriballs (2 balls)
Energy (kcal)	276	337	452
Carbohydrate (g)	32	40	53
Protein (g)	6	9	6
Fat (g)	6	8	16
Fibre (g)	1	1.7	1.5
Calcium (mg)	114	90	83
Iron (mg)	5.1	8.1	7.9
Cost / portion Rs	5.74	5.78	11.23

Data in Table 45 shows that Nutridrink had supplied 276 kcal, 32 g of carbohydrate, 6 g of protein, 6g of fat, one gram of fibre. The calcium content of nutridrink was 114 mg which was high compared to nutribar and nutriballs. The iron content of nutridrink was 5.1mg. The cost per portion of nutridrink was Rs.5.74.

Nutribar had supplied 337 kcal, 40 g of carbohydrate, 9g of protein, 6g of fat, 1.7g of fibre. The calcium content of nutribar was 90 mg. The iron content of nutribar was 8.1mg. The cost per portion of nutribar was Rs.5.78.

Nutriballs had supplied 452 kcal, 53 g of carbohydrate, 6 g of protein, 16g of fat, 1.5 g of fibre. The calcium content of nutriballs was 83 mg. The iron content of nutriballs was 7.9 mg. The cost per portion of nutriballs was Rs.11.23.

E. Efficacy of the pregame supplements formulated

1. Performance capabilities of the athletes before and after feeding the pregame supplements.

a. Health related physical fitness

Health related physical fitness consist of measurements related to cardiorespiratory fitness. The five selected tests namely Harvard step test, tread mill test, electronic bicycling, 2000 metres brisk walking and 1500 metres middle distance running were assessed before and after supplementation. The mean values recorded are presented in the Table 46. The individual values are given in the Appendix IX. Figures 14 to 20 also represents the values before and after supplementation.

Table 46

Mean scores of health related physical fitness before and after supplementation

Groups	Cardio vascular endurance tests					Muscular endurance test	Flexibility test
	Harvard step test(PEI)*	Tread mill test (km)	Electronic bicycling (km)	2000m B.W* (min)	1500m MDR* (min)	Push-ups (number)	sit and reach(cm)
Nutridrink before	90.60±10.25	1.44±0.06	1.87±0.33	15.14±1.33	6.24±0.24	11.80±4.60	29.60±7.98
After	92.36±10.19	1.69±0.10	2.07±0.29	14.88±1.31	6.16±0.23	12.47±4.35	31.07±7.11
't' value	14.77**	21.3**	21.0**	30.47**	9.76**	7.61**	8.25**
Nutri bar before	88.56±8.15	1.54±0.03	1.88±0.36	15.35±1.65	6.22±0.40	11.83±14.08	27.07±4.92
After	89.09±8.36	1.54±1.43	1.88±0.36	15.35±1.65	6.20±0.38	11.97±4.02	27.20±4.84
't' value	2.19*	2.11*	2.40*	2.40*	2.26*	2.11*	2.11*
Control before	89.65±8.57	1.43±0.05	1.85±0.31	15.30±1.41	6.29±0.27	11.00±3.05	30.67±5.09
After	89.76±8.57	1.43±0.05	1.85±0.31	15.28±1.41	6.28±0.27	11.00±3.05	30.77±4.89
't' value	1.000NS	1.43NS	1.36NS	1.54NS	1.43NS	1.79NS	1.79NS

***PEI-physical Efficiency Index; BW-Brisk walking; MDR-Middle distance running;**

*** - Significant at 5% level; ** - Significant at 1% level; NS – Not Significant**

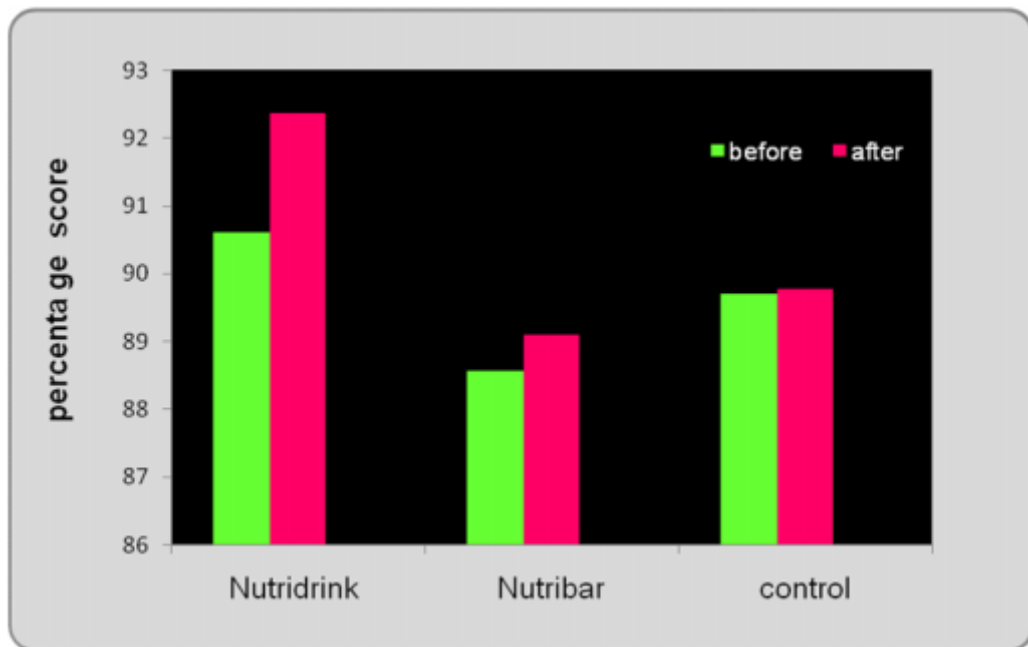


Figure 14

Harvard step test

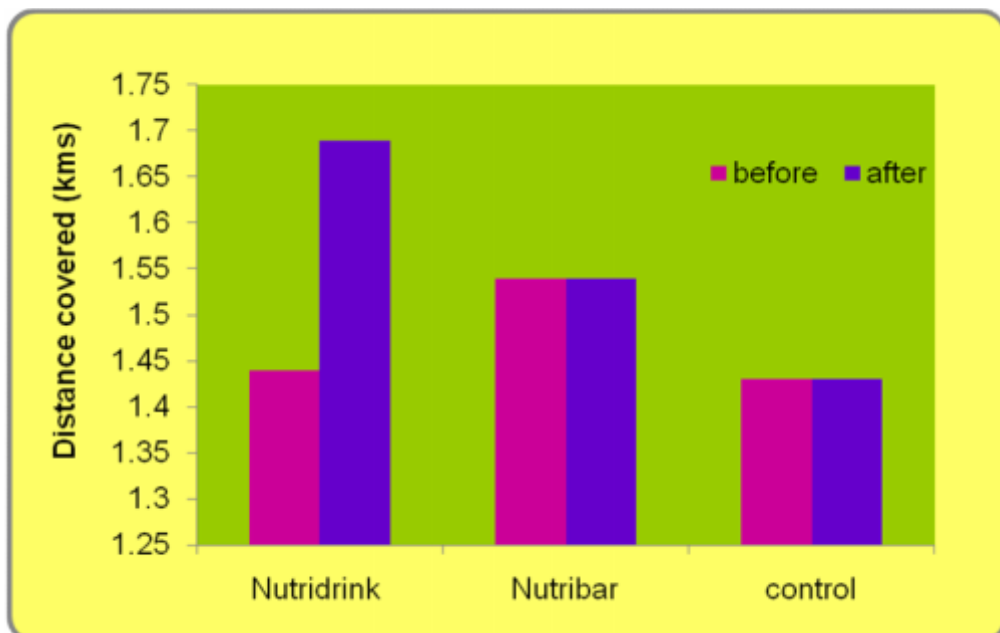


Figure 15

Tread mill test

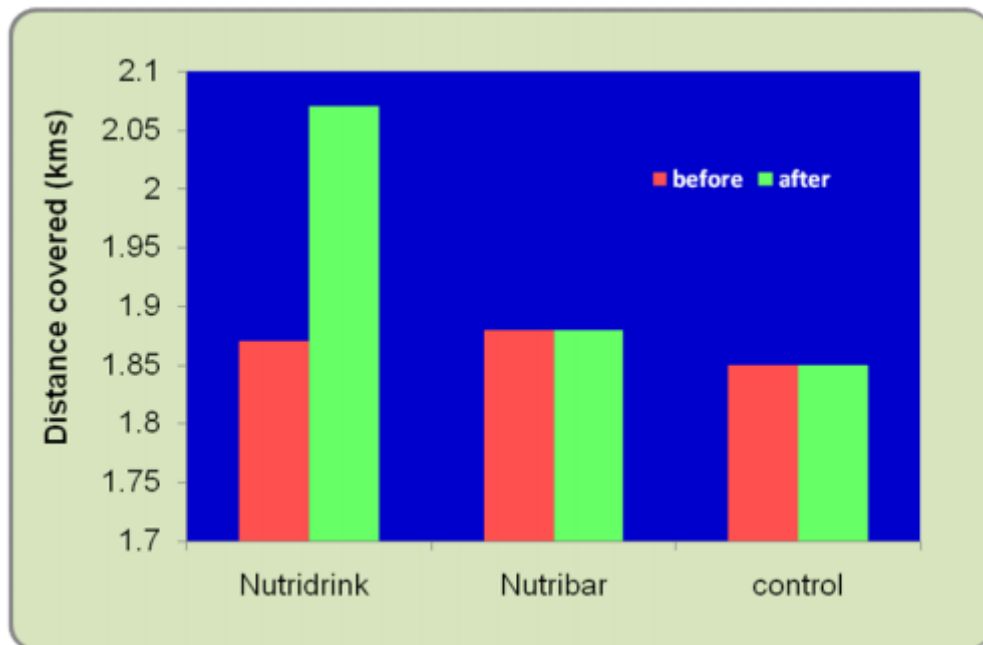


Figure 16
Results of electronic bicycling

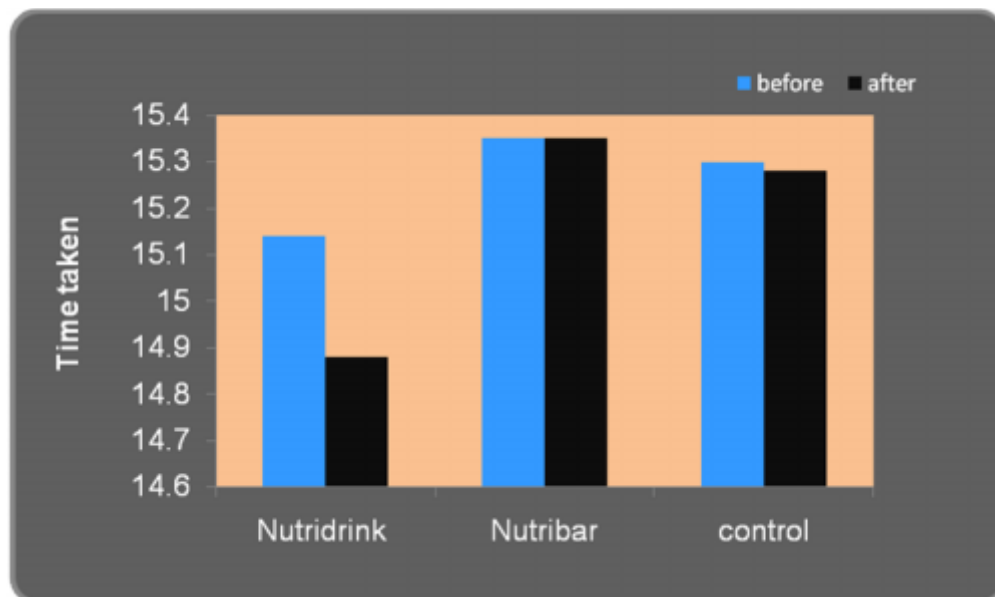


Figure 17
2000 meters brisk walking

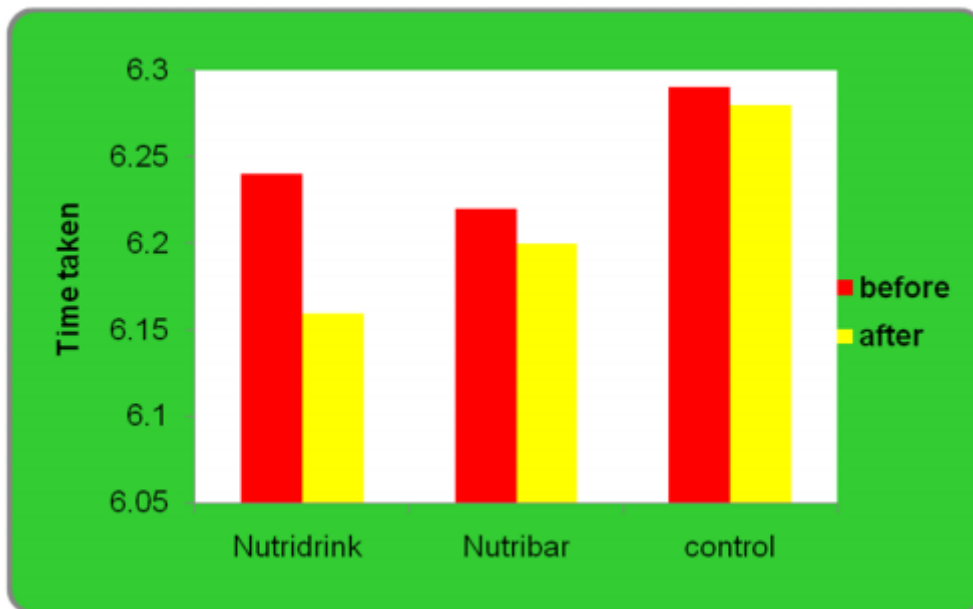


Figure 18

1500 meters middle distance running

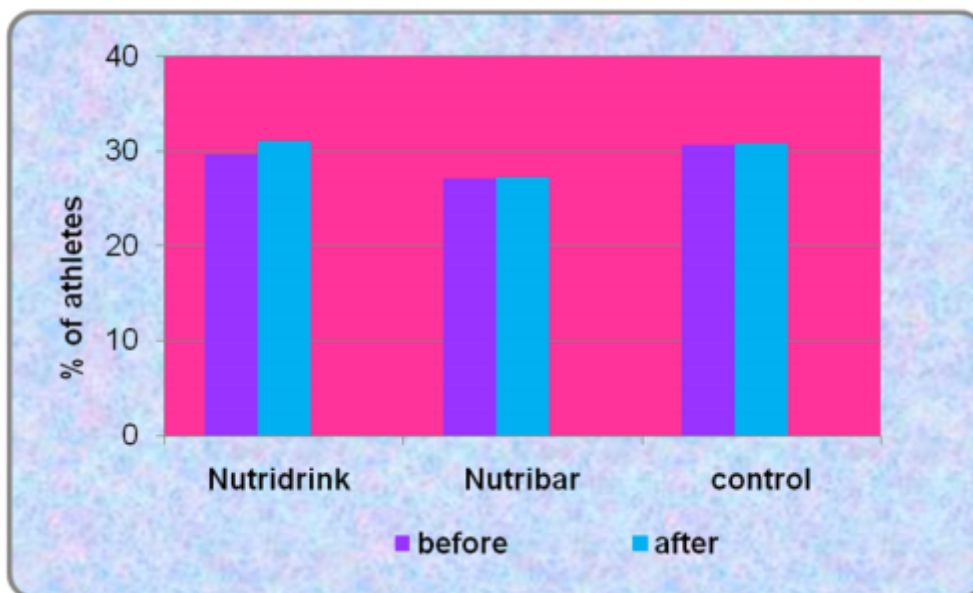


Figure 19

Flexibility test of athletes

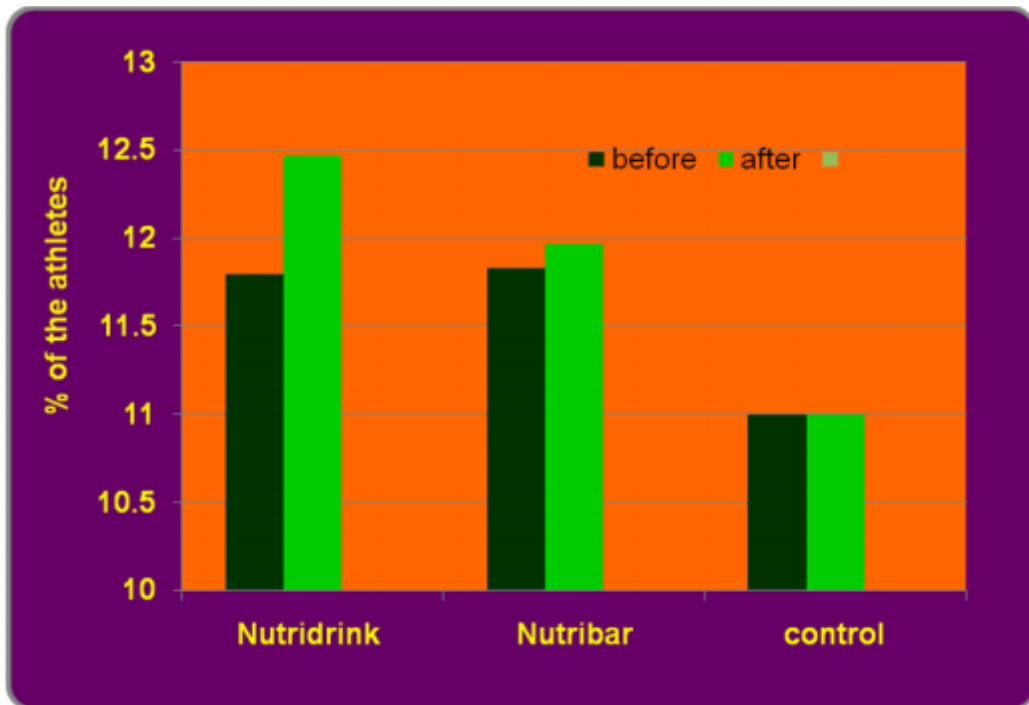


Figure 20

Muscular endurance test by floor push-ups

Harvard step test is one of the cardio-respiratory endurance tests. This test measures the ability of an athlete to sustain a series of repetitions of an activity during a fixed time period. The ability of the selected athletes to perform the Harvard step test had increased from a mean value of 90.60 to 92.36 which was statistically significant at one per cent level ($p < 0.01$) indicating improved cardiac endurance. In the tread mill test, the distance covered by the selected athletes in the treadmill test had increased from 1.44 km to 1.69 km after supplementation. Values registered in electronic bicycling, 2000meters brisk walking and 1500meters middle distance running also had shown improvements which were significant at one per cent level ($p < 0.01$) for nutridrink group.

The values registered by the nutribar group for the cardio respiratory endurance tests had recorded improvements after supplementation. The increase in the values were significant at five per cent level ($p < 0.05$). But contrary to these values the control group did not show improvements after a period of three months. The difference in the values were also not statistically significant.

Under health related physical fitness tests muscular endurance was measured through push-ups. The mean values of number of push-ups had increased from 11.80 to 12.47 which showed the efficacy of the nutridrink. The improvement was statistically significant at one per cent level. Flexibility studied by modified sit and reach test had also shown improvements, which were statistically significant at one per cent level ($p < 0.01$) for nutridrink group. The nutribar group had registered improvement at five per cent significant level. The control group did not register any statistically significant improvement.

a. Skill related physical fitness

The skill related physical fitness was evaluated by conducting speed and agility tests. Speed depends upon a number of factors such as muscle fibre composition, neuro- muscular co-ordination, elasticity of muscles and strength. In the present investigation speed was tested through 100 meters dash and agility by shuttle run.

The mean values obtained by the athletes for these tests before and after supplementations are given in the Table 47. Individual values are presented in Appendix IX.

Table 47
Mean scores of skill related physical fitness before and after supplementation

	Speed 100m dash (seconds)	Agility Shuttle run (seconds)
Nutridrink		
Before	16.76±1.06	10.96 ±0.63
After	16.72 ±1.03	10.84 ±0.58
't' value	5.03**	9.14**
Nutribar		
Before	16.65±1.27	10.90 ±0.38
After	16.63 ±1.25	10.88 ±0.35
't' value	2.11*	2.26*
Control		
Before	16.65±1.55	10.97 ±0.46
After	16.65±1.54	10.96 ±0.45
't' value	1.00 ^{NS}	1.43 ^{NS}

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

As presented in Table 47 the time taken to cover a distance of 100 meters had decreased for the nutridrink and nutribar groups. This indicates that the ability and endurance capacity of the athletes had improved and hence the athletes had reached the end point few seconds ahead of the attempt recorded before supplementation. The reduction in time taken was statistically significant at one per cent level ($p < 0.01$) for the nutridrink group and at five per cent level ($p < 0.05$) for nutribar group. Control group did not show improvement and hence the difference was also not statistically significant both for 100 meters dash and shuttle run.

2. Blood haemoglobin

The mean haemoglobin levels of the athletes estimated before and after supplementation are presented in the Table 48.

Table 48
Mean blood haemoglobin values before and after supplementation

Groups	Haemoglobin (g/dl)
NUTRIDRINK	
Before	11.36 ±1.31
After	11.44 ±1.22
't' value	3.44**
NUTRIBAR	
Before	11.47 ±0.93
After	11.49 ±0.95
't' value	2.283*
CONTROL	
Before	11.44 ±1.09
After	11.45 ±1.09
't' value	1.43 ^{NS}

* - Significant at 5% level;

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

As evident from the Table 48 the haemoglobin values increased from 11.36g/dl to 11.44 g/dl for nutridrink group while the nutribar group had shown an improvement of 0.02g/dl after supplementation. The increase in haemoglobin values were statistically significant at one per cent level ($p < 0.01$) for nutridrink group. For the group which consumed nutribar, the increase in haemoglobin was statistically significant at five per cent level ($p < 0.05$). Control group did not show statistically significant improvement even after a period of three months.

3. Anthropometric measurements

The anthropometric measurements namely weight, height, waist circumference and hip circumference were recorded for the three groups before and after supplementation. Body mass index and waist hip ratio were computed. The mean values of the three groups are presented in Table 49.

Table 49

Mean values of anthropometric measurements before and after supplementation

Groups	Weight (kg)	Height (cm)	BMI (kg/m²)	WC (cm)	HC (cm)	WHR (cm)
NUTRIDRINK						
Before	50.57±10.23	157.83±5.89	20.89±2.14	67.78±6.13	85.03±4.77	0.79±0.05
After	52.80±4.91	157.83±5.89	21.83±1.81	67.93±5.35	84.82±4.69	0.80±0.04
t' value	1.64 ^{NS}	0.00 ^{NS}	0.96 ^{NS}	0.29 ^{NS}	0.51 ^{NS}	1.43 ^{NS}
NUTRIBAR						
Before	49.63±5.66	158.49±5.50	19.87±2.29	64.15±5.05	82.50±4.57	0.77±0.04
After	49.60±5.70	158.23±5.02	19.86±2.27	63.74±5.73	82.07±4.97	0.77±0.04
t' value	0.00 ^{NS}	1.00 ^{NS}	0.24 ^{NS}	1.01 ^{NS}	1.13 ^{NS}	0.75 ^{NS}
CONTROL						
Before	51.30±5.19	158.03±5.02	19.86±2.27	63.74±5.73	82.07±4.97	0.77±0.04
After	51.00±4.52	158.03±4.94	20.49±1.58	66.98±5.15	85.10±4.88	0.79±0.04
t' value	0.96 ^{NS}	1.00 ^{NS}	0.80 ^{NS}	0.62 ^{NS}	0.08 ^{NS}	0.99 ^{NS}

NS – Not Significant ; WC – Waist circumference ; HC – Hip circumference ; WHR - Waist to Hip ratio ;

BMI - Body mass index

The values presented in Table 49 point out that there was no difference in the mean height of all the three groups before and after supplementation. In the case of nutridrink group there was a slight increase in the mean body weight. The mean body weight of this group had increased from 50.75 to 52.80 kg. There was no change in mean height and only weight had increased. The mean body mass index registered a higher value of 21.83 compared to the initial body mass index of 20.89. But the difference was not statistically significant. For nutribar group and control group no significant changes were noticed in height, weight and body mass index. Same trend was observed in waist circumference and waist to hip ratio also. The results of anthropometric measurements showed a slight increase in body weight alone for nutridrink group. This highlights the efficiency of nutridrink in improving body weight.

4. Body composition

The changes in the body composition measured through triceps skin fold measurement and body fat percentage are depicted in Table 50.

Table 50

Measurements of body fat before and after supplementation

Groups	Skin fold measurements (mm)	Body fat percentage
NUTRIDRINK		
Before	11.78 ±0.91	18.40 ±2.86
After	11.97 ±1.10	18.57 ±2.60
t' value	0.85 ^{NS}	0.43 ^{NS}
NUTRIBAR		
Before	11.47 ±0.97	19.76 ±6.14
After	11.57 ±0.90	19.82 ±6.16
t' value	1.36 ^{NS}	0.83 ^{NS}
CONTROL		
Before	12.00 ±1.14	18.26 ±2.56
After	11.83 ±1.12	18.45 ±1.92
t' value	1.22 ^{NS}	0.91 ^{NS}

NS – Not Significant

From Table 50 it is evident that the skin fold measurement had increased from 11.78 mm to 11.97 mm for nutridrink group and from 11.47 to 11.57 mm for nutribar group. Same trend was observed in the body fat per cent also. In the case of control group the skin fold measurement had reduced and body fat measurement had increased slightly. But the values were not statistically significant.

From the foregoing results it is evident that the nutridrink which was developed by the judicious combination of locally available low cost nutritious foods was more efficient in enhancing the endurance capacity, haemoglobin levels and body weight of the selected athletes.

Hence a commercial pregame nutridrink can be made available to athletes at a lower cost. This would enhance the performance capability of the athletes and aid in bringing laurels to our country.