International Journal of Academic Research and Development
ISSN: 2455-4197
Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 3; Issue 3; May 2018; Page No. 190-196

Influence of dietary intake and energy expenditure on nutritional status of sports students: A comparative study

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Abstract
Introduction: Sports help in overall development, providing ample of relaxation and recreation to human body in a healthy way. Sports nutrition tremendously improves body composition and nutritional status which invariably increases speed, quickness, mobility and strength, it will also aid in fast recovery, which increases practice and competition as body becomes more fit and adjust to the good nutrition. Sports diet will also boost immunity, which will allow one to stay healthy, able to continue and intensify practice and training.
Objective: To study the dietary practices, energy expenditure and their influence on nutritional status of selected subjects.
Methodology: This is the cross-sectional study carried on sports students residing in Alva's hostel, Moodbidri by selecting equal number of males and females (n = 30each). Data regarding demographic details, pertaining to sports and daily dietary practices, sports profile were collected using questionnaire. Anthropometric assessment, biochemical assessment (Hemoglobin level) was done to know about nutritional status. Energy expenditure was calculated using MET values. Macro and micro nutrient intake was calculated using seven days diet history.
Result: The results showed majority of selected male subjects were overweight and had WHR more than normal this may due to high intake of fat than the recommended intake, whereas majority of females were underweight and anemic, this may due to less intake of energy, carbohydrates, protein and iron than the recommended intake and negative energy balance. Dietary practices related to sports revealed that majority of selected subjects are lack in knowledge about sports nutrition.
Conclusion: Need to decrease fat intake and to increases protein, fruits and vegetables intake as well as need to give nutrition education to overcome poor nutritional status.

Keywords: sports diet, sports nutrition, anthropometric measurements, energy expenditure, MET

Introduction

Sports have gained a tremendous popularity, more organized and important in recent years across the world. It serves various vital social and cultural functions. Sports help in overall development, providing ample of relaxation and recreation to human body in a healthy way. It greatly provides opportunities for social interaction which in turn helps in understanding among nation, races, and religions to reach height of excellence of human endeavor and attainment [1]. Over the last two decades, a great transformation has occurred in the attitude of people towards sports activity and interest in competitive sports which mainly influence on sports performance.

Nutrition is an important component for any fitness program [2]. It not only improves performance but also promotes healthy dietary practices for long term [3]. The American College of Sports Medicine, American Dietetic Association and Dietitians of Canada reported that "physical activity, athletic performance and recovery from exercise are enhanced by optimal nutrition" [4].

Every individual sports event based on performance involves competition and winning. Better the performance leads to greater the chance of winning the sports event. Sports medicine, sports psychology, sports nutrition and sports physiology are few determinant fields which helps to increases the performance. Among these, sports nutrition is the strongest and important too [5]. Sports nutrition tremendously improves body composition and nutritional status which invariably increases speed, quickness, mobility and strength, it will also aid in fast recovery, which will increase practice and competition as body becomes more fit and adjust to the good nutrition. Sports diet will also boost immunity, which will allow one to stay healthy, able to continue and intensify practice and training [6].

The science of sports nutrition is new in India and special efforts of establishing dietary guidelines for sport persons have gained importance in the last twenty years. Diet significantly influences sports performance by providing the most essential nutrient. Foods provide recommended nutrients for daily activities and nutrient consumption by sports person is directly depends on their physical activity [1]. So, it is important to choose foods carefully and judiciously by considering the quality and quantity of macro and micro nutrients intake to meet specific needs of an event and training during the performance of sports person [7]. When the body has undergone extensive exercise, there is decrease in the nutrients from the body stored fuel, hence following proper eating habits and balanced diet provides fuel needed during training and competition. The diet should provide all the nutrients needed by an individual especially carbohydrates,

being the principle source of energy (in adequate amount and in proper proportion [1].

Stored nutrients are required to an optimum level at least twice and thrice during the performance. Accordingly, appropriate sports diet demands for the ratio like, carbohydrates is contributing about 50-55 per cent of the total energy intake and fat about 30 per cent and protein about 15-20 [8]. The body stores limited amount of carbohydrate in the liver and muscle in the form of glycogen. During the exercise, the glycogen is converted to glucose and used for energy. The ability to sustain prolonged intensive exercise is directly proportional to initial level of muscle glycogen. The glycogen stored in the muscle is sufficient to supply the energy for the event which last for 90 minutes. For events which require heavy work, more than 90 minutes, a high carbohydrate diet followed two to three days before the event; this allows glycogen spaces to be filled [9].

According to the Olympic training Center in Colorado Springs, endurance sports person on a high-carbohydrate diet will exercise longer than sports person following a low-carbohydrate, high-fat diet. Following a high-carbohydrate diet daily is not advised. Make sure that glycogen stores in the muscle and liver are at maximum for continuous activities of three to four hours [10]. Water is an important nutrient for the sports person. Water retention is often associated with carbohydrate loading. During the event water, along with electrolyte get loss from the body and this will leads to dehydration resulting in disturbance, and weakness which results in poor performance so one should start event hydrated and replace as much as fluid as possible by drinking chilled liquids with electrolytes at frequent intervals during the event [11].

Seventy five percent of total energy expenditure from fat controls the metabolism for moderate exercise. Fat intake depends invariably on the event's intensity, duration and physical condition. Events lasting for more than 90 minutes body use fats for energy and mainly in the sports person trained compared to untrained one. Less than 15% of fat intake in total energy intake limits the performance [9].

Energy is used mainly in the order, like carbohydrates being the prime, secondly the fat and protein the last source. Depending on type and frequency of event protein need of sports person varies. Excess protein consumed is stored as fat. Most authorities recommend 1.2-1.4g/kg body weight and 1.6-1.7g/kg body weight of protein for endurance and strength trained exercise respectively [10]. It is obvious that there is no correlation between increased energy expenditure and increased vitamins and minerals need, except riboflavin but exercise increases the maximum utilization of vitamins and minerals (B, 2014). Sports anemia incidence is high among sports person due to severe exercise especially in runners [12]. High prevalence of magnesium depletion, anemia and iron deficiency anemia were found among basketball players of both genders [13]. Sports persons are more prone to calcium and magnesium deficiency [14].

Water soluble nutrients like vitamin B complex i.e., Thiamine, riboflavin and niacin aids the energy release from the fuel sources in the diet and Vitamin-C rich foods helps in faster recovery of damaged tissues; little excess also not an issue as it is non toxic in contrast to fat soluble vitamins on [9]. Heavy exercise impairs the metabolism of sodium, potassium, iron and calcium. Sweating during the exercise increases the body's salt concentration and lowers the performance so proper rehydration with minerals lost during pre-and post exercise is essential. Iron supplies oxygen to all the tissues. Due to menstrual blood loss iron requirement is more for female sports person. Calcium is important for muscle function and bone health [10]. There is an increased risk of stress fracture among sports persons which is associated with lower calcium intake and lower bone intensity. Female sports person should have an adequate supply of calcium to avoid calcium loss from bones. The calcium intake of 1-2g/day is recommended. Dairy products, especially low-fat choices are the best sources of calcium. Magnesium improves the muscle strength [15].

Objectives

- To study dietary practices, energy expenditure and nutritional status of sports students and their influence on nutritional status.
- To assess the nutritional knowledge of selected subjects

Materials and Methods

The present cross-sectional study was carried out with the sports students of Alva's college, who are residing in Alva's hostel, Moodbidri. Prior permission was taken from the Principal of Physical Education Department.

Selection of the Subjects

Randomly a total of 60 sports students engaged in different sports events of age group 21-26 years were selected from the above-mentioned institution.

An equal distribution was made among the study population, 30(males and females each). The purpose of the study was explained to the subjects briefly

Formulation of Questionnaire and Collection of Data

A detailed questionnaire of 27 points was formulated consisting of questions related to selected subject's demographic information, general dietary practices, dietary practices pertaining to sports, physical activity and sports profile.

Detailed collection of demographic and dietary practices details

Demographic information mainly comprises of name, age, gender, family type, economic status, parent's occupation, education and personal habits. Dietary practices contain aspects regarding diet type, daily meal pattern, staple food, skipping of meals and eating outside

Eliciting information on sports profile including dietary practices

This consists of details regarding carbohydrate loading, fat restriction, and water intake per day, consumption of electrolyte, sports drink and supplements.

Also include type of sports involved, number of years engaged in sports, duration of practice, practice session and injury during sports. The questionnaire was distributed to selected sports person and data was collected

Anthropometric assessments

Anthropometric measurements were used as tools to measure the nutritional status of selected sports students. Various measurements like height, weight, were used to study the nutritional status. Waist and hip circumference were used to assess the fat distribution

Weight (in kg) of the selected subjects was measured using a portable balance to the nearest of 0.5 kg. The accuracy of the weight was ascertained by using standard weights. The zero adjustments of the scale were checked prior to each measurement. The height (in cm) of sports persons was measured by using measuring tape and converted to meter.

Body mass index (BMI) was calculated using weight and height measurements and compared with standards.

BMI = weight in kg / (height in meter) ^{2} [16].

Waist and hip circumference is measured using measuring tape and waist hip ratio (WHR) was calculated using formula, WHR = waist circumference/hip circumference and compared with standards. (WHO, 2004).

Estimation of daily energy expenditure

Energy expenditure was calculated using BMR and MET values. BMR was calculated using Harris Benedict equation [17].

Biochemical analysis

Estimation of hemoglobin of the subjects was done using Sahli's apparatus [18].

Dietary recall (7 days)

The complete dietary recall for the previous seven consecutive days of the selected subjects was collected and noted individually using diet dairy. The recall included each and every food that was consumed in that course of time. The approximate amount of all the food consumed was noted. Frequency of cereals, pulses, milk, fruits, vegetables, fat and sugar intake was calculated. Macro and micro nutrient intake was calculated using standard National Institute of Nutrition (NIN) nutrient composition table. Collected data was compared with standard values

Interpretation of collected data

The collected data was analyzed using mean, standard deviation and correlation using excel

Result and Discussion

Demographic details are presented in the table 1. It is heartwarming to note that females did not had any kind of bad habits but still it was found that occasionally 27% of selected males had a habit of alcohol intake and 63% of them did not exhibit any liking towards the bad habits as they keen on the sports.

Table 1: Demographic Information of selected sports students

Variables		Male	Female
		N (%)	N (%)
Economic status	BPL	7(57)	25(83)
	APL	13(43)	5(17)
Diet type	Vegetarian	1(3)	0(0)
	Non vegetarian	29(97)	30(100)
Personal habit	Smoking	2(7)	0(0)
	Alcohol	8(27)	0(0)
	Tobacco	2(7)	0(0)
	None	19(63)	30(100)

BPL- Below the poverty line
APL- Above the poverty line

Table 2 presents a wide detail on their daily dietary practice. Majority of the selected male subjects were non-vegetarians (97%) and among female subjects all in all were non-vegetarians. 42-61% of male and female had regular three meals. Two and more than three meals were practiced by 13% each. Thirty percent of the female subjects had only two meals with an addition of snacks in between.

As per the staple foods are concerned rice intake is increasingly high especially with females i.e., 84%. There was a wide variety of staple foods as residing hostellers are from different regions of Karnataka. Very interestingly we recorded that 33% and 34% of the female and male subjects skipped their regular lunch and breakfast respectively. Eating outside seems to be quite filling among the subjects as, all in all had a craving of eating outside, preferably non-vegetarian stuffs.

Table 2: Daily Dietary Practices of selected subjects

Particulars		Male	Female
		N (%)	N (%)
Daily meal pattern	Twice	4 (13)	1 (3)
	Twice with snacks	5 (17)	9 (30)
	Thrice	12 (40)	18 (61)
	Thrice with snacks	5(17)	1 (3)
	More than thrice	4 (1)	1 (3)
Staple food	Hostel (rice)	30 (100)	30 (100)
	Home		

	Rice	14 (47)	25 (84)
	Jowar	4 (13)	0 (0)
	Wheat	6 (20)	1 (3)
	Ragi	6 (20)	4 (13)
Skipping of meals	No	15 (50)	17 (57)
	Yes	15 (50)	13 (43)
	Breakfast	10 (34)	2 (7)
	Lunch	4 (13)	10 (33)
	Supper	1 (3)	1 (3)
Eating out side	Yes	30 (10)	30 (100)
	No	0 (0)	0 (0)
Preference	Non vegetarian	14 (47)	14 (46)
	Bakery	12 (40)	11 (37)
	Fried	4 (13)	5 (17)

Perusal of table 3 has clarity on dietary practices pertaining to sports. Carbohydrate loading was much preferred occasionally by the subjects in the range of 33-45% (male: female) and 50% of the male subjects has reported for rarely intake of carbohydrates. 20-23 5 of male and female have a daily restriction of fat. Sports drink was rarely consumed (63% by females, 73% by males occasionally), 47% of the total subjects had electrolytes; females rarely and male occasionally.

An intake of 8-10 glasses of water/day was seen among 50% of the male subjects and 70% of the females. 73% of females had liberal intake of water i.e. more than ten glasses a day. Surprisingly all subject population are not interested with any supplements, 90% have shown up with no interest of supplementation.

Table 3: Dietary practices pertaining to the sports

Particulars		Male	Female
		N (%)	N (%)
Carbohydrate loading	Always	5 (17)	7 (23)
	Occasionally	10 (33)	12 (40)
	Rarely	15 (50)	11 (36)
Fat restriction	Always	6 (20)	7 (23)
	Occasionally	15 (50)	11 (37)
	Rarely	9 (30)	12 (40)
Sports drinks	Always	0 (0)	5 (17)
	Occasionally	22(73)	6 (20)
	Rarely	8 (27)	19 (63)
Electrolyte	Always	0 (0)	3 (10)
	Occasionally	14 (47)	13 (43)
	Rarely	16 (53)	14 (47)
Mode	Powder	1 (3)	0 (0)
	Water	29 (97)	30 (100)
Water intake	6-8 glasses	6 (20)	3 (10)
	8-10 glasses	15 (50)	5 (16.7)
	>10 glasses	9 (30)	22 (73.3)
Supplements	Yes	4 (13)	3 (10)
	No	26 (87)	27 (90)

The table 4 represents that sports profile and which includes their duration and session of the practice and also off course about the events and injury caused. 30-37% of males and females were involved in the sports which are of physical endurance, team events found to be more in females. From the table, it shows that the whole study population has been in practice since years. Female with 37% are of experience and males around 57% of training practice experience. Maximum duration of practice 50% of males for 3 hours, 47%of females for 4 hours and 27% for 5 hours. As there is no restriction with the sessions, they are involved in both morning and evening session. 60-82% of the subjects have not majorly injured all through their sports life.

Table 4: Sports profile of selected sports students

Particulars		Male	Female
		N (%)	N (%)
Sports involved	Power events	6 (20)	5 (17)
	Endurance	11 (37)	9 (30)
	Team events	8 (27)	12 (40)
	Events of high weight category	5 (16)	4 (13)
	Skill games	0 (0)	0 (0)
Number of years of practice	5-8	6 (20)	7 (23)
	8-10	7 (23)	12 (40)
	>10	17 (57)	12 (40)
Duration (Hrs)	2	12 (40)	1 (3)
	3	15 (50)	7 (23)
	4	3 (10)	14 (47)
	5	0 (0)	8 (27)
Session	Morning	0 (0)	0 (0)
	Evening	0 (0)	0 (0)
	Both	30 (100)	30 (100)
Injury	Yes	12 (40)	4 (13)
	No	18 (60)	26 (87)

The nutritional status was classified based on body mass index (BMI) by comparing standards values to the observed values. From the figure 1 it is clear that boys were more of overweight (30%) in contrast to the girls; 37% of them were underweight. 43-47% were in the normal BMI range [19].

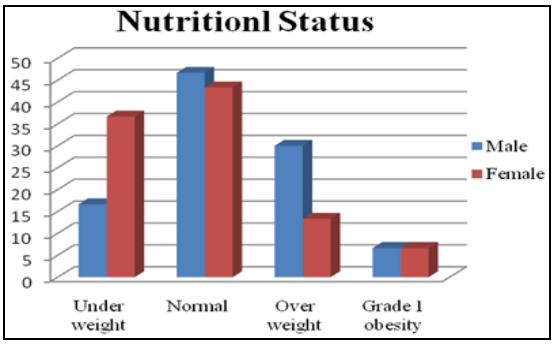

Fig 1: Nutritional status of selected sports students

In comparison, male subjects had a normal hemoglobin level with 43% and females with 30%. Very unambiguous the hemoglobin level was extremely below the normal among both subjects the range 57-70% so as per the information while counseling it's understood that there is an increased intake of stimulants which has left to the poor absorption of iron and inclusion of the iron rich foods extremely low which directly affects that hemoglobin level [19].

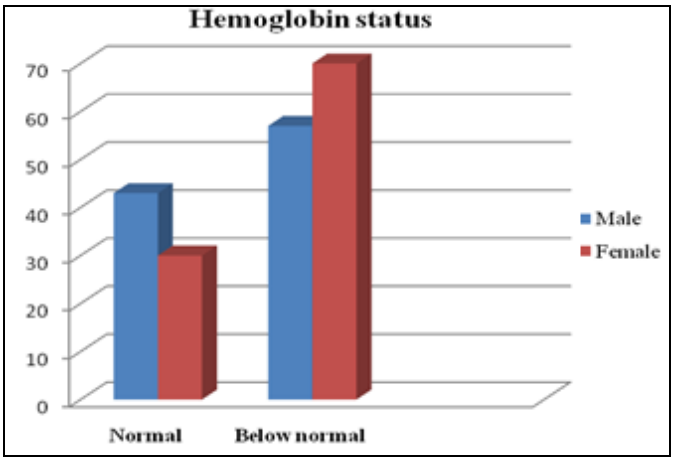

Fig 2: Hemoglobin status of selected subjects

Energy balance maintained by the intake and expenditure is well signified in terms of graphic representation. Males had a slight difference in their energy balance i.e. only 50% kcal, which in female almost 340 kcal of energy consumption which indicates negative energy balance [20].

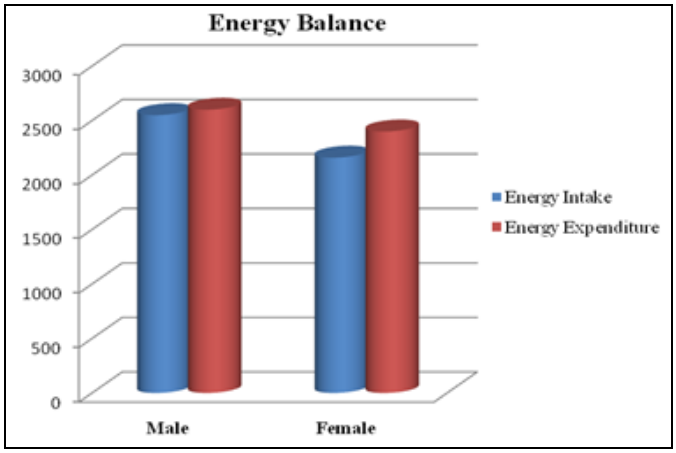

Fig 3: Energy Balance

Dietary intake of the selected subjects is present in the line graph. Although it is a comparative study, there is no huge difference found between the subjects, except for protein foods like pulses, egg, and meat with a low intake among females. Sugary foods are little on the higher side on the male subjects as there is regular intake of sweetened beverages. However, fat was considerably high among both male.

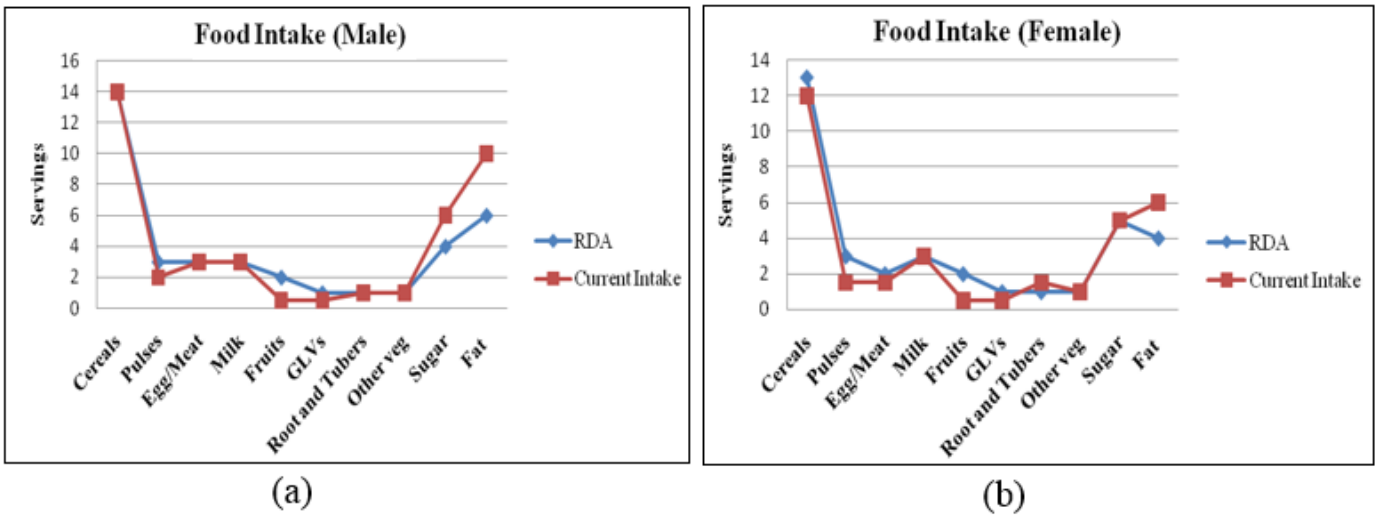

Fig 4: RDA and current food intake of selected subjects and female subjects.

The energy requirement of the male subjects is almost meeting the standard requirement where in female subjects also have their maximum intake of energy contribute from all its rich source 92-97% of protein and carbohydrates have filling their capacity compare to their raw counterparts. Except for fat all the other nutrients are below their standards and extra intake of fat i.e. 8 and 18% for males and females respectively.

Iron intake was only 36% of the requirement among female subjects which is also affected their hemoglobin. Being the sports men calcium has to be made-up by another 25-30% at least in the form of supplements which is indeed a more strengthing nutrients for their physical endurance [15].

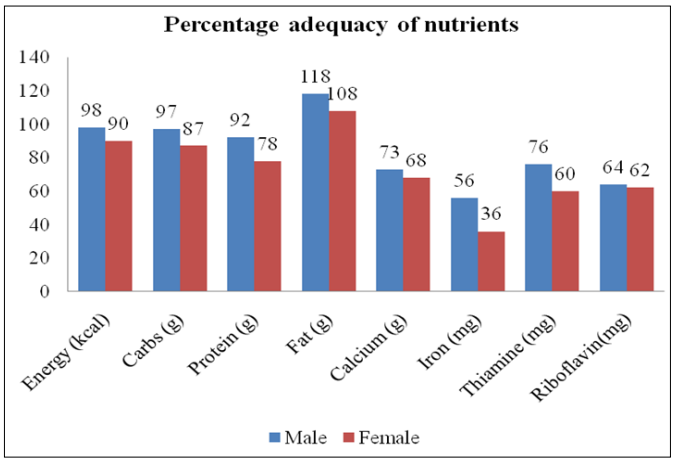

Fig 5: Percentage adequacy of nutrient intake of selected study population

Table 5 represents that there was a positive correlation between dietary intake and both BMI and WHR; among selected sports person. It was also found that it is extensively and positively correlated between energy intakes and from all its sources and BMI among all the research population. This supports the result as the majority of the selected subjects were underweight and overweight respectively due to low intake of energy and carbohydrates among girls and an excess of fat intake among boys. Fat intake also strongly correlated with WHR and followed by carbohydrates, energy and protein intake. Apparently maximum number of male sports men had normal WHR although with an increasing level of fat intake. Undoubtedly lower the intake of iron lowers the hemoglobin level profoundly [13].

Table 5: Correlation between dietary intake and nutritional status of selected sports students

Dietary Intake	BMI		WHR	
	Males	Females	Males	Females
Energy Intake	0.66	0.66	0.01	0.03
Carbohydrate Intake	0.61	0.66	0.02	0.04
Protein Intake	0.53	0.6	0.004	0.005
Fat Intake	0.42	0.59	0.09	0.06
	Haemoglobin			
Iron Intake	0.05	0.04	----	----

Summary and Conclusion

Sports performance is indeed an aspect of complex human performances, which has several dimensions; hence several disciplines of sports sciences are required to work in a coordinated manner to explore the nature and the process of improving sports performances. Sports nutrition is one of the important disciplines of sports science to improve the sports performance by improving the athlete's nutritional status. The nutrition needs of each player or participant are specific to the demand of the sport. Muscles that produce high tension need more protein for recovery, whereas muscles that perform high volumes of work need more carbohydrate to replenish the glycogen stores. Hence, it is important to understand the sports person's nutritional status, energy expenditure and dietary intake. The nutritional status of selected subjects was not up to the standards due to excess intake of fats, oils and sugar which is refereed as empty calories, nutritional status is also influenced by low intake of carbohydrates, protein, micro nutrients like iron, calcium, thiamine and riboflavin. There is need to reduce the intake of fats and sugar as well as to increases the whole grain, pulses, fruits and vegetable consumption to overcome the poor nutritional status. The study subjects had lack of knowledge about sports nutrition hence it is important to create nutritional awareness among the sports students through nutrition education.

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