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Monika Wasuja
Associate Professors, Indira Gandhi Institute of Physical Education and Sports Sciences University of Delhi, B-Block, Vikaspuri, New Delhi, India

Sarita Tyagi
Associate Professors, Indira Gandhi Institute of Physical Education and Sports Sciences University of Delhi, B-Block, Vikaspuri, New Delhi, India

Anil K Vanaik
Associate Professors, Indira Gandhi Institute of Physical Education and Sports Sciences University of Delhi, B-Block, Vikaspuri, New Delhi, India

Correspondence
Sarita Tyagi
Associate Professors, Indira Gandhi Institute of Physical Education and Sports Sciences University of Delhi, B-Block, Vikaspuri, New Delhi, India

Assessment of nutritional status of Indian university level female team game players

Monika Wasuja, Sarita Tyagi and Anil K Vanaik

Abstract
This study was carried out to assess the nutritional status of Indian University level female team game players and to evaluate relationship of their body composition components; selected physiological and physical fitness parameters with their present state of nutrient intake. A total of 40 female players of four team games *viz*. volleyball, handball, hockey and basketball (10 players from each game) in the age range of 18 to 22 years were selected from different colleges of Delhi University. In addition to nutritional status, anthropometric data was taken and BMI and WHR were computed. Body composition components were measured using Body Composition Analyzer (BODY STAT), cardiovascular endurance was measured by Harward step test and to measure agility, shuttle run test was administered, Hemoglobin and Serum Ferritin levels were assessed in a Pathological laboratory. Nutrient intake analysis was done by 3-day's dietary record method (two working days and one holiday). Standard descriptive statistics (mean ± standard deviation) were determined, ANOVA and Pearson's correlation coefficients (r) were applied and level of probability was taken at $p< 0.05$. The analysis of nutrient intake data revealed that the mean energy intake of all groups (1960.20±492.90 kcal) was much lower than recommended for these players during training. Low mean intakes of protein, iron, and fiber were seen in the diets of the subjects and calcium, vitamin C and folic acid intakes were sufficient. Intergroup comparisons revealed no significant differences in nutrient intake, anthropometric and body composition parameters among four groups of female players. Haemoglobin levels had normal mean values (12.31±0.2 g/dl), however, 22.5% players were anemic and their mean values of serum ferritin (20.18±2.32 ng/ml) were closer to the minimum value of the normal range. Physical efficiency index of majority of players was below average and a significant and positive correlation ($p< 0.01$) was found in shuttle run and serum ferritin levels.

Keywords: Nutritional status, body composition, body fat percent, fat free mass, physical fitness, nutrient intake, physical efficiency index, serum ferritin levels, shuttle run, agility

Introduction
Nutritional status is a critical determinant of athletic performance especially during intense training. Moreover, it requires long term planning of diet providing adequate amount of energy, right proportions of carbohydrates, proteins and fats and including rich sources of all other micronutrients to avoid any clinical manifestations of nutritional deficiencies that may affect their fitness levels and performance in sports. Appropriate nutritional intake is essential to maintain desired body composition which in turn influences the physical fitness parameters (Siddhu, 2002) [13]. The positive effects of training and conditioning on skill and fitness would be seen only if the nutritional intake is keeping the body composition and status of physiological parameters at desired levels.

During periods of training, the recommended intakes for energy and macro nutrients must be met in order to get adequate fuel, maintain appropriate body composition levels, optimal glycogen stores, muscle tissue repair and synthesis. Micronutrient intakes also should not be ignored because exercise increases micronutrient requirements (Burke, 2007) [3]. In athletes when intake of vitamins and minerals is lower than recommended, functional impairments may occur. Iron, folic acid and vitamin B_{12} deficiency reduce endurance work performance. Women participating in sports with weight categories or requiring aesthetic skills like gymnastics are prone to nutritional deficiencies because they restrict food intake. (Lukaski, 2004) [9] Extreme calorie restriction can cause serious problems like anemia, amenorrhea, osteoporosis that may cause fractures and injuries while playing.

In India, studies have indicated lower than recommended nutritional intakes in female sports persons (Priti and Siddhu 1998; Bains and Mann 2000; Jain *et al*., 2008; Asha *et al*. 2009; Koley and Sharma 2013) [11, 2, 5, 1, 8]. Inadequate nutritional intake especially in female athletes is more challenging than their male counterparts. Women with low energy and nutrient intake are susceptible to many complications, including fatigue, dehydration, decreased immune response, irritation, poor performance due to decreased maximal performance, poor concentration, hormonal imbalances leading to female athletic triad (eating disorder, Amenorrhea and osteoporosis). Amenorrhea is more prominent in the athletic population (3-66%) than in the general female population (2-4%). The female athlete triad can lead to severe and long-standing effects (Wolinsky, 1998) [15]. Bains and Mann (2000) [2] reported that in female college level players average daily consumptions of both energy and of iron were inadequate and showed adverse effects on their physical fitness levels. Sangeetha and Ramaswamy (2014) [12] also showed that there was dietary inadequacy of both macro and micronutrients with majority (55 percent) of the selected women sportspersons being underweight and about 60% being anemic. One of the most prevalent nutritional deficiencies among the female athletes is iron deficiency which may lead to early fatigue. Serum Ferritin values are commonly used to reflect iron stores. Most of the players are more susceptible to loosing iron through impact with other players causing red blood cell to be destroyed and plasma iron to be lost.

The relative contribution of the macronutrients to the energy consumption should make up 55 to 70% carbohydrates, 10 to 15% protein, and 25 to 30% fat (Wolinsky, 1998; ICMR, 2010) [15, 10]. However, studies consistently report higher contribution of energy from fat in the diets of Indian athletes particularly in power sports like wrestling, boxing, weight lifting etc. In the study carried out by Priti and Siddhu (1998) [11] highest dietary fat intake in female weight lifters (33.8 + 2.2 en%) among judo (30 + 1.5 en%), hockey (27.5 + 1.8 en%), archery (29 + 11.2 en%), cycling (27.8 + 1.8 en%) and athletics (27.1+ 5.3 en%) players during training in camp was observed. Higher fat free mass and lower body fat percentage have not only sports performance but health benefits as well. Inadequate macro or micro nutrient intake adversely affects many body composition and physical fitness components, thereby, performance in sports competitions. Therefore, a periodic examination of haemoglobin level among these players is very essential.

Objective

The present study was conducted to appraise the nutritional status, anthropometric status, body composition, selected physiological and physical fitness variables of Indian University level female team game players and to evaluate the relationship of these parameters with their nutrient intake.

Methodology

For the purpose of this study, a total of 40 female team game players in the age range of 18-22 years were taken from four games - Volleyball (n=10), Handball (n=10), Hockey (n=10) and Basketball (n=10) from various colleges of University of Delhi, India. These subjects were selected on the basis of their level of participation at the inter-collegiate level of their respective game and that they should be playing their respective game for at least three consecutive years.

For the purpose of nutrient intake analysis 3-day's dietary record method was used for two working days and one holiday and the average of nutrients for three days was taken for evaluation of nutritional status of the subject. This dietary data was computed using Nutrient Analysis computer package (DIETCAL).

The anthropometric variables assessed included body weight taken using electronic weighing scale with subjects wearing minimum clothing, height was measured using anthropometric rod and waist and hip circumferences were taken by measuring tape. Body Mass Index and Waist to Hip ratio were computed using standard formulas. Body fat percent and fat free mass was measured using Body Composition Analyzer (BODY STAT) which was based on the principle of bioelectrical impedance. Physical fitness variables measured included Cardio-Vascular Endurance using Harvard Step Test and Agility. For cardiovascular endurance, using the readings of recovery heart rate after administering Harvard step test and Physical Efficiency Index (PEI) was calculated. Shuttle Run test (4X10 m) was used to measure Agility and the time taken to the nearest of a second to complete the test was recorded as the score for each performer. Assessment of physiological variables included measurement of Hemoglobin and Serum Ferritin levels that were assessed in a Pathological laboratory using standard procedures.

Statistical analysis

Standard descriptive statistics (mean ± standard deviation) were determined for the variables studied. One way analysis of variance (ANOVA) was tested for the comparisons of data among players of different team games studied. Pearson's correlation coefficients were applied to establish the relationships among various variables measured. Data was analyzed using SPSS (Statistical Package for Social Science) version 22.0. The level of probability was taken at $p<0.05$ to indicate statistical significance.

Results

A total of 40 female players in the age range of 18 to 22 years were chosen for the study from four team games including Volleyball (19.7 ± 1.4 years; n=10), Basketball (19.4 ± 1.2 years; n=10), Handball (19.8 ± 1.3 years; n=10) and Hockey (19.3 ± 0.9 years; n=10). Anthropometric data of female players is given in table 1.

Table 1: Anthropometeric data of female team game players (MEAN ± S.D.)

Variables	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball(n=10)	Total (n=40)
weight (kg)	58.6±1.42 (47.2-81.9)	52.3±8.58 (43.3 -69.4)	58.5±7.18 (48.8-75.2)	60.6±13.90 (43.6-84.2)	57.5±10.67 (43.3-84.2)
height (cm)	162.35±5.011 (156-172)	156.70 ±4.16 (149-163)	162.0±5.47 (155.5-173.5)	164.30±8.96 (154-184)	161.34±6.59 (149-184)
body mass index (kg/m^2)	22.06 ± 4.301 (18.3-30.1)	21.26±3.54 (17.1 -28.5)	22.38±2.83 (18.52-28.6)	22.12±4.90 (15.5-30.2)	21.95±3.84 (15.5-30.2)
waist hip ratio	0.88± 0.08 (0.79 - 1.03)	0.88±0.06 (0.82-1.03)	0.90±0.05 (0.79-1.0)	0.88 ±0.11 (0.66-1.05)	0.89±0.08 (0.66-1.05)

* Figures in parenthesis () represent range

Basketball players were found to be having the highest body weight and height among all groups. No significant differences in anthropometric variables were found among groups.

Table 2: Distribution of subjects according to body mass index (kg/m^2) Classification

Standard value	Volleyball (n=10)	Handball(n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
<18.5 Underweight	2 (20%)	2 (20%)	0	2 (20%)	6 (15%)
18.5 – 24.9 Normal	5 (50%)	7 (70%)	9 (90%)	6 (60%)	27 (67.5%)
25.0-29.9 Overweight	2 (20%)	1 (10%)	1 (10%)	2 (20%)	6 (15%)
30.0-34.9 Obese Grade I	1 (10%)	0	0	0	1 (2.5%)
35.0-40.0 Obese Grade II	0	0	0	0	0
Above 40.0 Obese Grade III	0	0	0	0	0

In the present study, distribution according to BMI classification showed highest percentage (67.5%) of these players in normal category and 15% each in underweight and overweight with only one subject in obese grade 1 category (table 2). Waist to hip ratio values placed almost 58% of the subject having above 0.85 value (table 3).

Table 3: Distribution of female players according to waist hip ratio cut-offs

Standards	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
Below normal (< 0.85)	3 (30%)	3 (30%)	2 (20%)	4 (40%)	12 (30%)
Normal (0.85)	1 (10%)	2 (20%)	1 (10%)	1 (10%)	5 (12.5%)
Above normal (> 0.85)	6 (60%)	5 (50%)	7 (70%)	5 (50%)	23 (57.5%)

Table 4 reveals the nutrient intake data of female team game players. Mean energy intake of all groups was 1960.20±492.90 kcal and mean protein intake was 57.93±15.6 gm. Mean calcium intake was 890.1±377.80 mg/d and mean iron intake was 16.56±6.50 mg. No significant differences in any of the nutrients among all game players was found.

Table 4: Nutrient intake data of female team game players (Mean ± SD)

Variables	Volleyball (n=10)	Handball(n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
Energy(KCAL)	2058.01±350.80 (1440.15-2703.77)	1996.47±743.35 (1333.50-3809.7)	1897.80±367.24 (1421.88-2615.32)	1888.49±469.17 (1178.23-2644.5)	1960.20±492.90 (1178.23-3809.73)
Carbohydrate(GM)	282.20±37.20 (223.50-351.83)	263.31±111.61 (143.48-508.91)	240.57±49.85 (161.40-306.18)	257.01±67.45 (167.69-371.84)	260.80±71.03 (143.48-508.91)
Protien(GM)	61.76±15.01 (40.9-88.1)	57.52±19.25 (38.1-106.3)	56.83±11.86 (38.1-73.7)	55.60±17.09 (32.9-86.3)	57.93±15.60 (32.9-106.3)
Fat(GM)	68.73±14.27 (39.7-88.0)	73.23±27.76 (46.2-141.7)	71.50±17.29 (50.7-108.1)	63.70±15.62 (34.5-81.3)	69.29±19.10 (34.5-141.7)
Fibre(GM)	8.74±1.20 (7.02-10.41)	6.43±3.21 (3.51-13.58)	5.78±1.15 (3.60-7.40)	5.59±2.06 (3.26-9.92)	6.64±2.40 (3.26-13.58)
Calcium (MG)	937.68±502.04 (271.20-2150.56)	820.36±385.2 (311.55-1526.3)	924.26±350.31 (558.85-1572.7)	877.91±293.07 (453.22-1140.3)	890.1±377.80 (271.2-2150.56)
Iron(MG)	18.77±3.41 (14.62-24.79)	16.24±9.19 (9.26 - 40.35)	14.68±4.10 (9.36-23.12)	16.56±7.79 (9.59-36.77)	16.56±6.50 (9.26-40.35)
Vitamin C(MG)	91.57±37.91 (46.68-181.10)	60.22±38.57 (17.88-119.59)	56.04±26.06 (28.95-89.48)	69.90±67.58 (21.05-243.03)	69.44±45.60 (17.88-243.03)
Folic Acid(µG)	278.66±206.03 (140.29-829.84)	231.66±97.46 (124.90-389.2)	173.96±59.06 (80.38-264.83)	157.60±59.44 (85.38-261.87)	210.47±126.40 (80.38-829.84)

*Figures in parentheses () represent range

Table 5: Body composition of female team game players (Mean ± SD)

Variables	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
Fat Free Mass (KG)	40.51 ± 4.30 (34.9-49)	36.75± 3.66 (33.6-45.1)	39.50±2.72 (36.6-46.2)	41.10±6.04 (33.1-49.4)	39.46±4.51 (33.10-49.40)
Fat (KG)	18.07±7.59 (11.7-32.8)	15.56±5.68 (9.3-28.2)	18.63±4.79 (12.1-29)	18.55±9.42 (3.4-34.9)	17.70±6.94 (3.40-34.90)
Muscle Mass (KG)	38.01±4.72 (32.4-48.5)	34.2±3.47 (31.2-42.1)	37.36±2.60 (34.1-43.2)	39.26±5.55 (30.7-46.2)	37.21±4.50 (30.7-48.5)
Body Fat (%)	30.51±6.41 (23-40)	28.35±7.09 (15-41)	31.35±4.52 (24-39)	29.02±9.67 (7-41)	29.64±6.97 (7.2-41.4)

The assessment of body composition parameters of the team game female athletes (table 5) of the present study revealed the lowest mean FFM (39.50±2.72 kg) in handball players and highest mean FFM (41.10±6.04 kg) in basketball players (fig 1). Mean BF% of all players was 29.64±6.97%. No significant differences were observed in any of the body composition components among team game players.

The physical fitness parameters assessed in the present study included Harvard step test for cardio-respiratory endurance and shuttle run for agility (Table 6). ANOVA revealed significant difference in Physical Efficiency Index (PEI) (p<0.01) among four groups however, no significant difference in shuttle run was found among players of four team games studied.

Table 6: Physical fitness parameters of female team game players (Mean ± SD)

Variables	Volleyball (n=10)	Handball(n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
Shuttle Run(SEC)	11.73±0.84 (10.57-12.97)	11.87±1.12 (10.66-14.6)	12.03±0.63 (11.05-12.86)	11.91±0.78 (10.62-13.40)	11.89±0.838 (11-15)
Physical Efficency Index	59.49±12.87 (49.18-85.71)	61.04±6.92 (52.32-73.7)	65.40±7.12 (53.25-76.2)	51.38±5.31 (43.06-59.60)	59.33±9.69** (43.06-85.71)

* Figures in parenthesis () represent range **Significant at ($p< 0.01$)

Table 7: Distribution of players according to physical efficiency index (female team game players

Physical Efficiency index (PEI)	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball(n=10)	Total (n=40)
Excellent >96	0	0	0	0	0
Good 83-96	1 (10%)	0	0	0	1 (2.5%)
Average 68-82	1 (10%)	2 (20%)	4 (40%)	0	7 (17.5%)
Below average 54-67	3 (30%)	6 (60%)	5 (50%)	3 (30%)	17 (42.5%)
Poor <54	5 (50%)	2 (20%)	1 (10%)	7 (70%)	15 (37.5%)

Table 7 shows that Physical efficiency of majority of female players across all teams was below average indicating need to emphasize on more training focused on enhancing aerobic power of these players and taking a note of their energy and micronutrient intakes especially iron intake and correcting for any deficits.

Table 8: Physiological data of female team game players (Mean ± SD)

Variables	Volleyball (n=10)	Handball(n=10)	Hockey (n=10)	Basketball(n=10)	Total (n=40)
Haemoglobin Level (g/dl)	12.07±2.09 (8.0-13.9)	12.55±0.68 (11.1-13.6)	12.39±1.35 (9.9-14.2)	12.23±1.75 (8.2-14.1)	12.31±0.24 (8-14.20)
Serum Ferritin Levels (ng/ml)	13.82±10.14 (0.6-32.2)	24.31±16.80 (3.6-60.4)	20.71±18.73 (2.0-55.1)	21.89±11.45 (5.8-39.5)	20.18±2.32 (0.60-60.40)

Table 8 shows mean haemoglobin levels of female players of all games 12.31±0.2 g/dl and 22.5% players were anemic as shown in Table 9. Normal serum ferritin levels for females range from 10 ng/ml - 291 ng/ml. As seen from table 10, majority of the players were falling in normal category (72.5%) but their mean values of serum ferritin (20.18±2.32 ng/ml) were closer to the minimum value of normal range.

Table 9: Distribution according to Haemoglobin normal values (Female team game players) (%)

Standards	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball (n=10)	Total (n=40)
Below Normal (< 12g/dL)	3 (30%)	1 (10%)	2 (20%)	3 (30%)	9 (22.5%)
Normal (12g/dL - 15.5g/dL)	7 (70%)	9 (90%)	8 (80%)	7 (70%)	31 (77.5%)
Above Normal (> 15.5g/dL)	0	0	0	0	0

Table 10: Distribution according to normal serum ferritin levels (Female team game players) (%)

Standards	Volleyball (n=10)	Handball (n=10)	Hockey (n=10)	Basketball(n=10)	Total (n=40)
Below Normal (< 10 ng/ml)	4 (40%)	1 (10%)	4 (40%)	2 (20%)	11 (27.5%)
Normal (10 ng/ml - 291 ng/ml)	6 (60%)	9 (90%)	6 (60%)	8 (80%)	29 (72.5%)
Above Normal (> 291 ng/ml)	0	0	0	0	0

Discussion

Anthropometric status is the manifestation of long term dietary habits of a person. Mean BMI of all players was 21.95±3.84 **(**table 1) which was in normal weight category of BMI classification (table 3). However, distribution according to BMI classification (table 2), highest percentage (67.5%) of these players were placed in normal category and 15% each in underweight and overweight and one subject in obese categories. Underweight category also had 15% of total players signifying high health risks for these women. Mean Waist to hip ratio values for all groups was 0.89±0.08 with almost 58% of the subject having above 0.85 value (table 3) indicating accumulation of fat in the abdominal region (WHO, 2011) [14]. Females generally have a tendency towards central adiposity which further affects the core strength of players.

Analysis of nutrient intake data of the subjects (table 4) revealed that their mean energy intake was 1960.20±492.90 kcal which was closer to the RDA of Indian sedentary women (1900kcal/d; ICMR, 2010) [10]. These were team game players and the data was collected during peak season of their matches, placing their energy requirements were at 60-70 kcal/kg BW (ICMR, 1985) [10] but they were consuming much less than required. Mean BMI of the players of all games was normal (Table-3) but 20% each of volleyball, basketball and handball players were falling in underweight category of BMI classification. The underreporting of dietary data is also common but tendency to keep dietary intake low in these female athletes cannot be ruled out. Long term negative energy balance may have health implications such as amenorrhea and osteoporosis. Around 18% of the subjects reported menstrual irregularities in the present study. Low energy intake (e.g., < 1800–2000 $kcal \cdot d^{-1}$) for female athletes is a major nutritional concern because a persistent state of negative energy balance can lead to weight loss and disruption of endocrine function. Low energy intakes are also associated with poor performances which was apparent in their assessment of PEI (Tables-6 & 7) in the present study. In a study by Bains and Mann (2000) [2] also revealed that female college students of

Ludhiana, had mild energy deficiency of 21%. And were in a negative energy balance of 48 ± 10 kcal/day. Koley and Sharma (2013) [8] also reported Indian female athletes having lower intake of energy than recommended although other nutrients had adequate levels of intake.

In this study, mean protein intake of the subjects (57.93±15.6 gm) was also less even than RDA which is 1g/kg body weight while for sports persons the intake is placed between 1.5-2.0g/kg BW. Low protein intakes during training period are responsible for loss of muscle mass. Fat intake of subjects in this study was higher and was contributing to almost 33% of the total calories. Various studies have consistently reported higher intake of fat even in Indian sports women (Priti and Siddhu, 1998, Jain *et al*., 2008) [11, 5].

Higher FFM is directly associated with higher strength and aerobic capacity hence, better performance (Koley *et al*., 2010). The assessment of body composition parameters (table 5) of the subjects in present study revealed the lowest mean FFM (39.50±2.72 kg) in handball players and highest mean FFM (41.10±6.04 kg) in basketball players. Similarly mean body fat% values of handball players (28.35±7.09 %) were minimum as compared to the other team game players. Mala *et al*. (2015) reported mean FFM of elite female team game players of Prague, Czech Republic, as 57.81 ± 4.53kg of Volleyball players, 60.30 ± 5.42 kg of Basketball players and 56.95 ± 5.34 kg in Handball players. Similarly the mean body fat percent values have been reported to be 19.77 ± 1.77%, 21.22 ± 1.66% and 21.43 ± 2.48% for volleyball, basketball and handball players respectively. In comparison to these values the mean FFM values in the present study were lower and BF% (29.64±6.97%) values were higher (table 5). Although for normal women the normal BF% levels are 21-33%, literature suggests BF% levels of 20-27% for basketball players and 16-25% for volleyball players (Jeukendrup and Gleeson; 2010) [6]. As compared to these values the present study female players had slightly higher mean values for BF%.

As far as other nutrients are concerned, the Calcium intake was adequate for all the athletes in this study, as mean calcium intake (890.1±377.80 mg/d) was higher than the RDA (600mg/d). Mean iron intake in the present study was 16.56±6.50 mg while the recommended values are 21mg/d for women in India (ICMR, 2010) [10]. Sports women have even higher requirements due to higher losses of iron and are more susceptible to anaemia. Bains and Mann (2000) [2] have also reported low iron intake in college going females and average haemoglobin and serum ferritin levels were also below normal. In the present study, the mean haemoglobin level of the players was 12.31±0.24 gm/dl but the serum ferritin levels were more close to the minimum value of the normal range indicating that more percentage of these players may be prone to anaemia if their dietary iron intake remains deficient. However, the consumption of folic acid in the present study, was (210.47±126.40 µg) closer to the RDA (200 µg /d). Although Haemoglobin levels of players in the present study had normal mean values (12.31±0.2 g/dl**)**, 22.5% players were anemic (table 9). Normal serum ferritin levels for females range from 10 ng/ml - 291 ng/ml. As seen from table 10, majority of the players were falling in normal category (72.5%) but their mean values of serum ferritin (20.18±2.32 ng/ml) were closer to the minimum value of normal range. Low levels of ferritin are indicative of iron deficiency, which causes anemia (a reduction in the number of red blood cells) and has impact on cardio-respiratory efficiency of the players. The PEI of majority of the female players was shown to be below average in this study and also the correlation with hemoglobin levels and serum ferritin levels was positive but not significant. A significant and positive correlation ($p<0.01$) was found in shuttle run and serum ferritin levels. A study by Chandrasekhar and Bhargava (1988) [4] showed significant improvement in haemoglobin levels, cardiovascular parameters and endurance performance in female athletes due to iron rich food supplementation. As far as Vitamin C intake was concerned the mean intake (69.44±45.60 mg) was higher than RDA (40mg/d). Vitamin C with meals enhances iron absorption and also is an important nutrient as a free radical scavenger. Intergroup comparisons revealed no significant differences in any of the nutrients among all game players

Around 54% energy in their diets came from carbohydrates, 33% from fats and 13% from proteins. The subjects should be advised to increase intake of carbohydrate and protein sources while reduce the intake of visible and invisible fat sources. Fiber intake was also less than RDA. Increasing the consumption of complex carbohydrates, vegetables and fruits in the diet would not only help increasing fiber intake but also vitamin and mineral intake would be enhanced.

Conclusion

Thus, present study found low mean energy, protein, iron, folic acid and fiber in the diets of female team game players. The physical efficiency index of majority of subjects was below average and a significant relationship was found in shuttle run and serum ferritin levels. This study directed towards regular monitoring of nutritional intake, body composition, physical fitness and certain physiological variables so that any deficits and shortfalls could be identified and worked upon for better health and performance.

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