# A Study on Energy Balance among Female & Male Players Engaged in Different Sports Disciplines

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## Abstract

The study deals with assessment of energy intake & expenditure of players. Female [N=13] & male [N=46] players, aged 18-22 years, engaged in different sports disciplines were selected. All players were found regularly participating in specific games in which they were involved. Data was collected using questionnaire-cum-interview schedule. Mean ± SD & R values were calculated. Student's 't' test was used for comparisons. Irrespective of sex & games, all players were found significantly shorter than the respective standard heights for their age [t = 3.75 for females & 9.52 for males]. Majority of female players were not meeting the standards of weight for height. Based on 24 hour's dietary recall method, it was found that all players fell short of meeting the recommended dietary allowances [RDAs] for energy, carbohydrates, protein & fat. Total time spent on routine activities [TTSRA] by female players was computed as 1290 minutes/day & TTSRA by male players was found to range between 1260 – 1320 minutes/day. Energy expenditure [EE] reflected a direct relationship with body weight, time spent & type of activities. Highest values for EE on routine activities & EE on sports activities were found to be 1901 & 892 kcal as well as 2027.88 & 1358.78 kcal for female & male players, respectively. Negative energy balance was observed in all players.

**Key Words: Energy Intake, Energy Expenditure, Energy Balance, Recommended Dietary Allowances**

## Introduction

Good nutrition at all times is essential for effective athletic performance. During adolescence, individuals undergo significant growth & maturation, & unique changes take place in the body, thus, causing an increase of nutritional needs. An adolescent athlete have energy needs that are different from the needs of adult athlete, one should pay attention not only to energetic suitability, but also to the intake of protein & fluids before, during & after the exercise *(Fox, 1994; Thompan, 1998).*

Nutrition not only plays a role in performance, but it can also help to prevent injuries, enhance recovery from exercise, help maintain body weight, & improve overall health. It is important for all sports person to have a good working knowledge, understanding of exercise science & sports nutrition so that these can help in their own performance potential *(Bakulin & Efimo, 1996; Loucks, 2004).*

The need of an athlete in energy & nutritional substances essentially differ depending first of all on the kind of sport & the amount of work performed *(Astrand & Rodahl, 1988).*

In athletic training performance, carbohydrate & fat are the major sources of energy. The amount of fat used during exercise depends upon the duration & intensity of exercise, degree of prior training & the composition of the diet. Exercise performed under aerobic conditions will promote fat use as a source of energy. There is a good reason to increase body's ability to burn fat as fuel; using fat as a source of energy will spare muscle glycogen *(Grodner et al., 1996).* How long the activity lasts also determines what substrate is used during

the exercise bout. For example, the longer the time spent exercising, the greater the contribution of fat as the fuel. Athletes who consume a high fat diet typically consume fewer calories from carbohydrates *(Mahan & Escott – Stumps, 2004).*

Although the carbohydrates & fats are the main major fuels used for energy, studies indicate that protein use increases during exercise, & under certain conditions protein may contribute significantly to energy metabolism. Two factors that influence the use of protein as an energy source are the length of exercise & the carbohydrate content of the diet. The body may depend on protein for an increased percentage of energy in prolonged exercise (greater than 90 minutes), particularly when carbohydrate intake is low *(Dreon, 1989).*

Nutrition plays an important role in rendering the highest effectiveness of sports training, in accelerating the advances of restoration processes, in the upkeep of workability during competition loads and other problems of sports practice. Proper nutrition is essential to help athletes recover from workouts and competitions. In athletes, an adequate intake of nutrients are essential for the maintenance of an appropriate nutritional status, optimal performance & recovery as well as the reduction of health risks associated with regular highly intensive exercise *(Fred Brouns, 2003).*

## Material and Methods

The present study deals with energy balance among male & female players involved in different sports disciplines.

*Selection & Grouping of Sample:*

Players [both males & females] who were engaged in regular practice & participated in professional sport tournaments were taken as samples for the present study. The athletes were young players from different sports disciplines such as athletics, volleyball, cricket, judo, gymnastics, weight lifting, hurdle racing, half marathon, badminton, cross country etc. The subjects aged between 18-22 years were from a well known Physical Education Institution. Athletes who were participating in regular practice schedules & in many sports events from the past few years [players were in the field from last 3 – 7 years] were mainly of choice, data of which is shown in Table 1.

Table 1: Data on Meritorious Achievements of Female & Male Players classified Game-Wise

| Sports Disciplines | University Level | | State Level | | National Level | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| **FEMALES [N = 13]** | | | | | | |
| Half Marathon (n=3) | 3 | 100.00 | 3 | 100.00 | 0 | 0 |
| Hurdle Racing (n=2) | 2 | 100.00 | 2 | 100.00 | 0 | 0 |
| Athletics (n=4) | 3 | 75.00 | 3 | 75.00 | 0 | 0 |
| Badminton (n=4) | 2 | 50.00 | 2 | 50.00 | 0 | 0 |
| **MALES [N = 46]** | | | | | | |
| Athletics (n=7) | 4 | 57.14 | 4 | 57.14 | 1 | 14.3 |
| Badminton (n=4) | 3 | 75.00 | 3 | 75.00 | 1 | 25 |
| Cricket (n=6) | 5 | 83.33 | 5 | 83.33 | 0 | 0 |
| Judo (n=5) | 4 | 80.00 | 4 | 80.00 | 0 | 0 |
| Judo & Gymnastics (n=6) | 4 | 66.66 | 4 | 66.66 | 0 | 0 |
| Volleyball (n=14) | 11 | 78.57 | 11 | 78.57 | 0 | 0 |
| Weight Lifting (n=4) | 2 | 50.00 | 2 | 50.00 | 0 | 0 |

A total of 13 females & 46 males from various sports disciplines were chosen & surveyed. Game wise classification of subjects is shown in Table 2.

Table 2: Game-Wise Classification of Subjects

| Sr. No. | Sports Disciplines | No. of Subjects | Age (yrs) Mean ± SD |
|---|---|---|---|
| | **FEMALES [N = 13]** | | |
| 1 | Half Marathon | 3 | 19.89 ± 0.95 |
| 2 | Hurdle Racing | 2 | 20.13 ± 1.62 |
| 3 | Athletics | 4 | 19.27 ± 1.00 |
| 4 | Badminton | 4 | 20.45 ± 1.00 |
| | **MALES [N = 46]** | | |
| 1 | Athletics | 7 | 20.52 ±1.30 |
| 2 | Badminton | 4 | 21.87 ±0.50 |
| 3 | Cricket | 6 | 20.98 ±1.40 |
| 4 | Judo | 5 | 21.02 ±1.70 |
| 5 | Judo / Gymnastics | 6 | 21.00 ±1.20 |
| 6 | Volleyball | 14 | 20.39 ±1.50 |
| 7 | Weight Lifting | 4 | 21.08 ±0.50 |

*Study Protocol:*

Major areas of the study protocol were as follows: -

- General Information
- Data on Sports
- Dietary Information
- Recording body weight & height of players
- Energy Expenditure (through Daily Activity Schedule)
- Statistical Analysis

For collecting information, an interview schedule was designed to elicit information from all players on their socioeconomic background, sport profile (information regarding time & duration of subject's engagement in the chosen sport/s, their daily routine, hours of practicing a game, their meritorious achievements etc.), dietary profile, anthropometric measurements such as body weight & height & energy expenditure pattern.

Players were nutritionally assessed as follows -

*Dietary Survey:*

Precise information on food consumption pattern of subjects was gathered through three day dietary recall method. The intake of macro nutrients viz., carbohydrate, protein & fat was computed using the values given in the Nutritive Value of the Indian Foods *(Gopalan et. al., 2004).* Energy intake was computed for all players. Means were derived & nutrient intakes were compared with their respective RDAs *(Satyanarayana, 1991).*

Under anthropometric data, following measurements were taken:-

- Body weight
- Standing height

Body mass index (BMI) values were calculated. Measurements were compared with NCHS/ICMR standards *(NCHS / ICMR Standards, 2004).*

*Energy Expenditure Pattern:*

The time allocation pattern (TAP) was used to calculate the total energy expenditure through three days daily activity schedule. The TAP i.e., recording of the time spent by each individual in various day–to-day physical activities both in occupational (training) & non-occupational (routine) hours was done for each athlete separately. The total daily energy expenditure (TEE) was measured by recording the TAP *(Venkata Ramana et. al., 2004).* This information was recorded by asking all the daily activities, he/she had performed. Energy expenditure of each subject was calculated using three days daily activity schedule & means were derived. Reference energy expenditure values of various activities were used for calculation *(Katch & McArdle, 1983; Torun, 1989; Durnin, 1994; Ghafoorunissa & Krishnaswamy, 2004).* Energy expenditure/minute values were

adjusted to body weight of subjects & then for each routine & sports activity, energy expenditure was calculated & compared with energy intake.

*Statistical Appraisal of Data:*

Data was collected, tabulated & grouped based on game-wise classification of subjects. Means & standard deviation values were calculated. Minimum, maximum, range values & percentages were taken out. Comparisons were made with the available standards. Student's 't' test was applied to see the differences. The difference was tested at both 1% & 5% levels of significance.

## Results and Discussion

Table 3: Mean Height, Weight & Body Mass Index [BMI] Values of Sports Persons (Females & Males) Classified Game Wise

| Sr. No. | Sports Disciplines | Mean Age (Years) | Height ( cm ) | | Weight ( kg ) | | BMI ( kg / m² ) |
|---|---|---|---|---|---|---|---|
| | | | Mean ± SD | * Std | Mean± SD | ** Std | Mean ± SD |
| | | | **FEMALES [ N = 13]** | | | | |
| 1 | Half Marathon (n=3) | 19.9 | 162.56 ± 1.22 *R = 160.62 - 162.56* | 164 | 50.0 ± 3.6 *R = 47 - 55* | 53 | 19.47 ± 1.06 *R =18.59 – 20.95* |
| 2 | Hurdle Racing (n=2) | 20.2 | 158.75 ± 1.53 *R = 157.48 – 160.02* | 164 | 51.5 ± 8.5 *R = 43 - 60* | 55 | 22.5 ± 5.5 *R = 17.0 – 27.95* |
| 3 | Athletics (n=4) | 19.3 | 152.4 ± 3.1 *R = 144.78 – 157.48* | 164 | 44.8 ± 5.6 *R = 40 - 54* | 41.4 | 20.02 ± 1.5 *R = 18.22 – 22.18* |
| 4 | Badminton (n=4) | 20.5 | 157.48 ± 6.1 *R = 154.97 – 162.56* | 164 | 43.0 ± 3.3 *R = 39 - 48* | 49.7 | 20.01 ± 3.8 *R = 16.88 – 26.25* |
| | | | **MALES [ N = 46]** | | | | |
| 1 | Athletics (n=7) | 20.6 | 167.64 ± 12.2 *R = 175.26 – 180.34* | 177 | 60.0 ± 7.0 *R = 45 - 68* | 55.3 | 20.4 ±1.6 *R = 16.9 – 21.7* |
| 2 | Badminton (n=4) | 21.9 | 167.64 ± 9.2 *R = 167.67 – 172.72* | 177 | 61.0 ± 8.5 *R = 51 - 74* | 55.3 | 19.9 ± 2.3 *R = 17.7 – 23.7* |
| 3 | Cricket (n=6) | 21.0 | 167.64 ± 9.2 *R = 154.94 – 170.26* | 177 | 52.5 ± 1.2 *R = 51 - 54* | 55.3 | 19.0 ± 1.6 *R = 17.6 – 21.0* |
| 4 | Judo (n=5) | 21.03 | 165.1 ± 6.1 *R = 160.02 – 167.64* | 177 | 61.2 ± 6.3 *R = 53 - 73* | 52.6 | 21.6 ± 2 *R = 19.03 – 24.8* |
| 5 | Judo & Gymnastics (n=6) | 21.0 | 165.1 ± 6.1 *R = 160.02 – 167.64* | 177 | 50.5 ± 0.1 *R = 48 - 58* | 52.6 | 20.0 ± 1.5 *R = 16.7 – 20.7* |
| 6 | Volleyball (n=14) | 20.4 | 170.18 ± 6.1 *R = 162.56 – 175.26* | 177 | 50.7 ± 0.2 *R = 50 - 75* | 58 | 22.5 ± 1.5 *R = 19.4 – 24.6* |
| 7 | Weight Lifting (n=4) | 21.1 | 170.18 ± 6.1 *R = 162.56- 175.26* | 177 | 50.6 ± 0.2 *R = 52 - 74* | 58 | 23.4 ± 2.7 *R = 19.2 – 26.4* |

R- Range, Std- Standard, *- NCHS / ICMR Standards [height for age], 2004., **- NCHS / ICMR Standards [weight for height], 2004

*Physical Attributes of Male & Female Players:*

The height of an individual is influenced both by genetic (hereditary) and environmental factors *(Bamji et. al., 2005)*. Table 3 shows mean values of height, weight & body mass index of female & male players classified game-

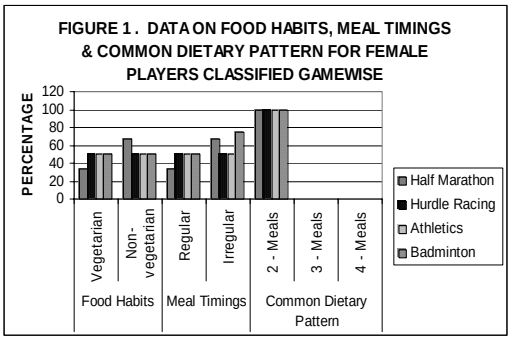
wise. For both females and males, NCHS/ICMR standards of height for age and weight for height were used for comparisons. From the table it can be seen that all females from different sports disciplines were shorter than the standard height for their age with significant difference at 1 % level ($t = 3.75$, $p<0.01$). For female players, it can be seen that players who were involved in half marathon were tallest among all (162.56 ± 1.22 cm) while female players involved in athletics were the shortest (152.4 ± 3.1 cm).

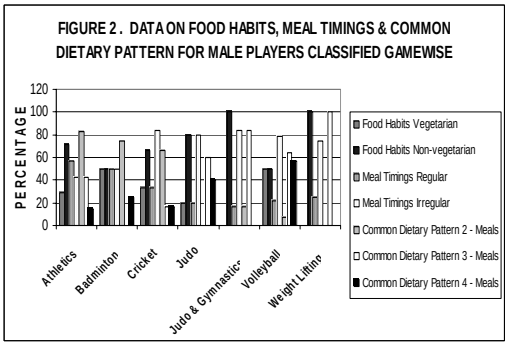
It was found that with the exception of players involved in athletics (44.8±5.6 kg), the rest of female players involved in different sports disciplines showed mean weight values less than the respective standards. However, the differences were insignificant at both 5 % and 1% levels of significance ($t = 0.42$).

It is evident from Table 3 that all seven groups of different sports disciplines of male players showed mean height values for their age significantly less than the respective standards at both 5% and 1% levels of significance ($t=9.52$). Male players from sports groups - athletics, badminton and judo had mean weights more than the given standards for their height.

An attempt had been made to calculate BMI for female & male players. With the exception of half marathon group, other three groups of female players had a mean BMI values as normal. Amongst male players almost all groups had normal mean BMI values. However, even though involved in University/State levels, few players, irrespective of sex & game, had BMI ranged between 16 (chronic energy deficient) to 19 (underweight). It is said that BMI correlates better with body fat than desirable body weight *(Bamji et. al., 2005)*.

*Energy Intake of Male & Female Players:*




Figures 1 & 2 depict data on food habits, meal timings & common dietary pattern for female & male players respectively. Majority of male players were found non vegetarian. Even though timely consumption of food is required for better athletic performance, maximum players – both females & males – showed irregular meal timings which can be attributed to college & practice schedules. 100% females had dietary pattern of two meals whereas variability was noticed for the same among male players.

Based on food intake data, intakes of energy were calculated for all groups of players. Macro nutrients viz., carbohydrate, protein & fat were computed. Data for females is shown in Table 4. One can clearly point out that irrespective of the sport group, female players showed mean intakes of energy

below their respective RDA's (t=3.62, p<0.01). Percent energy deficit among female players ranged from 8.54 to 58.94 for half marathon & athletics groups respectively. The main sources of energy in their diets were mainly cereals such as wheat and rice; pulses & legumes & oils.

Irrespective of the sports disciplines, male players failed to meet their energy requirements as mean energy intakes were found less than the respective RDAs (t = 8.05, p<0.01) (Table 5). Athletics was the group of male players with highest mean energy intake (2482.6 ± 243.7 kcal) and volleyball was the group with lowest mean daily intake of energy (2008.3 ± 300.4 kcal).

Table 4: Mean Daily Intake of Energy, Carbohydrate, Protein & Fat for Female Players Classified Game Wise

| Sports Disciplines | Energy ( Kcal ) | | | Carbohydrate ( gm ) | | | Protein ( gm ) | | | Fats ( gm ) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit |
| **Half Marathon (n=3)** | **1240.3 ± 232.8** | **3021** | **-58.94** | **217.4 ±57.90** | **424** | **-48.73** | **47.4 ±1.30** | **95** | **-50.10** | **50.5 ±2.90** | **90** | **-43.88** |
| **Hurdle Racing (n=2)** | **1862.5 ± 0.5** | **3300** | **-43.56** | **291.9 ±6.71** | **440** | **-33.66** | **49.0 ±9.60** | **99** | **-49.69** | **51.3 ± 3.06** | **94** | **-45.42** |
| **Athletics (n=4)** | **1701.2 ± 133.6** | **1860** | **-8.54** | **254.9 ± 32.04** | **330** | **-22.76** | **47.7 ±2.03** | **75** | **-36.40** | **50.2 ±1.20** | **70** | **-28.28** |
| **Badminton (n=4)** | **1965.3 ± 251.6** | **2700** | **-27.21** | **306.2 ± 51.60** | **348** | **-12.01** | **57.8 ±15.6** | **75** | **-22.94** | **51.0 ± 4.20** | **85** | **-40.00** |

RDA's referred from Satyanarayana (1991)

Table 5: Mean Daily Intake of Energy, Carbohydrate, Protein & Fat for Male Players Classified Game Wise

| Sports Disciplines | Energy ( Kcal ) | | | Carbohydrate ( gm ) | | | Protein ( gm ) | | | Fats ( gm ) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit | Mean ± SD | RDA | % Excess or Deficit |
| **Athletics (n=7)** | **2482.6 ± 243.7** | **3318** | **-25.18** | **422.3 ±34.9** | **442** | **-4.45** | **67.9 ±4.03** | **99** | **-31.41** | **51.4 ±2.2** | **94** | **-45.31** |
| **Badminton (n=4)** | **2351.4 ±241.9** | **3318** | **-29.13** | **399.6 ±55.3** | **442** | **-9.59** | **64.4 ±4.06** | **99** | **-34.94** | **51.7 ±2.9** | **94** | **-45.00** |
| **Cricket (n=6)** | **2322.8 ± 206.4** | **-** | **-** | **397.9 ±52.2** | **-** | **-** | **64.4 ±8.4** | **-** | **-** | **49.5 ±3.0** | **-** | **-** |
| **Judo (n=5)** | **2273.8 ± 131.9** | **2998** | **-24.15** | **375 ± 37.2** | **420** | **-10.54** | **58.7 ±6.0** | **105** | **-44.09** | **52.08 ± 4.2** | **90** | **-42.13** |
| **Judo & Gymnastics (n=6)** | **2092.4 ± 404.2** | **2788** | **-24.06** | **342.2 ± 101.2** | **420** | **-18.52** | **55.1 ±5.3** | **105** | **-47.52** | **51.3 ±3.2** | **90** | **-43.00** |
| **Volleyball (n=14)** | **2008.3 ± 300.4** | **3596** | **-44.15** | **325.8 ± 73.0** | **464** | **-29.78** | **53.6 ±5.6** | **127** | **-57.79** | **49.2 ±4.3** | **99** | **-50.3** |
| **Weight Lifting (n=4)** | **2170.5 ± 295.4** | **3596** | **-39.64** | **258.02 ± 49.8** | **464** | **31.41** | **61.09 ± 2.02** | **127** | **-51.89** | **50.3 ±2.9** | **99** | **-49.19** |

**RDA's referred from Satyanarayana (1991)**

*Intake of Energy Yielding Nutrients:*

It is noticed from Tables 4 & 5 that irrespective of sports disciplines, all

female & male players showed mean intakes of carbohydrate ($t = 0.87$, $p>0.05$ for females & $t = 1.79$, $p>0.05$ for males), protein ($t = 5.1$ $p<0.01$, for females & $t = 8.8$, $p<0.01$ for males) & fat ($t = 7.4$, $p<0.01$ for females & $t = 9.66$, $p<0.01$ for males) less than their RDAs. The main sources of protein in their diets were mainly pulses & those who were non-vegetarian were occasionally consuming egg, chicken, mutton or fish.

Range of % deficit in female & male players was found to be between 12.01–48.73 % & 4.45–31.41 % respectively for carbohydrate; 22.94–50.1 % & 31.41–57.79 % respectively for protein & 28.28–45.42% & 42.13–50.3 % respectively for fat intake.

To maintain concentration and replacement of muscular glycogen, carbohydrate intake should be of 500-800 gm/day. Low-carbohydrate diets may compromise physical performance, causing negative effects in those who practice physical activities *(Coleman, 1989; Sherman, 1989; Harkins, 1993; Position Statement of the American Dietetic Association and Canadian Dietetic Association, 1993; Burke, 1997).* Highest mean intakes amongst female players were found to be 306.2±51.6 g for carbohydrate, 57.8±15.6 g for protein & 51.3±3.06 g for fat respectively. Highest mean intakes amongst male players were found to be 422.3±34.9 g for carbohydrate, 67.9±4.03 g for protein & 52.08±4.2 g for fat respectively.

Table 6: Percentage of Energy Derived From Carbohydrates, Protein & Fat for Female & Male Players Classified Game Wise

| Sports Disciplines | Percent Energy Derived From | | |
|---|---|---|---|
| | Carbohydrate | Protein | Fat |
| **Half Marathon** | **49.0** | **15.0** | **36.0** |
| **Hurdle Racing** | **62.8** | **12.4** | **24.8** |
| **Athletics** | **60.0** | **13.2** | **26.8** |
| **Badminton** | **62.8** | **16.8** | **20.4** |
| **Athletics** | **68.6** | **12.8** | **18.6** |
| **Badminton** | **68.0** | **11.0** | **21.0** |
| **Cricket** | **68.5** | **12.3** | **19.2** |
| **Judo** | **67.1** | **12.0** | **20.9** |
| **Judo & Gymnastics** | **66.9** | **10.8** | **22.3** |
| **Volleyball** | **66.8** | **11.2** | **22.0** |
| **Weight Lifting** | **67.1** | **11.0** | **21.9** |

*Percent Energy Derived From Carbohydrate, Protein & Fat:*

An attempt had been made to calculate the percent of calories derived from mean intakes of three major nutrients for both female & male players classified game-wise. Table 6 shows the percent values of energy derived from carbohydrate, protein & fat for female & male players' classified game wise. Percent energy derived from carbohydrate was found to range between 49–62.8 % for females & 66.8–68.55% for males. The amount of carbohydrate required depends on the athlete's total daily energy expenditure, type of sport, gender, & environmental conditions.

Mean % energy derived from protein was found to range from a minimum of 12.4 % to a maximum of 16.8 % amongst male players involved in different sports disciplines. Judo & gymnastic group of males showed lowest mean energy % value from protein. It is evident from Table 6 that almost all groups of males had energy % from protein on lower side. A minimum of 12.4% & a maximum of 16.8% calories from protein were calculated for female players. More recent work suggests that persons who exercise at a higher intensity have protein needs that might be greater *(Tarnopolsky, 1994; Rasmussen, 2000; Tipton, 2001).* However, organizations such as the American College of Sports Medicine (ACSM), American Dietetic Association (ADA), and Dietitians of Canada (DC) have concluded that athletes have only slightly higher protein requirements than do non athletes *(Mahan & Escott – Stumps, 2004).*

Athletics is the group of male players with less mean percent of energy derived from fat (18.6%) & judo & gymnastics is the group which had highest mean percentage of energy derived for fat (22.3%). Among female players, half marathon group had highest mean % energy derived from fat (36%). Because each athlete is different; some may eat less and some slightly more than 30% of their calories from fat. Many athletes cannot get calories they need without eating a little extra fat. However, fat intakes greater than 35% of total calories have been associated with increasing risk of certain diet-related diseases. High fat intakes also have been shown to reduce endurance capacity *(Position Statement of the American Dietetic Association and Canadian Dietetic Association, 1993; Boyle, 2000).*

*Energy Expenditure Pattern of Male & Female Players:*

Physical activity by means of training or competition increases the daily energy expenditure depending on physical fitness, duration, type & intensity of sports. For this reason, athletes must adopt their energy intake by increased food consumption, according to the level of daily energy expenditure, in order to meet energy needs. This increased food intake should be well balanced with respect to the macronutrients (carbohydrate, fat & protein) & micronutrients (vitamins, minerals & trace elements) *(Fred Brouns, 2003).*

*Energy Expenditure for Routine Activities:*

Tables 7 & 8 show mean time spent and energy expenditure for a day for different routine activities respectively by female and male players classified game-wise. Differences were noted for time spent on different routine activities by different sports groups. It can be seen that majority of female and male players spent considerable amount of time for chatting, grooming and personal needs as well as for reading, watching T.V. and sleeping. Other different routine activities included ascending stairs, descending stairs, drinking, eating, driving as well as reading, writing, walking and cycling; personal needs included bathing, brushing, toileting etc.

For female players, mean total time spent (TSS) on routine activities is similar i.e. 1290 minutes/day. However, irrespective of same amount of TSS on routine activities by female players, EERA differed. It can be seen from Table 8, that athletics is the group of females who expended highest amount of energy on routine activities (1901.45 kcal).

However, this group did not have highest mean body weight. Female badminton players had the lowest mean value of EERA (1433.25 kcal).

Table 7. Mean Time Spent ( minutes / day ) For Different Routine Activities by Female & Male Players Classified Game Wise

| Sports Disciplines | Mean Time Spent On Routine Activities ( minutes / day ) | | | | | | | | | | | | | | | | * T.T.S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | |
| **FEMALES [N = 13]** | | | | | | | | | | | | | | | | | |
| Half Marathon (n=3) | 8.4 | 21.7 | 8.4 | 50 | 31.7 | 8.4 | 11.5 | 16.5 | 18.4 | 30.0 | 100.0 | 60.0 | 590 | 35.0 | 160 | 140.0 | 1290 |
| Hurdle Racing (n=2) | 2.5 | 15.0 | 5.0 | 112 | 12.5 | 3.5 | 5.0 | 10.0 | 0.0 | 15.0 | 185.0 | 123.5 | 600 | 30.0 | 128 | 42.5 | 1290 |
| Athletics (n=4) | 7.5 | 23.8 | 7.5 | 186 | 31.0 | 7.5 | 15.3 | 17.5 | 3.8 | 32.5 | 157.5 | 63.8 | 480 | 31.3 | 135 | 90.0 | 1290 |
| Badminton (n=4) | 7.5 | 16.3 | 7.5 | 180 | 2.5 | 42.0 | 16.4 | 13.8 | 0.0 | 25.0 | 97.5 | 78.5 | 560 | 35.0 | 140.5 | 67.5 | 1290 |
| **MALES [N = 46]** | | | | | | | | | | | | | | | | | |
| Athletics (n=7) | 4.3 | 17.9 | 9.3 | 183 | 21.5 | 4.3 | 13.6 | 15.0 | 47.2 | 30.0 | 197 | 93.0 | 463 | 49.3 | 77.2 | 34.3 | 1260 |
| Badminton (n=4) | 8.8 | 13.8 | 6.3 | 220 | 30.0 | 8.8 | 15.0 | 12.6 | 7.5 | 36.3 | 135 | 94.5 | 450 | 55.8 | 95.6 | 85.0 | 1275 |
| Cricket (n=6) | 9.2 | 15.0 | 7.6 | 207 | 15.9 | 9.2 | 14.2 | 12.6 | 70.0 | 30.0 | 160 | 47.6 | 480 | 46.7 | 75.0 | 60.0 | 1260 |
| Judo (n=5) | 7.5 | 17.0 | 8.0 | 267 | 22.0 | 7.5 | 15.0 | 13.0 | 60.0 | 27.0 | 144 | 57.0 | 480 | 63.0 | 60.0 | 72.0 | 1320 |
| Judo & Gymnastics (n=6) | 8.4 | 12.6 | 5.9 | 205 | 17.6 | 8.4 | 15.0 | 13.4 | 65.0 | 30.7 | 190 | 45.0 | 490 | 33.0 | 130.0 | 50.0 | 1320 |
| Volleyball (n=14) | 5.3 | 17.2 | 8.6 | 187 | 16.8 | 5.3 | 15.4 | 14.5 | 48.9 | 30.0 | 197 | 81.5 | 450 | 45.5 | 85.8 | 51.5 | 1260 |
| Weight Lifting (n=4) | 7.0 | 22.5 | 7.6 | 205 | 11.5 | 7.0 | 17.6 | 17.6 | 35.4 | 29.0 | 210 | 67.6 | 405 | 37.2 | 105.0 | 75.0 | 1260 |

NOTE :-

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Ascending Stairs | D | Chatting | G | Dressing | J | Eating | M | Sleeping |
| B | Bathing | E | Cycling | H | Drinking | K | Grooming & Personal needs | N | Walking |
| C | Brushing | F | Descending Stairs | I | Driving | L | Reading | O | Watching TV |
| *T.T.S. | Total Time Spent On Routine Activities (minutes/day) | | | | | | | P | Writing |

Table 8: Mean Energy Expenditure (kcal / day) for different Routine Activities by Female & Male Players Classified Game Wise

| Sports Disciplines | Weight ( kg ) M ± SD | Energy Expenditure For Routine Activities (kcal/day) | | | | | | | | | | | | | | | | *EERA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | |
| **FEMALES [N = 13]** | | | | | | | | | | | | | | | | | | |
| Half Marathon (n=3) | 50.0 ± 3.6 | 30.2 | 45.6 | 24.4 | 56.5 | 113.8 | 18.9 | 24.0 | 20.1 | 38.5 | 33.9 | 173.0 | 67.8 | 448.4 | 73.5 | 180.8 | 158.2 | 1507.6 |
| Hurdle Racing (n=2) | 51.5 ± 8.5 | 9.2 | 32.4 | 15.0 | 130.5 | 46.1 | 8.1 | 10.8 | 21.5 | 0.0 | 26.7 | 329.3 | 143.8 | 468.0 | 64.8 | 148.5 | 49.3 | 1503.8 |
| Athletics (n=4) | 44.8 ± 5.6 | 24.1 | 44.9 | 19.5 | 187.9 | 99.5 | 15.0 | 28.6 | 38.7 | 3.8 | 50.4 | 244.1 | 64.4 | 326.4 | 58.8 | 136.4 | 558.9 | 1901.5 |
| Badminton (n=4) | 43.0 ± 3.3 | 23.1 | 29.3 | 18.8 | 174.6 | 7.7 | 80.6 | 32.3 | 21.2 | 0.0 | 37.0 | 144.3 | 76.1 | 325.0 | 63.0 | 136.3 | 263.9 | 1433.3 |
| **MALES [N = 46]** | | | | | | | | | | | | | | | | | | |
| Athletics (n=7) | 60.0 ± 7 | 18.5 | 45.1 | 32.5 | 247.3 | 92.5 | 11.5 | 34.0 | 21.9 | 118.0 | 40.5 | 407.8 | 125.6 | 421.2 | 123.3 | 104.2 | 46.3 | 1890.1 |
| Badminton (n=4) | 61.0 ± 8.5 | 38.4 | 34.8 | 22.4 | 301.4 | 131.1 | 24.0 | 38.1 | 18.6 | 19.1 | 49.7 | 284.9 | 129.5 | 414.0 | 142.8 | 131.0 | 116.5 | 1896.2 |
| Cricket (n=6) | 52.5 ± 1.2 | 34.6 | 33.0 | 23.2 | 244.3 | 59.8 | 21.6 | 31.1 | 16.1 | 153.3 | 35.4 | 289.6 | 56.2 | 364.8 | 102.7 | 88.5 | 70.8 | 1624.9 |
| Judo (n=5) | 61.2 ± 6.3 | 32.9 | 43.7 | 28.5 | 368.5 | 96.6 | 20.6 | 19.2 | 19.4 | 188.4 | 37.3 | 303.8 | 78.7 | 446.4 | 161.9 | 82.8 | 99.4 | 2027.9 |
| Judo & Gymnastics (n=6) | 50.5 ± 0.13 | 30.2 | 26.7 | 17.3 | 233.7 | 63.7 | 19.0 | 31.7 | 16.5 | 137.2 | 35.0 | 235.6 | 51.3 | 372.4 | 70.0 | 148.2 | 57.0 | 1545.4 |
| Volleyball (n=14) | 50.7 ± 0.16 | 19.3 | 36.5 | 25.4 | 212.6 | 61.2 | 12.0 | 32.5 | 17.8 | 103.2 | 345.1 | 345.1 | 92.9 | 346.5 | 96.9 | 97.8 | 58.7 | 1903.4 |
| Weight Lifting (n=4) | 50.6 ± 0.19 | 25.4 | 47.7 | 22.3 | 233.7 | 41.7 | 15.8 | 37.1 | 21.6 | 74.7 | 367.5 | 367.5 | 77.1 | 77.1 | 78.9 | 119.7 | 85.5 | 1693.3 |

NOTE

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A | Ascending Stairs | E | Cycling | I | Driving | M | Sleeping | O | Watching T.V. |
| B | Bathing | F | Descending Stairs | J | Eating | N | Walking | P | Writing |
| C | Brushing | G | Dressing | K | Grooming & Personal needs | FERA | Energy expenditure for routine activities (kcal) | | |
| D | Chatting | H | Drinking | L | Reading | | | | |

Table 9: Mean Time Spent (minutes/day) For Different Sports Activities by Female & Male Players Classified Game Wise

| Sports Discipline | Mean Time Spent On Sports Activities ( minutes / day ) | | | | | | | | | | | | * PERT | ** T.T.S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | K | L | | |
| **FEMALES [N = 13]** | | | | | | | | | | | | | | |
| Half Marathon (n=3) | 4 | 4.4 | 0 | 12.4 | 12.4 | 65 | 30 | 0 | 0 | 8.4 | 8.4 | 0 | 5 | 150 |
| Hurdle Racing (n=2) | 3.5 | 4 | 0 | 12 | 10 | 70 | 0 | 5 | 20 | 7.5 | 7.5 | 0 | 10.5 | 150 |
| Athletics (n=4) | 6 | 7.5 | 0 | 10 | 15 | 50 | 18.8 | 16.3 | 7.5 | 3.8 | 3.8 | 0 | 11.3 | 150 |
| Badminton (n=4) | 5 | 5 | 0 | 5 | 3 | 80 | 12 | 15 | 5 | 5 | 5 | 0 | 10 | 150 |
| **MALES [N = 46]** | | | | | | | | | | | | | | |
| Athletics (n=7) | 6 | 6 | 11 | 15.8 | 11.5 | 38.5 | 31 | 25.2 | 16 | 2.9 | 6 | 4.3 | 5.8 | 180 |
| Badminton (n=4) | 6.2 | 8.5 | 11.2 | 8.8 | 16.3 | 16.3 | 25.8 | 26 | 12.6 | 1.3 | 6 | 11 | 15 | 165 |
| Cricket (n=6) | 6 | 5 | 11 | 11 | 21 | 21 | 30 | 31 | 16 | 0 | 6 | 11 | 11 | 180 |
| Judo (n=5) | 12 | 12 | 20 | 4 | 15 | 15 | 0 | 15 | 2 | 8 | 8 | 9 | 0 | 120 |
| Judo & Gymnastics (n=6) | 10 | 15 | 15 | 0 | 10 | 31 | 0 | 16 | 0 | 6 | 6 | 11 | 0 | 120 |
| Volleyball (n=14) | 15 | 15 | 10 | 15 | 30 | 60 | 0 | 10 | 5 | 10 | 10 | 0 | 0 | 180 |
| Weight Lifting (n=4) | 15 | 15 | 20 | 10 | 10 | 60 | 0 | 0 | 0 | 20 | 10 | 10 | 10 | 180 |

**NOTE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | Bending (Sitting) | E | Jumping | I | Running Fast | *PERT | Post Exercise Resting Time |
| B | Bending (Standing) | F | Practice (Light) | J | Stretching (Standing) | | |
| C | Dips | G | Practice (Heavy) | K | Stretching (Sitting) | **T.T.S. | Total Time Spent On Sports Activities (Minutes/Day) |
| D | Jogging | H | Running Slow | L | Sit-ups | | |

Table 10: Mean Energy Expenditure (kcal / day) For Different Sports Activities by Female & Male Players Classified Game Wise

| Sports Discipline | Weight ( Kg ) M ± SD | Energy Expenditure For Routine Activities (kcal/Day) | | | | | | | | | | | | * PERT | ** EESA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G | H | I | J | K | L | | |
| **FEMALES [N = 13]** | | | | | | | | | | | | | | | |
| Half Marathon (n=3) | 50.0± 3.6 | 20.8 | 22.5 | 0.00 | 138.9 | 72.5 | 282.8 | 252.3 | 0.0 | 0.0 | 43.7 | 37.8 | 0.0 | 19.2 | 890.4 |
| Hurdle Racing (n=2) | 51.5 ± 8.5 | 18.72 | 21.4 | 0.00 | 138.0 | 60.2 | 312.9 | 0.00 | 30.3 | 195.6 | 40.1 | 34.4 | 0.0 | 41.4 | 892.9 |
| Athletics (n=4) | 44.8± 5.6 | 27.9 | 34.9 | 0.00 | 100.3 | 78.6 | 194.0 | 116.7 | 85.9 | 63.8 | 17.7 | 15.1 | 0.0 | 38.8 | 773.7 |
| Badminton (n=4) | 43.0± 3.3 | 22.4 | 22.4 | 0.00 | 48.15 | 15.1 | 298.4 | 46.9 | 75.9 | 42.1 | 22.4 | 19.1 | 0.0 | 32.9 | 645.6 |
| **MALES [N = 46]** | | | | | | | | | | | | | | | |
| Athletics (n=7) | 60.0± 7.0 | 37.4 | 37.4 | 83.2 | 212.4 | 80.7 | 200.2 | 243.7 | 177.9 | 182.4 | 18.1 | 32.0 | 26.7 | 26.6 | 1358.8 |
| Badminton (n=4) | 61.0± 8.5 | 39.3 | 53.9 | 86.0 | 120.2 | 116.2 | 86.2 | 174.7 | 186.9 | 146.0 | 8.2 | 32.5 | 69.6 | 70.1 | 1189.8 |
| Cricket (n=6) | 52.5± 1.2 | 32.6 | 27.2 | 72.7 | 129.4 | 128.9 | 95.6 | 90.0 | 191.6 | 159.5 | 0.0 | 28.0 | 59.8 | 44.2 | 1059.5 |
| Judo (n=5) | 61.2± 6.3 | 76.5 | 76.3 | 154.2 | 54.8 | 107.4 | 79.7 | 0.0 | 108.0 | 19.2 | 50.9 | 43.5 | 57.2 | 0.0 | 827.6 |
| Judo & Gymnastics (n=6) | 50.5± 0.1 | 52.5 | 78.8 | 94.5 | 000.0 | 59.0 | 135.8 | 0.0 | 95.0 | 0.0 | 31.5 | 26.9 | 57.6 | 0.0 | 631.6 |
| Volleyball (n=14) | 50.7± 0.2 | 79.1 | 79.1 | 63.8 | 170.3 | 177.9 | 264.0 | 0.0 | 59.7 | 48.2 | 52.7 | 45.1 | 0.0 | 0.0 | 1039.7 |
| Weight Lifting (n=4) | 50.6 ± 0.2 | 78.9 | 78.9 | 127.4 | 113.3 | 59.2 | 263.4 | 0.0 | 0.0 | 0.0 | 105.0 | 45.0 | 52.5 | 38.7 | 962.3 |

**NOTE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | Bending (Sitting) | E | Jumping | I | Running Fast | *PERT | Post Exercise Resting Time |
| B | Bending (Standing) | F | Practice (Light) | J | Stretching (Standing) | | |
| C | Dips | G | Practice (Heavy) | K | Stretching (Sitting) | **EESA | Energy Expenditure For Sports Activities (kcal) |
| D | Jogging | H | Running Slow | L | Sit-ups | | |

Table 11: Data on Mean Body Weight, Total Energy Intake, Total Energy Expenditure & Energy Balance for Female & Male Players Classified Game-Wise

| Sr. No. | Sports Disciplines | Body Weight (kg) | Total Energy Intake (kcal) | Total Time Spent On Routine Activities [minutes] | Total Time Spent On Sports Activities [minutes] | Total Time Spent [minutes] | Energy Expenditure (kcal) * EERA | ** EESA | *** TEE | Energy Balance (kcal) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FEMALES [N = 13] | | | | | |
| 1 | Half Marathon | 50.0 | 1240.3 | 1290 | 150 | 1440 | 1507.57 | 890.38 | 2397.95 | -1157.65 |
| 2 | Hurdle Racing | 51.5 | 1862.5 | 1290 | 150 | 1440 | 1503.83 | 892.96 | 2396.79 | -534.29 |
| 3 | Athletics | 44.8 | 1701.2 | 1290 | 150 | 1440 | 1901.45 | 773.67 | 2675.12 | -973.92 |
| 4 | Badminton | 43.0 | 1965.3 | 1290 | 150 | 1440 | 1433.25 | 645.56 | 2078.81 | -113.51 |
| | | | | | MALES [N = 46] | | | | | |
| 1 | Athletics | 60.0 | 2482.6 | 1260 | 180 | 1440 | 1890.07 | 1358.78 | 3248.85 | -765.25 |
| 2 | Badminton | 61.0 | 2351.4 | 1275 | 165 | 1440 | 1896.19 | 1189.84 | 3086.03 | -734.63 |
| 3 | Cricket | 52.5 | 2322.8 | 1260 | 180 | 1440 | 1624.94 | 1059.47 | 2684.41 | -361.61 |
| 4 | Judo | 61.2 | 2273.8 | 1320 | 120 | 1440 | 2027.88 | 827.62 | 2855.50 | -581.7 |
| 5 | Judo & Gymnastics | 50.5 | 2092.4 | 1320 | 120 | 1440 | 1545.35 | 631.65 | 2177.00 | -84.6 |
| 6 | Volleyball | 50.7 | 2008.3 | 1260 | 180 | 1440 | 1903.44 | 1039.70 | 2943.14 | -934.84 |
| 7 | Weight Lifting | 50.6 | 2170.5 | 1260 | 180 | 1440 | 1693.27 | 962.30 | 2655.57 | -485.07 |

*EERA- Energy Expenditure for Routine Activities, **EESA- Energy Expenditure for Sports Activities, ***TEE –Total Energy Expenditure

For male players involved in different sports disciplines, it can be seen from Table 8 that judo and & gymnastics groups had highest total mean time spent on routine activities (1320.0 minutes/day). Males engaged in judo showed highest mean EERA (2027.88 kcal). The same group also showed highest value of mean body weight (61.2 kg). Even though, being one of the groups with highest mean TSS on routine activities judo & gymnastic group of males showed lowest mean EERA(1545.35 kcal) which can be attributed to low mean body weight (50.5 kg).

*Energy Expenditure for Sports Activities:*

Tables 9 & 10 show mean time spent and energy expenditure for different sports activities respectively for female and male players classified game-wise. Mean time spent on various sports activities such as work-outs like jumping, jogging, dips, running (fast/slow), sit-ups, stretching exercises, post exercise resting etc. was recorded.

For female players it can be seen that almost all sports groups spent considerably larger amount of time on individual game practice (both light and heavy). Similar observations were made for male players engaged in different sports disciplines. It is clear from Table 10 that irrespective of the sex & game considerable amount of energy was expended on jogging & jumping. EE on light practice by females was found to be less than that on heavy practice. Similarly, among male players, athletics & badminton showed higher mean value of EE on heavy practice. These findings could be attributed to the fact that longer the time spent for game practice higher the energy expenditure.

Many athletic events are characterized by extremely high exercise intensities. As a result, energy expenditure over a short time period may

be extremely high *(Fred Brouns, 2003)*. It was noticed that considerable amount of calories were expended on running (fast/slow) and stretching exercises by both female & male players engaged in different sports disciplines. Mean EE for post exercise recovery time (PERT) was computed which was found out to range between 19.15–41.37 kcal for females & 26.62–70.05 kcal for male players.

*Energy Balance:*

Table 11 presents data on mean body weight, total energy intake, total energy expenditure & energy balance for female & male players classified game-wise. One can see that total time spent on sports activities ranged between 120-180 minutes, irrespective of sex & games. All groups of female players spent 1290 minutes/day on routine activities. For male players mean total time spent on routine activities ranged between 1260 to 1320 minutes/day.

Athletics is the group of female players which showed highest TEE which can be attributed to its highest mean value of EERA (2675.12 & 1901.45 kcal respectively). Even though with similar amount of mean TTS on sports activities, female badminton players showed lowest mean EESA & TEE values (645.56 & 2078.81 kcal respectively) which can be attributed to the group's lowest mean body weight (43 kg) & highest mean EI (1965.3 kcal). Highest EESA by female hurdle racers could be because of their highest mean body weight (892.96 kcal & 51.5 kg respectively). However, similar group had lowest EERA (1503.83).

Higher is the body weight larger is the EE seems to be true for male judo players as far is EERA is concerned (61.2 kg & 2027.88 kcal). Lower the body weight lower the EE was the case for male judo & gymnastic players for EESA (50.5 kg & 631.65 kcal) & EERA (1545.35 kcal) despite the higher TTS on routine activities (1320 minutes). Sport demands considerable higher EE. Athletics group of male players showed highest mean EESA, TEE & EI values (1358.78, 3248.85 & 2482.6 kcal respectively). Calorie requirements vary greatly from person to person and are affected by activity level, body size, age and climate. Body size impacts on calorie requirements more than any other single factor. Some sports demand high energy expenditure, others do not. If intake is consistently above or below an athlete's requirement, weight gain or weight loss will occur, both of which can affect performance *(Venkata Ramana et. al., 2004)*.

100% of female & male players engaged in different sports disciplines showed negative energy balance, the minimum of which was for badminton group for females & judo & gymnastics for males (-113.51 & -84.6 kcal respectively) and that of maximum was recorded for half marathon group among females & volleyball among males (-1157.65 & 934.84 kcal respectively). The needs of an athlete in energy & nutritional substances essentially differ depending first of all upon the kind of sport & the amount of work performed. The energy derived from carbohydrate, protein & fat should always be in proportion to that of energy expenditure by an individual athlete with respect to his/her energy requirements for whole day activity schedule & to the process of performing physical exercise *(Chandrashekhar & Bhargava, 1988; Simopoulous & Pavlou, 1993)*.

Energy expenditure for routine activities (EERA), & sports activities

(EESA) by both female and male players was found to be influenced by mean body weight, amount of time spent and the type & intensity of sport in which the players were engaged.

Energy intake of the players therefore should be regulated with specific distribution of carbohydrate, protein & fat calories so as to maintain their body weight, meet the energy requirements of both routine & sports activities as well as enhance their performance.

*Conclusion*

The importance of the relationship between nutrition & exercise performance is obvious. Good nutrition is essential to proper growth & development. Too often, coaches think of good nutrition only during the season of their sport. Actually, for effective athletic performance, good nutrition is critical at all times.

For the present study, irrespective of the game, all female & male players were found to be shorter than the required height for age. Similar results were obtained for body weights for female players. Male players showed better body weight profile. Irrespective of sex & sports disciplines, mean intakes of energy were found to be considerably less than the respective RDAs for sports persons. EE was found to be directly related to time spent on activities, type & intensity of exercise & body weight. Highest TEE was found to be related with highest EERA in case of female athletics group. Lowest mean EESA, EERA & TEE value of female badminton players could be attributed to lowest mean body weight of the group. Body weight was found to be directly proportional to EE in case of male judo players whose EERA was computed as highest with highest mean body weight. However, judo & gymnastic male players whose EESA & EERA values were computed as lowest also had lowest mean body weight. All female & male players engaged in different sports disciplines reflected negative energy balance.

For competitive athletes, the diet must provide the optimal mix of energy yielding nutrients to fuel their special needs. To maximize performance, athletes strive to achieve an optimum sport specific body size, body composition & minimum of energy stores. To peruse these objectives, athletes need to manage fat, protein & carbohydrate balance. To guide their progress, athletes need to eat by discipline.

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