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Iron status of Indian national level women baseball players

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Abstract
This present investigation was carried out to assess Iron Status of All India Inter University/National Level Women Baseball Players. For this purpose, a total sample of 24 women baseball players in the age range of 17-22 years from University of Delhi were selected using purposive sampling. The anthropometric measurements taken included weight and height, and BMI was computed using standard formula. Physical Efficiency Index through Harvard Step Test was determined while Shuttle Run test was applied for agility. A self-designed questionnaire was administrated to the subjects to elicit general information, health profile and diet and activity related information. In order to gather information on dietary iron intake, 3-day's dietary record was used and haemoglobin levels were estimated in a clinical laboratory. The obtained data was analyzed by computing Mean (M), Standard Deviation (SD), Percentage (%) and Pearson's Product Moment Coefficient of Correlations (r). The level of significance was taken at 0.05. The anthropometric parameters of the subjects showed that weight had mean value of 55.91 +1.66 kg; height had mean value of 158.82 +1.16 cm; and BMI had the mean value of 22.2 +2.8 kg/m^2. According to the BMI classification, 62.5% players came in ideal BMI category and 16.6% were found in overweight category. The dietary intake data clearly indicated that the mean iron intake of female baseball players was 10.04 ± 3.32 gm/day, which was much lower than RDA 21 gm/d (ICMR 2010). The mean estimated hemoglobin level of the baseball players was 11.49 ±1.17, which was below the normal level of 12 g/dl as suggested by WHO. Mean P.E.I markedly established poor cardiovascular endurance levels despite intensive training for 5-10 years, this could be attributed to low haemoglobin levels in up to 75% of the players. However, the shuttle run performance of these players was relatively good and did not seem to be affected by low haemoglobin levels of the subjects as shuttle run is an indicator of agility and anaerobic fitness. Thus, the results of present investigation showed inadequate dietary intake of iron which was also reflected in low haemoglobin levels in these subjects, poor aerobic fitness in majority of the subjects; however, their shuttle run scores signifying anaerobic fitness were appropriate. These results clearly direct towards proper nutrition counseling of female baseball players focusing on including foods rich in iron content in their diets.

Keywords: Dietary iron intake, haemoglobin level, baseball players, anaemia, Physical efficiency index, shuttle run, agility, cardiovascular endurance

Introduction
Good dietary practices leading to adequate nutritional intake help athletes to train hard, recover fast and adapt more effectively with less risk of illness or injury. Iron is one of the essential nutrients that is required for numerous biological processes of the body. Iron deficiency is one of the most common nutrient deficiencies worldwide (Bailey *et al.* 2015) [2]. It is also the leading cause of anemia, therefore contributes to disability and fatality.

In developed areas of the world, only about 8% of the population has anemia, but in developing regions the percentage of anemia averages 36% (Ahmed, 2010) [1]. India continues to be one of the countries with very high prevalence. A large number of Indian females (53%) were estimated to be anaemic in the fourth National Family Health Survey (NFHS-IV) in 2015-16.

The prevalence of iron deficiency in female athletes is also commonly seen (Marx, 1997). For athletes demand of iron is much higher as one of the major functions of iron in the body is to transport oxygen to and carbon dioxide away from all the cells. Iron deficiency affects not only the physical capacities of an athlete but mental functions are also affected. The brain relies on oxygen transport as well so, without enough iron is it difficult to concentrate thus, one feels tired and irritable.

Iron is also needed to maintain a healthy immune system. If athletes don't have enough iron they may also be prone to more frequent infections (Beard, 2000) [4]. Results from numerous studies of female athletes involved in sports like volleyball, Basketball, field hockey, Soccer players have shown iron deficiency anemia (Beals, 2002; Dubnov and Constantini, 2004; Landahi *et al*., 2005; Majumdar, 2008) [3, 9, 8, 10].

A combination of the factors place athletes at risk of iron deficiency that include inadequate supply of dietary iron and increased demands for iron during training periods due to high iron losses. In female athletes, blood loss may occur through injury or menstruation. In endurance athletes, repeated foot strike damages the red blood cells in the feet due to running on hard surfaces with poor quality shoes and leads to iron loss. As iron is lost in sweat, heavy sweating adds to increased risk of deficiency.

Baseball is a physically demanding sport comprising of several specialized skills and types of fitness with cardiovascular efficiency particularly forming the basis to undertake sports efforts successfully because this game involves throwing, fielding, pitching, catching, base running and hitting. It has been well established that anemia reduces peak oxygen uptake, reduces work capacity and aerobic endurance and increases plasma lactate. Hence, it is imperative to regularly monitor the hemoglobin and serum ferritin levels in baseball players particularly in women players for timely intervention of iron supplementation and appropriate dietary counseling before it starts showing adverse effects on training and health.

Objective of the study

This study was undertaken with an aim to assess the dietary iron status and related physiological and physical fitness parameters in women baseball players who play at inter-university or National level.

Methodology

Selection of Subjects

The present study was conducted on 24 Inter-University level women baseball players in the age range of 17-22 years from University of Delhi. The subjects were selected using purposive sampling.

Collection of Data

Body weight of the subjects was taken using weighing machine, height was measured using anthropometric Rod and Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meters (kg/m^2). Haemoglobin levels of the subjects were estimated in a clinical laboratory. To evaluate cardiovascular endurance Harvard Step Test developed by Brouha (1943) was used and shuttle run test was done to measure agility. For determining the Dietary Iron status 3-day's dietary record method was used. The iron intake was calculated using a standard computerized programme based on nutritive values of different foods given in Nutritive value of different foods (ICMR, 2010) [5].

Statistical Analysis

The obtained data was analyzed by computing Mean, Standard Deviation (SD), Percentage (%) and Pearson's Correlations (r). The level of significance chosen to test the hypothesis was at 0.05.

Results of the study

The study was conducted on 24 women basketball players from Delhi University.

Table 1: Description of Dietary Information of the Subjects (n=24)

S. No.	Parameter/Question	No. of Subjects (n)	Percentage of Subjects (%)
1.	Nature of Diet		
	• Vegetarian	9	37.5
	• Non vegetarian	13	54.2
	• Ova-vegetarian	2	8.3
2.	Habit of Consuming Tea with Meals		
	• Yes	10	41.7
	• No	14	58.3
3.	Consumption of Fast/Junk Food		
	• Yes	24	100.0
	• No	0	0.0

It was evident from the table1 that almost half (54.2%) of the players consumed non-vegetarian foods, while 37.5% were vegetarian and only 8.3% were ova-vegetarian; 41.7% players had the habit of consuming tea with their meals; and all the players (100%) consumed fast/junk food often. Further, investigation revealed that 95.8% of them were in the habit of missing meals and all of them (100%) usually ate out on daily basis.

Table 2: Anthropometric Status of the Subjects (n=24)

Parameters	Mean ± SD	Range
Weight (kg)	55.91 ± 1.66	46-75
Height (cm)	158.82 ± 1.16	143-167
BMI (kg/m^2)	22.2 ± 2.8	17.21-28.58

The analysis of data in Table-2 shows the anthropometric parameters of the subjects, weight of the subjects had mean value of 55.91 $\pm$1.66 kg; height had mean value of 158.82. $\pm$1.16 cm and BMI having mean value of 22.2 $\pm$ 2.8. Table 3 shows distribution of subjects according to the BMI classification wherein 62.5% players came in ideal BMI category and 16.6% were in overweight and category.

Table 3: Distribution of Subjects According to BMI Classification (n=24)

BMI	Classification	No. of Subjects (n)	%
<18.49	Underweight	1	4.1
18.5 – 24.99	Ideal BMI	19	79.2
25.0-29.99	Overweight	4	16.7
>30	Obese	0	0

Table 4: Description of Physical Fitness Components of the Players (n=24)

Parameters	Mean ± SD	Range
Physical Efficiency Index (PEI)	51.08±4.58	45.0-58.0
Shuttle Run (sec)	11.24 ± .69	9.8-13.1

Table 5: Dietary Iron status and Haemoglobin level of the Players (n=24)

	Mean ± SD	Range
Dietary Iron intake (mg)	10.04 ± 3.32	5.4-21.38
Hemoglobin (gm/dl)	11.49 ±1.17	9.5-13.8

Table-4 depicts P.E.I score as 51.08 ±4.58; shuttle run had mean value 11.24 ±0.69 sec. Table-5 shows the total dietary Iron intake of players as 10.04 ±3.32 mg/day and mean hemoglobin level value of 11.49±1.17 gm/dl. A positive but no significant relation (r) was seen iron intake and haemoglobin levels and dietary iron intake and PEI.

Table 6: Distribution of subjects according to Hemoglobin level cut-off (n=24)

S. No.	Hemoglobin (gm/dl)	Number of Players	Percentage of Players
1	< 12	18	75%
2	More than 12	06	25%

The analysis of table 6 revealed that up to 75% of the players had haemoglobin values less than 12 gm/dl (WHO guidelines) indicating chances of iron-deficiency anaemia. Only 25% of the total subjects had normal haemoglobin levels and a large number (75%) were anaemic.

Discussion

The study was done on All India Inter-University level female baseball players (n=24). All the players chosen for the study were national level player and one player even had participated in the International Competitions. This level of participation puts lots of nutritional demands on the body and deficiencies could be detrimental for performance as well as for health. The analysis of data pertaining to the health profile of women baseball players demonstrated that most of the players suffered acute illnesses and around 30% of the players had suffered from injury in the past 6 months. Dietary imbalances are likely during illnesses and injuries and further such conditions hamper the practice thereby affecting performance. Further, subject reported no incidence of exhaustion till after moderate physical activity or feel lethargic throughout the day which are the general symptoms of anaemia. None of the subjects went for testing of hemoglobin in past 6 months; folic acid had been consumed as nutritional supplement by 16.7% players; while Liv-52 and Revital were being used by 4.2% each; and all the selected sample had regular menstrual cycles. Majumdar *et al*. (2008) [10] revealed that iron supplementation can reduce the chances for absolute anemia but has no role in the improvement of sports females suffering from certain iron deficiency within 6 weeks.

The dietary intake data of the sports persons was taken for three consecutive days, results from which, clearly indicated that the mean iron intake of female baseball players was 10.04 ± 3.32 gms/day (table 5), whereas the ICMR (2010) [5] recommended guidelines show that the iron intake per day should be more than 21 gm, hence, the female baseball players were consuming very less of iron as required per day. Almost 55% players reportedly consumed the non-vegetarian foods still such low levels of iron intake in these players were seen. Lower intake of dietary iron may have detrimental effects on overall performance and particularly on the health of female players.

Mean estimated hemoglobin level of the baseball players was 11.49±1.17 gm/dl, which was also below the level of normality (<12mg/dl). Due to wrong eating habits like 41.7% players had reported the habit of consuming tea with their meals, eating out, high reliance on junk food and inadequate dietary iron intake, the level of hemoglobin could decline. Although serum ferritin is a more specific indicator of iron deficiency anaemia, more than 50% cases with low haemoglobin levels are found to be anaemic due to iron deficiency. Increased blood plasma levels as a result of extensive training lead to decrease in absolute amounts of haemoglobin hence pseudoanaemia in sports person is also common.

Mean P.E.I as measured by Harvard Step Test showed the mean value of 51.08±4.58 which markedly established poor fitness levels in these subjects; as compared to the norms indicating below 54 fitness index as poor. This could clearly be attributed to low haemoglobin levels in up to 75% of the players studied in the present investigation. The impact of anaemia on aerobic fitness is well established (Rowland 2012; James *et al*. 2014) [11, 6]. A study done by Sugasri and Premakumari (2010) [7] on 95 collegiate sportswomen showed that dietary modification improved the blood haemoglobin levels significantly from 11.2g/dl to 12.0g/dl and the athletes showed significant improvement in their cardiovascular and performance parameters. On the other hand, shuttle run performance of the players in the present study was relatively good with mean values at 11.24 ± .69 sec. This does not seem to be affected by haemoglobin levels of the subjects as shuttle run is an indicator of agility and anaerobic fitness.

Conclusion

Thus, the results of present investigation showed inadequate dietary intake of iron which was also reflected in low haemoglobin levels in these subjects. Despite intensive training for 5-10 years, the physical efficiency index revealed poor aerobic fitness in majority of the subjects; however, their shuttle run scores signifying anaerobic fitness were appropriate. These results clearly direct towards proper nutrition counseling of female baseball players focusing on including foods rich in iron content in the diet. This is imperative for their fine performances in sports as well in maintaining good health throughout their life.

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