

## **A Comparison of a Vegetarian and Non-Vegetarian Diet in Indian Female Athletes in Relation to Exercise Performance**

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### **Abstract**

The study was conducted to explore the prevalence of vegetarianism and non-vegetarianism amongst the Indian female athletes and its effects on nutritional status and exercise performance of the subjects. Sixty four women national athletes attending national camps in preparation of international competition in the age group of 16-25 yrs participated in the present study. Anthropometric measurements viz; height, weight, body fat and lean body mass were taken and dietary intake pattern was assessed through 24 hour recall method. Performance was assessed by graded exercise till exhaustion. Blood samples were taken prior to exercise for assessment of haemoglobin. Results showed prevalence of non-vegetarianism was high amongst Indian sports women (61.9%) than lacto (22.2%) and ovo-lacto vegetarians (15.9%). None of them were pure vegetarians. Body fat was significantly higher among lacto vegetarians ( $27.2 \pm 4.2\%$ ) than non-vegetarians ( $24.3 \pm 4.0\%$ ) and ovo-lacto vegetarians ( $23.1 \pm 1.92\%$ ). No significant difference was found for energy and carbohydrate intake between the three groups. Protein intake was significantly higher in non-vegetarians as compared to ovo-lacto vegetarian and lacto vegetarian group ( $p < 0.01$ ) and fat intake was higher in lacto vegetarians as compared to ovo-lacto vegetarian and non-vegetarian group ( $p < 0.01$ ). B-complex vitamins, iron intake, haemoglobin concentration ( $p < 0.05$ ) were high in non-vegetarians. Calcium and fibre intake was high in lacto-vegetarians ( $p < 0.05$ ). Endurance time and recovery was better in non-vegetarians than other groups ( $p < 0.05$ ). The present study shows prevalence of non-vegetarianism was high in Indian National sports women than lacto, ovo-lacto vegetarianism. Some nutrients intake, haemoglobin level and endurance time was better in non-vegetarians than lacto or ovo-lacto vegetarians.

**Key Words: Prevalence, Dietary Intake, Nutritional Status, Endurance Time, Indian Sports Women**

### **Introduction**

In India due to the various socio-economic and religious beliefs, the dietary habits vary amongst different populations. An increasing number of athletes are adopting vegetarian diets for ecological, economic & religious reasons (Nieman, 1999). A well-planned and varied vegetarian diet is perfectly consistent with good health and can potentially reduce the risk of many chronic diseases (White & Frank, 1994). Physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition (Joint Position Statement, 2000). Multiple benefits of vegetarian dietary practices that extend to enhanced physical fitness

and performance have been explored since the early 20th century (Nieman, 1988). Athletes who were practicing meatless dietary regimen most frequently reported low energy intake, along with low levels of vitamins and minerals (Lukaski, 1995) particularly B-complex, calcium, iron, and zinc (Grandjean, 1987, Seiler, 1989). However vegetarian diets can meet the nutritional requirements of athletes with appropriate selection of foods (Joint Position Statement, 2000). Many studies have been conducted to compare the athletic ability of vegetarian vs. non-vegetarian subjects, but, no difference has been reported (Cotes et al., 1970, Williams, 1985, Hanne et al., 1986). Few recent investigations relating

vegetarian diet to performance have been published but the prevalence of vegetarianism among athletes has not been well researched (*Bachrach et al., 1990*).

The present study investigates the prevalence of vegetarianism among Indian sports women and possible differences between non-vegetarian, ovo-lacto and ovo-vegetarian diets in relation to performance of the sports women preparing for high-level competition.

### **Materials and Methods**

*Subjects:* 64 women national athletes attending national camps in preparation of international competition in the age group of 16-25 yrs participated in the present study. Subjects were divided into 3 groups according to their dietary patterns-

- a) Non-vegetarians
- b) Lacto vegetarians
- c) Ovo-lacto vegetarians

Subjects were classified as non-vegetarians if foods of plant and animal origin, including meat, fowl, eggs, milk and other dairy products, and fish were included in their diet; lacto vegetarians if foods of plant and dairy products were included in their diet; ovo-lacto vegetarian if foods of plant origin, with milk and other dairy products and eggs were included in their diets.

### *Anthropometry and body composition*

Body mass was measured with accurately calibrated electronic scales (Seca Alpha 770) to the nearest 0.1kg, and stature with stadiometer (Seca 220) recorded to the nearest 0.5 cm. Body density was estimated from the sum of the skin folds sites viz; biceps, triceps, subscapular and suprailiac (*Durnin and Womersely, 1974*). Percentage of body fat

was calculated using equation of *Siri (1956)*. Lean body mass was calculated by subtracting fat mass from total body mass.

### *Nutrient intake*

To collect the dietary information, 24 hour recall and weighing method was used. Nutrients like Calorie, carbohydrate, protein, fat, calcium, phosphorous, iron, zinc, vitamin A, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin B<sub>3</sub>, vitamin C and fibre were calculated by using table of food composition, ICMR, 2000 (*Gopalan et al., 1974*). Nutrient intake was compared with recommended dietary allowance, which was given by ICMR.

### *Exercise Testing*

Participants were advised not to engage in strenuous activities two days before an exercise test and not to exercise on the day of the test. Individuals were requested to maintain their normal diet. There after a treadmill test was performed to determine the heart rate responses to graded exercise so as to find out the sub maximal responses in cardiovascular system. The time taken till exhaustion was recorded to determine the maximal endurance performance. The test protocol started with 6 km/h speed and there after increased by 2km/h after every 2min. This protocol was continued until the subject got exhausted. Venous blood was taken to assess the haemoglobin concentration of the subjects

### *Statistical analysis*

Statistical Package (SPSS 11.00) was used for analysis of data. Values were presented as Mean and Standard Deviation. Percent distribution was computed to determine the prevalence of vegetarianism among subjects. One way

analysis of variance followed by Scheffe’s test was used to find out whether the difference of means in each parameter between the groups was significant. Differences were considered significant at  $p<0.05$  level and  $p<0.01$  level.

**Results and Discussion**

Prevalence of non-vegetarianism was highest among sports persons. Among subjects none of them were vegetarians.61.9 % of subjects were non-vegetarians, 22.2% were lacto vegetarians and 15.9 % were ovolacto vegetarians (Table.1).

**Table 1. Prevalence of non-vegetarianism and vegetarianism among subjects**

Dietary pattern	Total (64)	Prévalence (%)
Non vegetarians (NV)	39	61.9
Lacto vegetarians (LV)	14	22.2
Ovo lacto vegetarians (OLV)	11	15.9

**Table 2. Morphological characteristics of the subjects**

Parameters	NV	LV	OLV	‘F’ Value
Age (yrs)	19.30 ±2.79	18.40 ±2.13	17.60 ±1.34	2.27 <sup>NS</sup>
Height (cm)	167.21 ±8.60	164.64 ±7.13	169.65 ±9.26	1.04 <sup>NS</sup>
Weight (Kg)	60.47 ±8.36	60.35 ±7.06	63.2 ± 6.78	0.55 <sup>NS</sup>
Body fat %	21.1 ±1.9	27.2 ±4.2	24.3 ±4.0	4.14*
Lean body mass (kg)	45.52 ±5.67	43.41 ±5.87	45.19 ±5.45	1.06 <sup>NS</sup>

\*Significant at  $p<0.05$ , NS- Not significant

Morphological characteristics of the subjects are presented in *Table 2*. No significant differences were found amongst the groups for height, weight and

lean body mass. However, body fat was significantly higher among lacto vegetarians ( $p<0.05$ ) than non - vegetarians and ovolacto vegetarians.

**Table 3. Macronutrient intake of the subjects**

Macro Nutrients	NV	LV	OLV	‘F’ Value
Energy (kcal)	3133 ±484	3449 ±425	3030 ±692	2.55 <sup>NS</sup>
Carbo-hydrate (g)	408.6 ±72.5	424.7 ±58.3	398.3 ±115.8	0.36 <sup>NS</sup>
Protein (g)	151.9 ±24.5	106.7 ±15.4	111.7 ±16.7	29.11*
Fat (g)	96.28 ±13.99	148.6 ±26.7	131.4 ±26.8	41.41**

\*Significant at  $P<0.05$ , \*\* Significant at  $p<0.01$ , NS Not significant

Further, a look at their macro nutrient intake (Table.3) shows that intake of carbohydrate and energy was not significantly different in any group. Protein intake was higher in non-vegetarians as compared to other groups ( $p<0.01$ ) and fat intake was higher in lacto vegetarians as compared to non-vegetarians and ovolacto vegetarians ( $p<0.01$ ).

Calcium intake was found to be significantly higher among lacto vegetarians ( $p<0.01$ ) than other groups (Table.4). Iron intake was found to be higher in non-vegetarians as compared to the other two groups ( $p<0.05$ ). No significant differences were found for zinc intake amongst groups. Riboflavin and Niacin intake was higher in non-vegetarians ( $p<0.01$ ) as compared to lacto and ovolacto vegetarians. No significant difference was found amongst groups for thiamine and vitamin-C intake. A significant difference ( $p<0.05$ ) was found

for and *B*- carotene amongst the groups. *B*- carotene intake was found to be higher in non-vegetarians as compared to the other two groups. Fibre intake was more among lacto and ovolacto vegetarians as compared to non-vegetarians

**Table 4. Micronutrient intake of the subjects**

Micro nutrients	NV	LV	OLV	'F' Value
<b>Calcium (mg)</b>	1428.1 ±255.2	2693.3 ±594.4	1932.2 ±605.1	48.45**
<b>Iron (mg)</b>	22.7 ±1.88	21.8 ±1.67	20.8 ±2.33	4.39*
<b>Zinc (mg)</b>	6.08 ±0.91	6.13 ±0.76	5.89 ±1.13	0.24 <sup>NS</sup>
<b>Vitamin-A (µg)</b>	2496.5 ±276.6	2411.2 ±307.56	2162.7 ±590.1	3.67*
<b>Vitamin-B<sub>1</sub> (mg)</b>	2.05 ±0.33	2.02 ±0.55	2.00 ±0.84	0.06 <sup>NS</sup>
<b>Vitamin-B<sub>2</sub> (mg)</b>	1.91 ±0.30	1.45 ±0.22	1.77 ±0.48	10.46**
<b>Vitamin-B<sub>3</sub> (mg)</b>	11.04 ±1.26	9.23 ±1.50	7.96 ±1.36	25.62**
<b>Vitamin-C (mg)</b>	61.42 ±22.8	77.1 ±35.7	72.17 ±15.5	2.25 <sup>NS</sup>
<b>Fibre (gm)</b>	8.71 ±2.82	11.94 ±3.59	10.67 ±2.43	6.12**

\*Significant at p<0.05, \*\*Significant at p<0.01, NS Not significant

Total exercise time was noted to find out the exercise performance. Non-vegetarians were able to carry on the exercise for a longer time than lacto vegetarian and ovolacto vegetarians (p<0.01). Ovolacto vegetarians performed better than lacto vegetarians. Heart rate responses during rest, sub maximal, maximal exercise and recovery were noted and the presented in figure.1.No significant differences were found among

subjects for resting heart rate, sub maximal and maximum heart rate. A significant difference (p<0.05) was found among groups for the 2<sup>nd</sup> and 3<sup>rd</sup> min recovery heart rates. Recovery was faster among lacto vegetarians as compared to non-vegetarians and ovolacto vegetarians (table.5).

**Table 5. Physiological and Biochemical parameters of the subjects**

PARAMETER	NV	LV	OLV	F Value
<b>Endurance time (min)</b>	15.77 ±3.59	12.18 ±2.62	14.63 ±2.34	6.34**
<b>RHR (b/min)</b>	80.41 ±10.84	85.92 ±8.87	82.8 ±10.5	3.04 <sup>NS</sup>
<b>12<sup>th</sup> min HR (b/min)</b>	169.9 ±27.26	178.72 ±7.87	180.2 ±9.17	1.26 <sup>NS</sup>
<b>14<sup>th</sup> min HR (b/min)</b>	179.1 ±10.59	180 ±1.00	187.2 ±4.78	1.15 <sup>NS</sup>
<b>16<sup>th</sup> min HR (b/min)</b>	186.0 ±7.74	189± 1.00	191.3± 6.42	0.676 <sup>NS</sup>
<b>Max HR (b/min)</b>	184.0 ±9.39	189.0 ±8.59	188.0 ±8.67	1.84 <sup>NS</sup>
<b>1 min Rec HR (b/min)</b>	121.7 ±15.17	118.1 ±19.5	134.8 ±22.9	2.89 <sup>NS</sup>
<b>2 min Rec HR (b/min)</b>	104.6 ±14.8	93.0 ±16.4	112.9 ±16.4	5.2*
<b>3 min Rec HR (b/min)</b>	96.8 ±12.9	88.8 ±14.0	103.7 ±15.3	3.6*
<b>Hemoglobin (gm/dl)</b>	13.2 ±1.20	12.3 ±0.74	12.5 ±1.25	3.8*

\*Significant at p<0.05, \*\* Significant at p<0.01, NS Not significant

Hemoglobin concentration was found to be significantly different amongst groups (p<0.05). Non-vegetarians were found to have higher hemoglobin concentration than ovolacto and lacto vegetarians.

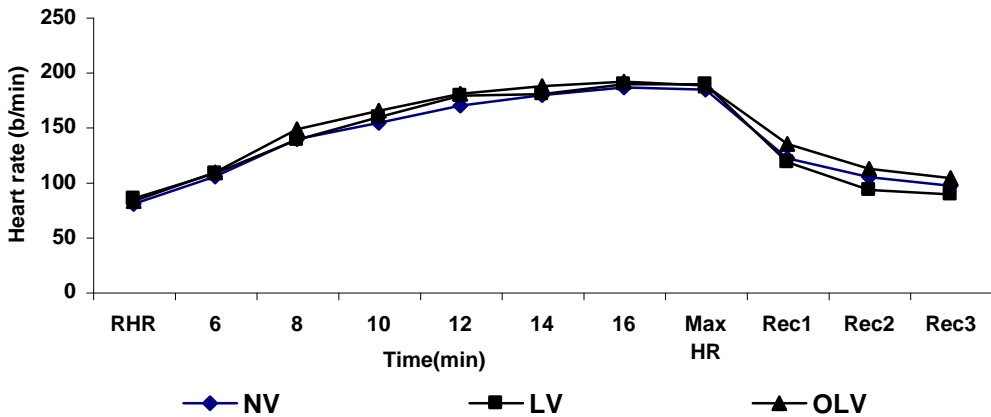


Figure 1. Heart rate responses of the subjects during rest, sub maximal, maximal and recovery period.

Prevalence of vegetarianism is high among Indian population (Majumdar, 1974), but the present study shows that among Indian sports women prevalence of non-vegetarianism is high. This may be because of Indian diets, which are essentially high carbohydrate diets; their staple being cereal and leguminous products with an inclusion of 3-4 exchanges of vegetables and fruits each. To this, the non-vegetarian adds 2-3 portions of meat and eggs where as ovolacto vegetarians and lacto vegetarians add eggs and/or milk products. Such diets are adequately high in carbohydrate as recommended in sports nutrition guidelines (NIN/ICMR, 1985).

In the present study there was a significant difference for body fat ( $p < 0.05$ ). Among subjects' lacto vegetarian and ovolacto vegetarian body fat was higher than non-vegetarians. Vegetarians have less body weight and low skin folds (Eisinger, 1994). In Indian context lacto and ovolacto vegetarians were consuming more dairy products and high fat foods. Higher body fat in lacto and ovolacto vegetarians may be due to

consumption of dairy products such as whole milk, ghee, paneer and high fat foods. This was also evident from their fat intake which was higher than  $>30\%$  in lacto and ovolacto vegetarians.

No significant difference was found between groups for energy intake in the present study for Indian sports women but mean intake was higher in lacto vegetarians than other groups. Some studies showed that Vegetarians, especially vegans, have lower energy intakes and more difficulty meeting energy requirements than non-vegetarians due to the low caloric density of their diets (Nathan et al., 1996). Energy intake of Indian female athletes ranges between 3030 Cal to 3449.3 Cal. The major source of energy from their diet was from carbohydrate  $>$ fat  $>$ protein.

Sports nutrition guidelines recommend that 60- 65 % of total energy should come from Carbohydrates. 50-55% of these should be from complex carbohydrates, and only about 10% from simple sugars. High Carbohydrate diets optimise muscle and liver glycogen stores

(Bergstrom et al., 1967, Nilsson & Hultman, 1973) and optimise performance during prolonged, moderate intensity exercise (Hargreaves et al., 1984) and short duration high intensity exercise (Maughan & Poole, 1981, Widrick et al., 1993, Larson et al., 1994 and Pizza et al., 1995). In this study there is no significant difference between three groups for Carbohydrate intake and all the groups' intakes could not meet the recommended dietary allowances. Carbohydrate intake of Indian sports women was only 50% from total calories, which could not meet the RDA. This shows their low intake of carbohydrate from the diet. Carbohydrate intakes are inadequate it is difficult to replenish glycogen stores used during exercise (Bergstrom et al., 1967).

Protein requirements are not different for the vegetarian athlete: 1.2 to 2 gm protein per kg of body weight is practiced depending on sport and duration (Millward et al., 1994, Lemon, 1995). Studies showed that vegetarians and lacto, ovolacto vegetarians can meet or exceed the requirements (Janelle & Barr, 1995). In this study non-vegetarians and ovolacto vegetarians could meet their recommended protein (15-20% from total calories) but lacto vegetarians' intake was less than 15% from total calories and could not meet the RDA.

Dietary fat should make up the remainder of energy intake after Carbohydrate and protein needs are met. The American, Canadian and Indian Dietetic Associations recommend that <30 % of total energy intake should come from fat (ADA, 1993). In Indian context non-vegetarian fat intake could meet the RDA (27.65%) but lacto (38.8%) and ovolacto vegetarian (39%) intake was

much higher than RDA >30%. This could be due to higher intake of dairy products and fat rich foods such as paneer, sweets, ghee, whole milk etc.

There was no shortage of calcium, vitamin –C and B carotene in all three groups but shortage of iron, zinc, thiamine, riboflavin and niacin vitamins amongst all the subjects than recommended allowances. A lactovegetarian and ovovegetarian diet may have shortage of iron, calcium, iodine, selenium, zinc, riboflavin, vitamin D and vitamin B<sub>12</sub> (Belko, 1987, Soares et al., 1993, Eisinger, 1994 Gibson, 1994). Non-vegetarians intake of iron and B-complex vitamins was high than other groups. Lacto vegetarians fibre intake (11.94g) was high than other groups but according to ICMR, all the groups fibre intake was less than RDA.

Haemoglobin concentration of non-vegetarians was significantly higher ( $p>0.05$ ) than other groups. This could be consumption of iron rich foods such as poultry, pulses, fruits and dried fruits etc. Non-heme iron absorption may be improved by vitamin-C or an acid diet but not by and alkaline diet or high fibre diet, both of which exist in vegetarian diets (Deuster et al., 1986).

In the present study endurance time was longer and recovery was fast in non-vegetarian, which could be a result of nutrient intake and high haemoglobin concentration than other groups. Good nutrition is important for maintaining a high level of performance. (Manore et al., 1993, Clarkson & Haymes, 1994, Fogelholm, 1995). Higher the concentrations of haemoglobin in blood, greater will the capacity of the system to carry oxygen to cells and tissues. If higher amount of oxygen is available

then one can sustain exercise for longer time and nutrients may also helped to exercise for longer period and faster recovery (Pate, 1983).

## Conclusion

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