Volume: I: Issue-2: Aug-Oct -2010 IJABPT ISSN 0976-4550

NUTRITIONAL DETERMINANTS OF FITNESS IN TENNIS PLAYERS IN VADODARA CITY

Uma Iyer[1]*, Nitya Elayath[2], Swati Dhruv[3] and Urvashi Sareen[4]

Department of Foods and Nutrition, Faculty of Family and Community Sciences,

The M.S. University of Baroda, Vadodara – 390002

Abstract : With the objective of assessing the role of nutrition and physical training on fitness in tennis players of Vadodara city, we conducted this study, employing a case-control design, wherein, 46 players from a tennis academy and 46 age and sex matched controls were studied. Socio-economic attributes, anthropometric measurements, physical fitness tests, nutrient intakes, energy expenditure, blood hemoglobin and mental well-being of the participants were evaluated using the standard protocols. BMI, WHR and weight/WC did not vary among the tennis players and controls. Nutrient intake (macronutrients and iron) and energy expenditure were significantly higher in tennis players than controls. Physical fitness and iron sufficiency were significantly higher in tennis players. Majority (75%) demonstrated good level of mental well-being. Hemoglobin levels correlated significantly with total fitness scores ($r=0.26$, $p<0.005$). To conclude, macronutrient intake and hemoglobin levels emerged as significant determinants of fitness levels of tennis players.

Key words: Nutrition, Fitness, Tennis Players

Background

Research over past decades has clearly demonstrated the beneficial effects of optimum nutrition on exercise performance of an athlete. What an athlete eats and drinks can affect health, body weight and composition, substrate availability during exercise, recovery time after exercise and ultimately, exercise performance [1]. Thus it becomes imperative to investigate the interrelations between various determinants such as dietary, socio-economic, anthropometric, iron sufficiency and mental well-being of an athlete, which can provide an insight on fitness levels of the athlete and can be made useful to optimize fitness levels. Taking into account the aforesaid factors, the present study was planned to analyze fitness levels in tennis players in Vadodara city and study the nutritional determinants which could affect athletic performance.

Methodology

Study Design and Subjects: Case-control study design was applied here to investigate the role of nutritional factors and physical training on fitness levels of tennis players. For this purpose, one tennis academy was purposively selected from 6 in the city. From the players who came to the academy for training sessions (at least 1-2 hours daily), 46 were enrolled depending on their willingness to participate in the study. Forty six individuals from free-living population, who were not involved in any regular physical activity, were also enrolled to serve as controls, after matching for age and sex.

Methods: Using a structured pre-tested questionnaire, background Information was obtained. Anthropometric measurements including weight; height; waist, hip, wrist and forearm girth were obtained using the customary measurement protocols [2]. Nutrient intake was calculated using food composition tables from "Nutritive Value of Indian Foods" [3]. Fitness of the subjects was studied using 5 tests [4]: Sit and Reach test to measure Flexibility, Vertical Jump test to assess Anaerobic power and Ab and Back hold, Ab crunches and Push Ups to assess Muscular strength. Using the scores for each test, a composite score was arrived at for assessing the fitness level. For determining energy expenditure, 7-day activity pattern of the participants was obtained, BMR was computed from body weight [5] and these were applied in predictive equations. Blood hemoglobin was estimated photometrically using Cyanmethemoglobin method. Mental well-being of the subjects was assessed using a structured questionnaire.

Statistical Analysis: Analyses were carried out in Microsoft Excel. For quantifiable variables, descriptive statistics (means and standard deviation) were calculated. In case of categorical variables, frequency distribution was computed. Comparison of means was done using't' test and difference in proportions were compared by 'chi-square' test. Pearson Correlation coefficient was computed to quantify the relationship between nutritional factors and fitness levels.

Results

Background Information of the Subjects

Baseline characteristics were comparable between the tennis players and the controls and it revealed that, most of them (58.71%) were in the high income group, and were aged between 10-12 years.

Anthropometric Indices

Anthropometric measurements namely height; BMI; waist, hip, wrist and forearm girth were also comparable between the tennis players and the controls and no gender difference was found in this regard (Table 1).

Table 1 Anthropometric Measurement of the Participants

Variable	Boys (n=33)		t value	Girls (n=13)		t value
	Athletes	Controls		Athletes	Controls	
Height (cm)	162±13.5[a]	157±19.1[b]	1.18	150±17.2[a]	146±18.3[b]	0.55
Weight (kg)	50+15.4	48+17.2	0.47	43+14.9	41+17.4	0.30
BMI (kg/m^2)	19+3.2	19+3.4	0.31	19+3.8	18+4.5	0.15
Waist (cm)	75+10.8	73+10.9	0.70	72+11.04	70+13.1	0.38
Hip (cm)	88+15.1	86+13.3	0.56	87+14.8	83+16.7	0.55
WHR	0.9+0.05	0.9+0.04	0.48	0.84+0.06	0.9+0.06	0.47
Wrist (cm)	16+1.3	15+1.6	1.07	15+2.1	14+2.01	1.57
Forearm (cm)	19+2	19+2.3	0.42	19+3.13	18+3.2	0.92
Weight/WC (kg/cm)	0.7+0.13	0.64+0.15	0.41	0.58+0.15	0.56+0.16	0.34

a, b significantly different from each other at p< 0.05

Nutrient Intake

Male tennis players had significantly higher intakes of energy (14.5% higher), protein (21.2% higher), carbohydrates (18.9% higher), fat (14.3% higher), iron (17.6% higher), and zinc (2.5% higher) than male controls. The percentage of RDA met (%RDA) for each nutrient (Table 2) was also significantly higher in male tennis players than controls as regards energy, protein, fat and iron.

However, nutrient intake was comparable among females of both the groups excepting energy, which was 12% higher in tennis players. The %RDA was marginally higher in tennis players, but the difference was not statistically significant (Table 2).

Table 2 Mean %RDA met for Various Nutrients among the Participants

Nutrients	Boys		t value	Girls		T value
	Athletes	Controls		Athletes	Controls	
Energy	82.2±7.8	72.6±10	**4.35*** **	76±13.8	70±8.7	1.32
Protein	91.3±19.1	76.3±14.2	**3.62*** **	85±32.3	71.4±16.8	1.39
Fat	259±45.2	220±57.7	**2.63****	190.3±60.4	169.4±39.4	1.05
Iron	51.5±74	40.3±21	**2.45***	65±25.6	63.5±29.8	0.12
Vitamin C	153.1±74	127±73.1	1.45	193±144.3	92.2±66.5	**2.3***

** Significant at p<0.05, ** Significant at p<0.01, *** Significant at p< 0.001*

The distribution of percentage of energy derived from various macronutrients did not vary significantly among the tennis players and the controls. Carbohydrates formed 58-60% of total energy intake, fats contributed 27-29% and proteins formed 12-13%, indicating that tennis players are not following the prescribed higher amounts of carbohydrates and proteins. The average per day fluid intake was significantly higher ($p<0.01$) in male tennis players (12.52 ± 4.72 glasses/day, 1glass = 200ml) than controls (9.79 ± 3.84 glasses/day); while female tennis players also had higher fluid intake than controls (13 ± 5.93 v/s 9.62 ± 4.01), the difference was not statistically significant though.

Energy Expenditure

The energy expenditure of the subjects was significantly higher for male tennis players than male controls in all age groups except in 15-18 year age-group, where though the expenditure was higher in athletes, statistical significance was not seen (Table 3). Females exhibited similar trend in 7-9 and 13-15 year age-groups.

Table 3 Energy Expenditure of Tennis Players and Controls

Age	Boys		t value	Girls		t value
	Athletes	Controls		Athletes	Controls	
7-9	2166+72.6	1558+5.5	11.8***	2001+136.2	1285+129.1	3.23**
10-12	2089+250.5	1710+209.8	4.34***	1988+480	1550+318.6	1.07
13-15	2638+223	2333+216.3	2.87*	2139+187.6	1859+151.6	2.32*
15-18	3143+657.5	2374+252.4	1.89	…..	…..	…..
>18	2687+284.2	2416+141.1	2.74*	2177+511.7	2162+383.4	1.55
Total	2417+467.4	2048+401.3	3.44***	2080+361.7	1696+416.3	2.51**

Significant at p<0.05, ** Significant at p<0.01, * Significant at p< 0.001*

On comparing energy intake and expenditure (Table 4) it was observed that the daily intake was lower than expenditure in all the groups.

Table 4 Comparison of Energy Intake and Expenditure of the Participants

Energy	Male Athletes	Male Controls	Female Athletes	Female Controls
Energy Intake (Kcal/day)	1919	1692	1548	1373
Energy Expenditure (Kcal/day)	2435	2036	2049	1675

Fitness Tests

Athletes had significantly higher fitness scores in 3 of the 5 fitness tests namely, sit and reach test, abdominal crunches, ab and back hold. For the remaining 2 tests, i.e. push ups and vertical jump test, the scores were higher for athletes, but the difference was not statistically significant. The results of fitness tests were assigned scores and a composite overall score was arrived at which quantified overall fitness. The maximum score that could be obtained was 15. On comparing these total fitness scores, it was seen that the tennis players had significantly higher scores compared to controls (Table 5).

Table 5 Comparison of Fitness Scores of the Athletes and Controls for Each Test

Fitness Tests	Athletes	Controls	t value
Sit and reach test	1.48+1.09	0.85+0.6	3.44***
Abdominal Crunches	0.96+1.01	0.37+0.61	3.37***
Ab and Back hold	1.04+0.76	0.72+0.81	1.99*
Push ups	0.89+0.53	0.76+0.43	1.30
Vertical Jump test	0.48+0.51	0.37+0.49	1.05
Total	4.76+2.67	3.02+1.88	3.78***

Significant at p<0.05, * Significant at p< 0.001*

Cross tabulation of fitness scores with duration of training (Table 6), depicted that 40% of athletes who played for more than an hour a day had total fitness scores greater than 6 as against only 16.6% who played <1 hour a day, thus highlighting the influence of duration of training on fitness scores.

Table 6 Duration of Training/Day and Fitness Scores of the Participants

Total score	≤ 1 hour/day		Total N=6	≥ Hour/day		Total N=40
	Boys n=3	Girls n=3		Boys n=30	Girls n=10	
< 6	2 (66.7)	3 (100)	5 (83.3)	18 (60)	6 (60)	24 (60)
≥ 6	1 (33.3)	0	1 (16.7)	12 (40)	4 (40)	16 (40)

Figures in parenthesis indicate percentages

Injury

The incidence of injury among the tennis players was 17.39% and the most common site of injury was knee (37.5%), followed by head and ankle (52% each) and then below ankle injury (12.5%). It was also observed that the maximum incidence of injury took place in cases where duration of tennis playing was more than 12 months (31.58%) than in cases where the same duration was less than 12 months (14.29%).

Iron Nutriture

The mean hemoglobin differed significantly between the genders (Males: 14.01 + 1.31 vs. Females: 10.6 + 1.67, $p<0.001$) in the tennis playing cohort, while no such difference was found in the controls. The prevalence of anemia was higher in females than males, irrespective of involvement in tennis playing (Table 7). However still, prevalence was slightly higher in controls than in athletes (69% vs. 59%).

Table 7 Hemoglobin and Prevalence of Anemia in the Study Subjects

	Athletes		Total N=22	Controls		Total N=26
	Boys n=14	Girls n=8		Boys n=19	Girls n=7	
Anemic	7 (50)	6 (75)	13 (59.1)	13 (68.4)	5 (71.4)	18 (69.2)
Non-anemic	7 (50)	2 (25)	9 (40.9)	6 (31.6)	2 (28.6)	8 (30.8)

Figures in parenthesis indicate percentages

Here, hemoglobin was also found to influence fitness scores (Table 8). Comparison of hemoglobin with fitness revealed that non-anemic subjects had higher fitness scores than anemic counterparts (Anemic: 4.15 + 2.15 vs. Non-anemic: 7.0 + 3.35); the difference being statistically significant in males, but not in females. Majority (66%) of non-anemic athletes had total fitness scores greater than 6 as compared to only 33% in anemic athletes.

Similar observations were seen in the control group, where 50% of non-anemic subjects had fitness score >6, as against only 38% of anemic counterparts (Table 9). Fitness scores and hemoglobin levels in anemic subjects were also found to be having significant correlation between them in both the groups (Table 10).

Table 8 Total Fitness Score and Prevalence of Anemia in Tennis Players

Fitness Scores	Anemic		Total N=13	Non-anemic		Total N=9
	Boys n=7	Girls n=6		Boys n=7	Girls n=2	
< 3	1 (14.3)	3 (50)	4 (30.8)	1 (14.3)	0	1 (11.1)
3-6	4 (57.1)	1 (16.7)	5 (38.5)	1 (14.3)	1 (50)	2 (22.2)
>6	2 (28.6)	2 (33.3)	4 (30.8)	5 (71.4)	1 (50)	6 (66.7)

Figures in parenthesis indicate percentages

Table 9 Total Fitness Score and Prevalence of Anemia in Controls

Fitness Score	Anemic		Total n=18	Non-anemic		Total n=8
	Boys n=13	Girls n=5		Boys n=6	Girls n=2	
<3	8 (61.5)	3 (60)	11 (61.1)	3 (50)	1 (50)	4 (50)
3-6	5 (38.5)	2 (40)	7 (38.9)	3 (50)	1 (50)	4 (50)

Figures in parenthesis indicate percentages

Table 10 Correlation Between Hemoglobin Levels and Fitness Scores

	Hb mean + SD	Fitness Scores	r value
Total Subjects	12.79+1.92	4.15+2.15	0.26*
Anemic girls	10.06+1.29	3.67+2.66	0.46*
Anemic Boys	13.01+0.71	4.57+1.72	0.45*

Mental well-being of the athletes / Athletes' perception of their fitness level

Majority (67.4%) of the athletes felt they have plenty of energy. Similarly, 67.4% felt they did not feel tired after training sessions. A vast majority (82.6%) of players reported they did not feel breathlessness after playing. As few as 10% reported soreness in muscles after playing.

DISCUSSION

The present study aimed at studying the role of nutrition and physical training in the fitness levels of tennis players in Vadodara. The nutrient intakes of the subjects depict that, athletes had met higher %RDA for majority of nutrients than controls, difference being statistically significant in case of males. Greg[6] made a similar observation and found that daily protein requirements are higher for athletes (1.2-1.5g/kg/day). In the present study, 57% of athletes were meeting < 80% RDA for energy compared to only 21% of controls. Similarly, 69% female athletes were meeting75% RDA as compared to 23% of female controls.

In line with the observations made by Cook[7], the present study found that both athletes and controls were meeting only about half of the RDA for iron (Athletes 51.5±15.7 vs. Controls 40.3±21), which might be a reason for poor fitness and eventually sub-optimal physical performance.

The fluid intake of majority of athletes were taking less than 4 glasses of water during training, similar to what was found by Noakes[8], which is imperative in order to avoid hyponatremia. Even the pre-exercise hydration of the athletes as gauged by fluid intake before training was satisfactory when weighed against National Athletic Training Association guidelines[9] which suggests fluid intake of 500-6060 ml for optimum pre-exercise hydration.

Energy expenditure of athletes was significantly higher than that of controls in both genders and corresponding energy intake was found to be less in almost all subjects in both groups; this was corroborated by the findings of Hassapidou and Manstrantoni[10] in Greek athletes and controls. Swinburn[11] further elucidated that the difference in energy intake and expenditure was due to longer hours of training by the tennis players.

Fitness was assessed using 5 tests and majority of the athletes scored fairly in all tests and these scores were higher than controls'. Markovic and Misigoj[12] assessed the comparative fitness in successful and less successful athletes and found that fitness scores were better in successful athletes. Following similar findings in his study, Scott[13] reported that the average fitness scores of tennis players calls for comprehensive integrated program to improve fitness levels.

Present study found that duration of training was associated with better fitness scores. Bergman et al[14] showed that increase in training period improves the athletes' ability to utilize oxygen and consequently, fat utilization. Thus duration of training positively affects fitness.

Our study found that males had higher mean hemoglobin levels than girls, which was also reported by Sabita[15], who found that overall prevalence of anemia as per WHO Guidelines was significantly higher among girls (23.9%) as compared to boys (OR 3.75, 95% CI – 2.59 to 5.43, $p<0.01$).

CONCLUSIONS

To conclude, the fitness levels of the athletes left much to be desired, when evaluated in terms of fitness levels scores and prevalence of anemia. A contributing factor here might be the fact that the energy expenditure of the participants well prevailed over their intake, thereby indicating energy insufficiency. Also, the recommended high amounts of carbohydrates and proteins were also missing in the diets of athletes. The hemoglobin levels were found to influence the fitness levels in the participants. Thus, meeting the nutrition demands seems to be the need of the hour for improving the fitness of athletes in our population.

REFERENCES

1. American Dietetic Association (2000). Nutrition and Athletic Performance: Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine. Journal of American Dietetic Association 100:1543–1566.
2. World Health Organization 1995 Physical Status: The Use and Interpretation of Anthropometry. WHO Expert Committee Report. WHO Technical Report Series 854
3. Gopalan C. Nutritive Value of Indian Foods. 2nd ed National Institute of Nutrition, ICMR, Hyderabad 2004; pg 47-98
4. Donatelle 1990 Access to health: Practical fitness from stretching to triathlon. Chapter 15, 342-352
5. World Health Organization. Energy and Protein Requirements - FAO/WHO/UNU Expert Consultation Report, Geneva 1985.
6. Greg 2002 Special Needs: The Vegetarian Athlete. Chapter 21, pg 656-71.
7. Cook 1994 Effect of Endurance Training on Iron Metabolism. Seminars in Hematology; 31:146-54.
8. Noakes and Tim 2003 Fluid Replacement during marathon running. Position Statement, Clinical Journal of Sports Medicine, 135 (5) 309-318.
9. National Athletic Training Association 2006 Fluid Replacement for Athletes. Journal of Athletic Training 35: 212-24.
10. Hassipidou and Manstrantoni 2001 Dietary Intake of elite female athletes in Greece. October 2001; Journal of Human Nutrition and Dietetics 14(5), 391-396
11. Swinburn and Ravussin Energy Balance or Fat Balance? American Journal of Clinical Nutrition 1993; 54 (Suplement): 766S-771S.
12. Markovic and Misigoj 2005 Fitness Profile of elite Croatian female athletes. Collegium Antropologicum, 29(1): 93-9, 2005.
13. Scott 1998 Fitness comparison among three different levels of elite tennis players. The Journal of Strength and Conditioning, Volume 10, no. 3, pg 139-43.
14. Bergman, Butterfly, Wolfel, Casazza, Lopa Schuk 1999 Evaluation of Exercise and Training on lipid metabolism. American Journal of Physiology 1999; 279: E 106-117.
15. Sabita, Srikanta, Ranjita and Veena 2005 Prevalence of anemia among school going adolescents in Chandigarh. Indian Pediatrics 2005, 42: 593-97.