NUTRITIONAL PROFILE AND PHYSICAL FITNESS OF SPORTS WOMEN

By

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THESIS

submitted in partial fulfilment of the requirements for the degree of

Master of Science in Home Science

(FOOD SCIENCE AND NUTRITION)

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KERALA, INDIA

2005

DECLARATION

I hereby declare that this thesis entitled **"Nutritional Profile and Physical Fitness of Sports Women"** is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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Certified that this thesis, entitled **"Nutritional Profile and Physical Fitness of Sports Women"** is a record of research work done independently by **Miss. Reena. C** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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ACKNOWLEDGEMENT

I feel very happy to express my deep sense of gratitude and indebtedness to my chairman Dr.V.Indira, Associate Professor and Head, Department of Home Science, College of Horticulture, Vellanikkara, for her revered guidance, critical suggestions, constant encouragement generous with utmost sense of patience and support which made smooth progress of my research project.

I acknowledge my sincere gratitude to Dr.V.Usha, Associate Professor, Department of Home Science, College of Horticulture, Vellanikkara, for her timely advice, encouragement and constructive criticism, during different stages of my investigation and preparation of thesis.

I extend my gratitude to Dr.V.K.G.Unnithan, Associate Professor and Head, Department of Agrl. Statistics, College of Horticulture, Vellanikkara for his estimable care and treasured advice during correction of thesis and statistical analysis of data.

I am respectfully thank Dr.E.Soman, Associate Professor and Head, Department of Physical Education, College of Agriculture, Padannakad and member of my advisory committee, for his valuable suggestions, critical scrutiny of the manuscript and ever willing help during the course of research.

I express my deep sense of gratitude to Sri.S.Krishnan, Assistant Professor, Department of Agrl. Statistics, College of Horticulture, Vellanikkara for his valuable suggestions and critical scrutiny of the statistical analysis.

Words fall short in expressing my heartfelt thanks to my classmates, Sujatha, Nashath and Sherin who provided the much-needed shoulders with immense patience and understanding. I am really lucky to have their whole hearted cooperation and encouragement.

True words of thanks to all my batchmates, Jitha, Saijyoti, Deepa, Smitha, Lekha, Ambika, Simi, Malini, Pratibha, Habeeba, Srikrishna, Mohan, Shankar, Ramu, Eldho, Femina,

Anupama, Johnkutty and Sreejith, and personally I am greatful to my close friends Saphi, Sappu and Ampily who were with me through constant encouragement and help.

I wish to express my sincere gratitude to senior friends Aneena, Sharon, Saleena, Neetha, Jishy, Seeja, Shyna and Suman chechi for their whole hearted support.

I am grateful to all my junior friends Remya, V.M, Jyothi, Renju, Remya mol, Smitha Sara, Shibi, Suja, Jitya, Sruthy and Joshi for their timely and thoughtful help during the course of study.

My sincere thanks are due to Umayba chechi (Permanent labourer, Department of Home Science) for her timely help and co-operation at various stages of the study.

I thankfully acknowledge Shri. Santhosh for his valuable help in computer work.

Above all, the moral support, constant encouragement, affectionate concern of my father Sri. K. Padmanabhan, my mother Smt. C. Lakshmi, brother Rijesh, Ravindran and sister Reeshma Ravindran motivated me to complete this endeavour successfully. I am in dearth of words to express my strong emotions and gratitude to them.

I would like to thank the athletes who sacrificed their time to participate in this study. Gratitude is also extended to the teachers who encouraged the participation of the athletes in the study.

A word of apology to those I have not mentioned in person and a note of thanks to one and all that worked for the successful completion of the endeavour.

REENA. C

DEDICATED TO MY BELOVED PARENTS

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INTRODUCTION

1. INTRODUCTION

Sports and games are gaining global attention today and have become one of the most challenging and competitive professions in the world. For most athletes and sports persons sports is an integral part of life, they not only love it but labour and live for it. For a nation it is a process of building of fraternity with other nations.

Sports consist of physical activities or skills carried out with a recreational purpose, for competition, self-enjoyment, to attain excellence, for the development of skills or some combination of these. Sports can be operationally defined as a physical activity characteristically involving the recreational exercise of useful physical skills for a purpose other than its practical application in daily life such as competition or pleasure (Evgeny and Lubyshev, 2005).

Nutrition assumes a vital role in the field of sports because it plays an important role in maintaining physical fitness and performance of athletes (Chandrasekaran and Easwaran, 2000). Adequate nutritional support is essential to maintain desirable body weight, composition and peak performance levels of athletes. Apart from nutrition other factors like motivation, skills, technique and commitment also play an important role in attaining peak performance of athletes.

Improved eating habits not only benefit health but also influence individual's endurance and capacity to perform exercises. Nutrition plays an important role for attaining a higher level of achievement in sports.

The right application of the principles of sports medicine, which includes nutrition, psychology, exercise, physiology and right scientific training help to achieve excellent performance in sports. In many European countries especially in former GDR and Russia the term sports medicine is replaced with GTMT (General Therapy and Methods of Sports Training) and has evolved as a new

branch of scientific sports training, which imparts training for elite athletes. In contrast to the situations in the Western world where scientific sports training is intensely practiced, in India, it is still in its infancy.

It is a very well known that active women and girls who are driven to excel in sports may develop the so-called female athlete triad in which malnutrition, amenorrhoea and osteoporosis appear as typical signs of medical complications frequently linked to serious psychological alterations. This outcome is mainly related to that found in eating disorders. Due to restrictive habits and an obsession with losing weight in order to maintain a particular level of body weight, the diet of athletes may become inadequate in nutrients and will adversely affect their nutritional status.

Sports persons require a 4-D's approach namely Discipline, Dedication, Determination and Diet, the last 'D' is often ignored and improper diet will interfere their performance. Hence, it is necessary to encourage all sports professionals the importance of taking care of their diet and nutritional status not only to avoid physical and psychological complications but also to improve performance and thus to achieve sporting goals.

There is no dispute that the most effective way to enhance athletic performance is through systematic and consistent scientific training. Nutrition makes its greatest impact by supporting training process to acquire improvement in strength, speed, power or endurance. In this context the assessment of nutritional profile of sports persons is essential and hence the present study was taken up with the following objectives

1. To assess the nutritional status and physical fitness of women engaged in sports activities.
2. To find out the impact of nutritional status on their physical fitness and performance.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The literature relevant to the study entitled "Nutritional Profile and Physical Fitness of Sports Women" are reviewed under the following headings.

2.1. Significance of nutrition in sports
2.2. Physical fitness and performance of athletes
2.3. Eating disorders among athletes
2.4. Health related problems of athletes

2.1. SIGNIFICANCE OF NUTRITION IN SPORTS

Sports persons and athletes should be considered as a special group, so far as their nutrient requirements are concerned. They have to maintain an optimum level of nutritional status to maintain maximum performance (Anon, 1987). Goswami and Anand (2000) indicated that sports nutrition is highly specialized because it is based upon the type of sports, the training phase, the climatic conditions and the physical requirement of an athlete.

Adolescent athletes, who are exposed to wide range of sports activities, require special nutritional support for optimum physical fitness and to maintain normal growth and physiological maturation (Rodwell, 1988). Garrow and James (1993) opined that, children are exposed to a wide range of sports activities and the athletic nutrition plays an important role.

Nutrition and medical support are essential for the realisation of the athlete's natural capacity for optimal performance (Alva, 1989). Positive influence of nutritional status on the physical fitness and performance of athletes was reported by Mini (1992); Chandrasekaran and Easwaran (2000) and Sajitha (2000). Debnath and Bawa (2000) opined that specialized nutrition is essential for the improvement of physical attributes, work capacity and for the outstanding

athletic performance. According to the authors planning a diet for specialized sports is just as important as planning a training programme. According to Skinner *et al.* (2001) nutrition intervention could improve athletic performance and reduce the risk of nutrition related problems in women athletes. Ittycheria (2003) indicated that success in sports depends on genes, training, nutrition and environment and right nutrition at right time is important for maximum performance.

Mihye, *et al.* (2002) reported that though athletes had positive attitude regarding the effect of nutrition on their sports performance and health, they did not apply scientific principles of sports nutrition to their diet. Beshgetoor and Nichols (2003) indicated that female athletes rely mainly on dietary supplements rather than nutrient dense food choice to provide daily nutrient need.

It is important for sports persons involved in different disciplines to adjust the dietary intake based on the type of their activity (Dandge and Mane, 2000). Kelker *et al.* (2003) indicated variation in the nutrient intake of runners, weight lifters and boxers and suggested that the nutrient intake of athletes vary with their sports discipline.

Significant influence on energy balance in athletes on the basis of energy intake and environmental temperature was reported by Dauncey and Binghan (1983). Energy requirement of sports persons will be doubled depending upon the intensity of activity involved (Carpender 1981; Satyanarayana *et al.*, 1985 and Costill, 1988).

Daily recommended allowances of calories will support only the body maintenance in most of the athletes (Rodwell, 1988). A well balanced normal diet with increased calorie is required for an athlete (Williams, 1994). Physically active persons, especially athletes require more fuel and their requirement is much higher than ordinary active persons (Bean, 1995).

The mean daily energy intake and expenditure among weight lifters were found to be 3900 Kcals and 3667 Kcals respectively (Celijowa *et al.*, 1970). Guzman *et al.* (1972) indicated that a mean energy expenditure of 3181 kcals as against an energy intake of 3007 Kcals per day among athletes. Devadas *et al.* (1979) reported daily energy intake of 3000 to 3500 Kcals among athletes. Gopalan *et al.* (1989) suggested an intake of 4320 Kcals for men and 3480 Kcals for women engaged in sports. A deficit in the intake of energy by 185 Kcals/day was reported by Devadas (1988). Weight *et al.* (1988); Mulligan and Butterfield (1990) and Sajitha (2000) found that both male and female endurance athletes failed to meet their recommended energy intake. Lother *et al.* (1989) observed excess energy intake among athletes than the recommended daily allowances. Barton and Smith (1997) recommended an additional amount of calories and protein for good athletic performance.

According to Jany *et al.* (1987) training for competitive sports increases the daily energy expenditure by 25- 50 per cent. According to Durnin (1990) measuring the energy expenditure provide some essential informations in the dietary modification in athletes. Fenn (1995) indicated an increased energy expenditure as high as 120 times at rest during sprint running and swimming. Danzel *et al.* (1997) estimated a total energy expenditure of 197 to 357 KJ per Kg body weight for swimmers and athletes in heavy training.

According to Swinburn and Ravussin (1993) achieving energy balance is essential for the maintenance of lean tissue mass, immune and reproductive function and optimum athletic performance. The author recommended that energy need is the first nutrition priority for athletes. Lal and Siddhu (1999) observed positive energy balance among 69 per cent of sports women during camp and during off season 67 per cent were found to be in negative energy balance. However, Devi *et al.* (1999) reported negative energy balance among athletes and positive energy balance among non athletes. An investigation conducted at National Institute of Nutrition (2000) among athletes indicated an

increased daily energy expenditure with increase in training load with no significant change in non occupational energy expenditure. Sajitha (2000) reported positive energy balance with adequate lean body mass and body fat among pre adolescent athletes residing in sports hostels. However, Sebastian (2003) indicated negative energy balance among volleyball and basket ball players residing in sports hostels.

The fuel burnt during exercise depends on the intensity and duration of the exercise, sex and prior nutritional status of the athletes (Brooks and Mercicer (1994) and Brooks and Trimmer (1995).

An adequate glycogen stores is essential to meet the needs of high intensity training session (Richard, 1981). Carter (1982) indicated an increase in the glycogen stores from the normal 15 g to around 25 g per kg of muscle among athletes who consume a high carbohydrate diet for 3 to 4 days after several days on a normal mixed diet. Seals *et al.* (1984) also exhibited similar glucose tolerance among athletes.

Issekutz *et al.*, (1986) reported that the athletes on high carbohydrate diet used high proportion of carbohydrate for energy and those on low carbohydrate diet used fat for this purpose. Burke and Maughan (2000) indicated the role of carbohydrate in the diet of athletes and pointed out the association between carbohydrate intake and enhanced performance of athletes.

Carbohydrate loading in athletes supersaturates the muscle glycogen, which is used in athletic competition (Forgue, 1979 and Burke *et al.*, 2000). Burke *et al.* (2003) indicated consistent dietary behaviour among the elite athletes. However, the authors reported sub optimal energy intake among athletes during and after training session. Increased skeletal muscle glucose uptake was observed by Fujimoto *et al.* (2003) among trained men at high

relative exercise intensity. However, the authors observed no difference at lower relative exercise intensities.

Chinglin *et al.* (2003) reported the influence of high carbohydrate diet with different glycaemic indices on substrate utilization during exercise. The authors also reported that pre exercise carbohydrate meals results in lower rates of fat oxidation during subsequent exercise than when subject performed exercise in fasting states.

According to Pendergast *et al.* (2000) since, fatigue is associated with reduced muscle glycogen, increasing fat and decreasing carbohydrate decreases performance. An increase in daily dietary carbohydrate content from 5.4 to 8.5g per kg body weight resulted in better maintenance of physical performance among athletes (Achten *et al.*, 2004). Saris *et al.* (2004) indicated the importance of bioavailability of carbohydrate and fat as a source of energy for top level performance in sports and as a pre requirement for optimum nutrition.

Extra protein is required for an athlete to meet the growth requirement and to meet the need for training (Van *et al.*, 1960). Paul (1989) emphasised the importance of protein during endurance events when carbohydrate source becomes exhausted. Protein needs of athletes are greater than those of sedentary people and a diet low in protein reduces efficiency (Paigh, 1991). William (1995) indicated increase loss of protein on the basis of the intensity of the exercise.

Evan and Simopoulos (1992) reported that prolonged sub maximal exercise increases the oxidation of essential amino acids, which certainly increases the dietary requirement of protein. Athletes who participated in high intensity sports need about 2-4 times the amount of RDA of protein for muscle growth, maintenance and repair (David and Marnnon, 2003).

Increased protein requirement for athletes is necessary to meet the need to repair exercise induced micro damage to muscle fibers, as an energy source during exercise and to support gain in lean tissue mass (Butterfield, 1987 and Lemon, 1998). Increased protein requirement for athletes is accounted for the oxidation of amino acids during exercise as well as the retention of nitrogen during the period of muscle building (Burke and Read, 1989). Weight *et al.* (1992) observed adequate intake of protein in the diet of endurance athletes. Gueznnec (1993) indicated that increased protein intake is necessary to avoid negative nitrogen balance during exercise. Meredith *et al.*(1998) stated that protein intake of 1.2 to 1.8g/kg daily should be sufficient to maintain a positive nitrogen balance in athletes.

Haymen (1983) recommended a protein intake of 1.2 g/kg body weight/ day for adult and 1.35 to 1.81g/kg body weight/day for adolescent athletes (National Research Council, 1989). For endurance athletes nitrogen balance studies in men suggested a protein recommendation of 1.2g/kg per day (Meredith *et al.*, 1998), where as Lemon (1998) suggested an intake of 1.2 to 1.4 g/kg/day and David and Marnnon (2003) suggested a protein requirement in the range of 1.5-2.5g/kg body weight for athletes.

Negative effect of increased protein need was reported by various authors. Lewis (1977) had the view that high protein diet improves athletic performance is a wide spread misconcept. According to Carpender (1981) a large protein diet may cause dehydration and constipation in athletes. Goodmen *et al.* (1987) suggested that exercise had negligible effect on protein requirement because amino acids contribute very little energy expended during exercise. However, Goswami (1991) suggested an increase in the intake of protein and fat among sports person with the increase of their performance level.

Percentage of fat is related positively to arm circumference and negatively to height in athletes (Watson and Donovan, 1977). Muoio *et al.* (1994) and Lambert *et al.* (1994) proposed a positive effect of relatively high fat diet on athletic performance. Sports Authority of India (1998-99) suggested an adequate fat in the diet of sports and athletic individuals to provide adequate energy density, to reduce bulk and to ensure intake of required high level of energy to support the need of even the longest endurance events.

Harris *et al.* (1982) indicated that top performance athletes generally had not more than 7 per cent of his body weight as fat. According to the authors poly unsaturated fat diet significantly decreases cholesterol in comparison with saturated fat and carbohydrate diet in athletes. William *et al.* (1986) indicated low fat levels in marathon runners, which ranged from 1 to 8 percent of body weight. Edward (1986) reported a positive correlation between fat free diet and athletic performance.

Franklin and Hendry (1969) indicated that there is no difference in the vitamin requirement of athletes and other active people. However, Manhan (1984) indicated increased need for water, total energy and vitamin B complex in athletes. Ben (1991) reported that athletes who voluntarily loose weight by controlled diet should take enough vitamins in their diet.

Sharma *et al.* (1971) indicated lower muscle performance in athletes due to the deficiency of vitamin B. Kristen *et al.* (1978) reported wheat germ and vitamins improve overall performance during training seasons in athletes. Dorothy *et al.* (1980) pointed out that wheat germ oil improves running performance, while vitamin B increases endurance in athletes.

According to Vander *et al.* (1984) the marginal deficiency of vitamins and minerals influence the performance in athletes. B complex vitamins have two major functions directly related to exercise. Thiamin, riboflavin, vitamin B6,

niacin, panthothenic acid and biotin are involved in energy production during exercise (Clarkson, 1995; Lewis, 1997; Peifer, 1997; Sampson, 1997; Manore, 2000 and Maughan and Maughan, 2000). Folate and vitamin B-12 are required for the production of red cells, protein synthesis and tissue repair and maintenance (Clarkson, 1995 and Martin, 1997). Manore (1995) and Manore (2000) indicated the increased need for B complex vitamins especially vitamin B-6, riboflavin and thiamin during exercise.

A study conducted by Dandge and Mane (2000) indicated deficiency of all nutrients except thiamin and riboflavin in the diet of sports persons. National Institute of Nutrition (2000) reported normal nutrient status among sprinters and moderate malnutrition among long distance runners. Sebastian (2003) reported deficiencies of macro and micronutrients in the diet of female volleyball and basketball players.

Enhanced bioavailability of oxygen in tissues leading to improved performance was reported by Ben (1991) when vitamin E was consumed. Intake of vitamin C increases the level of antioxidant in the body, which is vital in the removal of free radicals that are formed during heavy bouts of aerobic exercise (Rao, 1996). Robson *et al.* (2003) suggested that supplementation of antioxidant is essential to endurance athletes for the maintenance of particular function of innate immune system.

Salt, potassium and magnesium are lost in significant amounts in sweat (Brootherhood, 1984). Manore (1999) reported that the primary mineral low in the diet of athletes especially female athletes are calcium, iron and zinc. Berger *et al.* (2003) reported that running a marathon course does not lead to significant change in the whole blood levels of cobalt, nickel and molybdenum, where as it increases mobilization of chromium from body stores. Peak *et al.* (2003) reported that athletes are likely to benefit from zinc supplementation during period of moderately increased training volume. Magnesium also participate in

the break down of glucose, fatty acid and amino acids during energy metabolism (Subbulakshmi, 1996). Increased intake of energy, protein, vitamin D, calcium, zinc and magnesium are associated with greater bone density, where as deficiency of these nutrients lead to fracture and skeleto muscular lesions, which negatively influence health and physical performance (Quinter *et al.*, 2003).

Goswami (1991) emphasized iron deficiency as a common problem among young women gymnasts mainly because of diet restriction, heavy menstrual bleeding and poorly planned vegetarian diet. High incidence of clinical iron deficiency with reduced physical fitness was also observed among young women athletes (Basta, 1999 and Bains and Mann, 2000). A study conducted by Sajitha (2000) indicated a positive effect on performance during iron supplementation. Severe anaemia as well as restricted energy intake reduces the physical fitness (Basta, 1999). Eichner and Maughan (2000) also viewed that iron status had an effect on exercise performance.

Sodium is lost through urine and sweat and deficiency lead to muscle cramps and shaking. This can be prevented by drinking fluid containing 0.5 per cent salt. Salt increases the capacity to perform muscular work by altering circulatory ammonia levels (Mathews *et al.*, 1989). Glace *et al.* (2002) reported a dietary sodium requirement of 1g /hour for an athlete.

Water is an amazing but yet often forgotten nutrient that helps to improve energy, stamina, performance and cramping tolerance of every athlete (Grandjean, 1993). Athletes had an increased need for water (Manhan, 1984). The volume of fluid varies widely among the athletes, but in general the amount of fluid needed to compensate for the fluid lost is about 50 per cent of the sweat loss (Noakes, 1998).

Sawka *et al.* (2000) pointed out that hydration status had an effect on exercise performance and temperature regulation. Maughan and Maughan (2000)

also supported the above statement. Singh (2003) reported that staying well hydrated is important for better performance for sports persons in warm as well as dry weather.

2.2 PHYSICAL FITNESS AND PERFORMANCE AMONG ATHLETES

Good nutrition is vital to optimum athletic performance (Grandjean, 1993). Nutrition Reviews (1984) revealed that proper nutrition forms the foundation for physical performance. Leaf (1989) indicated the role of nutrition in favoring a fit state in elderly adult athletes. Kalara *et al.* (1980) also supported the above statement. Murphy and Murphy (1999) reported that sports performance is determined by a number of factors like height, weight, mental preparation, lung capacity, heart muscle, nutritional status and socioeconomic factors. Saris *et al.* (2004) had the opinion that optimal nutrition is an important pre requisite for top level performance.

Current and persistent under nutrition in athletes leads to reduced performance (Satyanarayana *et al.*, 1979). Burke (2000) indicated the association between carbohydrate intake and enhanced performance of athletes. Andrews *et al.* (2003) reported that carbohydrate loading/carbohydrate supplementation increases carbohydrate utilization. However, this may not necessarily results in significant improvement in performance. A combination of carbohydrates and protein or amino acid was found to be very effective to accelerate recovery after exhausting exercise.

According to Edward (1986), fat free diet is generally positively correlated with athletic performance. Wagner *et al.* (2004) suggested that low dietary n-3 highly unsaturated fatty acid /arachidonic acid ratio may negatively affect swimming performance.

Connor (2001) reported that there is obvious potential for a variety of functional foods to have specific application to athletes in maintaining their health recovery or in optimizing performance. Functional food ingredients such as caffeine and creatine results in a significantly enhanced performance. This is in contrast to many other ingredients and products for which the extravagant claims have not been substantiated. Hence, in addition to few functional sports supplements for which the value has been significantly demonstrated sound nutrition remains an absolute prerequisite for an optimal performance in sports (Saris *et al.*, 2004). Young *et al.* (2001) suggested that carnitine ingestion could promote fat oxidation, resulting in higher endurance performance in athletes and especially these ergogenic effect of carnitine co ingested with caffeine may be greater than those of carnitine alone. Kilduff and Pitsiladis (2003) revealed that creatine supplementation can increase muscle strength, the greater the creatine uptake and associate body mass change the greater the performance gain.

Peak *et al.* (2003) revealed that ingestion of 0.5g of sodium citrate/kg body mass shortly before a 5km running time trial improved performance in well trained college runners.

Hass (1983) had an opinion that scientific use of food supplements and concentrates will help to improve stamina, sports performance and health in active people. Digestibility of the pregame meal of an athlete, who is under emotional stress, is also an important factor in athletic performance. Sherma (1984) indicated that poor performance and early fatigue are due to deficiencies in major nutrients while excessive intake can impair performance resulting in undesirable increase in body's adipose fat. Lal and Siddhu (1999) reported that adequate monitoring and counselling are essential to aid physical fitness towards improved sports performance.

2.3. EATING DISORDERS AMONG ATHLETES

Black (1991) opined that eating disorders among athletes have become a major concern, which had evolved due to a number of factors related to athletes and sports performance. Eating disorders described include anorexia nervosa, bulimia nervosa, binge eating disorder, muscle dymorphia, anorexia athletica, exercise dependence and eating disorders not otherwise specified (Woolsey *et al.*, 2002).

The prevalence of eating disorders was found to be much greater in certain athletic activities like ballet, diving, figure skating and running (Gardner and Garfinkel, 1980 and Hausenblas, 1999). Ravaldi *et al.* (2003) observed eating disorders among elite performers of certain sports or physical activities.

William (1995) observed eating disorders among athletes because of the pressure of sports environment. According to Harmel (1999) performance and social pressure from coaches, judges and teammates increases the vulnerability to eating disorders symptoms among athletes.

The demands for leanness rather than exercise intensity appeared to be the main risk in elite athletes (Hulley and Hill, 2001). Athletes face the same cultural and social pressure to conform to a perceived ideal body image as every one else. In addition, they often experience added pressure from within their own sports to attain and maintain a certain body weight or shape (Halmi, 2002).

The combination of emphasis on a lean body and the endorsement of exercise might increase the incidence of eating disorders (Murthy *et al.*, 1989). Lemon (1991) indicated the main causes of eating disorders as unhealthy dieting practices and attitude of female athletes to their bodies and attempt to differentiate between more normative concerns about body image in western culture. According to Hausenblas (1999) drive for thinness could be strongly

motivated by external factors and pressure. James (2003) viewed that in western society athletes believed that thinness leads to success, power, beauty and happiness. In the drive for this 'nirvana' many people succumb to disorders associated with restricted eating habits.

Eating disorders were found to be more among female athletes than male athletes (Stephan and Pribute.,1996 and Johnson *et al.*, 1999). The incidence of severe eating disorders like anorexia and bulimia in athletic women were found to be much higher than general population and 90 per cent of eating disorders were found in females, (Swings, 1999). Montero *et al.* (2002) reported that female athletes particularly those who participate in sports that emphasize leanness such as gymnastics, distance running, diving, figure skating and classical ballet had sub optimal energy and nutrient intake and were at risk of compromised nutritional status, including fatigue, dehydration, nutrient inadequacies, delayed growth and an impaired immunocompetence. Athletes, mainly women suffered from anorexia athletica a disturbed eating behaviour and eating disorders like anorexia and bulima nervosa. The risk was greater in athletic, endurance and weight class sports (Schek, 2002).

Johnson and Naida (1994) stated that structural equation modeling is the risk factor for the development of symptoms of eating disorders in female athletes. Some of the health consequences of long term energy restriction in female athletes include poor energy and nutrition intake, poor nutritional status, decreased respiratory metabolic rate and total daily energy expenditure, increased psychological stress and risk for clinical eating disorder and increased risk for exercise induced amenorrhea and osteoporosis (Manore, 1999).

Reinking (2002) reported that not all female athletes are prone to eating disorders, those sports in which leanness is perceived as a competitive or an athletic advantage appear to be at greater risk of disordered eating behaviour than athletes in non lean sports or non athletes. Although eating disorders are

most prevalent among women, men are also at risk, particularly in sports that are seen to require low body fat levels such as distance running, gymnastics and light weight rowing (Mark, 2001).

The female athletes are doubly at risk of eating disorder and are subjected to constant social pressure to be thin and constant exposure to the demand of the athletic sub culture along with her daily on T.V, movies, magazines and transmitted by peers may make her vulnerable to the lures of weight loss and unhealthy ways of achieving that loss (Vancouver, 2001).

Wilmore (1991) observed a close relation between eating disorders, menstrual dysfunction and bone mineral disorder. Disordered eating, menstrual irregularities and reduced bone density were known as female athletes triad (Hill, 2000).

Menstrual irregularity is associated with low body mineral density and disordered eating is associated with low body mineral density (Malena and Haper, 1973; Frisch, 1981 and Tucker, 1985). Warren (1986) revealed that there should be concern about an increased incidence of scoliosis and decreased bone mass in young women with delayed puberty. Arendt and Rosemont (1999) stated that early age exercise/training, weight loss, psychologic factor, caloric insufficiency, body fat training and stress are the main causes of amenorrhea in female athletes. Cobb *et al.* (2003) observed disordered eating among young competitive female distance runners among which is strongly related to menstrual irregularity.

Exercise induced or athletic menstrual dysfunction such as amenorrhoea, oligomenorrhoea, anovulation, lutel phase deficiency, delayed menarche were found more commonly in active women and can significantly effect health and sports performance. Eating disorders and physical and emotional stress level

may contribute to the development of athletic menstrual dysfunction (Manore. 2002).

The prevalence of exercise related menstrual changes depends on age, previous menstrual cycles and the exercise status of women (Prior and Vigna, 1986). The female athletic triad composed of disordered eating, amenorrhea and osteoporosis is most common in achievement focused females, participating in sports where weight and body image are traditionally tied to performance (Joy, 1997). Swings (1999) reported that irritability, depression, poor concentration, memory attention, obsession with calorie, calorie restriction, hormonal disturbance, loss of bone density and increased stress adversely effect physical and mental health.

Kohrt *et al.* (2003) had an opinion that fluctuation in estrogen levels indirectly affect the physical performance, by affecting substrate utlization or maximal aerobic power. Estrogen deficiencies promote fat accumulation and may accelerate the loss of fat free mass and both of these changes could impair physical performance.

Dietary deficiencies of vitamins are not very common among athletes except in those who restrict their food intake (Haymen, 1983). Beals and Manore (1998) stated that although female athletes with sub clinical eating disorder had deficient dietary intake of energy, protein and carbohydrate, micro nutrient status appeared relatively unaffected, probably due to their use of supplements. Vancouver (2001) reported that there is no support for the concept that athletes with eating disorder are less ill than other eating disorder patients.

Lindeman (1994) had an opinion that low self esteem is a well recognized trait of those with eating disorders and are associated with a heightened self awareness. Johnson (1997) had opined that nutrition counselling can help the athletes to overcome eating disorder by clarifying misconception

and focusing on the role of nutrition in promoting health and athletic performance. Reducing the risk of eating disorders allows each athlete to reach her potential through positive and healthy behaviour. Power *et al.* (1999) stated that prevention of eating disorders in athletes, who are at high risk, may offer hope for effective prevention strategies in the general population.

2.4. HEALTH RELATED PROBLEMS AMONG ATHLETES

Bux *et al.* (2004) reported that intensive training had an effect on physical and psychological health of young athletes. These include sports related health problems, injuries and emotional disorders.

Exercise induced asthma is very common in as many as 80-90 per cent of asthmatics (Godfery, 1978; Anderson, 1983. and Cotiis *et al.*, 1980). Godfery (1984) stated that exercise induced asthma may be clinically described as transient increase in airway resistance following 6-8 minutes of vigorous exercise. After exercising for five to ten minutes patients with exercise induced asthma experience a decrease of 15 per cent or more in lung function tests.

Mellion (1989) reported that exercise induced asthma does not contraindicate sports participation and in fact is often benefited by sports participation. Like wise asthma is often benefited by sports conditioning particularly aquatic sports.

Smilkstein (1981) stated that systolic murmurs are common in athletes. Blood pressure management in sports person are very important. Huston and Rodney (1989) indicated that ability of the heart to deliver oxygen is a limiting factor in the performance of continuing muscular work. Herberth and Gabriel (2002) reported that the most common cardiovascular problems for dedicated athletes is hypertension. Sports events like weight /power lifting or rock climbing etc will trigger a heart attack.

Hara (1980) and Maron (1980) reported that hypertrophic obstructive cardiomyopathy is frequently a totally unsuspected cause of mortality in athletes. Maron (1980) reported out flow tract obstruction as a major cause of sudden death in young athletes. According to the opinion of Francis and John (1998) athlete's sudden death appears to be associated most strongly with congenital cardiac abnormalities. Myerburg (2005) reported that younger athletes have a greater chance of experiencing sudden cardiac arrest for instance high school athletes are at greater risk than collegiate athletes who are at greater risk than professional athletes.

According to Devries and Housh (1966) the term 'sports anaemia' was coined to describe the anaemia that occur in response to heavy endurance training in the absence of any recoganisable disease process. Hallbery and Maynurson (1984) explained sports anaemia as a side effect of the hard training in endurance sports, a physiological response of the regulatory system controlling the haemoglobin concentration and prolonged exercise load. According to the opinion of McDonald and Carlkeen (1988) marginal iron deficiency caused by increased erythrocyte fragility due to training had a greater risk in athletes. Nelson and Nachtingall (1998) indicated that endurance athletes are at risk of becoming iron deficient due to an imbalance between absorption of dietary iron and exercise induced iron loss. Daily ,exercise is closely associated with the increased risk of iron deficiency state among athletes.

Green *et al.* (1968); Vellar (1968) and Pauleve *et al.* (1983) revealed that profuse sweating can cause up to 1 mg/ day iron loss. Intense exercise can waste iron by microscopic or gross hematuria, hemoglobinuria and myoglobinuria (Davidson, 1969; Knockel and Schlein, 1972; Siegel *et al.*, 1979). Microscopic or frank gastro intestinal bleeding, common in runners can produce additional iron loss (McMohan *et al.*, 1984 and Stewart *et al.*, 1984).

Eastwood (1997) found that sports women, who engaged in highly demanding and competitive sports like running and gymnastics athletes, are most susceptible to anaemia.

Study conducted by Clement and Asmundson (1982) among 52 elite Canadian distance runners revealed that about 29 per cent of the men and 82 per cent of the women were iron deficient. Numerous other studies by Nickerson and Tripp (1983); Parr *et al.* (1984) and Wishnitzer *et al.* (1983) also demonstrated deficient iron stores in both male and female endurance athletes.

Alyea and Parish (1968); Boileau *et al.* (1980) and Fassett *et al.* (1982) indicated that exercise produce increased excretion of protein, red and white blood cells and both cellular and non cellular renal tubular casts known as pseudonephritis. Smith (1982) demonstrated that majority of urinary sediment findings in athletic pseudonephritis are renal in origin. Alyea and Parish (1968) and Blacklock (1977) found that the urinary sediment findings correlate with intensity of the exercise and the state of hydration and the interaction between these. Castenfors (1983) reported protein in the urine of soldiers after exercise where as it is absent in early morning sample. Callen (1984) found protein, red blood cells and hyaline and granular cuts in the urine of marathon runners.

Javitt and Miller (1982) had opinined that athletic pseudonephritis is a kidney response to the reduced renal blood flow during exercise. Poortmans (1984) reported that an intense exercise may reduce the glomerular filtration rate up to 50 per cent of the resting value.

Alyea and Parish (1968) and Blacklock (1977) correlated urinary sediment findings with intensity of exercise. Morris and Mellion (1989) indicated exercise may cause a reduction in renal blood flow and the extent of reduction varies with intensity of exercise.

Callen (1984) reported that exercise addiction is a well recognized syndrome in runners and other endurance athletes. Morgon (1979) opined that anxiety, restlessness, irritability, nervousness, guilt, muscle twitching, a bloat feeling and sleep disturbances are major symptoms of exercise addition.

McMohan *et al.* (1984) reported significant levels of faecal blood loss in runners. Cantwell (1981) and Buckman (1984) indicated that bleeding is associated with more strenuous or competitive running. Priebe and Priebe (1984) reported diarrhea and gastro intestinal bleeding among 30 per cent of runners and 12 per cent of these had frank rectal bleeding. Morris and Mellion (1989) found severe abdominal pain accompanied by grossly bloody diarrhoea, often containing large quantities of clotted blood among runners participated in intense performance.

Sullivan *et al.* (1984) believed that runner's diarrhea results from increased gut motility where as Stewart *et al.* (1984) suggested that it is caused by ischemia during intense exercise.

Appenzeller (1978) indicated that benign exertional head ache is precipitated by any level of physical activity. Athletes or sports persons also experienced head ache associated with other maneuvers that involve increased intrathoracic pressure such as coughing, sneezing, bending, defecating and sexual organ (Atkinson and Appenzeller, 1981 and Diamound and Medina, 1982).

Bennett *et al.* (1980) and Ashworth (1985) indicated Foot baller's migraine, which comes on a few minutes after minor head trauma in athletes.

Ashworth (1985) and Perry (1985) reported that athletic migraine is usually accompanied by nausea and frequently by vomiting and photophobia, which lasts for few hours to two days.

Vascular head ache is seen in poorly conditioned athletes and often associated with exercise in heat, dehydration, hypoglycemia, exercise by the poorly acclimated athletes at high altitude and antecodent alcohol consumption (Appenzeller, 1978).

Burnett and Robinson (1978) demonstrated that a long gradual warm up in a highly competitive swimmers prevent their head ache.

Ammundson and Caplan (1983) reported skin problems among athletes. which impair many functions including protection against abrasion and mechanical injury, regulation of body temperature, keeping out chemicals and pathogens protecting the body fluid content and filtering out harmful ultraviolet radiation. These functions can play a role in sports performance. Basler (1983) stated that sports equipments can create many sports related skin problems, as the skin is invariably exposed to trauma during athletic training and competitions.

Sunburn and sweat gland occlussion were commonly found among athlete's which results from exposure to sun light (Loren *et al.*, 1989).

Stewart *et al.* (1978) indicated that Tanning booths (UV-A) are currently popular and athletes frequently use them to prevent or control the amount of sunburn obtained through sports participation. Basler (1983) reported that aspirin intake 1-2 hours prior to sun exposure may reduce sunburn.

Forstnip and frostbite (numbness, white patches especially of the nose, earlobes, digits and male genitalia) were commonly found among distance runners (Master, 1982).

MATERIALS AND METHODS

3. MATERIALS AND METHODS

This chapter presents the details with respect to the locale of the study, samples and sampling procedures, methods adopted for data collection and statistical procedures used in the analysis of data. The details are presented under the following headings.

1. Selection of study area
2. Selection of sample
3. Plan of study
4. Methods adopted for the study
5. Development of tools
6. Conduct of study
7. Interpretation of data

3.1 SELECTION OF STUDY AREA

The study was conducted in Thrissur district of Kerala state. From the different colleges of Thrissur district, two colleges with hostel facilities and are giving more importance to sports and one institution of Sports Authority of India (SAI) were selected for the study.

3.2 SELECTION OF SAMPLE

The sampling frame consisted of women between 18 to 25 years of age who were actively involved in sports. A list of sports women in this age group who were residing in the hostel was prepared by collecting information from the head of the institution and a total of 100 women participating in different sports were selected randomly for the study. The sample size from each institution was in proportion to the total number of students who were actively involved in sports

in that institution. To conduct the detailed study a sub sample of 30 respondents was selected randomly.

3.3 PLAN OF STUDY

Based on the objectives, the plan of the study was designed, which included

3.3.1 A base line survey to collect details on socio-economic condition of the families and the personal habits of respondents.

3.3.2 A dietary survey to assess the food consumption pattern of the respondents and to assess the adequacy of the diet.

3.3.3 Assessment of nutritional status of the respondents through

3.3.3.1 Anthropometric measurements like ,

i. Height
ii. Weight
iii. Mid upper arm circumference
iv. Skin fold thickness
v. Waist and hip circumferences

3.3.3.2 Clinical examination (sub sample)

3.3.3.3 Biochemical examination (sub sample)

i. Blood for haemoglobin
ii. Urine for urinary urea

3.3.4 Physical fitness of respondents assessed by measuring

i. Endurance capacity
ii. Lung capacity

3.3.5 Computation of energy expenditure pattern and energy balance.

3.3.6. Statistical analysis and interpretation of data.

3.4 METHODS ADOPTED FOR THE STUDY

Determination of suitable methods and procedures are very important to get accurate and reliable data. Interview method can be made to yield an almost perfect sample of the general population and the information secured is likely to be more correct compared to that secured through other techniques (Wilkinson and Bhandarkar, 1979).

Appropriate interview schedules were formulated to collect relevant details on socio-economic status of the families and food consumption pattern and personal details of the respondents.

Food list method is often employed in institutions like hostels, orphananages, old age homes where homogenous group of people take their meals from a common kitchen. This method provides estimates of food available and are as good as the food records (Thimmayamma and Rau, 1996). So, to assess the adequacy of the hostel diet, food list method of dietary survey was employed.

According to Rao and Vijayaraghavan, (1996) nutritional anthropometry is the measurement of human body at various ages and levels of nutritional status. It is based on the concept that an appropriate measurement should reflect any morphological variation occurring due to significant functional physiological changes.

In the present study, anthropometric measurements like height, weight, mid upper arm circumference, skin fold thickness and waist and hip

circumferences of the respondents were measured. Different indices like Body mass index, waist hip ratio, percentage of body fat and lean body mass were computed using the different anthropometric measurements.

Height of an individual is influenced both by genetic and environmental factors. Height is affected by long term nutritional deprivation and considered as an index of chronic or long duration malnutrition.

Body weight is the most widely used and the simplest anthropometric measurement for the evaluation of nutritional status (Swaminathan, 1987 and Rao and Vijayaraghavan, 1996). Measurement of weight at various ages have been used as an index of nutritional status and have proved valuable when correctly interpreted (Beegum, 1991).

Monitoring anthropometric measurements like weight, height, waist and hip circumference were considered as the best method to detect various degrees of growth retardation among adult even before clinical manifestations. The growth pattern provides information regarding changes in nutritional status (George, 2000).

Mid upper arm circumference is an indicator of muscle development and reflect protein calorie malnutrition (Jelliffee, 1966 and Kamath, 1986). Mid upper arm circumference is the most useful and practical method for assessing muscle mass, as this region is easily accessible and measurement requires only a flexible fiberglass tape.

According to Malina *et al.* (1974) measurement of skin fold (fat fold) is one of the methods for assessment of the amount of subcutaneous fat which gives an indication of the calorie reserves in the body of an individual.

In the present study skin fold at triceps, sub scapula and abdomen were measured.

Body Mass Index is expressed as the ratio of weight to height square (ie, weight (kg)/height ^{2} (m)). It can be used as a good parameter to grade Chronic Energy Deficiency (CED) (National Institute of Nutrition, 2000) and is regarded as a good indicator of nutritional status (Brahman, 1999). Body Mass Index was known to correlate highly with percentage of body fat derived from skin fold measurements (Bray, 1987 and Bubb, 1992). According to Anderson (1979) and James *et al.* (1988) Body Mass Index is an index used to assess the current form of malnutrition.

Waist hip ratio (WHR) reflects the proportion of body fat located intra abdominally as opposed to that in the subcutaneous region. According to Lean *et al.* (1995) waist circumference is used as a measure indicating the need for weight management.

Percentage of body fat was determined by body density technique (BD) using the formula predicted by Katch and McArdle (1973).

Body density = $1.09665 - 0.00103 \times X_1 - 0.00056 \times X_2 - 0.00054 \times X_3$

Where, X_1 = Triceps Skin fold

X_2 = Sub scapula skin fold

X_3 = Abdominal skin fold

$$\text{Body fat percentage} = \left(\frac{4.5 - 4.142}{B.D} \right) \times 100$$

The lean Body Mass (LBM) was calculated by subtracting the percent fat from the body weight.

$$\text{Lean Body Mass} = \text{Body weight (Kg)} - \left(\frac{\text{body fat percentage} \times \text{Body weigh}}{100} \right)$$

Clinical examination provides direct information of signs and symptoms of dietary deficiencies prevalent among people (Swaminathan, 1986). Clinical examination is stated to be one of the most essential and the simplest tool used in the evaluation of nutritional status (Gupta *et al.*, 1989). According to Rao and Vijayaragavan (1996) clinical examination reveals the anatomical changes due to malnutrition that can be diagnosed by naked eye.

In the present study the presence or absence of clinical deficiency symptom, which is an index of nutritional status was assessed by a qualified physician.

Biochemical estimation represents the most objective assessment of nutritional status of an individual (Sausberlich *et al.*, 1977).

Park and Park (1991) stated that haemoglobin level is a useful index of the overall state of nutrition irrespective of its significance in anaemia. Accuracy of prevalence of anaemia depends upon the methods used for assessing haemoglobin concentration (Singh *et al.*, 2001). They also reported that for all degrees of anaemia, cyanmethaemoglobin method would give correct value of haemoglobin. Urea is the major end product of protein catabolism and urea production is increased during more amino acid metabolism such as high protein diet, tissue breakdown or decreased protein synthesis. Urinary urea test was used to determine nitrogen balance (Jung *et al.*, 1975).

Hence, in the present study estimation of blood was conducted in a sub sample of 30 respondents to assess their haemoglobin level. Urinary urea level of the sub sample was also estimated.

According to Satyanarayana (1989) a good physical work capacity can also be considered as an indicator of calorie and iron intake and resulting nutritional status. Nutritional deprivation appeared to impair work capacity, physical fitness and the capacity to handle moderate work loads.

Lung capacity varies with age, sex, body surface area, posture, habits and exercise. It is reduced in lung diseases, pleural effusion and cardiovascular disorders (Rattan, 1993).

3.5. DEVELOPMENT OF TOOLS

In order to elicit information regarding the socio economic background and dietary habits of the respondents, two questionnaires were developed. The schedule to assess socio economic status comprised of information on type of family, family size, composition of family, religion and caste, educational and employment status of the parents, personal details of respondents like age, birth order, birth interval, morbidity pattern, age at menarche, details on the participation in sports and games and physical activity, details on periodic medical check up and consumption of regular medicines and details on scholarships/fellowships received.

The schedule to assess the food consumption pattern of the respondents included details of food habits (vegetarian/nonvegetarian), frequency of use of various food items, food preferences, use of processed foods, fast foods, readymade foods, frequency of eating outside, use of food and nutrient supplement, details of pregame and postgame meals/food, modification made in the diet while preparing for competitions and during competition.

Both these questionnaires were pretested before field application and the details are presented in Appendix-I and II respectively.

Food list survey of one week as suggested by Thimmayamma and Rau (1996) was conducted to assess the adequacy of diet.

Anthropometric measurements like height, weight, mid upper arm circumference, skin fold thickness and waist and hip circumference were taken as suggested by Jelliffee (1966).

Suitably structured schedule was also developed for clinical examination and is presented in Appendix (III).

Haemoglobin was estimated by cyanmethaemoglobin method suggested by National Institute of Nutrition (2003). Urinary urea was estimated by Dieacetyl Monoxime (DAM) method.

The endurance capacity of sports women was measured by Harward step test suggested by Brouha (1943) by using a bench of 1-6 inch height and a stopwatch.

Lung capacity was measured by using incentive Spiro meter designed and manufactured by Hudson Respiratory Care Inc., California, USA, which is extensively used for clinical and research purpose.

Energy expenditure pattern of the respondents was conducted as suggested by Indian Council of Medical Research (1990).

3.6. CONDUCT OF STUDY

3.6.1. Socio economic status of the families and food consumption pattern of the respondents.

The informations on the socio economic status and dietary pattern of the respondents were collected with the help of pretested schedules by interview method. The accuracy of the answers were checked by supplementary questions whenever necessary.

3.6.2. Food list method

Food list survey of one week was conducted to monitor the adequacy of the diet consumed by the respondents. For this purpose information on the quantity of foods used by the institution for a week was collected from the records maintained by the hostel warden. From the quantity of foods used average intake of food per person per day was calculated using the formula.

$$\frac{\text{Stock at the beginning of the week- stock at the end of the week}}{\text{Total No. inmates partaking the meal X 7(days)}}$$

From the quantity of the foods consumed by the respondents the nutrient content of the diet was computed using the food composition table (Gopalan *et al.*, 1989) and the nutrient intake was compared with the Recommended Dietary Allowances (RDA) suggested by Swaminathan (2001) for sports persons.

3.6.3. Assessment of nutritional status

3.6.3.1. Anthropometric measurements.

In the anthropometric survey height, weight, mid upper arm circumference, skin fold thickness and waist and hip circumference of sports women were recorded.

Height of the respondent was measured using anthropometer. The subject was asked to stand straight on a leveled surface with the heels together and toes apart. The anthropometer rod was placed behind the subject in the center of heels perpendicular to the ground. The moving headpiece of the anthropometer was placed on the sagital plane over the head of the subject applying a slight pressure to reduce the thickness of hair. The reading was taken when the anthropometer rod was still in position. An average of the three measurements was taken as a final measurement. The height was recorded in centimeters.

Weight of the respondent was recorded using a bathroom balance, which was checked by calibration with standard weights. Weight was recorded with minimum clothing on the subject and expressed in kilograms.

Mid upper arm circumference of respondents was measured using a tape at the level mid way between the acromion and olecranon process with the left arm hanging freely and relaxed with the tape applied at right angles to the long axis of the humerous (Malima, 1972).

Skin fold thickness at triceps, scapula and abdomen were determined using a fatometer. A lengthwise skin fold was firmly grasped and slightly lifted up between the fingers and thumb of left hand. Care was taken not to include underlying muscles. The measurement was read to 0.1mm accuracy and recorded.

The technique suggested by Chadha *et al.* (1995) was followed to measure waist and hip circumferences. The circumference of waist at the umbilicus was measured for waist circumference and the circumference of hip at the maximum point of protrusion was measured for hip circumference using a fiber glass tape.

3.6.3.2. Clinical examination

Clinical examination was conducted with the help of a qualified physician. In the present study clinical examination was conducted in a sub sample of 30 sports women.

3.6.3.3. Biochemical estimation

Blood haemoglobin level of the sub sample was estimated using cyanmethaemoglobin method suggested by Raghuramulu *et al.* (2003). Urinary urea of same samples was measured by Dieacetyl Monoxime (DAM) method.

3.6.4. Endurance capacity

The functional performance of respondents was assessed by Harvard step test suggested by Brouha (1943). In this test the subject performed a stepping exercise on a 1-6 inch bench for 4 minutes. The lead foot was changed during the test but not more than three times. Immediately after completion of the exercise the tester sits down for 1 minute and the pulse count was taken at 1 minute, 2 minutes and 3 minutes for duration of 30 seconds and the index was computed using the following equation.

$$\text{Index} = \frac{\text{Duration of the exercise in seconds}}{2.2 \times \text{pulse count}} \times 100$$

3.6.5. Lung capacity

The lung capacity of the respondents was measured using an incentive spirometer.

For measuring the lung capacity the flow of the inspired air was adjusted to the minimum value of 200cc/second in the instrument.

The subject was asked to place the mouthpiece in her mouth and from a normal resting expiration the person was asked to inspire at a sufficient rate to raise the ball from the bottom of the spirometer. The inspiration was continued to keep the ball up and the time of floating of the ball in the air was noted using a stopwatch. Two trials were given and the best score was selected and recorded.

3.6.6. Energy expenditure and balance

Using the prediction equation proposed by (Indian Council of Medical Research, 1990), the Basal Metabolic Rate (BMR) in terms of Kilo Calories was computed for each respondent. The prediction equation suggested for women in the age group of 18-30 years (14 X Body weight (Kg) + 471) was used for this purpose. By substituting the body weight of the respondents, BMR in terms of Kilo Calories per day was computed. Using the BMR units calculated by activity break up method for heavy worker for sleep (1.0), Occupational (4.5) and non Occupational (2) activities the energy expenditure of the respondents for a day was computed by multiplying the BMR with the mean BMR unit of 2.5.

The energy expenditure of the respondents participating in different events was compared with the mean energy intake of each group, which was obtained from the food list method to find out the energy balance.

3.7. INTERPRETATION OF DATA

To interpret the results, the data was analysed using suitable statistical techniques such as Pearson Correlation, 't' test and percentage analysis.

RESULTS

4. RESULTS

The results of the study entitled "Nutritional profile and Physical fitness of sports women" are presented in this chapter under the following sub headings.

1. Socio economic profile of the families
2. Personal details of respondents
3. Dietary habits of the respondents
4. Nutritional status of respondents
5. Endurance and lung capacity of respondents

4.1 SOCIO ECONOMIC PROFILE OF THE FAMILIES

Socio economic profile of the families was studied with special reference to religion, caste, type of the family, family size, composition of family, family income, and educational and occupational status of parents.

4.1.1 Religion, caste, type of family and family size

Details of religion, caste, type of family and family size are presented in Table 1.

The table reveals that 56 per cent of the respondents surveyed were Hindus, 40 per cent Christians and 4 per cent Muslims.

Among Hindus, majority (62.5%) belonged to other back ward communities and about 20 per cent and 18 per cent belonged to forward and scheduled castes respectively. Among Christians 75 per cent belonged to Roman Catholic and the rest (25%) were Jacobites.

Majority of the families (93%) followed a nuclear family system and the rest followed joint family system.

Regarding the family size it was found that as much as 89 per cent of the families had 4-6 members in their family and only 6 per cent had above 6 members.

Number of children in the families were limited to two in 34 per cent of the families. About 47 per cent of the families had three children and 14 per cent of the families had more than four children.

Table 1. Distribution of families according to religion, caste, type of the family and family size

Sl.No.	Category	Number of families
1	Religion	
	Hindu	56
	Muslim	4
	Christian	40
	Total	100
2	Caste	
	Hindu	
	Forward community	11(19.64)
	OBC	35(62.50)
	SC/ST	10(17.86)
	Total	56(100)
	Christian	
	Roman catholic	30(75)
	Jacobite	10(25)

	Total	40(100)
3	Type of family	
	Nuclear	93
	Joint	7
	Total	100
4	Family size	
	a) Total number	
	1-3	5
	4-6	89
	above 6	6
	Total	100
	b) Number of children	
	1	5
	2	34
	3	47
	>4	14
	Total	100

(Numbers in parentheses are percentage)

4.1.2 Composition of family

It was found that as much as 54.79 per cent of the total population was in the age of 20 to 50 years and composed of 35.67 per cent male and 64.33 per cent female members. The people above 50 years constituted 15.49 per cent and children below 10 years were 1.59 per cent of the total population (Table 2).

Table 2. Distribution of family members on the basis of age and sex

Sl.No	Category Age (year)	Number		
		Male (n=168)	Female (n=303)	Total (n=471)
1	0-10	1(0.60)	6 (1.98)	7(1.49)
2	10-20	30(17.90)	103(34.0)	133(28.23)
3	20-30	41(24.40)	87(28.71)	128(27.20)
4	30-40	6(3.60)	22(7.26)	28(5.94)
5	40-50	44(26.10)	58(19.14)	102(21.65)
6	50-60	42(25.00)	22(7.26)	64(13.58)
7	>60	4(2.40)	5(1.65)	9(1.91)

(Numbers in parentheses are percentage)

4.1.3. Educational status of parents

Table 3. Educational status of parents

Sl.No.	Educational status	Number of families	
		Father	Mother
1	Illiterate	2	-
2	Lower primary	10	7
3	Upper primary	25	29
4	High school	53	44
5	College	10	20
	Total	100	100

From Table 3 it is evident that 53 and 44 per cent of the fathers and mothers had attained high school education and 25 and 29 per cent respectively had

upper primary level of education. Only 10 and 20 per cent of fathers and mothers respectively had attained college level education

4.1.4. Occupational status of parents

The details regarding the occupational status of the parents are given in Table 4.

Majority of the mothers (83%) were found to be unemployed. About 44 per cent of the fathers were engaged as agricultural laboures, 16 per cent were engaged in business and 6 per cent had office work. About 9 per cent (fathers) and 2 per cent (mothers) were working as coolies. Fourteen per cent and 4 per cent of fathers and mothers respectively were engaged in other occupation like insurance agents, brokers etc (Table 4).

Table 4. Occupational status of parents

Sl.No.	Occupational status	Number of families	
		Father	Mother
1	Coolie	9	2
2	Agricultural laboures	44	4
3	Office work	6	-
4	Business	16	-
5	Teacher	11	-
6	Nurse	-	3
7	Sweeper	-	4
8	Unemployed	-	83
9	Others	14	4
	Total	100	100

4.1.5. Other sources of income

Details regarding other sources of income are presented in Table 5.

Apart from the main source of income of parents, about 49 per cent of the families had other sources of income (Table 5). Among this 34.73 per cent had income from agriculture, 38.81 per cent had income from domestic animals and house rent. Rest (26.46%) had income both from agriculture and allied enterprises.

Table 5. Other sources of income

Sl.No	Sources	Number of families (n=100)
1.	Families having other sources of income	49
2.	Families not having other sources of income	51
i.	Agriculture	17(34.73)
ii.	Poultry	3(06.12)
iii.	House rent	8(16.30)
iv.	Business	1(02.09)
v.	Dairy	7(14.30)
vi.	Agriculture, poultry and dairy	5(10.20)
vii.	Agriculture, business and dairy	5(10.20)
viii.	Agriculture and house rent	1(02.09)
ix.	Poultry and business	1(02.09)
x.	Others	1(02.09)

(Numbers in parentheses are percentage)

4.1.6. Monthly family income

From Table 6, it is clear that 78 per cent of the families had an income below Rs.5000 per month and 18 per cent had a monthly income in the range of Rs.5001-10,000. Only 4 per cent families had a monthly income above Rs. 10,000.

Table 6. Monthly income of families

Sl.No.	Monthly income (Rs.)	Number of families (n=100)
1	<1000	22
2	1000-2000	25
3	2001-5000	31
4	5001- 10,000	18
5	>10,000	4

4.1.7 Per capita income of the family

Table 7. Per capita income of the family

Sl.No.	Per capita income (Rs)	Number of families (n=100)
1	100-300	49
2	300-500	32
3	500-700	7
4	700-1000	4
5	>1000	8
	Total	100

Details regarding per capita income of the families are presented in Table 7.

About 81 per cent of families had a per capita income below Rs.500, where as 11 per cent had per capita income in the range of Rs. 500-1000 and the rest (8%) had a pe- capita income above Rs.1000.

4.2. DETAILS OF RESPONDENTS

Details of respondents like age, birth order, birth interval, age at menarche, educational status, participation in sports and other activities, activity pattern for a day, fellowship/scholarships received, injury during past one year and details of medical check up and medicines consumed were assessed and the results are furnished in this section.

4.2.1. Personal details of respondents

The details with respect to age, birth order, birth interval and age at menarche are furnished in Table 8. The distribution of respondents on the basis of age indicated that 58 per cent of them were in the age group of 18-20 years, 37 per cent in between 20 to 22 years and the rest (5%) were above 22 years.

About 35 per cent of the respondents belonged to the first birth order, 40 per cent in the second birth order and 18 per cent in the third birth order. About 4 per cent belonged to the fourth birth order.

The birth interval of the respondents indicated that about 28 per cent of the respondents had a birth interval of 2 years, 27 per cent had a birth interval of 3 years and 14 per cent of respondents had only one year interval.

Table 8. Personal details of respondents

Sl. No.	Details	Percentage of respondents (n=100)
1.	Age (years)	
	18-20	58
	20-22	37
	22-24	5
	25	-
2.	Birth order (Years)	
	1st	35
	2nd	40
	3rd	18
	4th	4
	5th	1
	>5	2
3.	Birth interval (year)	
	1	14
	2	28
	3	27
	4	8
	>5	12
4.	Age at menarche (years)	
	12	12
	13	27
	14	34
	15	24
	>15	3

Details of age at menarche showed that 12 per cent of the respondents attained their first menstruation by the age of 12 years and 27 per cent in the age of 13 years. Nearly 34 per cent of the respondents attained menarche at 14 years of age and for 3 per cent the age of menarche was found to be above 15 years.

4.2.2. Educational status of respondents

Details regarding the educational status of respondents (Table 9) indicated that about 81 per cent of the respondents were studying for their under graduate course and 19 per cent were postgraduate students. Among the under graduate students 45.68 per cent were second year students and the rest were first year (40.74%) and third year (13.58%) students during the period of survey. Among the post graduate students 68.42 per cent were in the second year and the rest (31.58%) were in the first year.

Table 9. Educational status of respondents

Sl.No.	Educational status	Number of respondents (n=100)
1.	Under graduate Students	81
	i) ISt Year	33(40.74)
	ii) IInd Year	37(45.68)
	iii) IIIrd year	11(13.58)
2	Post graduate students	19
	i) ISt Year	6(31.58)
	ii) IInd Year	13(68.42)

4.2.3. Details of participation in sports

4.2.3.1. Details of events participated by the respondents.

Out of the total respondents selected, 28 per cent were athletes, 15 per cent were basket ball players and 14 per cent each participated in hand ball, swimming and kabadi and 9 per cent were weight/power lifters. Rest of the respondents were found to be Judo (2%) and Cricket and Hockey (4%) players (Table 10).

Table 10 Details of events participated by the respondents

Sl.No.	Event	Percentage of respondents (n=100)
1	Athletics	28
2	Basketball	15
3	Hand ball	14
4	Swimming	14
5	Kabadi	14
6	Judo	2
7	Weight/power lifting	9
8	Cricket and Hockey	4
	Total	100

4.2.3.2. Participation in competitions

As indicated in Table 11, all the respondents used to participate in sports and games competitions conducted by the institution and competitions conducted at district and state level. About 62 per cent of the respondents participated in University level competitions and 71 per cent participated in national level competitions also. Nearly 3 per cent participated in international competitions.

Table 11.Details of participation in competitions

Sl.No.	Details	Percentage of respondents (n=100)
	Level of participation	
i)	District	100
ii)	State	100
iii)	National	71
iv)	University	62
v)	International	3

4.2.3.3. Details of time spent for physical exercise

It was seen that all the respondents used to take regular physical exercise and training for 4 to 5 hours daily both in the morning and evening (Table 12).

Table 12 Details of duration of physical exercises

Sl.No.	Details	Number of respondents (n=100)
	Respondents doing regular physical exercise	100
a)	Frequency	
	Daily	100
b)	Duration	
	4-5 hours	100

4.2.3.4. Details of practicing yoga

Table 13 revealed that only 17 per cent of the respondents used to practice yoga and the duration of practice varied from 1 to 2 hours in a week among 76.5 per

cent of the respondents. About 23.5 per cent of respondents used to practice yoga only once in a while.

Table 13. Details of practicing yoga

Sl.No.	Details	Number of respondents (n=100)
1.	Participated in yoga practice	17
	Not participated	83
2.	Duration (hours)	
a)	i) 1	9 (52.94)
	ii) 2	8 (47.05)
	Frequency	
b)	i) Weekly	13 (76.50)
	ii) Once in a while	4 (23.50)

4.2.3.5. Details on participation in coaching camps

Table 14 showed that about 69 per cent of respondents participated in coaching camps during the past two years. Out of this 95.7 per cent participated in camps conducted at the state level and rest (4.3%) participated in the camps conducted out side the state.

About 13 per cent of the respondents participated in coaching camps of less than 10 days duration and most of the respondents (75.41%) participated in coaching camps of 25 days, while the rest (11.58%) participated in camps for more than 25 days.

Among the total respondents who participated in coaching camps, 81.15 per cent revealed that camps are beneficial to improve athletic performance and the rest opined that the camp helped them to learn new skills and improve their performance.

Table 14. Participation in coaching camps

Sl.No.	Details	Number of respondents
1.	Participated in coaching camps	69
	Not participated in coaching camps	31
2.	Place	
	a) Inside the state	66(95.7)
i).	b) Out side the state	3(4.3)
	Duration	
	a) <10 days	9(13.04)
ii)	b) 25 days	52(75.41)
	c) >25 days	8(11.58)
	Major activities	
	a) Event	56(81.15)
iii)	b) New skills	2(2.90)
	c) Both	11(15.95)

(Number in parenthesis are percentages)

4.2.4. ACTIVITY PATTERN FOR A DAY

All the three institutions selected had a strict time schedule (Table 16). It was found that the time schedule was almost similar in all the three institutions. All the respondents used to spent 5 hours in sports practice, 5 hours to attend classes, 1hour each for recreation, prayer and personal activities, 4 hours for studying and 7 hours for sleep.

Table 15. Activity pattern for a day

Sl.No	Activities	Time spent (hour)
1.	Sports practice	5.00
2.	Class time	5.00
3.	Recreation	1.00
4.	Studying	4.00
5.	Prayer	1.00
6.	Personal activities	1.00
7.	Sleeping	7.00

4.2.5. Details on participation in other activities

Table 16. Details on the participation of other activities

Sl.No.	Details	Number of respondents (n=100)
	Participation in other activities	
1.	Participated	92
2.	No participation	8
	Items	
	i) CSS	69 (75.00)
	ii) NCC and CSS	3 (3.26)
	iii) CSS and Entertainments	17 (18.46)
	iv) Entertainments	3 (3.26)

(Number in parentheses are percentages)

Majority (92%) of the respondents participated in other activities conducted by the institution. Among these about 75 per cent respondents participated in Compulsory Social Service (CSS), 18.48 per cent participated in entertainments and 3.26 per cent each in entertainment and were members of National Cadet Corps (NCC) along with Compulsory Social Service (Table 16).

4.2.6. Details of scholarship/fellowship

Table 17 revealed that only 21 per cent of the respondents received scholarships and all of them received above Rs 10,000 in a year. Among these, about 76.19 per cent received from sports council and 19 per cent from other Government agencies. Rest (4.76%) received scholarships from private agencies. Among the respondents who received scholarships 14.29 per cent received an additional amount of Rs 9,000/year as price money from Sports Authority of India.

Table 17. Details of fellowship/scholarships received by the respondents

Sl.No.	Details	Number of respondents (n=100)
1.	Received scholarship/fellowship	21
2.	Not receiving scholarship/	79
i).	fellowship	
	Amount (Rs/year)	21
ii).	10,000-12000	
	Agency	
	Sports council	16(76.19)
	Other Government agencies	4(19.05)
	Private agencies	1(4.76)

(Number in parentheses are percentages)

4.2.7. Details of injury occurred to the respondents

Details of injury occurred to the respondents during past one year indicated that 16 per cent of the respondents suffered from injury (Table18). Out of the total respondents who had injury, 37.5 per cent had hand injury, 31.25 per cent had injury in the leg and the rest (31.25%) had back pain. It was also seen that all the respondents who had hand injury were handball players.

Table 18. Details of injury occurred to the respondents

Sl.No.	Details	Number of respondents (n=100)
	Injury during past one year	
I	Suffered from injury	16
II	No injury	84
a.	Hand	6(37.5)
b.	Leg	5(31.25)
c.	Back pain	5(31.25)

(Number in parentheses are percentages)

4.2.8. Details on periodic medical check up

Table 19 showed that only 41 per cent of respondents used to undergo periodic medical check up. Among these respondents 60.98 per cent had monthly medical check up and 39.02 per cent used to have medical check up once in a year ie, during the beginning of the academic year. Majority (97.56%) of the respondents had periodic medical check up to know their fitness status and rest (2.44%) used to under go medical check up for treating their diseases.

Table 19. Details of periodic medical check up

Sl.No.	Details	Number of respondents (n=100)
1.	Undergo periodic medical check up	41
2.	No periodic medical check up	59
	i. Frequency	
	a) Monthly	25(60.98)
	b) Annually	16(39.02)
	ii. Reason	
	a) Fitness	40(97.56)
	b) Disease	1(2.44)

(Number in parentheses are percentages)

4.2.9. Details on consumption of regular medicines

Details on the intake of medicines indicated that majority of the respondents (96%) did not take any medicine regularly (Table 20). Only 4 per cent of respondents consumed medicines regularly. Among these respondents half of them were taking multi vitamin tablets to improve their health and rest (50%) took medicines prescribed by the physician to treat their diseased condition.

Table 20. Details on the consumption of medicines

Sl.No.	Details	Number of respondents (n=100)
1.	Consume medicines regularly	4
2.	Not consuming medicines regularly	96
i)	Reason	
	a. Disease	2(50.00)
	b. Fitness	2(50.00)

(Number in parentheses are percentages)

4.3. DIETARY HABITS OF THE RESPONDENTS

Dietary habits of the respondents were assessed with respect to food habits, frequency of use of various foods, food preference, use of processed foods, fast foods, readymade foods, frequency of eating outside and use of food and nutrient supplements.

4.3.1 Food habits of the respondents

All the respondents selected were found to be non vegetarians, both in the hostel and at home, and all of them preferred both vegetarian and non vegetarian foods. All the respondents had three meals a day pattern.

4.3.2 Frequency of use of various foods

Frequency of use of various food items by the respondents indicated that (Table 21) in all the three institutions cereals, other vegetables, fruits, nuts and oil seeds, fats and oils, spices and condiments and sugars were included daily, while roots and tubers and fish were included once in a week. They included pulses in the diet two to four times a week.

Table.21 Frequency of use of various food items in the three institutions

Sl.No.	Details	I	II	III
1	Cerea's	Daily	Daily	Daily
2	Pulses	Weekly (4)	Weekly (4)	Weekly (2)
3	Green leaves	Weekly (1)	Occasionally	Occasionally
4	Roots and tubers	Weekly (1)	Weekly (1)	Weekly (1)
5	Other vegetables	Daily	Daily	Daily
6	Fruits	Daily	Daily	Daily
7	Milk	Daily	Daily	Occasionally
8	Egg	Daily	Weekly(1)	Occasionally
9	Meat	Daily	Daily	Weekly(2)
10	Fish	Weekly(1)	Weekly(1	Weekly(1)
11	Nuts and oilseeds	Daily	Daily	Daily
12	Fatsand oils	Daily	Daily	Daily
13	Spices and condiments	Daily	Daily	Daily
14	Sugar	Daily	Daily	Daily

4.3.3. Details on the use of raw foods

Details on the consumption of raw food items indicated that all the respondents included raw foods in their diet in the form of salad, raitha and fresh fruits and vegetables (Table 22). However, the frequency of use of raw foods indicated that 83 per cent of the respondents included raitha once in a week and the rest (17%) included thrice in a week. About 83 per cent of the respondents included vegetable salad occasionally in their diet. All the respondents included at least a banana daily and 17 per cent of the respondents included fresh fruits like orange, guava or apple in their daily diet.

Table 22. Details on the use of raw food items

Sl. No.	Details	Number of respondents	D	W_1	W_2	W_3	Occ
1.	Salad	100	-	-	17	-	83
2.	Raitha	100	-	83	-	17	-
3.	Fruits (banana)	100	100	-	-	-	-
4.	Others (fruits)	17	17	-	-	-	-

D-daily

W-weekly

Occ-occasionally

4.3.4. Details on the purchase of prepared foods

Table 23. Details on the purchase of prepared foods

Details	Number of respondents
Used to purchase prepared foods	41
Not purchased	59
Total	100
Frequency of purchase	
i) Weekly	11(26.83)
ii) Monthly	20(48.78)
iii) Occasionally	10(24.39)
Total	41(100)
Type of foods	
i) Vegetarian foods	6(14.63)
ii) Vegetarian and non vegetarian foods	35(85.37)
Total	41(100)
Place of purchase	
i) Hotel	3(7.32)
ii) Bakery	10(24.39)
iii) Fast food center	16(39.02)
iv) Bakery and fast food center	12(29.27)
Total	41(100)

(Number in parentheses are percentages)

With respect to the purchase of prepared food items by the respondents, it was seen that about 41 per cent of the respondents purchased prepared food items from

outside. Among the respondents who purchased food from outside about 49 per cent purchased these items once in a month and 26.83 per cent purchased once in a week and the rest (24.39%) only occasionally. About 85.37 per cent of respondents preferred both vegetarian and non vegetarian foods. The respondents purchased these food items from bakery (24.39%), hotels (7.32%) and fast food shops (39.02%). About 29.27 per cent used to purchase food items both from bakery and fast food centers (Table 23).

4.3.5. Details on the use of readymade and prepared foods

Table 24. Details on the use of readymade and prepared foods

Sl. No.	Details (Items)	Number of respondents	D_1	W_1	W_2	W_3	Occ
1.	Readymade foods						
	a) Noodles	17	-	-	-	-	17
	b) Burger	80	-	17	-	-	63
	c) Others	100	17	-	-	-	83
2.	Prepared foods						
	a) Cake	100	-	-	-	-	100
	b) Fried foods	100	83	17	-	-	-
	c) Bread	100	-	-	100	-	-
	d) Sweets	100	-	-	17	-	83
	e) Biscuits	100	17	83	-	-	-
	d) Ice creams	100	-	17	-	-	83

From Table 24 it is seen that all the respondents included readymade food items like noodles, burger/ sandwich, sweet bun etc. However, majority included these food items once in a while and 17 per cent of the respondents received

readymade foods like noodles on the occasion of their hostel day. Cake, biscuits, sweets and ice creams were also included in the diet once or twice in a week. All the respondents indicated that they used to get bread twice in a week, while 83 per cent opined that they included biscuits and fried foods once in a week. However, most of the respondents received prepared foods like cake, sweets and ice creams only occasionally.

4.3.6 Details on the consumption of food from outside

Apart from the diet provided in the hostel about 47 per cent of the respondents opined that they used to eat from outside (Table 25). Among the respondents who took food from outside about 89.4 per cent used to consume both vegetarian and non vegetarian foods, while the rest (10.6%) used to consume only vegetarian foods (Table 25).

Among the respondents who took food from outside about 34 per cent had it from bakery or from fast food restaurants. Rest (19.16%) took from both hotels, bakery as well as from fast food restaurants. About 51 per cent of the respondents had their food from outside once in a week, while 25.54 per cent of the respondents took once in a month and rest (23.4%) took food from outside occasionally.

Table 25. Eating outside habits of respondents

Sl.No.	Details	Number of respondents
1.	Used to eat from outside	47
	Do not eat from outside	53
2.	Type of food preference	
	a. Vegetarian	5(10.6)
	b. Non vegetarian	-
	c. Both	42(89.4)
	Total	47(100)
3.	Place of purchase	
	a. Hotel	16(34.04)
	b. Bakery	11(23.4)
	c. Fast food center	11(23.4)
	d. Hotel and bakery	4(8.5)
	e. Hotel and fast food center	5(10.66)
	Total	47(100)
4.	Frequency	
	a. Weekly	24(51.06)
	b. Monthly	12(25.54)
	c. Occasionally	11(23.4)
	Total	47(100)

(Number in parentheses are percentages)

4.3.7 Intake of food and nutrient supplements

About 30 per cent of the respondents indicated that they consumed food and nutrient supplements daily (Table 26). Among the respondents who used to take

supplements 60 per cent consumed health drinks, while 30 per cent took allopathy supplements and 10 per cent only glucose.

Table 26. Details on the use of food supplements

Sl. No.	Details	Number of respondents (n=100)
1	Used to take food and nutrient supplements	30
2	Do not take supplements	70
i)	Type	
	a. Allopathy	9(30.0)
	b. Health drinks	18(60.0)
	c. Glucose	3(10.0)
ii)	Frequency	
	Daily	30(100)

(Number in parentheses are percentages)

4.3.8. Consumption of pre game meal/ food

About 73 per cent of the respondents indicated that they consumed glucose, fruits, fruit juice and electrole before the events (Table 27). About 41 per cent consumed glucose and fruits, 34 per cent consumed only fruit juice, 8.2 per cent consumed fruits and the rest (16.44%) had electrole before the event. About 67 per cent of the respondents who took pre game meal opined that they consumed these items as a source of energy (67.12%), to relieve their tension before competition (13.7%) and to get confidence during competition (19.18%).

Table 27. Details of pre game meal/food

Sl. No.	Details	Number of respondents (n=100)
1.	Consumed pre game meal	73
2.	Not consumed	27
i)	Items	
	a. Glucose and fruits	30(41.10)
	b. Fruits	6(8.2)
	c. Fruit juice	25(34.25)
	d. Electrole	12(16.44)
ii)	Reason	
	a. Store energy	49(67.12)
	b. Relieve tension	10(13.7)
	c. Confidence	14(19.18)

(Number in parentheses are percentages)

4.3.9. Food restriction before competition

Majority (65%) of the respondents restricted food items like ice creams, cold water, non vegetarian foods, heavy foods and other oily foods during the previous day of competitions (Table 28). Among the respondents who had the habit of restricting certain foods 30.76 per cent avoided items such as ice creams and cold water, 40 per cent restricted non vegetarian foods like chicken and beef along with cold food items. Heavy foods like biriyani and oily foods were also avoided by 10.63 per cent of the respondents. The respondents opined that they avoided these food items to avoid discomfort (46.15%), indigestion (23.38%) and to improve confidence (30.77%).

Table 28.Details of food restriction before competitions

Sl.No.	Details	Number of respondents (n=100)
1.	Restricted food items	65
2.	No restrictions	35
i)	Items	
	a. Cool items	20(30.76)
	b. Oily foods	4(6.15)
	c. Non-vegetarian foods	8(12.3)
	d. Other heavy foods	7(10.63)
	e. Cold items and non vegetarian foods	26(40.0)
ii)	Reasons	
	a. To avoid discomfort	30(46.15)
	b. Avoid indigestion	15(23.00)
	c. To improve confidence	20(30.77)

(Number in parentheses are percentages)

4.3.10. Modification of diet during competitions

Majority (93%) of the respondents modified their diet during competitions (Table 29). Among these respondents, nearly 64 per cent reduced the quantity of all food items while 23.66 per cent included more quantity of food. About 8.6 per cent reduced the quantity of rice and 3.23 per cent reduced the quantity on the basis of the competitions they participated.

Table 29. Modification in the diet during competitions

Sl.No.	Details	Number of respondents
1.	Modified dietary intake	93
	Not modified	7
	Total	100
2.	Modification	
	a. Reduce all foods	60(64.51)
	b. Include more foods	22(23.66)
	c. Reduce the quantity of rice	8(8.60)
	d. Other modification	3(3.23)
	Total	93(100)

(Number in parentheses are percentages)

4.3.11. Consumption of post game meals

Details on the intake of post game meals are presented in Table 30. It was seen that about 58 per cent of the respondents modified their diet after competitions mainly to store and replace the energy lost during competitions. About 55.17 per cent of the respondents took increased quantity of food and nearly 36 per cent took special foods like biriyani, payasam, ice creams etc. About 8.62 per cent took light foods especially those respondents who participated in power lifting events.

Table 30 Details on the consumption of post game meal

Sl. No.	Details	Number of respondents (n=100)
1	Consumed post game meals	58
	Normal diet	42
2.	Type of food	
	i. Normal but high quantity	32(55.17)
	ii. Special foods	21(36.21)
	iii. Light foods	5(8.62)
3.	Reasons	
	i. Store energy	30(51.72)
	ii. Replace energy	22(37.93)
	iii. Others	6(10.35)

(Number in parentheses are percentages)

4.3.12. Details of hostel diets

Majority (90%)of the respondents indicated that the hostel diet was different from the home diet (Table 31) by means of taste (43.33%), preparation style (11.11%), food items selected (15.56%) and with respect to quality (30%). Rest (10%) of the respondents indicated that the hostel diet is almost similar to the home diet.

With respect to the quality of the hostel diet only 4 per cent had the opinion that the hostel diet is nutritious and 6 per cent indicated that the diet is excellent. For 43 per cent of the respondents the hostel diet was found to be tasty. However, 10 per cent of the respondents complained about the strict time schedule of the hostel and 17

per cent complained about the fixed menu of the hostel and 9 per cent of the respondent s indicated that the hostel diet is tasteless.

Table 31. Details of hostel diet

Sl.No.	Details	Number of respondents
1.	Food pattern	
	a. Similar to home diet	10
	b. Not similar	90
	Total	100
2.	Variation observed in hostel diet	
	a. In taste	39(43.33)
	b. Style of preparation	10(11.11)
	c. Variation in ingredients	14(15.56)
	d. Superior quality	27(30.00)
	Total	90(100)
3.	Opinion about hostel diet	
	a. Excellent	6
	b. Tasty	43
	c. Nutritious	4
	d. Strict time schedule	10
	e. Fixed menu	19
	f. Tasteless	9
	Total	100
4.	Had specific time schedule	100

(Number in parentheses are percentages)

4.3.13. Meal pattern of respondents

Meal pattern of the respondents was assessed and the results are depicted in table 32. About 83 per cent of the respondents used to take black tea in the early morning, where as 17 per cent consumed tea with biscuits. During breakfast 80 per cent included cereals, pulses, vegetables, fruits, milk and egg and for lunch about 20 per cent of respondents included cereals, pulses, vegetables and meat/fish/curd. All the respondents consumed tea or coffee along with snacks during evening. About 80 per cent included cereals, pulses, vegetables and meat during dinner.

Table 32.Dietary habits of the respondents

Meal pattern	Number of respondents
Early morning	
a. Black tea	83
b. Tea with snacks	17
Break fast	
a. Cereals, pulses, fruits and vegetables	20
b. Cereals, pulses, fruits, vegetables and milk/egg	80
Lunch	
Cereals, pulses, vegetables and meat/ fish /curd	100
Evening tea	
Tea with snacks	100
Dinner	
a.Cereals, pulses and vegetables	20
b.Cereals, pulses, vegetables and meat	80

4.3.14. Adequacy of the hostel diet

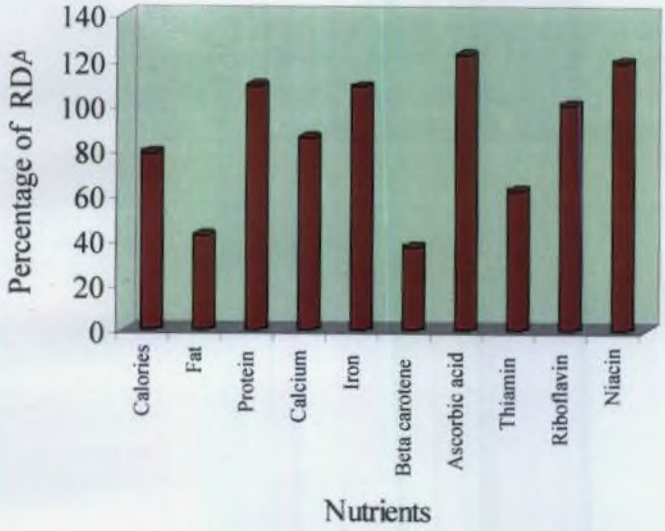
Adequacy of the hostel diet was assessed through food list method. From the details of quantity of the foods used by the institutions, the different nutrients were computed using the food composition tables (Gopalan *et al.*, 1989). The mean nutrient intake of the respondents was compared with the RDA for sports persons suggested by Swaminathan, (2001).

The results (Table 33) revealed that the intake of proteins, riboflavin, niacin, iron and ascorbic acid was above the RDA suggested by Swaminathan (2001). The intake of calories, fat, thiamin, beta carotene and calcium was found to be lower than the RDA. The intake of nutrients as percentage of RDA is illustrated in Figure 1.

Table 33. Comparison of mean nutrient intake of the respondents with RDA

Sl.No.	Nutrients	Mean intake	RDA	Percentage of RDA
1.	Calories (Kcal)	3143	3000-5000	78.5
2.	Fat (g)	37	60-90	41.8
3.	Protein (g)	125	80-150	108.2
4.	Calcium (g)	0.6	0.6-0.8	85
5.	Iron (mg)	32	30	108
6.	Beta carotene (µg)	888	2400	36.98
7.	Ascorbic acid (mg)	80	50-80	122
8.	Thiamin (mg)	1.55	2-3	62
9.	Riboflavin (mg)	2.6	2-3.2	100
10.	Niacin (mg)	23.48	26-36	118.9

Fig. 1. Nutrient intake of the respondents



4.3.15. Contribution of energy from carbohydrate, protein and fat

Contribution of energy from carbohydrate, protein and fat is presented in Table 34. From the table it is clear that out of the total energy consumed by the respondents about 73.50 per cent of the energy was met by carbohydrate, 15.91 per cent from protein and the rest (10.59 %) from fat.

Table 34. Contribution of energy from carbohydrate, protein and fat

Nutrients	Mean intake	Percentage contribution to RDA
Carbohydrate	577.5	73.50
Protein	125	15.91
Fat	37	10.59

4.4. NUTRITIONAL STATUS OF RESPONDENTS

4.4.1. Anthropometric measurements

4.4.1.1. Height and weight

Distribution of respondents on the basis of height and weight are presented in Table 35.

The height of the respondents varied from 150 cm to 177 cm with a mean height of 164.36 cm and the height was compared with the reference height of 155 cm suggested for reference women. The height of 88 per cent of the respondents was found to be higher than the reference height and 5 per cent had normal height. The height of 7 per cent of the respondents was found to be lower than the reference height suggested for a reference woman.

The weight of the respondents varied from 42 Kg to 94 Kg with a mean weight of 52.24 Kg. The weight of each respondent was compared with the reference

body weight of 50 kg suggested by ICMR (1990) for reference women and the results (Table 36) indicated that the body weight of 42 per cent of the respondents was lower than the reference weight. The weight of 48 per cent of the respondents was found to be above the reference body weight and the rest (10%) had normal body weight.

Table 35. Distribution of respondents on the basis of weight and height.

n=100

Weight (kg)	Percentage of respondents	Height (cm)	Percentage of respondents
40-49.9	42	150-159.9	36
50-59.9	41	160-169.9	54
60-69.9	9	170-179.9	10
70-79.9	7		
>80	1		
Mean	52.24(Kg)	Mean	164.36(cm)

Table 36. Comparison of weight and height of the respondents with standard weight and height

n=100

Sl. No	Category	Standard weight (kg)	Percentage of respondents	Standard height (cm)	Percentage of respondents
1	Above normal	>50	48	>155	88
2	Normal	50	10	155	5
3	Below normal	<50	42	<155	7
	t value	13.15**		2.7**	

(**) Significant at 1% level

ICMR (1990)

The mean height and weight of the respondents were found to be statistically significant when compared with the standards suggested by ICMR (1990).

4.4.1.2. Mid Upper Arm Circumference

The Mid Upper Arm Circumference (MUAC) of the respondents was compared with the standard MUAC for different age groups suggested by Gopaldas and Seshadri (1987). It was seen that 19 per cent of the respondents had an MUAC similar to that of standards suggested for the respective age groups. The MUAC of 5 per cent was lower than the standards and the MUAC of 76 per cent of the respondents was found to be higher than the standard. MUAC of respondents varied from 21 cm to 36 cm with a mean MUAC of 25.98 cm for 18 to 19 years and 24.9 cm for above 19 years.

Table 37. Distribution of respondents on the basis of MUAC and triceps skin fold thickness

Sl.No.	Details	MUAC (% of respondents)	SFT at triceps (% of respondents)
1	Less than the standard	5	54
2	Equal to standard	19	18
3	More than standard	76	28

	Age group	MUAC (cm)	SFT (mm)
Standard =	18-18.9	20.2	18
	19-24.9	20.7	18

4.4.1.3. Skin fold thickness

4.4.1.3.1.Triceps skin fold thickness

Triceps skin fold thickness of respondents varied from 11 mm to 37 mm with a mean skin fold thickness of 22.16 mm for 18- 18.99 years and 21.18 mm for 19-24.9 years. The triceps skin fold thickness of the respondents was compared with the standard triceps skin fold thickness suggested by Gopaldas and Seshadri (1987). It was seen that 18 per cent of the respondents had normal triceps skin fold thickness as suggested for particular age group, 54 per cent of the respondents had a triceps skin fold thickness lower than the standard and for 28 per cent the triceps skin fold thickness was found to be higher than the standard (Table 37).

4.4.1.3.2. Skin fold thickness at abdomen and sub scapula

Details of skin fold thickness at abdomen varied from 6 to 11 mm among 62 per cent of the respondents, 12-17 mm among 27 per cent. Seven per cent of the respondents had a skin fold thickness in the range of 18 to 23mm and 4 per cent had skin fold thickness above 24mm.

Skin fold thickness at sub scapula of the respondents varied from 3 mm to 13 mm with a mean skin fold thickness of 6.57 mm. The skin fold thickness at sub scapula of 37 per cent of the respondents varied from 3-5mm, 44 per cent had 6-8 mm skin fold thickness and for 19 per cent it varied from 9-14mm (Table 38).

Table 38. Distribution of respondents on the basis of skin fold thickness at sub scapula and abdomen

Sl.No	Abdomen		Sub scapula	
	Range (mm)	Percentage of respondents	Range (mm)	Percentage of respondents
1	6-11	62	3-5	37
2	12-17	27	6-8	44
3	18-23	7	9-11	15
4	24-29	3	12-14	4
5	30-35	1		
	Mean	11.4	Mean	6.55
	Total	100		100

4.4.1.4. Waist and hip circumference

Distribution of respondents with respect to their waist and hip circumference are given in Table 39. From the table, it is clear that the waist circumference of 92 per cent of respondents varied from 60 cm to 80 cm, 4 per cent had a circumference in the range of 91 cm to 100 cm. Only one individual had a waist measurement above 100cm.

In the case of hip circumference it was found that 62 per cent of the respondents had hip circumference in between 70 to 90 cm, 35 per cent had a measurement in between 91 to 100cm and 3 per cent of respondents had hip measurement above 100 cm.

Fig.2. Distribution of respondents with respect to waist hip ratio

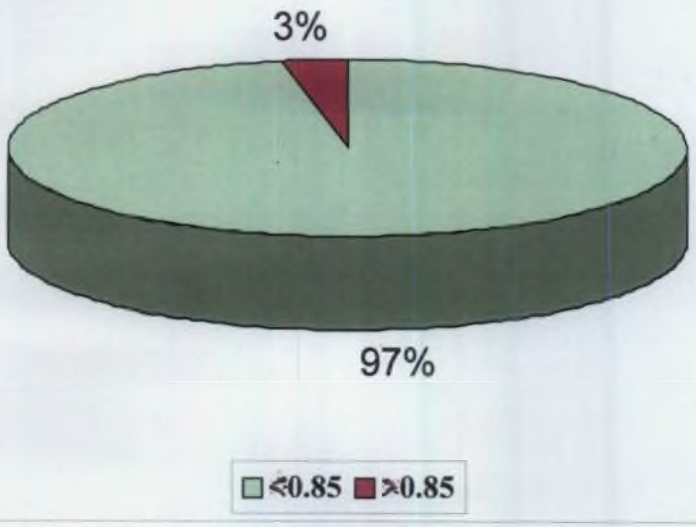


Table 39. Waist and hip circumference

Sl.No.	Measurements	Number of respondents
1.	Waist circumference (cm)	
	60-70	57
	71-80	35
	81-90	4
	91-100	3
	>100	1
	Mean	70.63
2.	Hip circumference (cm)	
	70-80	2
	81-90	60
	91-100	35
	>100	3
	Mean	89.55

4.4.1.5. Waist hip circumference ratio of respondents

The waist hip circumference ratio of the respondents varied from 0.7 to 0.9 and 97 per cent had a waist hip ratio less than 0.85, while 3 per cent had a ratio of above 0.85which is associated with risk among females (Sivakumar, 2000). (Table 40 and Figure 2).

Table 40. Distribution of respondents with respect to their waist hip ratio

Sl.No.	Waist hip ratio	Number of respondents
1.	<0.85	97
2.	>0.85(abdominal obesity)	3
3.	Total	100

4.4.1.6. Body Mass Index (BMI) of respondents

The respondents were categorized on the basis of their Body Mass Index (BMI), which was computed from their weight and height measurements. The respondents were graded into different categories on the basis of the classification suggested by IOTF/WHO (2000).

Table 41. Distribution of respondents based on their Body Mass Index

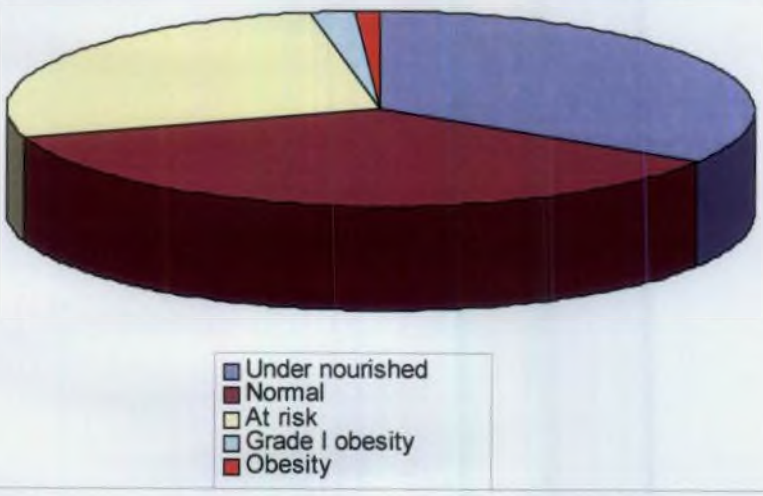
Sl.No.	Category (BMI)	Number of respondents
1	Under nourished (<18.5)	34
2	Normal (18.5-22.9)	36
3	At risk (23-24.9)	27
4	Grade I obesity (25-29.9)	2
5	Obesity (>30)	1

The results indicated that 36 per cent of the respondents had a normal BMI with in the range of 18.5 to 22.9 and only 3 per cent had obesity. Twenty seven per cent of the respondents were found to be in 'at risk' category and 34 per cent had a BMI less than 18.5 indicating that they are under nourished (Table 41 and Figure 3).

4.4.1.7. Body fat percentage

The body fat percentage was computed as suggested by Katch and McArdle (1973) from the skin fold measurements at triceps, scapula and abdomen (Table 42). The body fat percentage of the respondents varied from 10.5 per cent to 25.46 per cent. It was found that 77 per cent of the respondents had a body fat percentage below that of the standard, 13 per cent had a body fat percentage equal to that of standard

Fig. 3. Distribution of respondents based on BMI



and the body fat percentage of 10 per cent was found to be higher than the standard when compared to the standard suggested by Katch and McArdle (1973)

Table 42. Comparison of percentage of body fat with standard

Details	Percentage of respondents
Less than the standard	77
Equal to standard	13
More than standard	10

	Age group (years)	standard	mean
Standard =	18-20	17%	15.51
	20-22	18%	13.5
	23-25	19%	17.27

4.4.1.8. Lean Body Mass (LBM)

Table 43. Distribution of respondents on the basis of Lean Body Mass

Sl.No.	Lean body mass (Kg)	Percentage of respondents
1	35-39.99	16
2	40-44.99	48
3	45-49.99	22
4	50-54.99	8
5	55-59.99	3
6	60-64.99	-
7	65-69.99	1
8	70-74.99	2

The lean body mass of the respondents varied from 35 to 74 Kg. It was seen that 48 per cent of the respondents had a lean body mass in the range of 41 to 44.99 Kg, 16 per cent had a lean body mass in the range of 35 to 40 Kg and 22 per cent in between 45 to 49.99 Kg. About 3 per cent had lean body mass in between 55 to 59.99Kg and 1 and 2 per cent had a lean body mass index of 65-69.99 Kg and 70-74.99 Kg respectively (Table 43).

4.4.1.9. Mean BMI, body fat percentage and LBM of respondents of various events

Distribution of respondents with respect to BMI indicated that basket ball, kabadi, weight/power lifting, swimming and cricket and hockey players had normal BMI, in the range of 18.5 to 22.9. The respondents participated in athletics, hand ball and judo were having a BMI less than normal (Table 44).

Percentage of body fat was found to be low among judo players and athletes. Swimmers and weight and power lifters had a high body fat percentage followed by hand ball, cricket and hockey, basket ball and kabadi players.

Lean Body Mass (LBM) was found to be almost similar in all the respondents. Lower LBM was noticed among the respondents participated in cricket and hockey. Followed by basket ball players. Highest LBM was found among weight and power lifters (Table 44).

Table 44. Mean BMI, body fat percentage and LBM of respondents of various events

Events	BMI±SD	Body fat percentage ±SD	LBM±SD
Athletics	17.53±1.604	12.6±2.746	44.48±3.109
Basket ball	20.09±8.43	13.94±3.549	43.41±6.27
Hand ball	17.82±2.504	15.93±2.832	44.25±5.70
Kabadi	18.90±2.228	13.46±2.998	44.42±4.54
Weight/power lifting	21.4±2.053	17.21±2.265	47.66±3.901
Judo	18.15±0.1414	12.58±2.05	44.47±1.488
Swimming	18.95±2.165	16.75±4.29	44.8±6.14
Cricket and hockey	18.56±8.0018	14.21±6.234	40.07±12.065

4.4.2. Clinical examination

Incidence of clinical signs and symptoms observed among the respondents are presented in Table 45.

Different clinical symptoms related to nutritional deficiencies like pale conjunctiva (10%), cheilosis (3.3%), thin and sparse hair (10%), spongy bleeding gums (3.3%), slight enlargement of thyroid gland (13.3%) and Knock-knees (3.3%) were observed among the respondents.

The pulse rate of 53.3 per cent of the respondents was found to be above the normal rate and 40 per cent had a normal pulse rate.

Table 45. Clinical manifestations observed among respondents

Sl.No.	Symptoms	Number of respondents
1	General appearance	
	Good	29(96.7)
	Fair	1(3.3)
2	Face	
	No symptoms	30(100)
3	Hair	
	Thin and sparse	3(10)
	No symptoms	27(90)
4	Eyes	
	Pale conjunctiva	3(10)
	No symptoms	27(90)
5	Lips	
	Cheilosis	1(3.3)
	No symptoms	29(96.7)
6	Teeth	
	Normal	30(100)
7	Gums	
	Spongy bleeding gums	1(3.3)
	No symptoms	29(96.7)
8	Skin	
	No symptoms	30(100)
9	Nail	30(100)
	No symptoms	
10	Gastro intestinal	30(100)
	No symptoms	
11	Muscular and skeletal	
	Knock –knee	1(3.3)
	No symptoms	29(96.7)
12	Glands	
	Slight thyroid enlargement	4(13.3)
	Normal	26(86.7)
13	Nerves	
	Normal	30(100)
14	Cardiovascular	
	Pulse rate	
	Below normal	2(6.7)
	Normal	12(40.0)
	Above normal	16(53.3)

4.4.3. Biochemical estimation

4.4.3.1. Haemoglobin status of respondents

The haemoglobin level of respondents varied from 9.8 g to 12.7g100ml^{-1} and the values were compared with the normal haemoglobin values suggested by WHO as given in Gopaldas and Seshadri (1987) (Table 46).

Table 46. Haemoglobin status of respondents

Sl.No.	Hb level (g/dl)	Number of respondents	Percentage of respondents
1.	8-9.9	2	6.67
2.	10.11.9	3	10.00
3.	Normal	25	83.33
	Total	30	100

From the results it was revealed that the 83.33 per cent of respondents had a normal haemoglobin level of 12 g100ml^{-1}. Among 6.67 per cent of respondents the haemoglobin values varied from 8 to 9.9 g100ml^{-1}. While in 10 per cent the level was found to be in between 10 to 11.9g100ml^{-1}.

4.4.3.2. Iron status of the respondents

To interpret the iron status of sports women, they were grouped according to the criteria suggested by Gopaldas and Seshadri (1987) with reference to haemoglobin level and the details are given in Table 47. The results revealed that only 6.7 per cent of the respondents had acceptable iron status and 86.6 per cent had low iron status and 6.7 percent had deficient iron status on the basis of haemoglobin values (Fig. 4).

Fig. 4.Distribution of respondents with respect to iron status

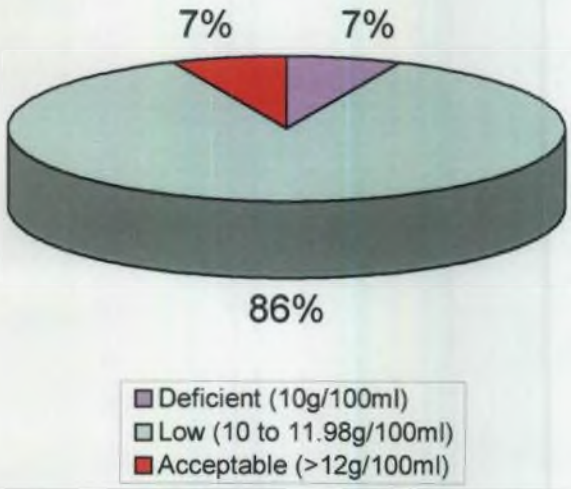


Table 47. Distribution of respondents on the basis of iron status

Sl. No.	Category	No. of respondents	% of respondents
1.	Deficient (10g/100ml^{-1})	2	6.7
2.	Low (10 to 11.98g/100ml^{-1})	26	86.6
3.	Acceptable (>12g/100ml^{-1})	2	6.7

4.4.6.3. Urinary urea level of respondents

Table 48. Urinary urea level of respondents

Sl.No.	Urea level (mg100ml^{-1})	Number of respondents	Percentage of respondents
1	Below normal <820	20	66.7
2	820-1024 (normal)	7	23.3
3	Above normal >1024	3	10
	Total	30	100

Urinary urea level of the respondents varied from 340 mg100ml^{-1} to 1039mg 100ml^{-1} with a mean level of 789 mg100ml^{-1}.Nearly 23.3 per cent of the respondents had a normal urinary urea level of 820-1024 mg100ml^{-1}, while 66.7 per cent had lower values and 10 per cent had a high urinary urea level above the normal values (Table 48).

4.5. PHYSICAL FITNESS STATUS OF RESPONDENTS

4.5.1. Endurance capacity of respondents

Endurance capacity of respondents was measured by Harward's step test and the respondents were grouped based on their physical condition. Results presented in Table 49 revealed that about 39 per cent of the respondents had an index lower than 55, which indicated their poor physical capacity. The physical condition of 21 per

cent of the respondents was found to be between 55 to 64, which indicated their lower physical capacity. Only 14 per cent of the respondents had excellent physical condition in which their index was found to be above 90 and 15 and 8 per cent respectively had high (65-79) and good (80-89) physical conditions (Figure. 5).

Table 49. Distribution of respondents on the basis of physical condition

Sl.No.	Index	Physical condition	Number of respondents
1.	<55	Poor	39
2.	55-64	Low average	21
3.	65-79	High average	15
4.	80-89	Good	8
5.	>90	Excellent	14

4.5.2. Lung capacity of the respondents

The lung capacity of the respondents varied from 260cc/second to 1220cc/second with a mean lung capacity of 889.94 cc/ second. Results (Table 50) revealed that 13 per cent of the respondents had a lung capacity between 200-350 cc/second, 39 per cent had 351-501 cc/second and 17 per cent had a lung capacity of 502-652 cc/ second.

Table 50. Distribution of respondent based on their lung capacity

Sl. No.	Lung capacity (cc/second)	Number of respondents (n=100)
1	200-350	13
2	351-501	39
3	502-652	17
4	653-803	9
5	804-954	11
6	955-1105	8
7	>1105	3

Lung capacity of 9 per cent of the respondents varied from 653 to 803 cc/second. About 8 and 3 per cent of the respondents had a lung capacity in between 955 to 1105 and above 1105 cc/second respectively.

4.6. ENERGY EXPENDITURE PATTERN

Details about the daily energy intake and expenditure pattern are presented in Table 51. It was seen that respondents participated in basket ball and kabadi had an energy intake less than energy expenditure, where as participants of athletics, hand ball, weight/ power lifting, judo, swimming and cricket and hockey had a positive energy balance.

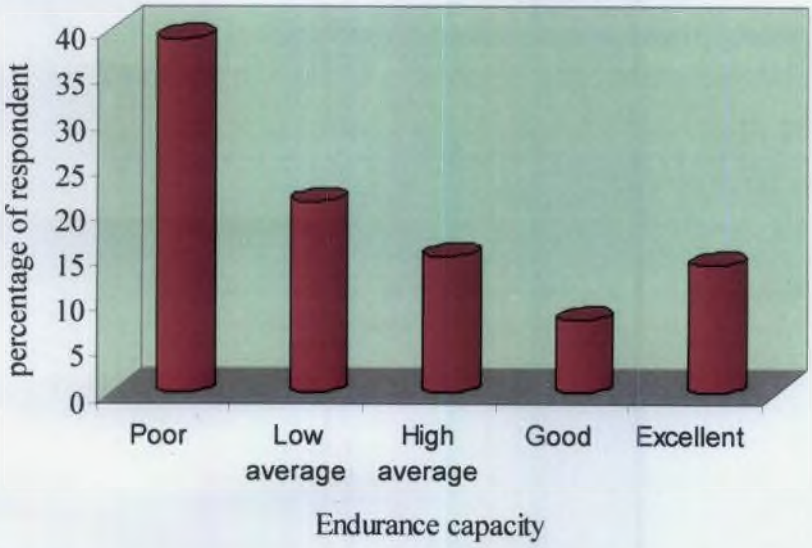
Table 51. Comparison of the energy intake and expenditure pattern of respondents

(n=100)

Events	Mean energy intake	Mean energy expenditure	Balance
Athletics (28)	2693.18	2378.8	314.38
Basket ball (15)	3184.8	3918.6	-733.80
Hand ball (14)	2797.8	2317.15	480.65
Kabadi (14)	2708.2	3401.52	-693.32
Weight/ power lifting (9)	2775.63	2425.87	349.76
Judo (2)	2558.04	2198.3	359.74
Swimming (14)	3014.2	2353.8	660.40
Cricket and hockey (4)	2697.92	2100.76	597.16

(Figures in parentheses are number of respondents)

Fig 5. Distribution of respondents with respect to endurance capacity



4.7. CORRELATION COEFFICIENTS

4.7.1. Relationship between BMI and other body parameters

Relationship between BMI and different body parameters indicated significant relationship with weight, MUAC and percentage of body fat. There was no significant relation between height, WHR and lung capacity with BMI (Table 52).

Table 52. Relationship between BMI and body parameters

Sl.No.	Details	Correlation coefficient
1.	Weight Vs BMI	0.515(**)
2.	Height Vs BMI	0.689(Ns)
3.	MUAC Vs BMI	0.221(*)
4.	Lung capacity Vs BMI	0.006(Ns)
5.	Body fat Vs BMI	0.332(**)
6.	Waist hip ratio Vs BMI	0.152(Ns)

**Significant at 1% level

*Significant at 5% level

Ns not significant

4.7.2. Relationship between endurance capacity and other selected parameters

Table 53. Relationship between endurance capacity and other selected parameters.

Sl.No.	Details	Correlation coefficient
1.	Weight	0.001
2.	Height	0.019
3.	BMI	0.006
4.	Energy	0.014
5.	Protein	0.081
6.	Fat	0.123
7.	LBM	0.065
8.	Haemoglobin	0.145

Endurance capacity of the respondents was correlated with height, weight, BMI, haemoglobin level and intake of energy, fat, and protein. The results revealed that there is no significant correlation between endurance capacity and these independent variables (Table 53).

4.7.3. Relationship between lung capacity and other selected parameters

Lung capacity of the respondents was highly correlated with energy and fat intake at 1 per cent level. Comparison of lung capacity with BMI, height, weight, body fat percentage, LBM were found to be statistically insignificant (Table. 54).

Table 54. Relationship between lung capacity and other selected parameters

Sl.No.	Details	Correlation coefficient
1.	Weight	0.001(Ns)
2.	Height	0.172(Ns)
3.	BMI	0.006(Ns)
4.	Body fat percentage	0.136(Ns)
5.	LBM	0.042(Ns)
6.	Energy	0.309(**)
7.	Protein	0.142(Ns)
8.	Fat	0.354(**)

**significant at 1% level

Ns not significant

4.7.4. Relationship between haemoglobin and other selected parameters

Correlation between haemoglobin status and height (0.103), endurance capacity (0.145) and iron intake (0.075) were statistically not significant.

4.7.5. Relationship between urinary urea and other selected parameters

Correlation of urinary urea with endurance capacity (0.007), lung capacity (0.092) and protein intake (90.052) were statistically not significant.

DISCUSSION

5. DISCUSSION

The discussion pertaining to the findings of the present study entitled "Nutritional Profile and Physical Fitness of Sports Women" is presented in this chapter under the following broad sections.

1. Socio economic profile of the families
2. Personal details of respondents
3. Dietary habits of the respondents
4. Nutritional status of respondents
5. Physical fitness of respondents
6. Energy balance

5.1. SOCIO ECONOMIC PROFILE OF THE FAMILIES

In the present study it was observed that majority of the families (56%) were Hindus, followed by Christians (40%) and Muslims (4%). Among Hindus only a minority (19.64%) belonged to forward community and the rest (17.86%) belonged to other backward communities (62.5%) or schedule caste communities (17.86%).

Due to urbanization and changes in social values, joint family system is disintegrating in different communities of Kerala. According to Saxena (1986) nuclear type families are better than joint families in health and development. In the present study it was seen that majority (93%) of the families followed nuclear type family system. Similar findings were observed among the different groups of Kerala by Thomas (1989); Nagammal (1989); Karuna (1993); Seshadrinath (1993); Ranganathan (1996); Shyna (1996); Jose (1998); Smitha (1999); Anil *et al.* (2001); Ukkru (2001); Jyothi (2003); Lawrence (2003) and Saleena (2004). Nuclear type family system was also reported by National Institute of Nutrition (1995) in the

households of Kerala, Gujarat and Andhra Pradesh. Similar findings were reported by Swamy *et al.* (2000) and Rajkumar and Kamble (2003) and Kumari and Singh (2003) in households of Karnataka, Maharashtra and Bihar respectively.

In Kerala, unlike other states, small family norm has become very popular even among the low income groups probably due to the availability of medical and educational facilities as well as constant exposure of the public to small family norm through different media. Family size is a major factor influencing the nutritional status of family members. Children from small families had lesser evidence of nutritional deficiencies than children from larger families. Majority of the families (89%) in the study were found to be from medium sized families with 4-6 members. Similar finding of a small family norm with limited number of children was observed among the households of labourers of different categories in Kerala by Jayanthakumari (1993), Karuna (1993), Jose (1998), Smitha (1999), Anil *et al.* (2001), Jyothi (2003) and Saleena (2004). Kumari and Singh (2003) also reported small and medium sized families in the households of Bihar. Contrary to this finding Usha *et al.* (1990) reported that most of the labour families in Thiruvananthapuram district of Kerala had a large family size consisting of five to nine members. Shantrugna *et al.* (1993) and Swamy *et al.* (2001) also reported larger families in the households of Hyderabad and Karnataka respectively.

Literacy is an important demographic characteristic, which is an indicator of the level of advancement of the people. The census of India 2001 ranked Kerala as the most literate state with a higher literacy rate of 90.02 per cent (Manorama Year Book, 2001). A positive association between parental literacy and nutritional status was reported by Devadas (1994). In the present study also it was seen that all the mothers and most of the fathers were literate. Similar findings were observed by Smitha (1999); Jyothi (2003); Lawrence (2003) and Saleena (2004). In contrast to

this finding Rajkumar and Kamble (2003) indicated literacy among 73.3 per cent of mothers and 40 per cent of fathers of adolescent girls in Maharashtra.

In India, even though literacy level is very high, men have better education than women probably because of the social discrimination against women (Ingle and Khai, 1987 and Joseph, 1991). Contrary to this observation in the present study female members were found to be more educated than their male counterparts. Similar findings were reported by Anil *et al.* (2001) among the dairy farmers of Kerala. Jyothi (2003) also reported similar findings among the agricultural labour families of Palakkad district of Kerala. However, studies in Kerala, Haryana, Andrapredesh, Karnataka and Gujarat by Choudhary (1990); Sujatha (1990); National Institute of Nutrition (1996), Mathen (1998) and Smitha (1999) indicated higher literacy percentage among male members.

Though, in recent years a transition has taken place in the role of women from wife or mother and to a member of work force to make them economically independent, in the present study it was seen that 83 per cent mothers were unemployed. About 53 per cent of the fathers were found to be engaged as casual laboures on daily wages.

Economic status of the family is reflected by their family income, number of earning members of the family and monthly expenditure pattern (Wood and Baylock, 1982). Income decides standard of living of a family. In the present study, monthly income of 25 per cent of families ranged from Rs.1000 to Rs.2000 and 49 per cent had a monthly income in the range of Rs.2001- 10,000. This is in line with the observation of Karuna (1993); Verma (1996) and Devi (2000) who reported a mean monthly income of Rs. 1000 to 3000 among the families of the casual

laboures in Kerala. Rajkumar and Kamble (2003) observed similar findings in the households of Maharashtra.

Per capita income of the families indicated that majority (81%) of the families had a per capita income below Rs. 500.

5.2. PERSONAL DETAILS OF RESPONDENTS

Majority of the selected respondents belonged either to 1^{ts} or 2nd birth order. About 40 per cent of the respondents belonged to the 2 nd birth order and 18 per cent and 4 per cent respectively belonged to 3 rd or 4th birth orders. Increasing birth order is associated with poor nutritional status of the child because as the number of children increases care given to elder siblings decreases. Similarly shorter birth intervals also adversely affect the nutritional status of the children. The present study revealed that about 42 per cent of the respondents had a birth interval of 1 or 2 years.

The mean age at menarche among rural adolescent girls in Kerala was found to be 14.64 years (Rau *et al.,* 1984). Earlier studies from India have indicated that nutritional status during early adolescence has a greater influence on the adolescent growth spurt and age at menarche. In the present study also it was seen that about 39 per cent of respondents attained menarche at the age of 12 to 13 years and 34 per cent at the age of 14 years. Similar findings were reported by Panjikkaran (2001). Parveen and Beegum (2001) reported the mean menarcheal age of adolescent girls as 12.5 years among low income groups. They also noted a decreasing trend in the age at menarche in all the segments of population irrespective of their rural urban residence or social class during the last two or three decades which is due to the changes in food habits.

New and popular sports attracted our youth, more than six million were involved in a wide variety of sports activities. The present study revealed that about 28 per cent of the selected respondents were athletes, 15 per cent were basket ball players, 14 per cent each in hand ball, swimming and Kabadi. The rest are judo players (2%), weight and power lifters (9%) and cricket and hockey players (4%). All the respondents participated in district and state level of competitions and were found to be National (71%), University (62%) and International players (3%).

Physical exercise, which is a prerequisite for health, improves blood circulation and tones up the muscles and it increases energy expenditure. Exercise relives tension and helps an individual to relax and sleep properly. Exercise should become a part of one's daily routine and regular exercise is very important for individuals who are engaged in sports. In the present study all the selected respondents used to take physical exercise regularly for 4 to 5 hours daily both in morning and evening.

Yoga, the age old Indian practice of mind and body control can play a prominent part in all walks of life including health (Ghafoorinissa and Krishnaswamy, 2000). The functions and state of the mind has its repercussions upon physical well being. Though, yoga practice is beneficial for better health, in the present study only 17 per cent of the respondents practiced yoga.

About 69 per cent of the respondents participated in state and national coaching camps which helped to familiarize with new sports equipment, scientific way of practicing and to gather current knowledge about new skills and helped to improve their performance.

About 92 per cent of the respondents participated in extra curricular activities like compulsory social service, NCC, and entertainments.

About 76 per cent of the respondents received scholarships/fellowships from sports council in the range of Rs. 10,000–12,000/year and more than 50 per cent of the amount was utilized for food and education.

Poor conditioning, lack of warm up and cool down were considered as the risk factors with regard to over use and acute sport injuries (Millards, 1994., Machellen, 1984., Zanda, 1994., and Hawkins and Kennedy 1990). Majority (84%) of the respondents in the present study were found to be free from injury, where as rest (16%) suffered from injury of hand, leg and had back pain.

Periodic medical check up is important to find out the fitness in sports activities. In the present study also all the respondents used to undergo periodical medical check up either monthly or once in a year.

Four per cent of the respondents consumed regular medicines either to cure the diseased condition or to improve their physical fitness.

5.3. DIETARY HABITS OF THE RESPONDENTS

Though, vegetarianism is gaining importance now a days, the present study indicated that all are habitual non vegetarians. Earlier studies conducted by Mini (1992) and Sajitha (2000) among adolescent athletes also supported the above findings. Though, all the respondents were non vegetarians, the respondents prefer both vegetarian and non vegetarian foods. Food preference and selection are influenced by social and external pressure (Bull, 1988).

Meal pattern indirectly indicates the dietary habits of an individual. Analysis of the meal pattern of the respondents indicated that all the respondents had three major meals daily. Similar findings were observed by Mini (1992) and Sajitha (2000) among adolescent athletes.

Frequency of use of various food items among the respondents indicated that they included cereals, other vegetables, fruits, nuts and oilseeds, fats and oils, spices and condiments and sugar in their daily diet. This is mainly because the staple food is rice and the main source of fat and oil is coconut oil, which is used for seasoning the food and Keralites use coconut in almost all preparations. They consumed banana daily and included sugar in coffee or tea which they consumed daily.

Consumption of pulses is found to be two or four times in a week. Stephanie (1984) also did not observe regular consumption of pulses in south India and was found to be once or twice in a week. Udaya (1996), Smitha (1999), Jyothi (2003) and Aneena (2003) observed pulses as a medium frequently consumed food item in the low income groups of rural Kerala.

Regarding the consumption of green leaves it was found that in one institution they included leafy vegetables once in a week and in the other two they consumed leafy vegetable only occasionally. The low consumption of green leaves among the respondents is due to difficulty in preparation and serving of green leaves for the large number of inmates residing in the hostels. It was also noticed that cabbage is the main green leafy vegetable provided in the three hostels. Usha and Beegum (1985) also indicated decreased consumption of green leafy vegetables by the hostelers.

Frequency of consumption of fruits was found to be daily among all the respondents and banana was the major fruit consumed by all the respondents. Banana

being rich in carbohydrate and phosphorus helps to replenish the energy and phosphorus lost through exercise.

In two institutions respondents consumed one glass of milk daily and in the other they consumed milk occassionally. However, they used to consume milk through tea and coffee.

Consumption of meat showed that the respondents of two institutions consumed meat as a special food item daily. Only in one institution respondents consumed egg daily. Studies of Mini (1992) and Sajitha (2000) indicated weekly consumption of meat and egg among adolescent athletes in Thiruvandapuram district of Kerala.

Though, Indian population is mostly vegetarians the intake of vegetables or raw foods has been too low in daily diet. People do not eat vegetables or raw foods or eat less in quantity mainly due to ignorance of the importance of these foods. The present study revealed that all the respondents included raw foods. About 17 per cent of the respondents included fresh fruits like orange, guava and apple. Salad and raitha were also included in their diet. However, the frequency was found to be weekly once or twice.

It was also seen that care was taken by sports departments to include foods from various groups in the daily dietaries of the respondents in order to avoid monotony.

According to Arya (1992) there is an increasing demand for processed and prepared foods around the globe as these are convenient to use and readily acceptable especially by adolescents. The present study revealed that about 41 per cent of the

respondents purchased prepared foods from hotels, bakery and fast food centers. Frequency of purchase varied from once in a week to occasionally. It was also noticed that majority (85.37%) of the respondents purchased both vegetarian and non vegetarian foods.

Prepared foods like cakes, fried foods, bread, sweets, biscuits, ice creams etc are preferred most commonly by the respondents. Robson *et al.* (1991) studied the snacking habits of 1015 adolescent respondents and found that majority of them preferred sweet preparations such as sweets, cake and biscuits and purchased these food items once in a while from hotels and bakery. Consumption of fast foods like noodles, burger, cutlets etc were also noticed among the respondents.

Eating outside habits of respondents revealed that about 47 per cent of the respondents used to eat from out side and majority consumed both vegetarian and non vegetarian foods from outside. Similar findings were also reported by Panjikkaran (2001) among the adolescent girls.

Data collected to gather information about the use of food and nutrient supplements revealed that about 30 per cent of the respondents consumed food and nutrient supplements like health drinks, allopathy supplements and glucose. It was also noticed that majority of the respondents ignored about the commercial sports supplements available in the market and believed that these sports supplements adversely affect their health status.

An athlete, however fit and trained for a competition, will have an impaired performance if liver and muscle glycogen stores are depleted due to lack of proper attention to pre- competition meal (Joshi, 2002). Present study revealed that most of the respondents (73%) were aware about the pre game meal. Individual preferences

were observed in the selection of pre game meal or foods depending on their event of participation. The respondents consumed glucose, fruits, fruit juices and electrole as their pre game meal/ food as an immediate source of energy during competition, to relieve tension before competition and to improve their confidence in competition.

Cool items, oily foods, non vegetarian foods etc were avoided by 65 per cent of the respondents during the previous day of competitions so as to avoid discomfort which may occur during competitions, to avoid indigestion and to improve the confidence during competitions.

Majority (93%) of the respondents modified their diet during competitions, either by reducing the quantity of foods or by including more food items. These modifications also were found to be on the basis of competitions they participated ie, weight/power lifters included more foods in their diet so as to cope up with their prescribed weight category during the competitions. Majority of the respondents consumed glucose and water to maintain fluid and energy balance.

When an exercise ends the body must shift from the catabolic state of breaking down glycogen, triglycerides and muscle protein for fuel to the anabolic state of restoring muscle and liver glycogen, deposing lipids and synthesising muscle protein's. The present study revealed that about 58 per cent modified their diet. Among this, about 55 per cent of the respondents consumed normal diet with increased quantity, 36.21 per cent consumed special foods and 8.62 per cent consumed light foods. Rest (42%) consumed normal diet.

Comparison of the hostel diet with the home diet indicated vide variation in the hostel foods with respect to taste, preparation style and selection of ingredients.

The hostel diet was viewed as nutritious only by 4 per cent of the respondents and 43 per cent opined that it is tasty and 6 per cent ranked it as excellent. However, few of the respondents were not happy with the strict time schedule of the hostel mess and fixed menu followed in the hostel. Nine per cent of the respondents ranked the hostel food as tasteless.

Food list survey for one week was carried out to find out the intake of different nutrients and the results revealed that the mean intake of fat, thiamin, calcium and beta carotene was found to be less than the RDA. The intake of other nutrients like energy, protein, niacin, vitamin C and iron were more than the RDA. Percentage intake of riboflavin was equal to RDA.

The mean energy intake of 3900 Kcals and 3007 Kcals per day was reported among athletes by Celijowa *et al.* (1970) and Guzman *et al.* (1972). Devadas *et al.* (1979) reported daily energy intake of 3000 to 3500 Kcals among athletes. In contrast to these observations Mulligan and Butterfield (1990) and Sajitha (2000) found that both male and female endurance athletes failed to meet their recommended energy intake.

Increased protein requirement for athletes is necessary to repair exercise induced micro damage to muscle fibers, as an energy source during exercise and to support gain in lean tissue mass (Butterfield, 1987 and Lemon, 1998). The present study indicated higher intake of protein among athletes and this was found to be in line with the findings of Gueznnec (1993).

Intake of vitamin C increases the level of antioxidant in the body, which is vital in the removal of free radicals that are formed during heavy bouts of aerobic

exercise (Rao, 1996). The present study revealed that intake of vitamin C was found to be higher than the RDA.

Study conducted by Clement and Asmundson (1982) among 52 elite Canadian distance runners revealed that about 29 per cent of men and 82 per cent of women were iron deficient. However, the present study indicated normal intake of iron among the respondents.

Muoio *et al.* (1994) and Lambert *et al.*(1994) proposed a positive effect of relatively high fat diet on athletic performance. Sports Authority of India (1998-99) suggested an adequate fat in the diet of sports and athletic individuals to provide adequate energy density, to reduce bulk and to ensure intake of required high level of energy to support the need of even the longest endurance events. However, in the present study, the mean intake of fat was found to be lower than the RDA. William *et al.* (1986) also reported lower fat intake among athletes, and Goswami and Anand (2000) reported high fat intake among athletes.

Study conducted by Sebastian (2003) reported deficiencies of macro and micro nutrients in the diet of female volley ball and basket ball players. Dandge and Mane (2000) indicated deficiency of all nutrients except thiamin and riboflavin in the diet of sports persons. The present study revealed that intake of riboflavin is equal to that of RDA suggested for sports persons while thiamin intake was found to be lower than the RDA.

Contribution of energy from carbohydrates, fats and proteins revealed that contribution of energy from carbohydrates is 73.50 per cent, fat is 10.59 per cent and from protein 15.91 per cent.

Carbohydrates are essential for the best athletic performance. Maximum glycogen stores is the primary goal of sports nutrition. National Institute of Nutrition (2002) has recommended that about 50 – 75 per cent of the energy requirement must be met through carbohydrate. If lower levels of carbohydrates are consumed, they may result in glycogen depletion, resulting in staleness that affects performance in training and competition. The energy contributed by carbohydrate was found to be 73.50 per cent.

According to National Institute of Nutrition (2002) about 32 per cent of energy requirement of sports persons must be met through lipids. Of this 10 per cent from invisible and 20 % from visible fat. However, in the present study the contribution of energy from fats was found to be only 10.59 per cent.

Since, the consumption of calories for the different categories of sports events ranges between 50-80 Kcal/Kg/day, the amount of protein ingested by the athletes also rises proportionally. About 15 per cent of the daily energy requirement should be met by proteins. In the present study the energy from protein was similar to that suggested by National Institute of Nutrition (2002).

5.4. NUTRITIONAL STATUS OF THE RESPONDENTS

The nutritional problems of developing countries are due to the fact that majority of the population subsist on an inadequate diet in terms of quality and quantity (Gopalan, 1991). Hence, determination of food and nutrient intake of different groups is of utmost importance.

In the present study, anthropometry, clinical examination, and biochemical estimation of blood for haemoglobin and urine for urea were reckoned as the major determinants of nutritional status of sports women.

Anthropometric measurements viz. height, weight, Mid Upper Arm Circumference (MUAC), skin fold thickness at triceps, subscapula and abdomen and waist and hip circumferences were taken into account to assess the nutritional status of the respondents. From these measurements Body Mass Index (BMI), Waist Hip Ratio (WHR), body fat percentage and Lean Body Mass (LBM) were computed.

The mean height and weight of respondents were found to be 162.36 cm and 52.24 kg respectively with a variation of 150 cm to 177 cm in height and 42 to 94 Kg in weight

The present findings are in line with the mean height and weight of 162.32cm and 54kg reported by Debnath and Bawa (2000) among female swimmers. Ramaswamy (2001) also reported almost similar height and weight of 166.3cm and 56.91kg respectively among middle and long distance runners. Different studies conducted among male sports persons have indicated higher mean height and weight than that observed in the present study. Garay *et al.* (1974), Carter (1982), and Tittle and Wutscherk (1992) reported a mean height and weight of 168cm and 76.6kg, 170.5cm and 86.9kg and 171.9cm and 79.9 kg among sports persons of Mexico, Montrel and France respectively. Bawa *et al.* (2000) also indicated a mean height and weight of 173.62cm and 62.74kg respectively among volley ball players of Patiala and Kolkata. Rajini *et al.* (2000) reported a mean weight and height of 71.48 kg and 167.5cm respectively among adult weight lifters. However, Chandrasekaran and Easwaran (2000) reported an higher mean weight and height than that observed in the present study among the selected athletes belonging to the various sports disciplines.

Height is an indicator of long term nutritional status. The height of respondents was found to be higher than the reference height for an Indian reference woman. Sajitha (2000) indicated an increased height for age among pre adolescent athletes of Trivandrum district while Mini (1992) indicated a lower height for the corresponding age among athletes.

Weight for age is the most sensitive index to evaluate the current nutritional status. In the present study it was observed that the body weight of 48 per cent of the respondents was higher than the reference body weight for an Indian reference woman suggested by ICMR (1990). Studies conducted by Mini (1992) and Sajitha (2000) indicated low body weight among athletes when compared with Indian standards.

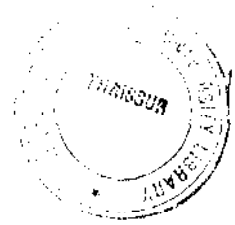
Mid upper Arm Circumference (MUAC) is an indicator of muscle development and also help to assess the amount of subcutaneous fat, which in turn gives an indication of the calorie reserves in the body of an individual (Malina *et al.*, 1974). The present study revealed that majority of the respondents had a mid upper circumferences either almost similar to the standard (19%) or above the standard (76%). Only 5 per cent had a mid upper arm circumferences lower than the standards suggested by Gopaldas and Seshadri (1987). Similar findings were reported by Mini (1992) among adolescent athletes. In contrast to this Sajitha (2000) observed a lower mid upper arm circumference among pre adolescent athletes.

Skin fold thickness represents a comparatively simple and reasonably accurate assessment of body fatness, which is an important part of the estimation of nutritional status. According to McNill *et al.* (1991) skin fold may provide the most valid estimates of fatness. The skin fold thickness at triceps of 54 per cent of the

respondents in the present study was found to be lower than the standard. Mini (1992) also reported a lower skin fold thickness among adolescent athletes of Trivandrum district.

Waist hip ratio is a sensitive indicator to assess the risk of developing various degenerative diseases. Ghafoorunissa and Krishnaswamy (2000) indicated that fat around the abdomen (android) is more dangerous than fat around the hips (gynoid) and suggested to maintain the waist line trim and to maintain a waist to hip ratio less than 0.8 among women. The present study revealed that 97 per cent had a waist hip ratio less than 0.85, while 3 per cent had a ratio greater than 0.85. Android obesity is quite often associated with hypertension, hyper triglycerdemia, hyper insulinemia and diabetics. Sivakumar (2000) also indicated that waist hip ratio of more than 0.85 in women is associated with high risk. NIN (2000) had stated that women with a waist hip ratio measurement of more than 0.85 have an higher health risk because of fat distribution. In the present study also only 3 per cent women had a waist hip ratio more than 0.85.

Body mass index describes Chronic Energy Deficiency (CED) among adults and is an important indicator of current nutritional status and health risk. On the basis of the criteria suggested by IOTF/WHO (2000) for Body Mass Index, about 36 percent of the respondents were found to be having a normal Body Mass Index in between 18.5 to 22.9 and 27 per cent were categorized as 'at risk' group ie, they are prone to become obese. Chandrasekaran and Easwaran (2000) in a study conducted among athletes participating in different sports events had indicated normal body mass index among all athletes except the athletes belonging to marathon and basket ball events who were categorised as having normal body mass index with low body weight. In the present study the respondents participating in basket ball, kabadi, weight and power lifting, swimming and cricket and hockey were found to be having



normal body mass index (Table 45) while the respondents participating in athletics, hand ball and Judo had lower body mass index. With respect to obesity, only 3 per cent of the respondents were categorized as having obese on the basis of body mass index indicating that the respondents are keen to maintain their body weight, which might be attributed through their regular training.

The importance of body fat content is well recognized because it may influence the morbidity and mortality and serves as an index of health status (Roy *et al.*, 2001). Body fat percentage of respondents revealed that 77per cent of them were having lower percentage of body fat than that of the standard suggested by Katch and McArdle (1973). Majority of the respondents under study did not have accumulated fat stores and 13 per cent had a body fat per cent equal to that of the standard. Only 10 per cent of the respondents had a body fat percent above the standard measurement. The lower body fat percentage observed among majority of the respondents might be due to their regular training and exercise. Sajitha (2000) also indicated a lower percentage of body fat among pre adolescent athletes. However Roy *et al.* (2001) observed low, medium and high body fat mass among 36.6 per cent, 45 per cent and 18.4 per cent respectively of female university students.

The Lean Body Mass (LBM) of the respondents varied from 35 to 74 Kg. As the body fat per cent increases lean body mass gradually decreases. Chandrasekaran and Easwaran (2000) observed a lean body mass of 52.48, 55.12 and 59.04 among athletes participating in marathon, cross country and walk events. However in the present study the lean body mass of sports women participating in different events was found to be below 45. Cole *et al.* (1997) indicated greater lean body mass among tall individuals than short subjects.

Results of clinical examination among the respondents indicated different clinical manifestations related to nutritional deficiencies. Pale conjunctiva, cheilosis, thin and sparse hair, spongy bleeding gums, slight enlargement of thyroid gland and knock-knee were the important symptoms observed among some respondents. Some of these symptoms might be due to their daily exposure to climatic changes rather than nutrient deficiency. Mini (1992) indicated dental carries and mottled enamel as the common clinical manifestations among athletes. Xerosis, bitot's spot and enlargement of thyroid glands were the other clinical symptoms noticed by the author. In the study conducted by Sajitha (2000) among pre adolescent athletes majority were found to be anaemic and 5 per cent showed thyroid enlargement.

Biochemical estimation is a direct method to assess nutritional status of an individual. Blood haemoglobin level of the subsample was estimated using cyanmethmoglobin. Urinary urea of same samples was measured by Dieacetyl Monoxime (DAM) method.

Majority of the respondents had a normal haemoglobin status. Similar result was reported by Weight *et al.* (1992) and Sajitha (2000). Study conducted by Mini (1992) also indicated higher haemoglobin levels among all athletes. This observation was supported by Lanbadarius *et al.* (1976) who pointed out high haemoglobin levels among athletes than normal, possibly due to physiological response to stress.

Urea is the major end product of protein catabolism and urea production is increased during more amino acid metabolism such as high protein diet, tissue break down or decreased protein synthesis etc. Urinary urea test is used to determine nitrogen balance (Jung *et al.*, 1975). In the present study nearly 23.3 per cent of the respondents had a normal urinary urea level, while 66.7 per cent had lower values and

10 per cent had increased urinary urea level. Correlation coefficient of urinary urea with protein showed that there is no significant correlation between these two variables.

5.5. PHYSICAL FITNESS OF RESPONDENTS

Endurance capacity of the respondents measured by Harward step test indicated excellent physical condition only among 14 per cent of the respondents, 39 per cent of the respondents had poor physical capacity and the physical condition of 21 per cent of the respondents was found to be low. Suman (2000) and Panjikkaran (2001) did not observed excellent physical condition among adolescents.

The lung capacity of the respondents varied from 260cc/second to 1220cc/second with a mean lung capacity of 889.94cc/second. About 13 per cent of the respondents had lung capacity in between 200 to 350 cc/second and 3 per cent had a lung capacity above 1105 cc/second. Jose (2001) observed high lung capacity among elderly man when compared to elderly women and reported that age is inversely proportional to lung capacity.

5.6. ENERGY BALANCE

According to Nair and Pochlman (1991) energy balance is determined by energy intake and energy expenditure. In this study a positive energy balance was observed among majority of the respondents. Similar findings of positive energy balance were reported (Celijowa *et al.*, 1970.,Guzman *et al.* 1972 and Mini (1992) among sports persons of different categories. In contrast to these findings Devadas (1988); Weight *et al.* (1988); Mulligan and Butterfield (1990) and Sajitha (2000) found that both male and female endurance athletes failed to meet their recommended

energy intake. Lother *et al.* (1989) observed excess energy intake among athletes than the recommended daily allowances.

A significant positive correlation was observed between MUAC and body fat with BMI. None of the variables including the nutrient like energy, fat and protein intake had no relationship with endurance capacity. However lung capacity of the sports women was found to be related to their energy and fat intake. Hence, apart from the nutrient intake probably their genetic make up as well as the nutrient stored in the body might be influencing their endurance capacity.

SUMMARY

6. SUMMARY

The present study entitled "Nutritional profile and Physical fitness of Sports women" was conducted in Thrissur district among 100 women in the age group of 18 to 25 years who are engaged in various sports activities. The respondents for the study were selected from the two colleges which have hostel facilities of Sports Council of India and also from the institution of Sports Authority of India.

Information regarding the socio economic condition of the families indicated that majority of the families (56%) were Hindus and belonged to other backward communities. Nuclear family system was followed by most of the families and 89 per cent of the families had a family size of 4 to 6 members.

Composition of the families showed that 54.79 per cent of the total population was in the age group of 20 to 50 years and composed of 35.67 per cent male and 64.33 per cent female members. Most of the male and female members were found to be literates.

Majority (83%) of mothers were unemployed and 44 per cent of the fathers were engaged as agricultural laboures.

Monthly income of 56 per cent of the families varied from Rs. 1000 to Rs. 5000 and per capita income of the 81 per cent of the families were below Rs. 500.

About 35 per cent of the respondents belonged to first birth order and birth interval was found to be 2 years among 28 per cent of the respondents. About 34 per cent of the respondents attained their first menstruation by the age of 14 years. Eighty one per cent of the respondents were studying for their under graduate courses.

About 28 per cent of the respondents were athletes and rest of the respondents participated in various sports activities like basket ball, swimming, kabadi, judo, weight and power lifting, hand ball, cricket and hockey. All the respondents participated in district and state level competitions and 71 per cent participated in national level competitions also.

All the respondents practiced regular physical exercise and the duration was found to be 4-5 hours per day. Only 17 per cent of the respondents practiced yoga that too only occasionally.

Majority of the respondents participated in coaching camps conducted at state level. The duration of coaching camps varied from less than 10 days to more than 25 days.

Daily activity pattern of the respondents indicated strict time schedule in all the three institutions with 5 hours of practice in sports.

Nearly 75 per cent participated in compulsory social service.

Details of scholarships revealed that 21 per cent of the respondents received scholarships worth Rs.10,000 to 12,000 annually and most of them received the scholarships from Sports council.

About 41 per cent of the respondents used to undergo periodic medical check up. Among this 60.98 percent had monthly check up and most of them did the check up to know their physical fitness. Only 4 per cent of the respondents consumed regular medicines.

Food consumption pattern of the respondents indicated that all the respondents surveyed were non vegetarians and their staple food was rice. All of them preferred both vegetarian and non vegetarian foods.

Cereals, other vegetables, fruits, nuts and oil seeds, spices and condiments and sugar were the most frequently used food items. Pulses, fish, roots and tubers were used medium frequently. Green leafy vegetables were used only occasionally.

All the respondents had three major meals a day pattern and all of them included raw foods in their diet.

About 41 per cent of the respondents purchased prepared foods. Majority purchased both vegetarian and non vegetarian foods. All the respondents used to consume ready made and prepared foods.

About 47 per cent of the respondents used to eat from outside, 89.4 per cent consumed both vegetarian and non vegetarian foods. Frequency of consumption was found to be once in a week among 51 per cent of the respondents.

About 30 per cent of the respondents indicated that they consumed food and nutrient supplements daily.

Pre game meal was consumed by about 73 per cent of the respondents. About 65 per cent of the respondents avoided certain items like cold items, oily foods, non vegetarian foods and other heavy foods during the previous day of the competitions.

Diet modification during competition was observed among 93 per cent of the respondents. Majority (73.11%) reduced the quantity of foods they consumed.

Details of post game meal revealed that about 58 per cent of the respondents consumed post game meals/foods. Majority (55.17%) preferred normal diet with an increase in quantity.

The comparison of mean nutrient intake with RDA indicated that the intake of energy, fat, thiamin, calcium and beta carotene was lower than the RDA suggested for sports persons.

Contribution of energy from carbohydrate, protein and fat was found to be 73.50 per cent, 15.91 per cent and 10.59 per cent respectively.

The nutritional status of the respondents was assessed through anthropometric measurements, clinical examination and biochemical estimation.

The height of the respondents varied from 150 cm to 177 cm with a mean height of 162.36cm, which was statistically higher than the height suggested by ICMR (1990) for reference women.

The mean weight (52.24kg) of the respondents was statistically higher than the reference body weight suggested by ICMR (1990) for Indian woman.

Mid Upper Arm Circumference (MUAC) of majority (76%) of the respondents was higher than standards.

Details of skin fold thickness of respondents revealed that the triceps skin fold thickness of majority of the respondents was lower then standard. Skin fold thickness at scapula and abdomen of majority of the respondents was in the range of 6-8 mm and 6-11 mm respectively.

Majority had a waist circumference in the range of 60 to 70 cm and hip measurement of 60 per cent of the respondents was in between 81 to 90 cm. WHR

of the respondents revealed that only 3 per cent had a waist hip ratio greater than 0.85.

Body mass index showed that 36 per cent of the respondents had normal BMI and 34 per cent were under nourished. Body fat percentage of 77 per cent of the respondents was found to be lower than the reference standards.

Lean body mass index of majority of the respondents was in the range of 40 to 44.99 Kg.

Clinical examination showed symptoms related to nutritional deficiencies like pale conjuctiva, chielosis, thin and sparse hair, spongy bleeding gums, slight enlargement of thyroid gland and knock-knee among some respondents.

Biochemical examination of blood showed that the haemoglobin level of 83.33 per cent of the respondents were normal. Urinary urea level of the respondents showed that only 23.3 per cent had normal urinary urea level.

Endurance capacity of the respondents revealed that 14 per cent had excellent physical capacity and the endurance capacity of 39 per cent was found to be poor.

Lung capacity of the respondents showed that 39 per cent of the respondents had a lung capacity between 351 to 501 cc/Second.

Daily energy expenditure pattern of the respondents indicated a positive energy balance among athletes, hand ballers, weight/power lifters, judo players, swimmers and cricket and hockey players. Negative energy balance was observed only among basket ball and kabadi players.

A significant positive correlation was observed between BMI and weight, MUAC and body fat and lung capacity was related to fat and energy intake.

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APPENDIX

APPENDIX – I

INTERVIEW SCHEDULE TO ELICIT INFORMATION REGARDING THE SOCIO-ECONOMIC CONDITIONS OF THE FAMILIES AND PERSONAL HABITS OF RESPONDENT

1. Name of the respondent :
2. House address :
3. Place of survey :
4. Name of institution
5. Religion
6. Caste :
7. Family size. :
8. Type of family. : Joint. \Nuclear.
9. Composition, education and occupation, composition, education and occupation of family members

Sl.No.	Name	Relationship with head	Age	Sex	occupation	Educational status					Income
						Illiterate	L.P	U.P	H.S	College	

10. Other sources of income of family. :Agriculture.

Poultry.

House rent.

Business
Dairy.
Others (specify).

11. Total income of family :

12. Deatails regarding the respondant

1. Age
1. Class in which studying.
2. Birth order.
3. Birth interval.
4. Age at menarche
6. Morbidity pattern (during past one year)

Diseases

i). Diarrhoea/Vomitting
ii). Measles
iii). Chickenpox
iv). Mumps
v). Fever
vi). Jaundice
vii). Respiratory disease
viii). Others (specify).

13. Details on injuries during past one year

14. Participation in sports and games

1. In which sports and games activities do you participate :
2. Do you practice the activities regularly : Yes/No

   If No, give reasons :
3. Do you participate the competitions conducted by the institution :Yes/No

   If Yes,specify the item in which you participate:
4. Do you participate in the competition conducted at :District level
   :State level
   :University level
   : National level

If yes, specify the event in which you participate in each level

:District level
:State level
:University level
: National level

5. Do you take any physical exercises regularly : Yes/No

If yes, specify

(i) Type of the exercises
(ii) Frequency :Daily
:Weekly
:Once in a while

(iii) Duration
(iv) Session : Morning /evening

6. Do you practice Yoga ? :Yes/No

If yes, specify
(i) Duration
(ii) Frequency :Daily/weekly/once in a while
(iii) Time :

Details of coaching

7.Did you participate in any coaching camps' during previous two years

If yes, specify
(i) Place
(ii) Duration
(iii) Name of the camp
(iv) Major activities done in the camp :

8. Do you participate in any other activities in the institution :Yes/No

If Yes, specify whether :NSS
:NCC
:Entertainments

:Others, specify

15.Activity pattern of a day

Activity	Time spent for each activity

16. Do you get any fellowship/scholarship :Yes/No
If yes ,specify
(i)Amount
(ii) Agency

17. Do you take any medicine regularly :Yes/No
If yes, specify

(i) The medicine
(ii) Reason for taking

APPENDIX – II

INTERVIEW SCHEDULE TO ELICIT INFORMATION ON FOOD CONSUMPTION PATTERN OF RESPONDENT

1.Name of the respondent

2.Food habit of respondent : Vegetarian/ Non Vegetarian

3. Food consumption pattern followed in the home :Vegetarian/ Non Vegetarian

4. Food consumption pattern followed in the hostel :Vegetarian/ Non Vegetarian

5. Is the food pattern of the hostel similar to home :Yes/ No

If No, state the variation in the meal pattern of the hostel

6. Food preferences of respondent in the hostel :Vegetarian/ Non Vegetarian/both

7.Details of usage of various food items

SI No	Food item	Frequency of use					Weekly	Monthly	Occasionally	Never
		Daily								
		1	2	3	4	5				

8.Meal pattern followed in the home

3 major meals
2 major meals
1 major meal
Others – specify

9.Meal pattern followed in the hostel

3 major meals
2 major meals
1 major meal

10.Do you consume any processed foods : Yes/ No
If No, why? :

if yes

Sl.No.	Name of the food	Frequency of purchase Daily	weekly	monthly	occasionally	Frequency of use
1	Cake					
2	Fried item					
3	Bread\bun					
4	Toffee					
5	Sweets					
6	Jam					
7	Pickle					
8	Biscuits					
9	Soft drinks					
10	Ice creams					
11	Cutlet					
12	Puffs					
13	Juice					
14	Squash					
15	Other items					

11. Do you get any other readymade food items
in the hostel :Yes/No

If yes, specify the items :

Frequency of use: :Daily
: Weekly
: Monthly
: Occasionally

12. Do you get any processed foods in the hostel: :Yes/No

If yes, give details

Name of the food item :

Frequency :Daily/weekly/monthly/occasionally

13. Do you consume any raw foods :Yes/No

If yes specify the items :Salad
Raitha
Fruits
Others-specify

Frequency of use :Daily
Weekly
Monthly
Occasionally

14. Do you have specific time schedule for taking meals in the hostel : Yes/No

If yes, give details

Break fast	Lunch	Evening tea	Dinner

15. Do you have the habit of taking food from out side :Yes/No

If Yes, details of food items

Frequency of taking :Daily/ Weekly/ Monthly/Occasionally

16. Do you have the habit of taking any nutrient /food supplement :Yes/No

Frequency of use :Daily/ weekly/Monthly/Occasionally

Reason for taking supplement

17. Do you purchase any prepared food from outside : Yes/No

If Yes, specify the item :

Frequency of purchase

S.l. No.	Item	Daily	Weekly	Monthly	Occasionally

18. From where do you purchase: : Hotel/Bakery/Fast food center

Reason for purchase

19. Meal pattern followed in the hostel for a week

	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day
Early morning							
Break fast							
Lunch							
Evening tea							
Dinner							

20. What is your opinion about hostel diet?

1. Excellent
2. Tasty
3. Nutritious
4. Animal foods included in high quantity
5. Animal foods not included
6. Milk is not provided
7. Strict time schedule

8. Any other, specify

21. Details of consuming pre game meals /foods :

Do you consume any pre game meal /foods : Yes/No
Glucose
Fruits
Fruit juices/ other drinks
Any other- specify

22. Is there any specific reason for taking the pre game meal /food?

23. Do you restrict any foods while preparing for competitions :Yes/No

If Yes, specify the item

Reason

24. Do you make any modification in the diet during competition :Yes/No

If yes, specify
Reduce the quantity of rice
Restrict the animal foods
Reduce the quantity of all foods
Restrict the animal foods
Include more foods
Any other

25. Do you take any post game foods/meals :Yes/No
If yes, specify the type of foods

Specify the reason

APPENDIX - III

SCHEDULE FOR CLINICAL ASSESSMENT

1. Sex
2. Age
3. Height
4. Weight
5. General appearance
   a) Good
   b) Fair
   c) Poor
   d) Very poor
6. Hair
   a) Lack of lustre
   b) Thin and sparse
   c) Straight
   d) Dyspigmentation
   e) Flag sign
   f) Easy pluckability
7. Face
   a) Diffuse depigmentation
   b) Naso-labial dyssebacea
   c) Moon face
8. Eye
   a) Pale conjunctiva
   b) Bitot's spot
   c) Conjuctival Xerosis
   d) Corneal Xerosis
   e) Keratomalacia
   f) Angular palpebritis
9. Lips
   a) Angular stomatitis

b) Angular Scars

c) Cheilosis

10. Tongue

a) Oedema

b) Scarlet and raw tongue

c) Magenta tongue

d) Atrophic papillae

11. Teeth

12. Gums

a) Spongy, bleeding gums

13. Glands

a) Thyroid enlargement

b) Parotid enlargement

14. Skin

a) Xerosis

b) Follicular hyperkeratosis - types 1 and 2

c) Petechiae

d) Pellagrous dermatosis

e) Flaky paint dermatosis

f) Scrotal and vulval dermatosis

15. Nail

a) Koilonychia

16. Subcutaneous tissue

a) Oedema

17. Muscular and skeletal systems

a) Muscle wasting

b) Craniotabes

c) Frontal and parietal bossing

d) Epiphyseal enlargement (tender or painless)

e) Beading of ribs

f) Persistently open anterior fontanelle

g) Knock-knees or bow-legs

h) Diffuse or local skeletal deformities

i) Deformities of thorax (selected)

j) Muscle-skeletal haemorrhages

18.i) Gastro-intestinal

a) Hepatomegaly

ii) Nervous

a) Psychomotor change

b) Mental confusion

c) Sensory loss

d) Motor weakness

e) Loss of position sense

f) Loss of vibratory sense

g) Loss of ankle and knee jerks

h) Calf tenderness

iii) Cardiovascular diseases

a) Cardiac enlargement

b) Tachycardia

iv) Other clinical symptom noticed

NUTRITIONAL PROFILE AND PHYSICAL FITNESS OF SPORTS WOMEN

By

REENA. C.

ABSTRACT OF THE THESIS

submitted in partial fulfilment of the requirements for the degree of

Master of Science in Home Science

(FOOD SCIENCE AND NUTRITION)

Faculty of Agriculture

Kerala Agricultural University, Thrissur

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2005

ABSTRACT

A study on the nutritional status and physical fitness of 100 sports women was carried out in Thrissur district during the year 2004-2005.

Details pertaining to the socio- economic variables, dietary habits, food consumption pattern, nutritional status, energy balance and physical fitness of the respondents were studied in detail.

The results of the study indicated that majority of the families were Hindus and belonged to other backward communities. The family size ranged from four to six and majority followed nuclear family system.

Majority of the families had a monthly income of Rs.1000-5000 and majority of the families had a per capita income below Rs. 500.

Selected respondents were in the age group of 18-24 years. Majority of the respondents were of first birth order and birth interval was found to be 2 years. Most of them attained their first menstruation by the age of 14 years.

All the respondents participated in district and state level competitions and used to undergo regular physical exercises. Most of them participated in coaching camps. Very few of them practiced yoga.

About 41 per cent of the respondents used to undergo periodic medical checkup and only 4 per cent of respondents consumed regular medicines.

All the respondents surveyed were non vegetarians and consumed rice as the staple food. All of them preferred both vegetarian and non vegetarian foods. Most

frequently used foods were found to be cereals, other vegetables, fruits, nuts and oil seeds, spices and condiments and sugar. Three major meal pattern a day was followed by all the respondents.

All the respondents included raw foods in their diet. Ready made and prepared foods were also consumed by the respondents.

About 30 per cent of the respondents used to take food and nutrient supplements.

Majority of the respondents consumed pregame meal, post game meal and modified their diet during competitions.

Actual nutrient intake of the respondents indicated that the intake of energy, fat, calcium, thiamin and beta carotene was lower than RDA.

The nutritional profile of the respondents indicated that the body weight varied from 42 kg to 94 kg with a mean weight of 52.24 kg and the height varied from 150 cm to 177 cm with an average height of 162.36 cm. Only 36 per cent of the respondents had a normal body mass index.

Majority of the respondents had a mid upper arm circumferences above standard, where as triceps skin fold thickness of the respondents was found to be less than the standard. Waist hip ratio of 97 per cent of the respondents was found to be less than 0.85.

Most of the respondents had a body fat percentage less than the standard. Lean body mass of majority of the respondents was in the range of 40 to 44.99 Kg.

Clinical examination showed different symptoms of nutritional deficiencies among few respondents.

Biochemical estimation showed that majority of the respondents had a normal haemoglobin status and low urinary urea level.

About 14 per cent of the respondents had an excellent endurance capacity and 39 per cent had a lung capacity in between 351 to 501cc/second.

A positive energy balance was noted among athletes, hand ballers, weight/ power lifters, judo players, swimmers and cricket and hockey players and a negative energy balance was noted among basket ball and kabadi players when the daily energy intake was compared with daily energy expenditure.