

Nutritional Status and Performance Ability of Trained Adolescent Athletes

BY

Manjula. S

(11PN06)

**A thesis submitted to the
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore - 641 043.**

**In Partial Fulfilment of the requirements for the Degree of
Master of Science in Food Science and Nutrition**

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Certified as Bonafide Research Work



Signature of the
Head of the Department



Signature of the
Guide

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I INTRODUCTION

Sport is defined as pleasant pastime, entertainment, reaction, diversion, amusement, play and athletic contest. It has been an integral part of everyday life from immemorial. Societies developed sport which eventually evolved into more serious forms of athletic contest. Today sports is defined as a contest between athletes in a struggle for victory (Melvin, 2000).

In order to be successful as an athlete, genetic endowment, training, coaching, and work ethics play a vital role in achieving optimal performance. While most athletes focus their efforts on one or more of these factors in order to improve their athletic performance, many of them fail to pay adequate attention to their dietary intakes. Optimal energy and nutrient intakes may enhance athletic performance anywhere from six to 20 percent (American Dietetic Association 2009). An individual' dietary behaviors may be detrimental to his athletic performance potential, especially when considering elite athletes who compete at the school Olympic, and professional levels.

According to Maughan (2003) when talented, motivated, and highly trained athletes meet for competition, the margin between victory and defeat is usually small. When everything else is equal, nutrition can make the difference between winning and losing (Williams, 2007). It is important for school athletes to understand basic nutrition information and have basic knowledge of their energy and nutrient needs in order to optimize athletic performance (Rashet *al.*, 2008).

Nutrition can be the deciding factor in whether an athlete comes in 1st or 10th, or wins or loses. Furthermore, it is important for athletes to understand and utilize basic nutrition knowledge for general health purposes because it is vital for them to first establish and then continue utilizing healthy dietary practices to maintain their quality of life after their competitive career is over. The more nutrition knowledge athletes acquire, the more likely they will apply such knowledge to their actual dietary intake and make better food choices (Kunkel *etal.*, 2001; Skinner *et al.*, 2001;

Grandjean, 1997). In contrast athletes who lack basic nutrition knowledge are less likely to maximize their athletic performance potential as well as their health status later in life.

Sports nutrition is the study of foods and nutrients and their effect on health, growth, and development of the individual. It applies nutrition principles to sport with the intent of maximizing performance. Success in sports depends on three factors - genetic endowments, the state of training and nutrition. Genetic make-up cannot be changed. Specialized exercise training is the major means to improve athletic performance and proper nutrition is an important component of the total training program. Athletes and Fitness Enthusiasts need the same essential nutrients that non-active people need with varied increases in their caloric needs as well as some increase in macro and micronutrients. Therefore, it is essential to explore and assess these increased nutritional needs of athletes before, during, and after competition for achieving optimal sports performance (Vishwan, 2009).

It is the study and practice of nutrition and diet as it relates to athletic performance. It is concerned with the type and quantity of fluid and food taken by an athlete and deals with nutrients such as vitamins, minerals, supplements and organic substances such as carbohydrates, proteins and fats. Although an important part of many sports training regimens, it is most commonly considered in strength sports (such as weight lifting and bodybuilding) and endurance sports (for example cycling, running, swimming (Susan, 2008).

Sports nutrition assumes critical importance because long before deficiency symptoms start appearing, physical performance declines. It would not be prudent to think in terms of minimum needs to keep the blood levels or enzyme levels at normal limits. Rather attempts should be made to find out the level below which physical performance starts showing changes. The level, which permits the athlete to achieve the maximum possible physical performance should be the minimum level aimed in the sports nutrition (Adam, 2009). Athletes are interested in nutritional manipulations that may enhance lean tissue gains stimulated by resistance training. Some research

demonstrates that acute consumption of food containing protein causes superior muscle protein synthesis compared to isoenergetic foods without protein. This benefit has not been verified in longer-term training studies (Collins, 2010).

Exercise of all types requires energy in the form of calories. The amount of calories needed to fuel physical activity depends on several factors including age, gender, level of conditioning, and the intensity and duration of activity. For example, sports that require repetitive muscle contractions (running, rowing and swimming) use more energy than activities that require maintenance of muscle contractions (gymnastics and golf). Athletes need to consume large amounts of calories and carbohydrates to be sure they have enough fuel available to support high-intensity exercise. Competitive endurance athletes have increased caloric needs. Female athletes may need 4,000 calories per day or more, while male athletes may require up to 6,000 calories or more. A nutritionist or health coach can often help to determine the exact calorie needs will be. During periods of active exercise, however, as many as 10-15 calories additional intake per minute may be required (Shirreffs, 2009).

Many athletes consider taking dietary supplements because they are looking for the “magic ingredient” to increase performance. In the extreme case of performance-enhancing supplements, athletes (particularly bodybuilders) may choose to use substances such as anabolic steroids, compounds which are related to the hormone testosterone, which can quickly build mass and strength, but have many adverse effects such as high blood pressure and negative gender specific effects (Taneja, 2003).

High energy supplements have shown to increase the performance of physical activity. A study done at the University of Texas saw a 4.7 percent increase of performance in 83 percent of participants after drinking Red Bull Energy Drink which was more intense than the compared placebo. The energy drink most dominantly increased the epinephrine and norepinephrine (adrenaline and its precursor) levels and beta-endorphins in the blood than before consumption. Caffeine, carbohydrates

and Vitamin B are factors that may have favored performance increase with no change in perceived exertion (Bhasin, 2004).

Glycogen, the form in which carbohydrate is stored in muscle cells, is the primary source of energy used to fuel exercising muscles. It is well accepted that fatigue during exercise is caused primarily by depletion of glycogen stores. Most glycogen stores are depleted within 90 minutes of intense exercise, leaving muscles with inadequate energy sources to fuel activity. As a result, athletes who train daily often require large amounts of carbohydrate (more than 500 grams per day) to continue to perform at peak levels (Laughlin, 1996).

Dietary protein began to be consumed in the 1940s and muscle building results were found in resistance and strength training athletes. Protein intake is a part of the nutrient requirements for the regular athlete and is an important component of exercise training, because it can also aid in performance and recovery. Dietary protein intake for well-trained athletes should occur before, during and after physical activity as it is advantageous in gaining muscle mass and strength. However, if too much protein and amino acid supplements are consumed. It can be more harmful than beneficial; health risks include dehydration, gout, calcium loss, liver, and renal damage. Gastrointestinal side effects include diarrhoea, bloating, and water loss (Lawerence, 2005).

A protein diet must be paired with a healthy, well-rounded meal plan and regular resistance exercise. The type of exercise, intensity, duration, the carbohydrate content of diet, sex, age, training, training environment and gender specific effects determine the physical performance of athletes (Phillips, 2004).

Sports supplements including vitamin and mineral supplements should be taken only in case of their deficiency and only after consulting a Doctor and of prescribed potencies to avoid any adverse effect on health. Some athletes take excessive amounts of supplements under the mistaken belief that it will improve performance. They are not aware of long term consequences. Research studies

suggests that vitamin and mineral supplements are unnecessary for the athlete receiving a balanced diet (Koszawski, 2004).

Caffeine, carbohydrate and vitamins B are factors that may have performance increase with no change in perceived exertion (Bhasin, 2004).

Exercise causes loss of fluid through sweating and respiration. The fluid that is lost is taken from the blood, which can reduce blood volume. If fluid is not replaced during and after exercise, serious dehydration can result, causing an increase in body temperature and impairing heart function. Drinking water is probably the best way to replace fluids. However, some experts believe that it is also necessary to replace lost electrolytes sodium, chloride, and potassium that are lost in sweat. (Other minerals can be lost through sweat as well - including the antioxidant mineral, zinc). While many different electrolyte-replacement sports drinks are available, you may not need to spend money on these expensive drinks to ensure adequate replacement of electrolytes. In most cases, a well-balanced diet rich in fruits and vegetables provides an appropriate amount of these important minerals (Maughan, 2008). During strenuous exercise, athletes must drink enough water to maintain their pre-exercise weight. One pound of weight lost is equal to two cups of fluid that should be replaced. It is important to remember that thirst is not a dependable indicator of the need for fluids, and athletes must make a habit of drinking water and other fluids frequently, both during and after exercise.(Jain, 2005) .

Health related fitness activities generally include cardiovascular training (aerobic activities such as jogging, swimming, cycling, and hiking), flexibility (stretching), strength (heavy resistance training), muscular endurance (extended resistance to a particular muscle), and appropriate body composition (as opposed to a general scale measurement of total weight). For example, one may set a goal to lose body fat (health-related fitness or event specific goal) and to achieve that goal, he or she would create a regular exercise program that includes all of the above components in addition to choosing more nutrient dense foods in the diet that would support increased demand from activities. Sports-related fitness involves skills that are

necessary for sports performance. These skills are sport-specific neuromuscular motor skills such as agility, timing and accuracy, balance, speed, strength, power, and endurance. Specificity of training involves training these components as well as the health components that will be directly needed for one's sport (Melvin, 2005).

The basic principles of weight training are essentially identical to those of strength training, and involve a manipulation of the number of repetitions (reps), sets, tempo, exercise types, and weight moved to cause desired increases in strength, endurance, and size. The specific combinations of reps, sets, exercises, and weights depends on the aims of the individual performing the exercise; sets with fewer reps can be performed with heavier weights (Slater, 2011).

Aerobic exercise is large-muscle, dynamic physical activity that raises heart and respiration rates as well as body temperature for an extended period of time. Examples include walking, running, swimming, cycling or even using the elliptical trainer at gym. For most people, varying the type of aerobic activity is good in order to improve aerobic capacity, prevent boredom and see continual progress. However, amateur and professional athletes need to focus their aerobic training (Stuart, 2011).

A healthy and well balanced nutrition program combined with an appropriate exercise and training regimen is the foundation for developing optimal health, fitness and success in sports. However, sports nutrition is a complex, and often times confusing, area of study and with the vast amount of information and misinformation available in the popular press, there is a desperate need for a credible resource that individuals can rely on to provide research based information regarding basic and advanced nutritional concept.

Educate strength and conditioning professionals, coaches, and athletes on the importance of proper nutrition when striving to attain optimal performance results. In the Sports Nutrition Education Program, you will learn the latest scientific research and arm yourself with critical knowledge to educate your athletes and clients with the

vital information required to fuel performance, improve fitness levels, and maintain health.

There is dearth for studies on teen aged athletes in Tamil Nadu especially, those from Tribal areas. This study aims to throw some light on the nutritional status and performance ability of adolescent athletes from the Nilgiris. The objectives of the study are to

1. To assess the nutritional status of the athletes.
2. To determine the physical performance ability of the athletes.
3. Formulate, standardize and evaluate the impact of interventions on selected athletes.

II REVIEW OF LITERATURE

The topic “**Nutritional Status and Performance Ability of Trained Adolescent Athletes**” has been reviewed under the following headings:

- A.The Current Sports Scenario.
- B.Nutritional Requirements of Adolescent Athletes.
- C.Performance Ability Among Athletes.
- D.Sports Training for Athletes.
- E.Nutritional Supplements for Athletes.
- F.Sports Nutrition Education for athletes.

A. THE CURRENT SPORTS SCENARIO

India has world level athletes and sports persons, who are very few as compared to other countries and population of India. Legendary sports persons from India made a great impact on world stage. Many sporting authorities are working towards the wellness of the sports in India. Sporting bodies get aids from the government of India for developing the infrastructure and nurturing the growing talent. India has some world which have standard facilities world sports persons. These bodies are supposed to arrange the basic requirements for their concerned sports.

More sporting events should be organized to promote the sports in low levels. Sports persons have to move towards big cities for better facilities, since in there is the lack of basic requirements in towns. Still Indians have to prove their capabilities in Olympics, the greatest sporting event in international scenario. Indians have won very few personal medals in Olympics. Lack of basic requirements, fundamental facilities and promotional sporting events in root level are the main reasons behind the failure of Indian athletes in the big events like Olympics. (Anuj Mathur 2006).

B. NUTRITIONAL REQUIREMENTS OF ADOLESCENT ATHLETES.

The nutritional requirements, assessment of nutritional status, and discusses the nutritional risks imposed the athletic involvement. Energy (calories) and protein are essential in development. Adolescent females require approximately 2200 calories/day, whereas male adolescents require 2500-3000 calories/day. Additional intake requirements include fat, calcium, iron, zinc, vitamins, and fiber. Nutritional status begins with obtaining a good diet and this could be offered by the body mass index. Nutritional deficiencies and poor eating habits established during adolescence can have long-term consequences, including delayed sexual maturation, loss of final adult height, osteoporosis, hyperlipidemia, and obesity. In addition, substances in some grains reduce gut absorption, thus increasing mineral deficiencies.. Among adolescentathletes many are turning to nutritional supplements in an attempt to improve athletic performance. A balanced, varied diet provides adequate calories and nutrition to meet the needs of most adolescents. They also have greater water needs than do adult athletes (Pediatr Ann, 2001).

The first priority for any athlete, nutritionally, should be to obtain recommended energy needs. In order for an athlete to reach and maintain optimal athletic performance, increase and maintain lean body mass, and maintain proper immune and reproductive function, it is vital for him/her to achieve energy balance. Athletes who fail to reach energy balance may ultimately compromise their athletic performance, ability to train at a high level, and they may also increase their risk of injury (ADA, 2009).

Athletes at all athletic levels, ages, and gender often fail to meet energy requirements. Athletes involved in aesthetic sports such gymnastics and dancing, weight class sports such as wrestling and bodybuilding, and sports that put much emphasis on having a extremely lean body, such as long distance running, are most at risk for poor nutrient intake, female athletes are more likely to have an inadequate dietary intake when compared to male athletes (Williams, 2007). These groups of athletes are at an increased risk for injury and developing stress fractures due to the

combination of the high impact sport and chronic low calorie diet, which is often low in certain micronutrients such calcium (Anderson & Anderson, 1993). Athletes who are not meeting their macronutrient energy requirements through dietary intake to take a nutrient supplement/s in order to meet their micronutrient needs and maintain a healthy status (Anderson & Anderson, 1993). A study conducted on female runners who had regular and irregular menstrual functions found the energy intake of the irregular menstrual functioning group was significantly lower than in the regular menstrual function group (Tomten & Hostmark, 2006). This led the to believe a chronic inadequate energy intake along with other dietary intake factors could play a role in the disturbance of the endocrine system in female athletes (Tomten & Hostmark, 2006).

The 2009, American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine position paper on nutrition and athletic performance recommends for athletes to consume 6 to 10 grams of carbohydrates per kilogram of body weight each day, whereas some sources set the minimum recommended value at approximately 5 grams of carbohydrates per kilogram of body weight per day (Kundrat, 2005). In order to determine the specific amount of carbohydrates required to support an athlete's energy requirements, several factors such as gender, type of sport, and environmental conditions have to be taken into consideration (ADA, 2009) A study conducted by Rosenbloom and colleagues (2002) found that over half of the athletes surveyed knew that carbohydrates, along with fats, are the main sources of energy for activity. A surprising 85% of athletes surveyed in another study correctly identified that carbohydrates provided immediate energy during activity, but in the same study researchers found that only 5.1% of participants identified the recommended percentage of carbohydrates from total calories (Jacobson & Aldana, 1992). A positive trend was reported six years later in the follow-up study conducted by Jacobson et al. (2001) with 29.5% of the athlete correctly identifying the recommended percentage of carbohydrates from total calories. Although some positive trends in carbohydrate knowledge have been reported among athletes,

researchers have documented numerous negative trends and thus recommend that athletes need to improve their carbohydrate knowledge (Dunns *et al.*, 2007).

Protein recommendations for athletes differ depending on the level at which the athlete trains and what type of sport the athlete is involved in, such as endurance and strength sport (Lamont, 2003). According to the most recent Dietary Reference Intake (DRIs), the general protein recommendation for all adults active or sedentary, is 0.8 grams per kilogram of body weight per day (ADA, 2009). The DRIs state there is a lack of consistent evidence demonstrating that healthy adults who participate in endurance or resistance exercise need additional protein (ADA, 2009), nitrogen balance in endurance athletes need anywhere from 1.2 to 1.4 grams of protein per kg of body weight per day (Phillips, *et al* 2007; Tipton & Witard, 2007). With respect to strength athletes, between 1.2 grams per kg of body weight per day to 1.7 gram per kg of body weight per day to be most effective in maintaining and supporting muscle growth (Phillips *et al.*, 2007). The International Society of Sports Nutrition (ISSN) position stand on protein and exercise came to similar protein recommendations, ranging from 1.4 to 2.0 gram per kg of body weight per day for active adults (Campbell *et al.*, 2007). ISSN also recommends individuals who take part in endurance activity to consume levels of protein at the lower end of the range, individuals who take part in a combination of endurance and strength should consume levels in the middle of the range, and for individuals who take part in power/strength activity to consume level at the upper end of recommendation range (Campbell *et al.*, 2007). Research has not supported a protein intake of more than 2.0 grams per kg of body weight per day to be beneficial for any type of athlete (Williams, 2007).

Fat is a very important and necessary part of an athlete's daily dietary intake. Out of the macronutrients, it provides the greatest amount of energy per gram, and provides essential nutrients such as fat-soluble vitamins, D, A, K, and E and essential fatty acids. The 2005 Dietary Guidelines for Americans recommend fat intake to make up between 20-35% of total calories with the majority of fat coming from polyunsaturated and monounsaturated sources, less than 10% coming from saturated

sources, and minimal amount coming from *transfatty* acids. The American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine current position on recommended intake of dietary fats for athletes coincide with the 2005 Dietary Guidelines for Americans and the organizations further recommend athletes to avoid diets where fat makes up more than 20 percent of energy because they have been shown to hinder athletic performance (ADA, 2009). The recommendation includes avoiding high-fat diets as well.

Adequate vitamins and minerals intake is essential to optimal performance. In addition, the need for some micronutrients may be increased by exercise. However, most athletes who consume a balanced diet that meets energy needs also meet their micronutrients needs. For example B-complex vitamins are involved in energy production and are required for red blood cells synthesis, protein synthesis, and tissue repair and maintenance. These process are increased during exercise, therefore exercise may increase the need for B- complex vitamins. However, because energy expenditure is increased, a diet that provides enough food to meet energy meet will most likely provide sufficient B-complex vitamins. Athletes who consume low fat diets or restrict their intake of energy or specific food groups may be at risk for micronutrient deficiencies. Iron and calcium are particular concern (Hartman, *et al.*, 2009).

Proper hydration and athletic performance goes hand in hand. It is vital for athletes to consume adequate amounts of fluids before, during, and after exercise to optimize athletic performance, maintain health, and avoid dehydration and heat related injuries (ADA, 2009). If an athlete loses 2 percent of body weight through fluid loss, dehydration occurs which can impair athletic performance, cognitive performance, and place an athlete at greater risk of experiencing heat syncope, heat exhaustion, and even heat stroke (Nichols et al., 2005, Sawka et al., 2007). To help prevent dehydration and protect athletes from heat illness the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine position paper on nutrition and athletic performance (ADA, 2009) established fluid

intake recommendations for athletes before, during and after exercise. It is recommended that individuals drink 5 to 7 mL per kilogram of body weight of water or sports drink prior to engaging in physical activity (at least 4 hours before) (ADA, 2009). Also, they need to consume 16 ounces of water or a sports drink 1 hour before physical activity (Howe & Boden, 2007). During exercise, several factors influence the hydration status of an athlete, including the following: the type of exercise, duration, intensity level, environmental conditions, and individual's sweat rate (ADA, 2009).

The prevalence of iron deficiency anemia is higher in athletic populations and groups, especially in younger female athletes, than in healthy sedentary individuals. In anemic individuals, iron deficiency often not only decreases athletic performance but also impairs immune function and leads to other physiologic dysfunction. Although it is likely that dietary choices explain much of a negative iron balance, evidence also exists for increased rates of red cell iron and whole-body iron turnover. Other explanations of decreased absorption and increased sweat or urine losses are unlikely. The young female athlete may want to consider use of low-dose iron supplements under medical and dietary supervision to prevent a decline in iron status during training (Brian Tobin, 2000).

Brad and Tobin (2000) indicate that the prevalence of iron deficiency anemia is likely to be higher in athletic groups, especially younger female athletes. The normal haemoglobin level is 14-16 grams per deciliter (100ml) of blood for male and 12-14 grams per deciliter (100ml) of blood for females. Males have been classified as anemic with less than 13g, whereas less than 11g some case less than 12g in females.

C. PERFORMANCE ABILITY AMONG ATHLETES

The ability to generate explosive muscle power and strength is critical to success in Olympic weightlifting and over lifting, as well as throwing events, including javelin, discus, shot put and hammer, plus sprints (100–200 m) in track and field. Consequently, athletes competing in these events will typically incorporate

some form of generic resistance exercise into their overall training programme despite sport-specific training varying markedly. Athletics competitors participating in throwing events typically undertake periodized training programmes that aim to develop maximum strength and power of the major muscle groups using a range of modalities such as plyometric exercises, sprinting, power lifts, Olympic lifts and weighted throwing drills to complement technical throwing training. Periodization of resistance training typically involves a transition from high-volume, high-force, low-velocity movements requiring less coordination characteristic of traditional powerlifting (Hoffman, Cooper, Wendell, & Kang, 2004) to more explosive, lower-force, low-repetition training using Olympic lifts in preparation for competition (Judge, Moreau, & Burke, 2003). The focus on explosive Olympic lifts over more traditional strength-based lifting results in more favourable power and strength gains (Hoffman et al., 2004), derived primarily from neural rather than skeletal muscle hypertrophy adaptations (Folland & Williams, 2007).

D. SPORTS TRAINING FOR ATHLETES

Training component to the activities of recreationally active subjects or physical education students has resulted in improvements in vertical jump, agility, shuttle run and downhill slalom skiing. A proposed mechanism for the enhancement in motor skills from balance training is an increase in the rate of force development. There are limited data on the influence of balance training on motor skills of elite athletes. When the effectiveness of balance training was compared with resistance training, it was found that resistance training produced superior performance results for jump height and sprint time. Balance ability was related to competition level for some sports, with the more proficient athletes displaying greater balance ability. There were significant relationships between balance ability and a number of performance measures. Evidence from prospective studies supports the notion that balance training can be a worthwhile adjunct to the usual training of non-elite athletes to enhance certain motor skills, but not in place of other conditioning such as

resistance training. More research is required to determine the influence of balance training on the motor skills of elite athletes (Hrysomallis, 2011).

Endurance training consists of a structured exercise programme that is sustained for a sufficient length of time with sufficient intensity and frequency to induce an improvement in aerobic fitness. Elite young athletes generally have higher peak oxygen uptakes (peak VO_2) than their untrained peers largely due to their greater maximal stroke volumes. Trained young athletes have faster VO_2 kinetic responses to step changes in exercise intensity but whether this is due to enhanced oxygen delivery or increased oxygen utilization by the muscles remains to be explored. Blood lactate accumulation in young athletes during submaximal exercise is lower than in untrained youth and this appears to be due to enhanced oxidative function in the active muscles. No well-designed, longitudinal endurance training studies of elite young athletes have been published. Even in the general paediatric population peak VO_2 is the only component of aerobic fitness on which there are sufficient data to examine dose-response effects of endurance training. The existence of a maturational threshold below which children are not trainable remains to be proven (Barker, 2011).

The magnitude of training responses is independent of sex. Pre-training peak VO_2 has a moderate but significant inverse relationship with post-training peak VO_2 which suggests that elite young athletes are likely to experience smaller increases in peak VO_2 with further endurance training than untrained youth. Empirical evidence strongly indicates that both trained and untrained young people can benefit from endurance training but the relative intensity of exercise required for optimum benefits is higher than that recommended for adults (Barker, 2011).

The goal is to build upon the knowledge constructed through basic coursework in human anatomy and physiology by applying the principles learned to how the body performs and responds to physical activity. It begins in chapter one with an historical overview of sport and exercise physiology as they have emerged from the parent disciplines of anatomy and physiology.

E. NUTRITIONAL SUPPLEMENTS FOR ATHLETES

Dietary Supplement Health and Education Act (DSHEA) of 1994. A dietary supplement is a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet. The "dietary ingredients" in these products may include: vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandulars, and metabolites. Dietary supplements can also be extracts or concentrates, and may be found in many forms such as tablets, capsules, softgels, gelcaps, liquids, or powders.

Ergogenic aids

There are a large number of products available which claim to help sports performance in some way. These are known as ergogenic aids. The range of nutritional substances used as ergogenic aids in sport is huge and includes amino acid supplements, ginseng and bee pollen.

For many of these supplements there is little scientific evidence for their effectiveness. Moreover, undesirable side-effects can occur and the implications for long-term health have not been fully tested. Ergogenic aids are not a substitute for a healthy, balanced diet, regular training and adequate rest (Thomas,2001). Two ergogenic aids which have received much research attention in recent years are caffeine and creatine.

Creatine

Creatine has been of particular interest as an ergogenic aid because of the role that creatine phosphate plays in energy production. During the first few seconds of exercise creatine phosphate is broken down to produce ATP. This is an extremely fast method of energy production yet the muscle only has very limited creatine stores. The use of creatine supplements attempts to maximise muscle stores and thereby enhance energy production. Results to date are equivocal but are most supportive of a beneficial effect of creatine in events involving bouts of high intensity exercise with

only short recovery periods in between, such as football. There have been no studies on the long-term safety of creatine (Watson,2008).

Caffeine

There is evidence for a positive effect of caffeine on performance during prolonged endurance events. The ergogenic effect may be related to its stimulant properties, particularly to the effect of caffeine in mobilising fatty acids, which can then be used as a fuel, sparing glycogen stores (see above). A caffeine level in the urine above 12mg/l is not permitted under international doping regulations (a level achieved by taking approximately 500mg caffeine, equivalent to 6-8 cups of coffee, in a single sitting). However, ergogenic effects are produced at lower levels than this. (Shirrefs, 2007).

Fluid Supplements

A person's physiological drive for fluid intake during exercise is perceived through 'thirst mechanisms' and it has long been known that when given ad libitum access to fluid, and thus drink voluntarily, that these mechanisms compel people to drink at a rate that replaces approximately one-half of their fluid losses and at best two-thirds (Pitts and Consolazio, 1944; Hubbard et al., 1984).

The concept that thirst during exercise does not drive people to take in fluid at the rate of fluid loss is termed 'voluntary dehydration'. In the 1960s, athletes were generally advised 'to drink only a little water during exercise' and to 'ignore their thirst' and to thus replace a small percentage of lost fluid. Furthermore, the scientific literature in the 1960s was interpreted to suggest that dehydration by less than 3–4% of body weight caused insignificant hyperthermia or impairment of physiological function and performance, although it was recognized that dehydration by more than 4% is dangerous to health (Wyndham and Strydom, 1969). This belief that dehydration by 3–4% was tolerable prevailed despite evidence to the contrary from carefully conducted studies around the time of the Second World War that had clearly shown that dehydration by less than 3–4% during prolonged marching in the heat

impaired performance and caused exhaustion and collapse . The athletic community of this era appears to have remained unaware or unconvinced that the demands of marching were not unlike athletic endurance events, except, of course, for the speed and practical aspects of drinking while running compared with walking (Pitts,2008)

F. SPORTS NUTRITION EDUCATION FOR ATHLETES

If athletes do not possess basic nutrition knowledge, it is possible they may never reach their peak athletic performance. Several previous studies investigating the level of nutrition knowledge among athletes has come to one similar conclusion; athletes appear to lack basic nutrition knowledge (Zawila et al., 2003).

The balance diet is the, nutrients in our body are available in sufficient amounts and in the right proportion. This is achieved by eating a balanced diet. Eating variety of foods, since different foods contain different nutrients in varying amounts. Food selection based on the 'Healthy Eating Pyramid'.

EATING PYRAMID

Eating according to the structure of food pyramid ensures consume eating healthy diet.

The food pyramid is a simple practical guide to selecting varied foods for meals.

- i) Generous amounts of plant-based foods (cereals, legumes, fruits and vegetables),
- ii) Moderate amounts of animal products (meat, fish, milk, eggs) in our diets.
- iii) Small amounts of energy-dense foods (e.g. sugar, fats and oils).

Nutrients:

There are chemical substances found in food that are used by the body for growth and health.

Cereals are good sources of complex carbohydrates, fiber, vitamin B and E, zinc, calcium and iron

Pulses are a highly nutritious food group containing beans, peas and lentils. They form high quality protein.

Fruits are good sources of fiber, vitamin- A & C, and potassium, antioxidants (effective in helping to prevent cancer, heart disease, and stroke).

Fruit juices are concentrated source of calories, good sources of vitamin C .

Vegetables are a source of important vitamins, minerals, fiber and carbohydrates.

Meat, poultry, fish and eggs are important sources of protein, iron, zinc, and B vitamins. Chicken and fish contain less fat when compared to beef, pork, mutton, kidney and liver that are rich in fat content.

Importance of Sports Nutrition for Athletes:

1. Carbohydrate Provides Energy for Exercise.
2. Protein need to repair and rebuild muscles.
3. Fat provides an athlete's main fuel source.
4. Waters prevent dehydration .
5. A rapidly digested meal should be eaten.

Importance of Protein, Vitamin C and Iron:

1. Meats, beef, liver that are rich in iron can easily be absorbed by the body
2. Dates are also good agents to treat anemia.
3. Take vitamin C to aid in the absorption of iron.
4. Treat anemia by drinking healthful juices, like beetroot juice mixed with honey, apple juice mixed with honey, blend apple juice with tomato juice, or try gooseberry juice mixed and honey.
5. Date in a mug of hot water and leave it there for a few hours; then drink the water when it cools down.

Nutritional Guideline for Athletes:

1. 1-4 hours prior to exercise, athletes should consume meals that are high in carbohydrate, moderate in protein, low in fat and adequate fluid and energy. It provides glucose, prevent dehydration and delay fatigue.
2. In hour prior to exercise, focus narrow to carbohydrate and fluid intake .
3. Smaller meals are eaten closer to an athletic starting time.
4. Fluid during exercise should be consumed 150-350 ml at 15 – 20 minutes interval beginning with the onset of exercise.
5. Within one hour after exercise 1 g of carbohydrate/kg of body weight consumed.
6. Small amount of protein is also beneficial.
7. After exercise carbohydrate- fluid consumption should continue for at least the next 4-6 hours.

III METHODOLOGY

The methodology followed in the study on “**Nutritional Status and Performance Ability of Trained Adolescent Athletes**” is discussed under the following headings:

- A. Selection of Area and Athletes
- B. Formulation of Tools
- C. Collection of Data
- D. Formulation and Standardization of Interventions
- E. Imparting Interventions and Evaluation of Impact

A. SELECTION OF AREA AND ATHLETES

Two schools namely, Government Higher Secondary School, Gurukulam Matriculation School were selected from Thuneri, The Nilgiris. These two schools were selected because they were in the vicinity and easily accessible to the investigator. These schools were well developed and they are represented in district level athletics. Two hundred male and female athletes of 14-18 years of age were selected from the two schools. This age group was selected because at this stage bone growth and muscle flexibility develop, to ensure good performance in athletics. Moreover, these athletes were trained to participate at district level and underwent coaching in sports technique and tactics.

B. FORMULATION OF TOOLS

A simple and self explanatory questionnaire was formulated to collect the background details namely age, socio-economic status, dietary pattern, and details regarding sports activities. The 24 Hour Food Recall record was used to elicit the food and nutrient intake of the selected athletes (Appendix-I). Appropriate equipment such as human weighing balance, stadiometer, skin fold caliper, flexible fiber glass tape etc were used to assess anthropometric parameters such as body weight, height, skin folds at triceps and subscapula, chest and arm circumferences respectively. Suitable

formula was used to compute body mass index (BMI). Cyanmethaemoglobin method was used to determine the haemoglobin level of athletes. Physical ability was assessed through flexibility, endurance, power and speed tests. A pamphlet was prepared for nutrition education. The importance of sports nutrition for athletes, balanced diet, importance of protein, vitamin C and iron to avoid anaemia, nutrient requirements and RDA for athletes were included in the pamphlet (Appendix-II).

C. COLLECTION OF DATA

Data was collected from all the 200 athletes on

1. Anthropometry

a. Height

The maximum growth potential of an individual is decided by hereditary factors. It is affected only by long term nutrition deprivation (Eastwood, 2001). Height was measured using an anthropometer or stadiometer. The athletes were made to stand erect looking straight the correct position for the head is in the Frankfurt horizontal plane on a leveled surface with heels together and toes apart, without shoes. The moving head piece of the anthropometer was lowered to rest flat on the top of the head and then reading was taken to nearest millimeter. Height measured was a continuous variable measured to the nearest 0.1cm (Cameron, 1978).

b. Weight

Possibly the most effective, sensitive and simplest reproducible diagnostic examination is to look at the person and to decided whether the patient is underweight, normal or overweight. Anthropometric measurement is used for the evaluation of nutritional status of young children (Wilson, 2003). For measuring body weight the human weighing balance was used. The athletes were made to stand over the centre of the weighing instrument with the body weight evenly distributed between both feet. Light indoor clothing can be worn excluding shoes, belts, and sweaters (Cole, 2000).

c. Body Mass Index

Weight is judged in the context of the height of the individual. This relationship is contained in the quetelet index or body mass index (BMI). This index uses weight (kg) and height (m) as $\text{weight (kg)/height (m}^2\text{)}$. The body mass index (BMI) was computed using the formula (Lohmann, 1988).

$$\text{Body Mass Index} = \frac{\text{Weight (kg)}}{\text{Height (cm)}^2}$$

d. Mid Upper Arm Circumference

Mid upper arm circumference (MUAC) is recognized to indicate the status of muscle development. On the left hand, the mid- point between the tip the acromion of scapula and tip of the olecranon of the fore-arm bone ulna is located with the arm flexed at the elbow and the reading is taken using a flexible fibre glass tape to the nearest millimeter (Martorell, 1988).

e. Chest circumference

The circumference is taken at the nipple level preferably in mid inspiration with a flexible fiberglass tape (Prashant and Chandran, 2009).

f. Skin fold thickness

i) Triceps

By using skin fold caliper, thickness of the fat layer is measured by picking the skin fold between the thumb and forefinger on the dorsal side at the same midpoint where MUAC is measured on the right arm.(From the top of the shoulder, the measurement down to the elbow is just about 13 inches. The skin fold measurement is taken at six and a half inches. At the mid-point measured, small pinch, about an inch width is picked, with two fingers. The muscle tissue is kneaded away from the skin, separating the fat from the muscle tissue and the fold is measured to the nearest millimeter) (Sharma, 2005).

ii) Biceps

At the midpoint of the muscle with the arm hanging vertically, an inch pinch is taken and muscle is kneaded away from the skin. The calipers are then inserted, not releasing the fingers. After five to ten seconds the calipers and fingers are released and the skin fold is measured to the nearest millimeter(Siltham, 2003).

g. Blood Haemoglobin

Among the 200 athletes, those with low body weight (less than 45kg), showing clinical symptoms of anaemia- easily fatigue, koilonychia and pale pallor and willing to undergo the test were selected for estimation of haemoglobin.

The hemoglobin level of twenty such athletes was measured by using the finger prick method. Cyanomethaemoglobin method was used to estimate the haemoglobin from blood (NIN, 1993).

2. Dietary Survey

Dietary assessment is made in terms of two basic measurements - they are foods eaten and chemical composition of food. These data are collected from the direct diet survey of the individual (Food Agricultural and Organization, 1996). Food eaten by the athletes is recalled using the questionnaire it is possible to collect detail information about the foods that actually been eaten as 24 hour (Adelson, 1990).

The athletes were made to recall the foods (and quantity) that they consumed the previous day. The quantity of the foods was recalled by showing them standard cups and measures. The nutritive value of the foods were then calculated using the Tables of Food Composition (Gopalan, Nutritive Value of Indian Foods, 2007).

3. Physical Performance

Physical Performance was assessed through

a. Physiological variable

Cardio Respiratory Endurance -vo₂ max

Cardio Respiratory Endurance

Cardio respiratory fitness, measured as maximum oxygen consumption ($\dot{V}O_{2max}$) or peak oxygen consumption ($\dot{V}O_{2peak}$), is related to all-cause mortality. Specifically, reduced cardio respiratory fitness is associated with increased risk of cardiovascular disease, stroke, hypertension, and mortality. Interventions that improve cardio respiratory endurance can have important health implications by decreasing the probability of disease, disability, and mortality (Ronald *et al.*, 2006).

The Queens College Step Test

The Queen College Step Test is one of many variations of step test procedures, used to determine aerobic fitness. Compared to the Harvard Step Test, this version has a lower step height, slower cadence, shorter test and more simple analysis. A 16.25 inches / 41.3 cm step, stopwatch, metronome or cadence tape, monitor were used for test. The athlete steps up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The subjects are to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The athlete stops immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiplying this 15 second reading by 4 will give the beats per minute (bpm) value to be used in the calculation below. (McArdle *et al.*, 1972). Rating is determined using the formula:

Men: $VO_{2max} \text{ (ml/kg/min)} = 111.33 - 0.42 \times \text{heart rate (bpm)}$

Women: $VO_{2max} \text{ (ml/kg/min)} = 65.81 - 0.1847 \times \text{heart rate (bpm)}$

b) Physical Performance variables:

- i. Flexibility -sit and reach
- ii. Muscular strength endurance –sit ups
- iii. Explosive Power- vertical jumps
- iv. Speed -50 meter dash

i) Flexibility

Flexibility is a common fitness component and refers to the ability to maximize the range of motion of joints and muscles. With improved flexibility, a cricket player can also improve speed, agility and other fitness components. Flexibility can be improved with stretching after practice sessions or strength and conditioning workouts (Wells and Dillon, 1952).

Sit and Reach Flexibility Test

The sit and reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and hamstring muscles. This test was first described by Wells and Dillon (1952) and is now widely used as a general test of flexibility. The test involves sitting on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet are placed flat against the box. Both knees should be locked and pressed flat to the floor - the tester may assist by holding them down. With the palms facing downwards, and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for at one-two seconds while the distance is recorded. Make sure there are no jerky movements. The score is recorded to the nearest centimeter or half inch as the distance reached by the hand. The reliability will depend on the amount of warm-up allowed, and whether the same procedures are followed each time.

ii) Muscular strength endurance (Sit up test)

Muscular strength and muscular endurance are not the same, although they are often mentioned together. Strength refers to maximum power and does not require oxygen, while endurance is strength over a prolonged period and does require oxygen (Gilbert, 2009).

This is a general description of a sit up test to measure abdominal muscle endurance. The procedures and technique can vary depending on which specific test you are performing. The curl up test measures abdominal muscular strength and endurance of the abdominals and hip-flexors, important in back support and core stability. Equipment required: flat, clean, cushioned surface, stopwatch, recording sheets, and pen. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees. Some techniques may specify how far the feet are from the buttocks, such as about 12 inches. A partner may assist by anchoring the feet to the ground. The position of the hands and arms can affect the difficulty of the test. They are generally not placed behind the head as this encourages the subject to stress the neck and pull the head forward. The hand may be placed by the side of the head, or the arms crossed over the chest, reaching out in front. Some protocols use curl up strips or other marks on the ground to slide the hands along and indicate how much to curl up. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor (Martorell, 1988).

iii) Explosive Power (Counter movement jump test)

Power is the ability to apply a maximum amount of force in a minimum amount of time. Power is crucial for cricket players while striking or bowling the ball. Improving power can be achieved by improving strength with strength training and Olympic lifts along with plyometrics and speed training (Slater 2008).

This procedure describes the method used for measuring leg power using the Counter Movement Jump. Though here the athlete begins in an upright standing position and squats down to the 90 degree leg bend position before immediately jumping vertically. Jump height is calculated using a timing mat which measures the time the feet are off the mat. The athlete stands upright in socks or bare feet, as still as possible on the mat with weight evenly distributed over both feet. Hands are placed on the hips, and stay there throughout the test. When all is ready, the athlete squats

down until the knees are bent at 90 degrees, then immediately jumps vertically as high as possible, landing back on the mat on both feet at the same time. Good rest is allowed between trials. The take-off must be from both feet, with no initial steps or shuffling. They must also not pause at the base of the squat. The best result of at least three attempts is recorded - athletes may continue to jump as long as improvements are being made. The timing mat may give a score of the time in the air, and the calculated vertical jump height can be calculated. Height can be calculated using this formula: $\text{jump height} = 4.9 \times (0.5 \times \text{Time})^2$). The jump height is usually greater than achieved with the Squat Jump. The jump height is affected by how much the athlete can bend his knees. The subject may benefit from practice, and should be verbally encouraged to perform maximally each time (Shanmugapriya, 2007).

iv) Speed 50 (Meter dash test).

Speed is the ability to move quickly across the ground or move limbs rapidly to grab or throw. Speed is not just how fast someone can run (or cycle, swim etc.), but is dependent on their acceleration (how quickly they can accelerate from a stationary position), maximal speed of movement, and also speed maintenance (minimizing deceleration). Movement speed requires good strength and power, but also too much body weight and air resistance can act to slow the person down (Joshi, 2004).

Sprint or speed tests can be performed over varying distances, depending on the factors being tested and the relevance to the sport. The 50 Meter Sprint is part of the International Physical Fitness Test, and their protocol is listed here. The aim of this test is to determine acceleration and speed. Measuring tape or marked track, stopwatch, cone markers, flat and clear surface of at least 70 meters. The test involves running a single maximum sprint over 50 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary standing position (hands cannot touch the ground), with one foot in front of the other. The front foot must be behind the starting line. Once the subject is ready and motionless, the starter gives the instructions "set" then "go". The tester should provide hints for maximizing speed (such as keeping low, driving hard with the arms and legs)

and the participant should be encouraged to not slow down before crossing the finish line. Two trials are allowed, and the best time is recorded to the nearest two decimal places. The timing starts from the first movement (if using a stopwatch) or when the timing system is triggered, and finishes when the chest crosses the finish line and/or the finishing timing gate is triggered. Soccer other sport in which speed over a similar distance is important. Reliability is greatly improved if timing gates are used. Also weather conditions and running surface can affect the results, and these conditions should be recorded with the results. If possible, set up the track with a crosswind to minimize the effect of wind the timer should stand back away from the running track so they can clearly see the first movement and also see the runner pass the finish line.

c. Skill Performance Variables

- i. Throwing -Cricket Ball Standing Throwing Test
- ii. Catch -Alternate Cricket Hand Ball Toss Test

Standing cricket ball throw

To measure the throwing ability as well as explosive power of the throwing arm. The athletes were tested in three throw after three warm-up throw with a standard cricket ball. The trail thrown the farthest distance an average of the three trails was used for evaluation. The athletes stood still a line and throw the ball as far as possible across the field. The player may not use a run up (or) go over the line. The place where the ball landing was marked for measuring in meters (Kraemer and Fleck, 1993).

Alternate hand ball toss test

The test was used to measure hand eye-coordination and catching ability on both hand. A mark was placed on a certain distance of two meters from the wall. The athletes was standing behind the line and facing the wall. The ball thrown from one hand in an underarm action against the wall and attempted to be caught with the opposite hand. The ball is then thrown back against the wall and caught with the initial hand. The test can continue for nominated number of attempt or for a set time period 30 second. The score was recorded in number of successful catches in a 30 second period (Parameshwaran and Ravichanda, 2004).

D. FORMULATION AND STANDARDIZATION OF INTERVENTIONS:

1. Training

a. Pre-exercise Stretching

The strength training workout consisted of a five minute pre –exercise stretching routine, followed by three sets of eight to 12 repetitions in each of five exercises. The first set consisted of eight to 12 repetitions at approximately 50 percent of the athlete. The second and third set consisted of eight to 12 repetitions at 100 percent of the athlete. Resistance was increased when 12 repetitions were completed at a particular weight during sets two and three. Ten minute rest was given before actual sprint training.

b. Sprint Training

The sprint training workout consisted of two 10- second sprint at 50 percent of the subject's maximum effort, three 10 second sprint at 100 percent of the subject maximum effort , and one 20 second sprint at 100 percent of the subject's maximum effort. Athlete was given a 30- second rest period between each sprint to allow for recovery.

c. Aerobic Dance

The aerobic dance workout consisted of a five minute pre-exercise followed by 30 minutes of aerobic dance training and led by instructor. The aerobic dance routine included various low- and high intensity exercise. The program was designed to work the upper and lower torso in an effect to enhance of the cardiovascular respiratory. The athlete exercised at of 60 to 90 percent of heart rate reserve.

2. Supplement

The nutritional supplement was prepared using dates to provide iron. Amla was included to provide vitamin C for the proper absorption of iron. First the seeds were removed from the dates and amla. They were then weighed and added required amount of water, then mixed well in the blender. The mixture was strained and added little amount of sugar.

Three variations of these two foods were tried out (Plate I). From the Tables of Food Composition (Gopalan *et al* 2007) it was seen that 100g of dates provides 2.1mg of iron and 100g of amla provides 463mg of ascorbic acid. The RDA for iron and vitamin C for 14-18 year old boys is 12mg/d and respectively and for girls is 15mg/d respectively. The supplement provided the daily requirements for iron and vitamin C.

Variation I: 50g dates and 50g amla.

Variation II: 75g dates and 25g amla.

Variation III: 80g dates and 10g amla.

Acceptability trials were carried out on teenagers in the 14-19 years age group. (Plate II). It was observed that variation III was the best of the three blends. Variation I and II were sour in taste and could not be consumed by athletes. Variation III was sweetest in taste and was preferred by athletes and was selected as supplement.

E. IMPARTING INTERVENTIONS AND EVALUATION OF IMPACT

i) Training

The 200 students were randomly divided into five groups of 40 members each. The training was given three days per week (Monday, Wednesday, Friday). In morning sessions the training duration was 35 minutes. In evening sessions practice would go on.

Group I was trained in weight/sprint

Group II was taught aerobic dance

Group III was provided both weight/sprint and aerobic dance

Group IV was imparted both weight/sprint and aerobic dance and provided the supplement

Group V was provided no training

ii) Supplement

The supplement was given for 45 days, to Group IV as a combination intervention every morning after breakfast.

iii) Nutrition Education

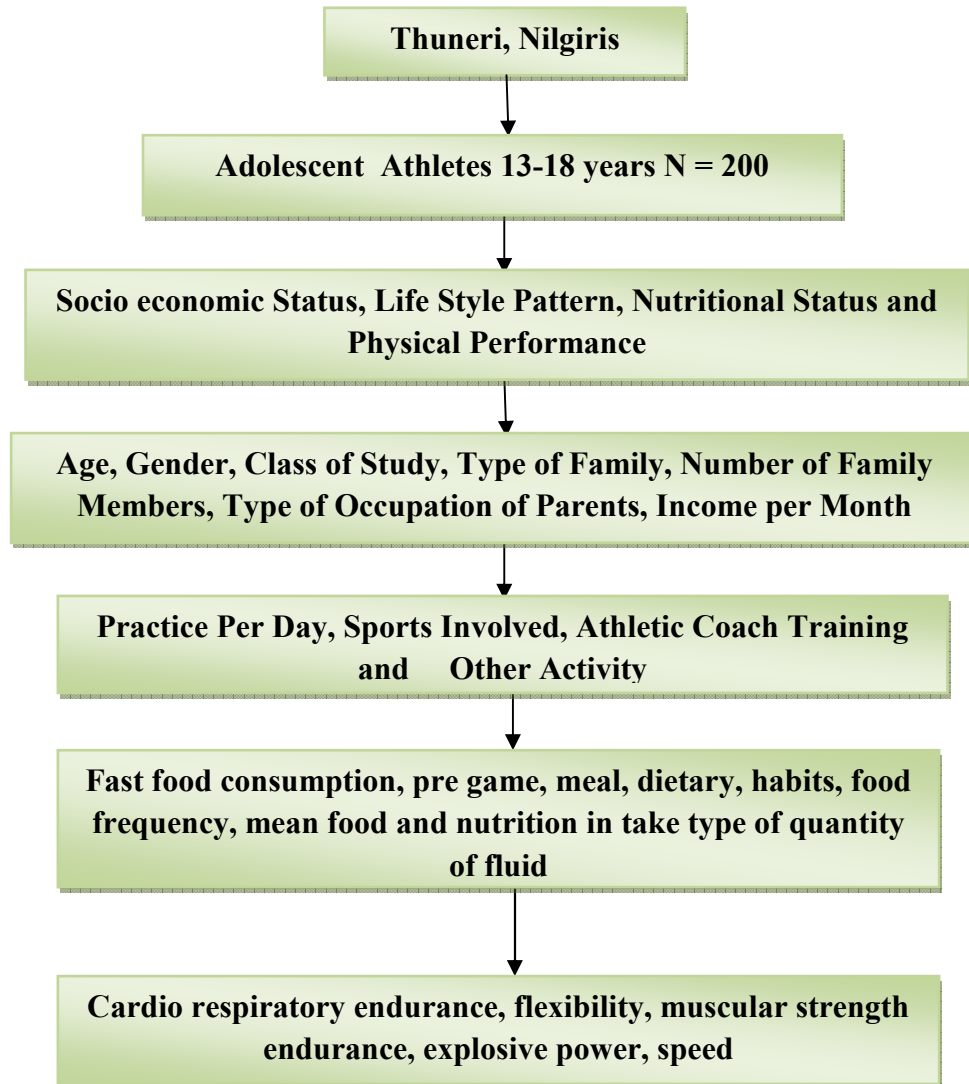
Nutrition education was given to all the athletes for one week through the designed pamphlet (Appendix-II) (Plate III). The information about nutrition and its importance was imparted through class room teaching. Aspects on balanced diet, importance of sports nutrition for athletes, importance of protein, vitamin C and iron to avoid anaemia and nutrient requirements and RDA for athletes were taught to the athletes. The impact of the interventions was assessed by comparing the initial and final values of performance, nutritional status and nutrition education parameters respectively.

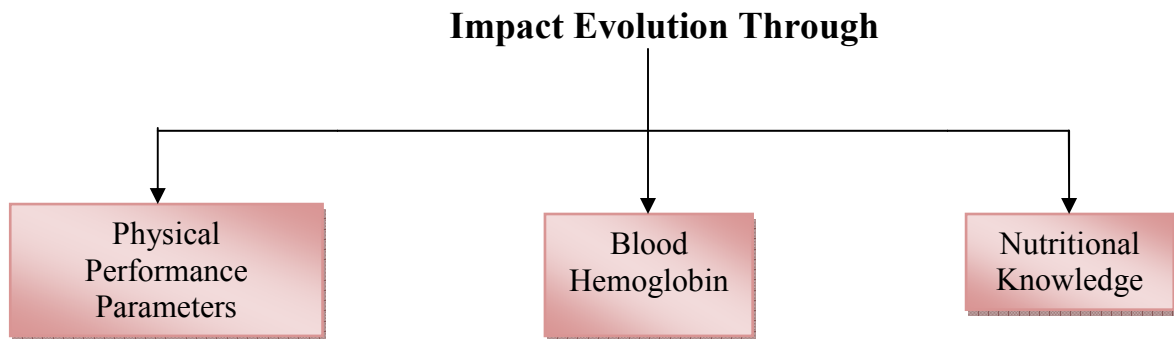
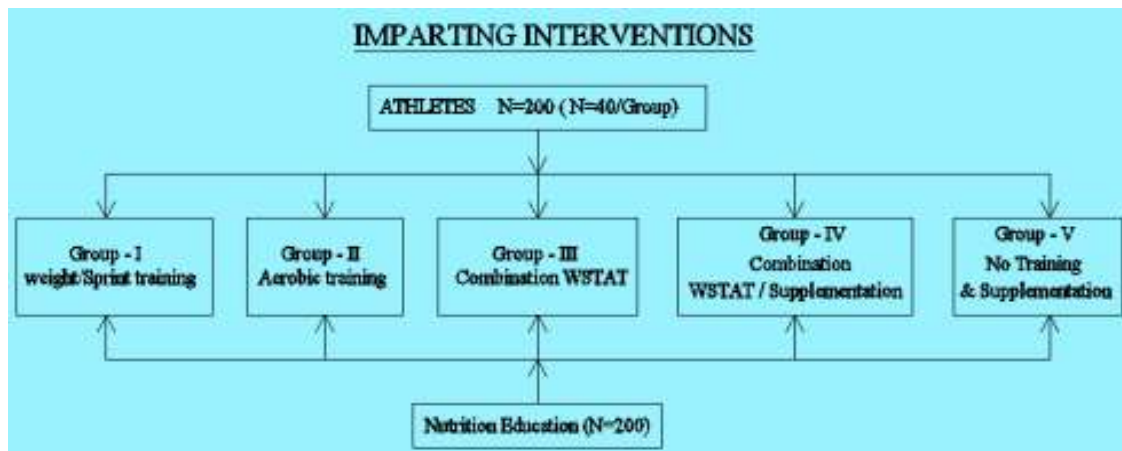
Plate 1, 2

Plate 3

RESEARCH DESIGN

Phase I Assessment of Background, Nutrition Status and Physical Performance.





IV RESULTS AND DISCUSSION

The results of the study titled “**Nutritional Status and Performance Ability of Trained Adolescent Athletes**” are presented and discussed under the following headings:

- A. Background Information on the Athletes
- B. Nutritional Status of the Athletes
- C. Impact of Interventions on Athletes

A. BACKGROUND INFORMATION ON THE ATHLETES

1. Information on athletes

Details of Background Information on the Athletes are presented in table.

TABLE I
BACKGROUND DETAILS OF THE ATHLETES
(N=200)

Details	N	%
Age (years)		
14-16	108	54
17-18	92	46
Total	200	100
Gender		
Male	105	52.5
Female	95	47.5
Total	200	100
Class Of Study		
VII-IX	78	39
X-XII	122	61
Total	200	100

Fifty four percent of the athletes were 14-16 years of age and 46 percent were 17-19 years of age; 52.5 percent were boys and 47.5 were girls; thirty nine percent of the athletes were studying in VII- IX standard and 61 percent of athletes were from X- XII standard.

2. Information on Family

Table II provides information of the families of athletes.

TABLE II
INFORMATION ON FAMILY

(N=200)

Details	N	%
Type of family		
Nuclear	175	87.5
Joint	25	12.5
Total	200	100
Number of family members		
3-5	184	92
6-7	16	8
Total	200	100
Type of occupation of parents		
Agriculturists	146	36.5
Teacher	25	6.25
Housewife	96	24
Office	75	18.75
Tailor	10	2.5
Bank	12	3
Wage	36	9
Total	400	100
Income/month and range (HUDCO, 2006)		
	N=304	
Low income (<5000)	105	34
Lower middle income(5000-10000)	82	27
Upper middle income (10000-20000)	75	25
High income (>20000s)	42	14
Total	304	100

Around 87.5 percent of adolescent athletes were from nuclear family and 12.5 percent of adolescent athletes were from joint family. The family of 92 percent of athletes had at 3-5 numbers and eight percent of athletes had 6-7 numbers. Of the four hundred parents 36.5 percent were agriculturists, 6.25 percent were teachers, 24 percent were housewives, 18.75 percent were officers, 2.5 percent were tailors, 3 percent were working in banks, and nine percent were daily wage earners. Thirty four percent of the athletes belonged to low income group, 27 percent of them were from lower middle income group, 25 percent were from upper middle income group, 14 percent were from high income group.

3. Life Style Pattern Of Athletes

Table III present the details on life style pattern of athletes of the athletes.

TABLE III
DETAILS ON LIFE STYLE PATTERN

Details	N	%
Practice per day(hour)		
1-2	178	89
3-4	22	11
Total	200	100
Sports involved		
Tennis	24	12
Cricket	34	17
Volley ball	22	11
Foot ball	23	11.5
Ko-ko	16	8
Basket ball	2	1
Athletics	41	20.5
Shuttle	38	19
Total	200	100
Athletic coach training/day(hour)		
1-2	189	94.5
3-4	11	5.5
Total	200	100
Other activity/day (hour)		
3-4	166	83
4-5	34	17
Total	200	100
Sleep/day(hours)		
<7	63	31.5
8	137	68.5
Fast food		
Weekly once	114	57
Weekly twice	29	14.5
Occasionally	50	25
Never	7	3.5
Total	200	100
Pregame meal		
Juice	140	70
Bread	24	12
Glucose	36	18
Total	200	100

Eighty nine percent of athletes practiced 1-2 hours per day and 11 percent of athletes practiced 3-4 hours per day. Twelve percent of adolescent athletes involved in the tennis, 17 percent in cricket, 11percent in volley ball, 11.5 percent in foot ball, 8 percent in ko-ko, 1 percent in basket ball, 20.5 percent in athletics and 19 percent in shuttle. While, 94.5 percent of athletes are trained for one to two hours per day and remaining 5.5 percent trained for three to four hours per day. Eighty three percent of athletes spend three to four hour per day and 17 percent spent four to five hours for orher activity. Only. 31.5 percent of adolescent athletes slept less than seven hours a day and remaining 68.5 percent of adolescent athletes slept eight hours a day. Fifty seven percent of athletes consumed fast food once in a week, 14.5 percent of athletes consumed fast food twice in a week, 25 percentof athletes were consumed fast food occasionally and 3.5 percent of athletes never consumed fast food. Seventy percent of athletes consumed juice as a pregame meal, 12 percent of athletes consumed bread as a pregame meal and remaining 18 percent consumed glucose as a pregame meal.

B. NUTRITIONAL STATUS OF THE ATHLETES

1. Dietary Habits

Table IV present the details on dietary habits of the athletes.

TABLE IV
DIETARY HABITS OF THE ATHLETES
(N=200)

Details	Number(N=200)	%
Dietary habit		
Vegetarian	70	35
Non-vegetarian	130	65
Total	200	100
Coffee/milk/tea		
YES	195	97.5
NO	5	2.5
Total	200	100
Skip meals		
YES	30	15
NO	170	85
Total	200	100
Carbonated beverages		
YES	113	56.5
NO	87	43.5
Total	200	100
Fluid intake (ml)/day		
100-500	175	87.5
>500	25	12.5
Total	200	100

Thirty five percent of athletes were vegetarians and 65 percent non – vegetarians; 97.5 percent of athletes consumed coffee/milk /tea and 2.5 percent of athletes did not consume coffee/milk/tea. Only 15 percent of adolescent athletes skipped their meals while 85 percent of adolescent athletes did not skip their meals. While 56.5 percent of adolescent athletes consumed carbonated beverages, 43.5 percent of adolescent athletes did not consume carbonated beverages; 87.5 percent athletes consumed 100-500 ml fluid per day and 12.5 percent consumed more than 500ml of fluid per day.

2. Food Frequency

Table V Presents the frequency of food consumed by the athletes.

TABLE V
FREQUENCY OF FOOD CONSUMED BY THE SELECTED
ADOLESCENT ATHLETES

(N=200)

Food groups	Daily		Weekly once		Weekly twice		Occasionally		Never	percentage
	N	%	N	%	N	%	N	%	N	%
Rice	200	100	-	-	-	-	-	-	-	-
Ragi	3	1.5	108	54	53	26.5	36	18	-	-
Wheat	48	24	79	39.5	58	29	15	7.5	-	-
Bengal gram dhal	-	-	129	65.4	65	32.5	6	3	-	-
Black gram dhal	-	-	148	74	48	24	4	2	-	-
Red gram dhal	26	13	91	45.5	83	41.5	-	-	-	-
Green gram	-	-	133	66.5	67	33.5	-	-	-	-
Soya bean	1	0.5	51	25.5	4	2	106	53	38	19
Bitter gourd	-	-	43	21.5	15	7.5	57	28.5	85	42.5
Ladies finger	-	-	73	36.5	16	8	71	35.5	40	20
Brinjal	-	-	39	19.5	-	-	92	46	69	34.5
Potato	130	65	9	4.5	61	30.5	-	-	-	-
Onion	200	100	-	-	-	-	-	-	-	-
Carrot	2	1	121	60.5	70	35	7	3.5	-	-
Beetroot	-	-	138	69	62	31	-	-	-	-
Coriander	200	100	-	-	-	-	-	-	-	-
Curry	200	100	-	-	-	-	-	-	-	-
Coconut	19	9.5	95	47.5	78	39	5	2.5	3	1.5
Groundnut	-	-	57	28.5	15	7.5	89	44.5	39	19.5
Banana	61	30.5	22	11	60	30	32	16	25	12.5
Apple	23	11.5	59	29.5	53	26.5	35	17.5	30	15
Grapes	-	-	66	33	82	41	52	26		
Ghee	52	26	100	50	-	-	-	-	48	24
Milk	200	100	-	-	-	-	-	-	-	-
Curd	200	100	-	-	-	-	-	-	-	-
Sugar	200	100	-	-	-	-	-	-	-	-
Honey	-	-	-	-	-	-	33	16.5	167	83.5
Jaggery	-	-	11	5.5	-	-	68	34	121	60.5
Egg	14	7	56	28	43	21.5	16	8	71	35.5
Chicken	-	-	81	40.5	11	5.5	37	18.5	71	35.5
Agathi	-	-	74	37	-	-	31	15.5	65	32.5

Rice, onion, coriander, curry leaves, milk, curd, sugars were consumed daily. Ragi was consumed by 1.5 percent daily, 54 percent weekly once, 26.5 percent weekly twice, and 18 percent occasionally. Wheat was consumed by 24 percent daily, 39.5 percent weekly once, 29 percent weekly twice and 7.5 percent occasionally. Bengal gram dhal was consumed by 64.5 percent weekly once, 32.5 percent weekly twice and three percent occasionally. Black gram dhal was consumed by 74 percent weekly once, 24 percent weekly twice and two percent occasionally. Red gram dhal was consumed by 13 percent daily, 45.5 percent weekly once and 41.5 percent weekly twice. Green gram was consumed by 66.5 percent weekly once and 33.5 percent weekly twice. Soya bean was consumed by 0.5 percent daily, 25.5 percent weekly once, two percent weekly twice, 53 percent occasionally. Nineteen percent never consumed soya at all. Bitter gourd was consumed by 21.5 percent weekly once, 7.5 percent weekly twice, 28.5 percent occasionally while 42.5 percent never consumed bitter gourd. Ladies finger was consumed by 36.5 percent weekly once, eight percent weekly twice, 35.5 percent occasionally and 20 percent never consumed ladies finger. Brinjal was consumed by 19.5 percent weekly once, 46 percent occasionally and 34.5 percent never consumed them . Potato was consumed by 65 percent daily, 4.5 percent weekly once and 30.5 percent weekly twice. Carrot was consumed by one percent daily, 60.5 percent weekly once, 35 percent weekly twice and 3.5 percent occasionally. Beetroot was consumed by 69 percent weekly once and 31 percent weekly twice. Coconut was consumed 9.5 percent daily, 47.5 percent weekly once, 39 percent weekly twice, 2.5 percent occasionally while 1.5 percent never consumed coconut. Groundnut was consumed by 28.5 percent weekly once, 7.5 percent weekly twice, 44.5 percent occasionally and 19.5 percent did not consume ground nut. Banana was consumed by 30.5 percent daily, 11percent weekly once, 30 percent weekly twice, 16 percent occasionally and 12.5 percent were never had bananas. Apple was consumed by 11.5 percent daily, 29.5 percent weekly once, 26.5 percent weekly twice 17.5 percent occasionally and 15 percent never consumed apple. Grapes was consumed by 33 percent weekly once, 41 percent weekly twice and 26 percent occasionally. Ghee was consumed by 26 percent, 50 percent weekly once and 24

percent never consumed gee. Honey was consumed by 16.5 percent occasionally and 83.5 percent never consumed honey. Jaggery was consumed by 5.5 percent weekly once, 34 percent occasionally and 60.5 percent never had jaggery. Egg was consumed by seven percent daily, 28 percent weekly once, 21.5 percent weekly twice, eight percent occasionally while and 35.5 percent never consumed egg. Chicken was consumed by 40.5 percent weekly once, 5.5 percent weekly twice, 18.5 percent occasionally while 35.5 percent never had chicken. Agathi was consumed by 37 percent weekly once, 30.5 percent occasionally and 32.5 percent never consumed agathi.

3. Mean Food Intake

Table VI represent the mean food intake of athletes

TABLE VI
MEAN FOOD INTAKE (g/dl)

FOOD ITEM	RDA 2010 Non- Athletes	RDA 2010 Athletes		ACTUAL INTAKE		DEFICIT/EXCESS %	
		Male	Female	Male	Female	Male	Female
Cereals & millets	390	420	350	354.34	315.12	-15.6	-9.96
Pulses	75	84	60	55.23	40.43	-34.25	-32.61
Milk & milk products	500	500	500	350	300	-42.85	-40
Roots and tubers	200	200	100	175.56	132.67	-12.22	+32.67
Green leafy vegetables	100	100	100	34.22	28.5	-65.78	-71.5
Other vegetables	200	100	100	39.23	32.76	-60.77	-67.24
Fruits	100	100	100	39.19	34.5	-60.81	-65.5
Sugar	25	35	30	20	20	-42.85	-33.33
Fat/oil	35	25	25	20	20	-20	-20

All the foods were consumed at levels less than the RDA recommended for mean food intake of athlete by the ICMR (2010). The percent deficits in the intake of cereals and millets in male 15.6 and in female 9.96, pulses 34.25 and 32.61, milk and milk products 42.85 and 40, roots and tubers 12.22 and excess in 32.67, green leafy vegetables 65.78 and 71.5, other vegetables 60.77 and 67.24, fruits 60.81 and 65.5, sugar 42.85 and 33.33 and fats /oil 20 and 20.

4. Mean Nutrient Intake

Table VII represent the mean nutrient intake of the athletes

TABLE VII
MEAN NUTRIENT INTAKE

Nutrient	RDA 2010 Non- athletes	RDA 2010 Athletes		Actual intake		%Deficit/excess	
		Male	female	Male	Female	Male	Female
Energy	2750	2500	2200	1489.64	1462.18	-40.4	-33.5
Protein	54.3	52	45	42.69	41.9	-18	-8.8
Fat	45	40	40	30.20	38.23	-24.5	-4.4
Calcium	800	1200	1200	892.6	846.68	-25.6	-29.4
Iron	32	12	15	11.4	11.40	-5	-24
Thiamin	1.4	1.4	1.1	1.17	1.13	-16.4	2.7
Riboflavin	1.6	1.6	1.3	1.04	1.04	-35	-23
Vitamin A	4800	1000	800	720.79	699.5	-27.9	-12.5
Vitamin C	40	55	55	41.23	38.2	-64	-30.5

Deficits were observed in the intake of all nutrients in energy for male 40.4 percent and female 33.5 percent, protein 18 percent and 8.8 percent, fat 24.5 percent and 4.4 percent, calcium 25.6 percent and 29.4 percent, iron 5 percent and 24 percent, thiamin 16.4 percent and 2.7 percent, riboflavin 35 percent and 23, vitamin A 27.9 percent and 12.5 percent and vitamin C 30.5 percent.

5. Energy Balance

Table VIII represents the energy balance of the athletes.

TABLE VIII
ENERGY BALANCE

(N=200)

RDA Energy	Energy intake	Energy expenditure	% excess /deficit
Male	2500	5551	-22.4
Female	2200	3806	-73

Deficits were observed in the energy balance of the athletes, for male 22.4 percent and female 73 percent.

6. Nutritional Anthropometry

Table VII represents the anthropometry of the athletes.

The reference height and weight for male athlete is 157-176cm and 45-66kg and for female is 157-163cm and 46-55kg (RDA, 2010).

TABLE IX
HEIGHT OF SELECTED ADOLESCENT ATHLETES

(N=200)

Particulars	Male		Mean ±S.D	Female		Mean ± S.D
	N	%		N	%	
130-139	-	-	-	20	21	136.1± 2.68
140-149	4	3.8	144.25±4.92	38	40	145.5 ±3.11
150-159	58	55.2	153.95±2.77	24	25.4	152.37± 2.26
160-169	37	35.2	161.57±2.29	13	13.6	161.92± 2.84
>170	6	5.8	171±0.89	-	-	-
Weight(kg)	N	%	Mean ±S.D	N	%	Mean ±S.D
30-39	11	10.4	36.09±1.45	30	31.5	35.77±2.11
40-49	44	42	43.68±3.04	50	52.6	44.49±2.89
50-59	40	38	53.25±2.52	13	13.6	53.38± 2.47
>60	10	9.6	62.3±2.11	2	2.1	61.5± 0.71
BMI	N	%	Mean ±S.D	N	%	Mean ±S.D
<18.5	4	4.8	17.67 ±0.54	55	58	17.19 ± 0.76
20-29	50	47.6	23.83 ±2.14	29	30.5	23.20 ±1.98
>30	49	46.6	32.03 ±1.38	11	11.5	32.63±1.29
MUAC(cm)	N	%	Mean ±S.D	N	%	Mean ±S.D
8-10	16	15.3	8.74 ±0.57	58	60	9.53 ±0.81
11-12	89	84.7	11.83 ±0.59	37	40	12.21±0.62
Biceps(mm)	N	%	Mean ±S.D	N	%	Mean ±S.D
8.5-10.5	25	23.8	9.64 ±0.70	76	80	9.3±0.70
10.6-12.5	80	76.2	11.85 ±0.60	19	20	12.07 ±0.53
Triceps(mm)	N	%	Mean ±S.D	N	%	Mean ±S.D
7-9	21	20	7.81 ±0.60	47	49.5	8.67 ±0.94
10-12	84	80	12.01±0.75	48	50.5	11.01±0.70
Chest	N	%	Mean ±S.D	N	%	Mean ±S.D

circumference(cm)						
28-30	23	22	28.66±0.40	47	49.5	8.67 ±0.94
30-32	36	34.2	30.26±2.48	31	32.5	30.88 ± 2.06
33-35	46	43.8	34.18 ±0.59	10	10.5	33.52 ±0.28

The height of male athletes were, 3.8 percent were from 140-149cm, 55.2 percent were from 150-159 cm, 35.2 percent were from 160-169cm, and 5.8 percent were more than 170cm. Twenty one percent of female were from 130-139cm, 40 percent were from 140-149cm, 25.4 percent were from 150-159cm, and 13.6 percent were from 160-169cm.

Weight of the male athletes were 10.4 percent are of 30-39kg, 42 percent are of 40-49 kg, 38 percent are of 50-59 kg and 2 percent are of above 60 kg. Around 31.5 percent of female athletes were 30-39kg, 52.6 percent are of 40-49kg, 13.6 percent are of 50-59kg and 2.1 percent are above 60kg.

BMI of the male athletes were, that 4.8 percent of them are underweight, 47.6 percent of them are normal and 46.6 percent are obese. In the female athletes 58 percent were underweight, 30.5 percent were normal and 11.5 percent were obese.

MUAC of the male athletes were observed that sixty percent 15.3 percent were from 8-10 cm, 84.7 percent were 11-12 cm and female athletes were 60 percent from 8-10 cm and 40 percent were from 11-12cm.

Biceps of the male athletes were observed that 23.8 percent were from 8.5-10.5mm, 76.2 percent were 10.6- 12.5mm and female athletes 80 percent were from 8.5-10.5mm and 20 percent were from 10.6-12.5mm.

Triceps of the male athletes were observed that 20 percent were from 7-9 mm and 80 percent 10-12 mm. the female athletes were 49.5 percent from 7-9 mm and 50.5 percent were 10- 12 mm.

Chest circumference of the male athletes were observed that 22 percent were from 28- 30 cm, 34.2 percent were from 30- 32 cm and 43.8 percent were from 33-35 cm. female athletes 57 percent were from 28-38 cm, 32.5 percent were from 30-32 cm and 10.5 percent were from 33-35cm.

C. IMPACT OF INTERVENTION:

i. Training

Table and figures 2-4 represent the impact of training methods on physical fitness components of athletes.

TABLE X
PHYSICAL FITNESS COMPONENTS

Variable	Pre test Mean \pm S.D	Post test Mean \pm S.D	Mean diff/ 't' ratio
Weight/sprint training			
Flexibility(cm)	23.05 \pm 4.07	31.25 \pm 4.96	8.20/15.02*
Agility(sec)	13.38 \pm 1.10	10.83 \pm 1.27	2.55/12.22*
Speed(sec)	8.32 \pm 0.83	7.42 \pm 0.80	0.89/2.14 ^{NS}
Power(cm)	31.00 \pm 3.37	37.65 \pm 2.81	6.65/15.65*
Aerobic training			
Flexibility(cm)	23.00 \pm 3.71	30.55 \pm 3.80	7.55/13.97*
Agility(sec)	13.36 \pm 0.89	11.30 \pm 1.56	2.06/7.89*
Speed(sec)	8.30 \pm 0.70	7.67 \pm 0.74	0.67/2.14 ^{NS}
Power(cm)	30.95 \pm 3.41	37.10 \pm 4.05	6.15/11.01*
Combination group			
Flexibility(cm)	22.95 \pm 3.34	32.85 \pm 3.70	9.90/16.32*
Agility(sec)	13.39 \pm 1.04	10.16 \pm 1.25	3.23/10.97*

Speed(sec)	8.31±0.73	7.04±0.36	1.27/9.10*
Power(cm)	31.10±3.62	38.45±4.67	7.35/15.05*
Control group			
Flexibility(cm)	22.90±3.79	23.05±3.85	0.15-1.14 ^{NS}
Agility(sec)	13.39±1.53	13.25±1.67	0.13-1.29 ^{NS}
Speed(sec)	8.32±0.73	8.31±0.71	3.25-1.22 ^{NS}
Power(cm)	31.05±4.46	31.15±4.65	1.10-0.62 ^{NS}

Combination group with Supplementation		
Variable	Pre test Mean ±S.D	Post test Mean ±S.D
Flexibility(cm)	23.05± 4.07	31.25 ± 4.96
Agility(sec)	13.44±1.14	10.83±1.27
Speed(sec)	8.32±0.83	7.42±0.80
Power(cm)	31 ± 3.37	37.65±2.81

* Significant at 0.05 levels; NS –Not significant

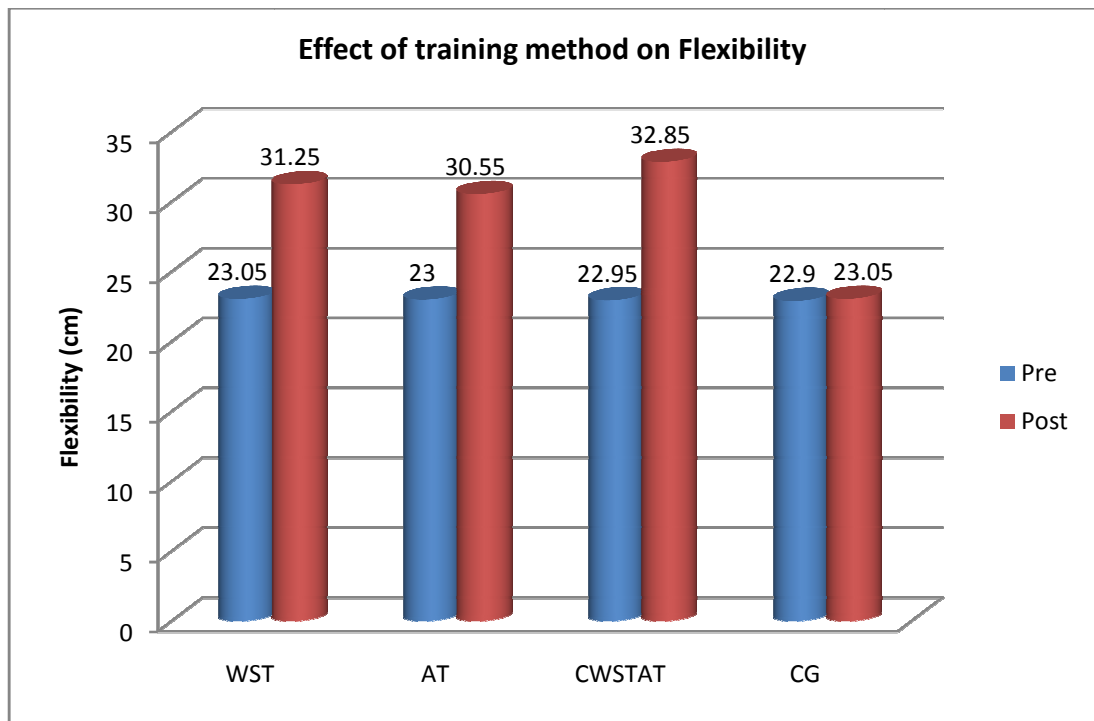


FIGURE 2

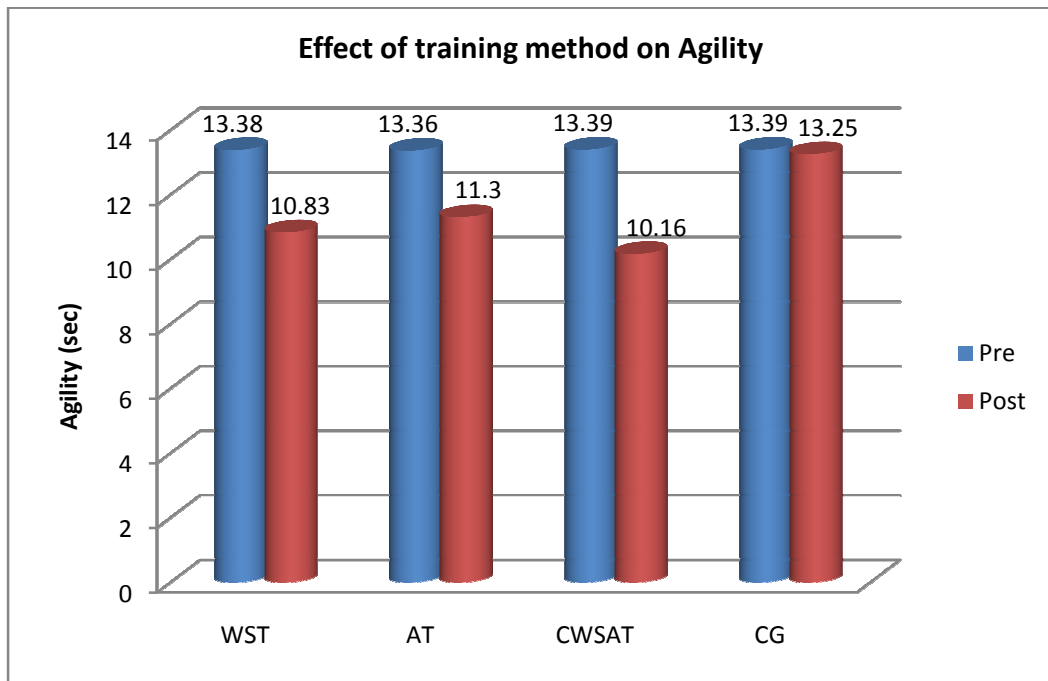


FIGURE 3

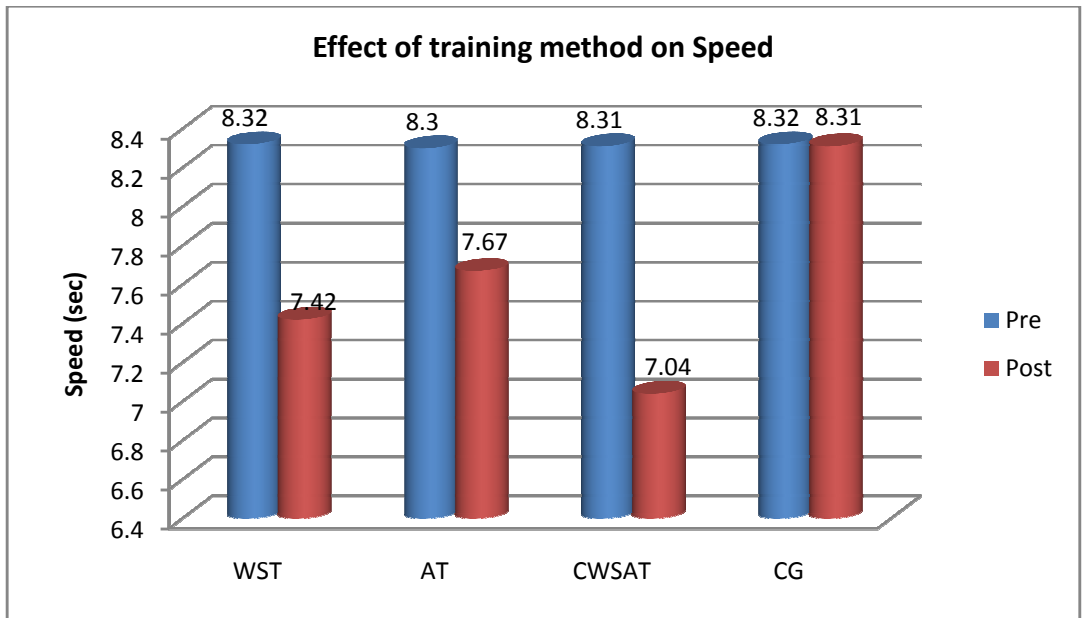


FIGURE 4

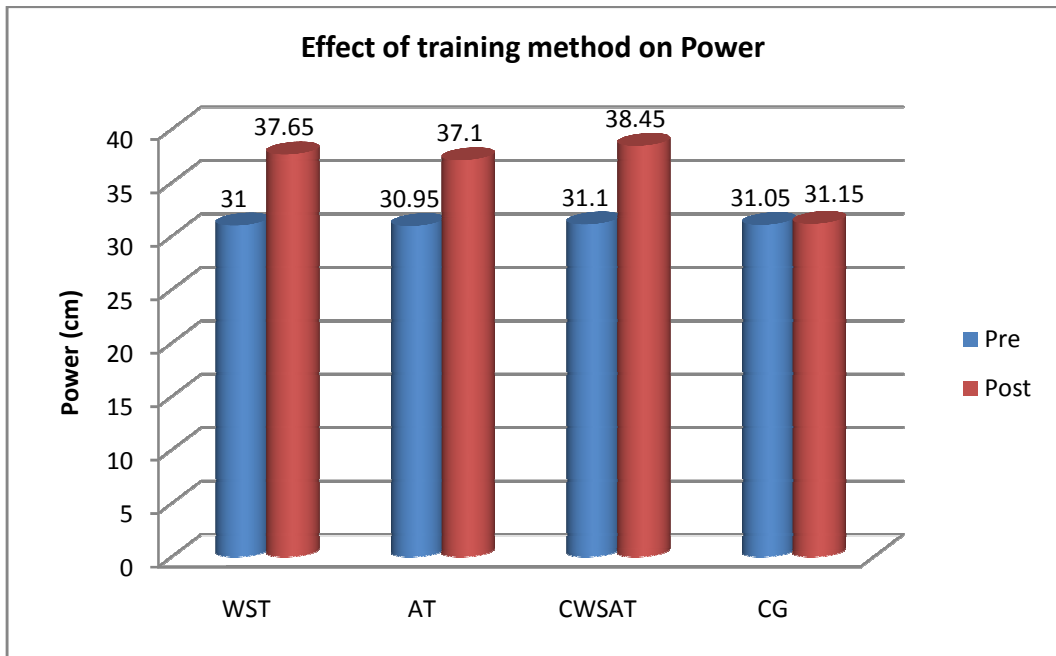


FIGURE 5

Weight with sprint training (WST) produced a significant increase in flexibility, agility, and power ($p < 0.05$). there was no significant difference in speed.

Aerobic training (AT) produced a significant difference increase ($p < 0.05$) in flexibility and power. There was no significant difference in speed and agility.

The Combination of (CWSET) of weight with sprint and aerobic produced a significant increase ($p < 0.05$) in flexibility, agility, speed and power.

There was no significant difference in control group (CG) due to lake of training.

Analysis of variance before training showed no significant difference while after training the improvement in all the parameters were significant at five percent level.

Table gives the iron and vitamin C content of the food supplement.

TABLE XI
NUTRITIVE VALUE OF THE GIVEN SUPPLEMENT

Food groups	Quantity	Iron (mg)	Ascorbic acid(mg)
Date	80	13.6	-
Amla	10	0.12	46.30
RDA (ICMR, 2010)	-	15	55

The iron content of 80g dates was 13.6 mg and ascorbic acid content of amla was 46.30 mg. The iron and ascorbic acid supplied for one day was 13.32 mg and 46.30.

2. Blood haemoglobin

Figure six shows the difference in haemoglobin level before and after supplement.

HAEMOGLOBIN (g/dl) BEFORE AND AFTER SUPPLEMENTATION

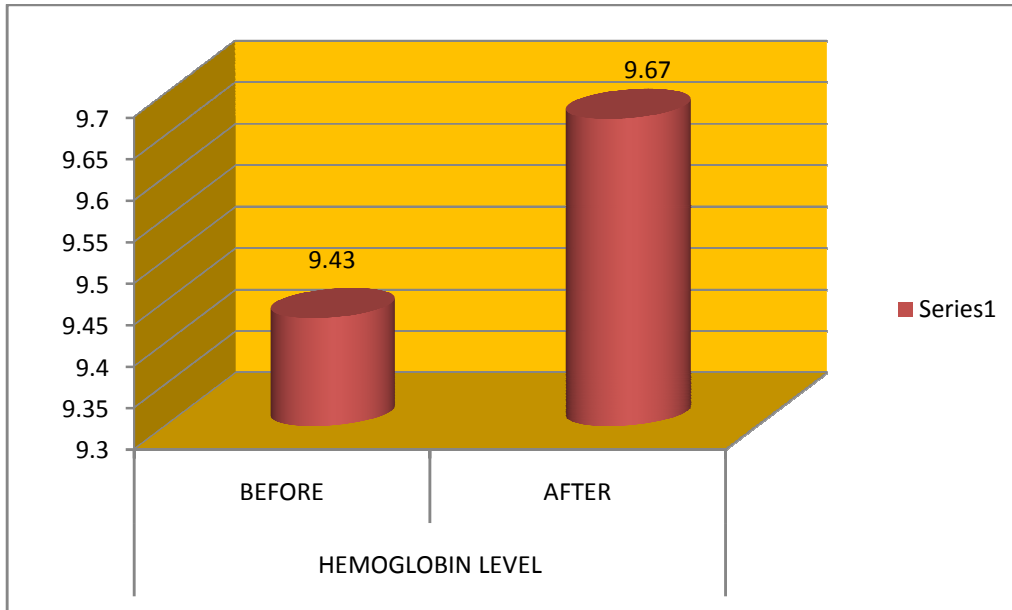


FIGURE 6

The haemoglobin level of the athletes improved though not significantly on supplementation of dates and amla syrup. This could be because of the short duration of supplementation.

TABLE XII
NUTRITIONAL KNOWLEDGE OF THE ATHLETES

(N=200)

Group	Pre test score%	Post test score%
Weight/sprint	70.8	71.9
Aerobic group	80	67.5
Combination group	65	68.3
Combination group with supplement	83.6	85
Control group	86.6	90

The nutritional knowledge of the athletes was improved. In the weight/sprint group it as increased from 70.8 percent to 71.9 percent, aerobic group have increased from 80 percent to 67.5 percent, combination group have increased from 65 percent to 68.3 percent. Combination group with supplement have increase 83.6 percent to 85 percent and control group increase 86.6 to 90 percent.

V SUMMARY AND CONCLUSION

The present investigation “Nutritional Status and Performance Ability of Trained Adolescent Athlete” is summarized as follows:

Nutritional status of athletes exerts a significant impact upon athletic performance. When talented, motivated, and highly trained athletes meet for competition, the margin between victory and defeat is usually small. When everything else is equal, nutrition can make the difference between winning and losing.

Sports nutrition is the application of eating strategies to promote good health and adaptation to training, to recover quickly after each exercise training session, and to perform optimally during competition.

A total 200 athletes were selected from Nilgiris. Government Higher Secondary School and Gurukulam Matriculation School. Information regarding the back ground information, nutritional status, and life style pattern were collected using the questionnaire. Performance ability training, supplementation was given to ten female athletes with low haemoglobin level (<9.5g/dl), and nutrition education were given for all the athletes. Blood Haemoglobin levels were taken for ten athletes.

The salient findings of the study are as follows:

1. Majority (54%) of the athletes were 14-16 years of age. When compared to the girls more boys (52.5%) involved in sports; 61percent of athletes were from X-XII standard.
2. Majority(87.5%) of the athletes were from nuclear family and had 3-5(92%) members in family. Around 36.5 percent of parents were agriculturist and 34 were from low income group and nine percent were daily wage earners and remaining percent was employed.

3. Eighty nine percent of athletes practiced 1-2 hours per day. Athletes were involved in athletics (20.5%), cricket (17%) and shuttle (19%) when compared to other events.
4. Around 94.5 percent of athletes were trained for one to two hours per day, 83 percent of athletes spent three to four hour per day while 68.5 percent of adolescent athletes slept eight hours a day.
5. All athletes consumed fast food, only 3.5 percent of athletes never consume fast food and 70 percent of athletes consumed juice, bread (12%) and glucose (18%) as a pregame meal.
6. Around 65 percent of the athletes were non –vegetarians, 97.5 percent of athletes consumed coffee/milk /tea and 85 percent of adolescent athletes did not skip their meals. While 43.5 percent of adolescent athletes did not consume carbonated beverages; 87.5 percent athletes consumed 100-500 ml of fluid per day.
7. Rice, onion, coriander, curry leaves, milk, curd, sugars were consumed by all the athletes. Pulses, roots and tubers are consumed weekly once or twice. The foods like chicken and green leafy vegetables were consumed occasionally.
8. Deficits were observed in the intake of all foods (9.96% - 71.5%) and all nutrients (5% - 64%) and all for male and female athletes.
9. The energy expenditure of the male athletes is deficit 22.3 percent and for female is 73 percent.
10. Combination training (weight with sprint and aerobic training CWSTAT) recorded the best improvement in flexibility, agility, speed and power followed by weight with sprint(WST) and aerobic training (AT).
11. The supplement provided a day's RDA for iron and ascorbic acid.

12. Mean height of male athletes was 157.69cm and for female athletes was 148.99 cm. The mean weight for male athletes was 48.58kg and for female athletes was 48.78kg. Mean BMI of the male athletes was 23.51 and for female athletes was 24.34. Both male and female athletes were underweight. Mean MUAC of the male athletes was 10.28cm and for female athletes was 10.87cm. Mean biceps of male athletes was 10.74mm and for female athletes was 10.68mm. Mean triceps of the male athletes was 9.91mm and for female athletes was 9.84mm. Mean Chest circumference of the male athletes was 31cm and for female athletes was 31.
13. Improvements in haemoglobin were not statistically significant due to the short duration of supplementation.
14. The nutritional knowledge of the athletes was improved. In the weight with sprint group it has increased from 36 percent to 76.3 percent, aerobic group have increased from 32.6 percent to 78 percent, combination group have increases from 32.2 percent to 80.3 percent and control group 33.3 to 73.6 percent.

It can be concluded that combination training (weight with sprint and aerobic training CWSTAT) is the best method in improving in flexibility, agility, speed and power. Supplementations can be given for a longer period of time to observe a significant increase in haemoglobin level. It is also concluded that imparting nutrition education had a positive impact in increasing their nutritional knowledge.

From the findings of the study the following recommendations are made

- Extended supplementation studies could be implemented to determine the efficiency of the supplement formulated in the present study.
- Implementation of new combination techniques to improve flexibility, power, agility and speed for aerobic dance.
- Imparting sports nutrition education to a large number of samples and evaluating its impart on dietary modifications.

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APPENDICES - I

NUTRITIONAL STATUS AND PERFORMANCE ABILITY OF HIGHLY TRAINED ADOLESCENT ATHLETES

I. Background Information of the student:

- 1. Name :
- 2. Age :
- 3. Gender :
- 4. Standard :
- 5. Address :
- 6. Phone number :
- 7. Type of family: Nuclear Joint
- 8. No. of family Members:
- 9. Family structure:

S. No	Name of the family members	Relationship	Age (yrs)	Sex	Education	Occupation	Income/month

II. DIETARY PATTERN:

- 10. Dietary habit
Vegetarian Non-Vegetarian

- 11. Do you drink Milk/ Coffee/ Tea?
Yes No
- 12. Do you skip meals?
Yes No

13. Do you drink carbonate beverages?

Yes No

14. Daily Meal Pattern (24 hrs)

Meal/ Day	Menu	Ingredients	Quantity Consumed
Breakfast			
Mid morning			
Lunch			
Tea time			
Dinner			

III. DIETARY SURVEY

15. Details of food consumption

S. No	Food items	Daily	Weekly once	Weekly twice	occasionally	Never
1	Cereals and millets Rice Ragi Wheat Millet Any other					
2	Pulses Bengal gram dhal Black gram dhal Red gram dhal Green gram Green gram dhal Soya bean Any other					
3	Vegetables Bitter gourd					

	Ridge gourd Ladies finger Bottle gourd Brinjal Any other					
4	Roots and tubers Potato Onion Carrot Beet root Yam Any other					
5	Green leafy vegetables Agathi Amaranth Drumstick leaves Fenugreek Coriander leaves Curry leaves					
6	Nuts and oil seeds Coconut Groundnut Sesame Almond Pista Cashew nut					
7	Fruits Apple Banana Grapes Mango Papaya Guava Lime Pomegranate Sapota					
8	Milk and milk products Cow milk Buffalo milk Curd Buttermilk Ghee					

	Cheese Panneer					
9	Sugar and Jaggery Sugar Honey Jaggery Palm jiggery					
10	Non Vegetarian Egg Chicken Fish Crab/Prawn Beef/Pork Meat					

16 .How often do you consume fast foods?

Weekly once weekly twice monthly

17. What do you take as pregame meal?

18. Mention some foods which you think increase your performance and state the reasons.

1) Home food mixes

2) Market foods

III. ANTHROPOMETRIC MEASUREMENT

19. Height (cm):

20. Weight (kg):

21. BMI (Body Mass index):

22. MUAC (cm):

23. Chest circumference (cm):

24. Biceps (mm):

25. Triceps (mm):

IV.PERFORMANCE ABILITY:

	Variables	Test
26	Flexibility	Sit & reach
27	Power	Vertical jump
28	Speed	50 m dash
29	Agility	T- agility test

V.LIFE STYLE PATTERN

30 .How many hours do you practice every day?

31. Which type of sports do you involve in?

32. How many hours does your athletic coach train you?

33. How many hours do you spend for other activity?

34. How many hours do you sleep?

35. 24hours energy expenditure schedule.

Time	Activity

36. Details on fluid intake

Time	Type of fluid	Quantity(ml)

APPENDIX II

APPENDICES –III

Performance Ability before and after training

Weight with sprint training

Flexibility		Agility		Speed		power	
Pre	Post	Pre	Post	pre	Post	pre	post
18	25	13.33	11.11	9.55	7.62	35	42
20	28	12.1	10.55	8.29	7.25	28	35
28	35	13.65	10.54	7.93	6.52	26	32
27	36	14.19	11.97	7.55	7.1	30	38
26	33	12.97	9.14	7.82	6.03	32	38
18	25	14.89	12.14	7.8	6.98	32	38
18	23	13.65	11.85	8.23	6.92	25	38
24	29	11.9	9.89	7.57	6.8	32	37
21	29	12.8	10.25	10.1	8.23	27	35
24	38	13.98	10.11	8.15	7.32	35	42
29	36	14.69	12.15	9.2	7.25	30	38
25	31	14.58	12.6	9.25	8.7	28	34
18	27	14.56	12.1	8.3	8.2	35	40
21	30	13.98	9.15	7.2	6.7	36	42
17	24	12.17	9.56	7.35	6.75	35	39
24	35	11.18	9.24	9.1	8.6	34	40
21	30	11.7	9.78	9.33	9.1	29	34
29	36	13.9	10.17	8.2	7.25	28	35
25	39	13.16	10.8	7.25	7.25	33	38
28	36	14.32	13.52	8.23	7.98	30	38
461	625	267.7	216.62	166.4	148.55	620	753
23.05	31.25	13.385	10.831	8.32	7.4275	31	37.65

Aerobic training

Flexibility		Agility		Speed		power	
Pre	Post	Pre	Post	pre	Post	pre	post
24	29	13.25	11.78	7.82	7.02	30	36
26	32	13.52	11.52	7.8	6.99	25	28
24	30	13.45	11.54	9.57	9.32	36	39
30	35	13.95	9.25	9.12	8.12	35	39
25	29	13.1	10.62	9.35	8.25	31	38
27	35	13.75	10.78	7.55	7.25	33	39
21	27	12.4	9.7	7.94	7.52	33	37
20	29	14.45	14.13	7.56	7.01	26	34
21	31	14.97	11.98	7.16	6.97	29	32
25	32	13.07	10.25	9.23	9.1	27	33
16	25	12.16	8.1	8.31	7.8	39	45
25	35	13.18	10.27	8.15	7.72	31	35
22	35	12.16	10.25	9.12	8.66	31	36
26	36	14.23	13.65	7.94	7.02	27	32
21	31	11.45	10.34	7.9	6.95	29	38
26	30	13.1	11.2	8.32	7.01	30	38
22	28	14.5	12.6	9.21	8.2	33	40
15	21	13.88	13.2	8.6	7.97	31	44
19	28	12.7	11.5	8.41	7.7	32	39
25	33	14.1	13.5	7.8	6.89	31	40
460	611	267.37	226.16	166.86	153.47	619	742
23	30.55	13.3685	11.308	8.343	7.6735	30.95	37.1

Combination with weight/sprint and aerobic training

Flexibility		Agility		Speed		Power	
Pre	post	pre	post	pre	post	pre	post
27	38	14.3	10.35	7.46	6.12	31	43
21	35	14.62	9.65	8.1	6.95	32	42
20	30	13.6	8.25	8.69	7.56	40	52
18	29	13.98	11.76	9.21	7.21	33	39
27	38	13.1	9.32	9.45	7.13	35	42
29	35	14.01	9.45	7.94	6.85	29	36
26	36	13.98	9.64	7.82	7.02	28	33
21	31	12.3	10.58	7.44	6.96	28	36
18	31	13.1	10.85	8.21	7.6	28	35
22	33	12.75	9.75	8.5	7.15	30	38
21	36	14.25	11.2	9.4	7.12	31	40
21	31	13.8	8.25	7.98	6.9	35	42
19	25	10.9	8.65	7.45	6.64	28	34
21	28	13.69	10.45	7.14	6.7	29	36
28	34	10.98	8.96	8.1	7.52	23	29
26	35	14.26	12.1	8.75	6.98	30	38
25	38	13.7	12.45	9.14	7.52	34	38
24	35	14.15	11.85	9.4	7.25	31	39
23	30	13.93	9.28	7.56	6.97	34	38
22	29	12.56	10.56	8.56	6.65	33	39
459	657	267.96	203.35	166.3	140.8	622	769
22.95	32.85	13.398	10.1675	8.315	7.04	31.1	38.45

Control group

Flexibility		Agility		Speed		Power	
pre	post	pre	post	pre	post	pre	post
18	19	10.54	10.53	7.25	7.24	30	31
22	22	11.54	11.53	7.45	7.45	25	25
20	20	12.65	12.64	8.25	8.23	36	36
23	23	13.85	13.83	8.24	8.24	38	38
21	21	12.84	12.84	8.36	8.36	31	32
29	29	11.64	11.64	8.25	8.24	33	33
24	23	13.52	13.51	9.12	9.12	33	34
20	20	14.65	14.62	9.25	9.26	26	25
19	19	13.84	13.83	9.14	9.14	29	29
25	26	12.52	12.5	7.35	7.35	27	28
20	20	11.54	11.23	8.52	8.51	39	39
20	21	12.56	10.41	8.36	8.37	31	31
23	23	12.87	12.86	7.25	7.25	28	26
29	30	13.85	13.84	8.24	8.24	26	26
25	25	14.59	14.58	9.31	9.32	37	37
26	25	15.38	15.38	9.32	9.31	35	36
28	29	15.36	15.23	8.21	8.19	35	35
29	29	15.25	15.23	9.25	9.26	29	29
18	18	12.52	12.51	7.25	7.24	28	28
19	19	16.34	16.34	8.21	8.21	25	25
458	461	267.85	265.08	166.58	166.53	621	623
22.9	23.05	13.3925	13.254	8.329	8.3265	31.05	31.15

ANTHROPOMETRIC VALUES OF THE SELECTED ADOLESCENT ATHLETES

Sl. No	HEIGHT(cm)			
1	135	147	155	161
2	135	145	152	162
3	135	149	157	160
4	135	145	150	162
5	134	142	150	160
6	130	143	152	162
7	130	140	152	160
8	139	147	150	161
9	138	140	150	165
10	139	155	150	160
11	139	158	153	163
12	135	150	150	163
13	136	157	151	160
14	138	155	155	161
15	138	158	151	165
16	137	152	155	162
17	139	150	155	160
18	138	151	153	161
19	148	157	155	160
20	140	152	150	160
21	140	155	153	162
22	149	152	150	160
23	148	156	150	160
24	147	157	158	168
25	148	154	153	168
26	146	155	155	160
27	145	151	156	161

28	149	153	150	167
29	147	157	151	160
30	143	150	151	160
31	142	158	151	160
32	145	157	150	165
33	145	154	152	168
34	145	158	153	160
35	144	156	150	161
36	140	155	153	162
37	140	155	153	161
38	140	156	154	160
39	149	155	151	160
40	145	158	150	161
41	141	157	160	170
42	149	157	160	172
43	148	158	161	171
44	145	152	160	170
45	147	150	163	172
46	149	155	160	171
47	149	150	160	171
48	149	155	160	172
49	148	155	160	170
50	148	155	161	170

S.NO	WEIGHT(kg)			
1.	37	48	47	54
2.	38	47	43	55
3.	35	49	45	51
4.	36	46	42	50
5.	38	48	40	50
6.	36	44	40	50
7.	35	42	40	50
8.	35	45	42	50
9.	34	45	45	50
10.	35	46	46	50
11.	38	40	47	52
12.	35	42	42	52
13.	39	46	47	51
14.	35	45	49	50
15.	35	40	42	52
16.	35	45	42	50
17.	35	49	45	54
18.	35	45	40	50
19.	35	43	45	53
20.	35	49	45	54
21.	35	48	42	57
22.	35	41	49	55
23.	35	44	48	52
24.	31	45	45	54
25.	38	45	43	51
26.	30	47	45	56
27.	36	40	49	50

28.	34	45	42	50
29.	35	42	43	51
30.	38	40	40	59
31.	35	40	43	58
32.	39	40	43	53
33.	36	42	43	52
34.	35	40	49	56
35.	37	40	45	51
36.	35	40	42	54
37.	37	40	40	55
38.	37	40	46	52
39.	39	46	48	53
40.	38	40	45	55
41.	39	43	49	58
42.	48	40	46	54
43.	47	45	49	55
44.	49	45	48	56
45.	46	40	51	51
46.	48	44	50	50
47.	44	48	51	50
48.	42	45	51	60
49.	45	47	55	60
50.	45	44	50	62

APPENDICES V

HAEMOGLOBIN LEVEL BEFORE AND AFTER SUPPLEMENTATION

S. No	BEFORE	AFTER
1.	8	8.3
2.	8.1	8.3
3.	9	9.2
4.	10	10.4
5.	9	9.3
6.	7.5	7.8
7.	10.3	10.4
8.	11	11.2
9.	10.8	11
10.	10.6	10.8