EFFECT OF AEROBICS EXERCISES AND NUTRITIONAL SUPPLEMENTATION ON SELECTED MOTOR FITNESS COMPONENTS OF BADMINTON PLAYERS

DR.SUDHAKARABABU MANDE

BADMINTON

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Dedicated to

My Parents, Abraham, Vanakumari.

Wife, Dilleswari.

Daughter, Mythri Sudheepya Paul.

DECLARATION

I hereby declare that the Topic entitled, "**EFFECT OF AEROBICS EXERCISES AND NUTRITIONAL SUPPLEMENTATION ON SELECTED MOTOR FITNESS COMPONENTS OF BADMINTON PLAYERS**" being Published to that it has not previously formed on the basis for the any Topic any other similar title of any wearer Institution.

Place: Kothavalasa

Date: 01-03-2019

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LIST OF ABBREVIATIONS

μmg	Nano-Milligram
16 PF	16 Personality Factors
AAU	Amateur Athletic Union
AIS	adiopathic seokosis
ATP	adenosine triphosphates
C.I.	Confidence Interval
CD	conjugated dienes
CHF	congestive heart failure
cm	centimetre
Cu	Copper
Diff.	Difference
DS	Down syndrome
ECMO	extracorporeal membrane oxygenation
FAO	Food and Agriculture Organization
Fe	Ferrous
FW	fortified water
G	gram
G/dL	gram per desilitre
GSH Rd	glutathione reductase
GSH	reduced glutathione
GSH-Px	Platelet glutathione peroxidase
GSSG	oxidized glutathione
H	hour
Hb	Haemoglobin
HBR	hemoglobin response
HR max	Maximum Heart Rate
HR	heart rate
HSPs	heat shock proteins
ID	Iron deficiency
IFA	iron folic acid
IFS	iron+folic acid supplement
IQ	intelligence quotient

IS	iron supplement
kcal/d	kilocalorie per day
kg	kilogramme
LA	lactate accumulation
LDL	low-density lipoprotein
LOOH	lipid hydroperoxide
LPO	Lipid peroxide levels
MALDI-TOF-MS	Name of a test to analyse protein and DNA
MAS	Meconium aspiration syndrome
Mg	milligram
Min	Minutes
MM	multiple micronutrient
MMN	Multiple Micro Nutrient
MMS	multiple micronutrient supplement
Ng/mL	nanogram / milliliter
NK	natural killer
PC	protein carbonyl
PCF	food as porridge powder
PCM	protein-calorie malnutrition
PEI	Physical Efficiency Index
RA	retinoic acid
RBC	Red Blood Cells
Reqd	Required
R-ol	retinol
SD	Standard Deviation
Se	Selenium
SF	serum ferritin
SMD	standardised mean difference
SOD	superoxide dismutase
s-TfR	serum transferrin receptors
TAC	total antioxidant capacity
Tex	Exercise time
TPN	total parenteral nutrition
TSH	Tyroid Stimulating Hormone

Tsp	Teaspoon
VAD	vitamin A deficiency
VO_2	peak oxygen consumption
WHO	World Health Organization
WIFS	weekly iron-folic acid supplementation
Wk	week
Wp	peak sustained workload
Y/s	year/s

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CHAPTER I

INTRODUCTION

Performance of an athlete in a sport or event depends upon physical, motor and psychological components. Generally, these variables are performance oriented and are dependent upon functioning of different systems of the body in an integral manner. The strength and power are essential qualities required for excellence in sports. A proper and specific training tend to improve most of the physical variables by which a definite improvement in the performance of the athlete could be achieved. In majority of the sports events and competitions it is the performance in the physical and motor variables such as speed, power, agility, endurance with balance and coordination which contribute to one's ability to perform difficult and complex skills.

The science of sports training is a recent to the field of sports science. The sports science discipline have improved at a very fast pace in the past few decades. The knowledge gained by these disciplines has to be understood by the coaches and trainers to apply it correctly to the training process. But majority of the coaches do not have sufficient scientific background and training to make full and effective use of the knowledge acquired by the sports science disciplines. This creates a gap between scientists and coaches. The science of training with its workers having sufficient background of science and sports are able to fill this gap and can become mediator between the scientists and the coaches.

According to Hardayal Singh (1991), Sports Training is a pedagogical process based on scientific principles, aiming at preparing sportsmen for higher performance in sports competition.

Sports training aims to improving the performance of sports persons. Weight training and plyometric training are very popular now a days and effective training

methods to promote higher performance in sprinting and jumping events. Plyometric exercises are included depth jumping, hopping, bounding drills etc are legs plyometric and medicine balls exercise are arms plyometric exercises. These exercises are used to improve speed, explosive strength and other motor ability components. Weight training is on activities of high intensity and short duration and opposite side low intensity and high volume or duration. Weight training exercises helps to build muscle, strength and endurance.

TRAINING

Sports training is the basic form of an athlete's training. It is the preparation systematically organized with the help of exercises, which in fact is a pedagogically organized process of controlling an athlete's development. (Singh, 1984)

Sports Training is the physical, technical, intellectual, psychological and moral preparation of an athlete by means of physical exercise. The word training has been a part of human language since ancient times. It denotes the process of preparation for some task. This process invariable extended to a number of days and even months and years. The term 'training' is widely used in sports to achieve the high level of performance to a particular competition.

Sports training is a systematic process extending over a long period. For best results the system of training has to be based and conducted on scientific facts and lines. Where it is not possible to do that, the training has to be based on the results of successful practice which has withstood the test of time. Sports science has still not been able to provide a scientific base for all the aspects and elements of training. Many things are still based on the results of successful practice which on deeper analysis is also a method of science to prove or disprove a theory.

IMPORTANCE OF SPORTS TRAINING

According to Mathew (1981) Sports Training is the basic form of preparation of sportsmen. The aim of sports training is to prepare a sportsperson physically,

physiologically and psychologically for a possible highest sports performance at the time of main competition, a specific sports. To make a sports person capable of putting up optional performance, systematic improvement of performance capacity and readiness of sports performance is to be carried out.

Sports training is based on systematic fact and principles. A systematic and suitable for achieving high performance has to be first made on the basis of which sports training is planned. It is always assessed, planned organized and implemented by a coach or a sports teacher or some other person.

Sports training aims at improving sports performance through physical, physiological, psychological, social intellectual and moral aspects thus contributing to development of all-round personality of the sports person. In other words the performance of a sports person improves as a result of development of total personality. Therefore, since sports training directly or indirectly focuses attention on development of all-round personality of a sports person, sports training is an educational process (pedagogical process).

BADMINTON

The game was first named when army officers leave from India played Badminton in 1873 on a Country Estate owned by the Duke of Beauport in Glocestire, England.

In India it appears to have been played at Poona a year earlier by English, officers. But it also appears that the game was played in China and Poland in 17th and 18th Century and there are even references in twelfth century royal courts records.

The first organized body was the English Badminton Association formed in 1893 and it was England, which started touring countries like Canada in 1920's.

The S.B.F. was founded in London, in 1934. Thirty-seven others have joined the nine founder countries.

A council consisting of elected representatives of all the country Association plus three cooped members three of who are regular players govern the Badminton Association of England. Two members of this council represent England at I.B.F. Meeting.

The I.B.F. is governed by an annual meeting of the elected representatives of every national association in membership and before and alteration in the laws of the game it should be approved by at least two thirds of the meeting.

Ball Badminton is a racquet game played upon a court of fixed dimensions with a woolen ball of yellow colour. The royal family in Tanjore District of Tamil Nadu, India played this game as early as 1856. It is extensively played for three decade, since Ball Badminton Federation was recognised by the very few indigenous game in the school games, National and Inter University competitions. Ball Badminton has got six Arjun awards among its players. This is game having rural origin.

Ball Badminton is mostly played in day light and outdoor. As a result climatic conditions do influence the trend of the game. Game rules were modified to distribute the effect of the climate more or less evenly, on both the teams owing to its dependence on light, breeze and rain, most of the North Eastern regions and regions of similar nature could not adopt this game well. In the recent years Ball badminton was tried and played under floodlight and even as indoor game. It gained momentum after it is played under floodlights.

Five players shall play the game a side, two fronts, one centre and two backs with ball badminton racquet and woolen ball upon a court as laid out as per the diagram. Such a game shall be called a FIVES and the game consists of 29 points.

AEROBICS

Aerobic refers to a variety of exercises that stimulate heart and lung activity for a time period sufficiently long to produce beneficial changes in the body (Cooper, 1970)

"Aerobics" basically means living or working with oxygen. Aerobics or endurance exercises are those in which large muscle groups are used in rhythmic repetitive fashion for prolonged periods of time.

Aerobic is a system of exercises designed to promote the supply and use of oxygen in the body. Some of these exercises include running, dancing, rowing, skating and walking. Aerobic exercise increases cardio respiratory fitness, which is the heart's ability to pump blood and deliver oxygen throughout the body. Some benefits of cardio respiratory fitness are increased endurance and energy. weight control decreased blood pressure, decreased heart rate, decreased cholesterol levels, and an increased ability to manage stress.

The word "aerobics" is relatively old in the context of sport and exercise. Cooper has developed an aerobics exercises programme in the spirit of preventive medicine with a view that aerobic types of exercises would be useful to develop cardio respiratory health and fitness.

Many of the early aerobics classes were called "high impact" that is, both feet may be off the floor at any given time. High impact was characterized by running or jogging in place, jumping jacks, and small jumps or hops. This was an exciting beginning to aerobics, however this style created a tremendous amount of stress on the joints, and many of the participants developed impact – related injuries. So 'low impact' aerobics was developed in response to the increase in injuries. In low impact aerobics one foot is on the floor at all times, the routines are characterized by marching in place and traveling from one side of the room to the other. The variable impact aerobics is a combination of high and low impact moves with a combination

as high intensity impact with the safety of low impact. (Livenson and Christianson, 1999).

The creativity of aerobic instructors and the industry in general have developed new and varied types of aerobic classes. These include water aerobics, sculpting, strength, abdominal, sports conditioning, and circuit or interval classes.

Step Aerobics

Step aerobic was innovated by Gin Miller Circa, 1989. It is distinguished forms of aerobic exercise by its use of an elevated platform (the step) which enables a more vigorous work out that can be achieved with regular aerobics.

The step aerobics was developed by Gin Miller while she was recovering from a knee injury, is a trend that took the aerobics industry by storm. This extremely popular style involves stepping up and down from a platform 15 to 30 centimeters (6 to 12 inches) high while performing different step combinations.

In step aerobic exercises the heart rate increases substantially, but never reaches its maximum level. The heart is always able to deliver sufficient oxygen – rich blood to muscles so that they can derive energy from fat and glycogen aerobically. Aerobic exercises builds stamina for sports and it is also the most important form of exercise for health, since it increases the efficiency of heart, circulation and muscles.

Aerobics is extremely beneficial for developing overall physical fitness. Aerobic dance can improve a participant's flexibility, strength, cardiovascular fitness, and reduce the percentage of body fat. The rhythmic movements performed to music also help to develop balance and co-ordination. The popularity of aerobics is also attributable to the social support, understanding and reinforcement inherent to a group of exercise situation.

To ensure safe and effective aerobic exercise programmes with training, educational organizations emerged to help guide the aerobics industry. The fundamental components of the aerobic exercise programme consists of five segments: the warm – up or pre stretch (10 min) the aerobic segment (20 – 45 min) cool down (5-10 minutes), strength work (10-20 min) and the final stretch (5-10 min).

Benefits of Aerobics Exercises

Aerobics and step aerobics are more efficient method to decrease the percentage of body fat to attain the other metabolic benefits of fitness. It has also a very good way to develop musculoskeletal fitness while building strength, flexibility and coordination. Aerobic exercise has a positive effects on stamina, blood pressure, weight, sleep patterns, energy levels, lipid profiles, and can reduce the risk of cardio vascular diseases, diabetes and certain type of cancer.

Aerobic progressive physical conditioning programme that stimulates cardio respiratory activity for a time period sufficiently long to produce beneficial change in the body and reduce the resting heart rate. As the intensity and duration of work increases the demand for fuel in the working muscle also increases to meet the additional demand for energy. (David Levinson, 1996).

It is strengthening muscles involved in respiration to facilitate the flow of air in and out of the lungs. Toping muscles throughout the body which can improve overall circulation and reduce blood pressure. Increasing the total number of red blood cells in the body, to facilitate transport of oxygen throughout the body. Regular vigorous aerobic activity can stimulate bone growth, as well as reducing the risk of osteoporosis for both men and women.

NUTRITION

Nutrition is the science of foods, the nutrients and other substances there in action, interaction and balance in relationship to health and disease, the processes by

which the organism digests, absorbs, transports and utilises nutrients and disposes of their and products. (Lawler 1982)

Proper nutrition is important to the health of an athlete for physical fitness, recuperating fatigued muscles, energy and the repair of damaged tissues. The athlete should include proper amount of carbohydrates, fats, proteins, minerals, vitamins and Water in his or her diet.

A Basic understanding of nutrition and its effects upon health, weight control and Physical performance is essential for all people, including the coach trainers and athlete. An athlete's performance may be improved with good and sound nutrition. (Sharer 1982)

NUTRITION SUPPLEMENTATION

Nutrition supplementation is a preparation intended to supplement the diet and provide nutrients, such as vitamins, minerals, fiber, fatty acids, or amino acids, that may be missing or may not be consumed in sufficient quantities in a person's diet. Some countries define dietary supplements as foods, while in others they are defined as drugs or natural health products.

Supplements containing vitamins or dietary minerals are included as a category of food in the Codex Alimentarius, a collection of internationally recognized standards, codes of practice, guidelines and other recommendations relating to foods, food production and food safety. These texts are drawn up by the Codex Alimentarius Commission, an organization that is sponsored by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO).

Nutritional supplements help one to overcome nutritional deficiencies. We need all the nutrients in their proper amounts for optimum health. Since our diets most likely cannot provide all of them, nutritional supplements can fill in those gaps.

Nutritional supplements also help boost our immune system. The stronger the immune system, the more resistant the body can be against disease. We know that popping a tablet or two of Vitamin C can help to avoid colds and related illnesses. This is exactly how useful supplementation is.

Nutritional supplements are also useful in getting rid of the toxins which we horrendously take in everyday. The environmental stresses we go through, chemicals we are in touch with, as well as our lifestyle - these all subject us to harmful toxins which can lead to serious health problems. Supplements, most especially anti-oxidants, can help our body keep toxins to a minimum.(Fox 1988)

There are much more benefits that nutritional supplements can provide. The main point is that these supplements help one to have the optimum health deserved and minimize the risk of diseases.

FITNESS

Fitness is a term which is often used as synonyms to health in a limited manner. Fitness denotes, different facts of health. The term fitness is the capacity of the individual to live and function effectively, purposefully, here and now to meet confidently the problems and crises which are among his expectations.

Fitness is a state which characterizes the degree to which a person is able to function. Ability to function depends upon the physical, mental, emotional, social and spiritual components as fitness, all of which are related to each other and are mentally independent. This may be referred to as total fitness. (Uppal, 2004).

The relationship between the soundness of the body and the activity of the mind is subtle and complex. In this sense, motor fitness, physical fitness and physiological components are the basis of all activities in our society.(Yobu, 2001)

Participation in daily physical activities result in the proper growth and maintenance of good health. Running, jumping, throwing, climbing and hanging

form the basic pattern of motor movements throughout the life of man. Physical activities promote muscular strength, endurance, agility, speed, balance and co-ordination, which is the basis for all physical work of the human body.(Bucher, 1978)

PHYSICAL FITNESS

The goal of physical fitness programme is to improve the performance in activities of daily living, job demands, sports and recreational activities (Singh, H. 1984)

The concept of physical fitness, in general athletic terms, means the capability of the individual to meet the varied physical and physiological demands of sporting activities, without reducing the person to an excessively fatigued state which reduces an individual's ability to perform the skills of the activity accurately and successfully.

"Fitness is composed of many complex factors where complete evaluation cannot be done by testing a single factor. Many variables such as those included in measuring cardio-respiratory balance, flexibility and nutrition reflex each in special way, some aspect of total physical fitness." (Donald, 1981)

MOTOR FITNESS

A motor skill is a skill that regards the ability of an organism to utilize skeleton muscles effectively. Muscles also depend upon the proper functioning of the brain, skeleton, joints and nervous system and that motor skills involve the proper functioning of such system.

Motor ability has been defined as the present acquired and innate ability to perform motor skills of a general or fundamental nature exclusive of high specialized sports and gymnastic techniques. This definition capacity and diverse training and experience is further implies that a valid measure of it must avoid

highly specialized skills as revealed in dance or sports. For the purpose of this research the following motor fitness variables were selected.

Speed

Speed can be influenced only to a limited extend and cannot be improved to a considerable extend like strength and endurance speed plays an important role in all sports except in endurance activities. Speed is the quickness of movement of a limb, whether this is the legs of a runner or the arm of the short putter.

Speed is a prerequisite to perform motor actions under given conditions such as movement task, external factors and is an individual prerequisite for sports, specifically sports and games that required movements in minimum time. Speed is a determining factor in explosive activities such as sprints, jumps, and most field sports (Hardayal Singh, 1991)

Speed is one of the most important physical fitness components, which is highly essential for many physical sport activities and explosive strength is highly related to speed. Generally in team events the team with higher speed and strength wins because they are the faster team. Speed of muscle contraction is an innate quality. Speed is an important factor for success in games like football, basketball, hockey, soccer and track and field events.

Endurance

Endurance is defined as the capacity to continue to work under strain for a long period of time without undue fatigue (Fall, T.L., and Bigbee, R, 1968)

It is the ability to persist in strenuous activity this definition, may apply to the body as a whole, to a particular body system or to a local area of the muscular system. Endurance is one of the basic components of general athletic ability and it is usually considered to be the most important component of physiological fitness. Some activities of which endurance is of prime importance are running, swimming,

cycling, wrestling, basketball, handball, soccer, rugby and football. In all these activities endurance training occupies an important place in preparation for performance.(Jenson and Fisher, 1972)

Explosive Power

Athletes contribute to physical fitness by developing organic vigour neuromuscular skill and desirable attitudes, towards play and exercises, to develop and maintain a degree of fitness, the individual must voluntarily submit a vigorous programme of exercise, perhaps the strongest force capable of motivating a person to engage in strenuous conditioning programme is the decree to excel is athletic competition to enhance their poor status.

In many games and sports, the height of an individual is important. It has definite and decisive advantage. Similarly the leg length is of considerable advantage in selected events in athletics and in certain games requiring jumping ability and sprinting action.

Vertical jump is one of the oldest forms of performance tests in Physical Education. It has been labeled as a test of neuromuscular efficiency. At present it is primarily accepted as means of explosive energy a test of the body to develop power in relation to the weight of the individual himself.

Leg strength plays a vital role in the daily activities of man. It is an essential factor for indulging in almost all games and sports. There is an old adage that an athlete will go on only as long as his leg could carry him. Vertical jump is used to measure the explosive power and strength of legs. Jumping ability depends on strength muscles and tendons and flexibility of ankles, knee and hip joints.(Larson, 1971)

Power is a composite of a number of different factors operating together to produce an explosive effort to get away to a first start, to accelerate the shot, to get maximum life when jumping all these require the explosive power.

The importance of selected motor fitness variables are discussed below.

Muscular Power

The power of muscle contraction is different from muscular strength. Power is determined not only by the strength of muscle contraction but also on its distance of contraction and the number of times that it contracts each minute. Muscle power is generally measured in kilogram meters per minute. The importance of power in athletics can be readily appreciated as in most events the greatest energy generated as a result of release of high energy phosphate produced in the shortest period of time which is essential for high intensity short duration exercises and is a prime factor in successful performance. This is true, for instance, in jumping, running, particularly in sprinting and throwing.

Flexibility

Flexibility is a pre requisite for maximal development of movement force and speed. Greater range of movement enables the muscles to develop more force and speed and also allows movements with minimum of muscle tension and internal resistance help in achieving higher movement economy (Singh, 1991)

Movement about a joint creates changes in pressure in the joint capsule that derive nutrients from the synovial fluid towards the articulation cartilage of the joint (Baechle, 1994) . The motor learning requires adequate level of flexibility of the concerned joints. Flexibility is joint specific, in other words, a high degree of flexibility in one joint differs from other joints. For example, back stroke in swimming needs more shoulder flexibility; wrist flexibility of shot putter and discuss thrower is greater and there is above average flexibility of gymnasts in the hip (Edward and Mathews, 1981).

Flexibility is significant in performing sports skills and also in physical medicine such as rehabilitation, general health and fitness, example, flexibility exercises for relief of dysmenerrhea, general neuromuscular tensions and low back

pains (Baechle, 1994). Inadequate flexibility leads to errors in movement execution. Because of its effect on technique it assumes importance for tactical skills. Optimum level elasticity, stretch ability and suppleness of muscles and ligaments help in absorbing the shocks and external forces tending to cause an injury.

Strength

Strength depends largely on the energy liberation process in the muscles and it is a direct product of muscle contractions caused by the intensity of neuro-muscular excitation. In sports movements strength is utilized in combination with endurance and speed abilities (Singh, 1991)

Strength is highly related to muscle hypertrophy. The process of hypertrophy increases in the synthesis of the contractile protein, action and myosin within the myofibrils within a muscle fiber. Increase in the size of muscle fibers increases the overall bulk of muscle. Strength training has positive effect on bone, muscle and associated connective tissues. The entire musculoskeletal systems is based on intimate linkage of contractile and non contractile tissues.

The energy stores in muscle glycogen, cretin phosphate and adenosine triphosphates (ATP) subtract stores, glycolytic enzymes myokinase and creatinine kinase can be used effectively to organise strength (Baechle, 1994)

NEED OF THE STUDY

Motor Fitness is the base of every man in every walk of his life. Every individual is interested to maintain optimum motor fitness, irrespective of his participation in physical and sports activities. For a good performance of Badminton, the players need good motor fitness levels. The investigator was interested to study whether aerobic exercises or nutritional supplementation contributes on selected motor fitness variables of badminton players.

STATEMENT OF THE PROBLEM

The purpose of this study was to find out the effect of aerobics exercises and nutritional supplementation on selected motor fitness components of badminton players.

HYPOTHESES

It was hypothesized that:

1. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as speed among badminton players
2. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as endurance among badminton players.
3. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as leg explosive power among badminton players
4. There would not be any significant difference in altering selected motor fitness variables, speed, endurance and leg explosive power among badminton players.

DELIMITATIONS

The study was delimited as below:

1. This study was delimited to the badminton players of school level boys in the age group of 15 to 17 years.
2. The 60 school level badminton players were randomly selected for this study.
3. The experimental treatment aerobic training and nutritional supplementations were given for a period of 12 weeks.
4. The aerobic exercises training were given for four days a week.

5. Only selected motor fitness variables speed, endurance and leg explosive power were assessed

LIMITATION

The study was limited in the following aspects:

1. Regular activities pertaining to their day to day affairs were not controlled.
2. The factors such as climate, study hours and motivation of the subjects were not taken into consideration.
3. The subjects' diet and nutrition were not taken into consideration
4. The parental influence and support towards participation in the study were not considered.
5. The growth and maturity factors were not controlled and
6. The influence of academic work on the performance variables and training could not be controlled.

DEFINITION OF TERMS

The important terms used in this study are defined below:

Aerobic Exercise

Step aerobics is a variation of traditional aerobics with the addition of a specially designed platform that you step on and off of during the workout.

Fitness

According to Karpovich (1962) , "it is the degree of ability to execute a specific physical task under specific condition."

Motor Fitness

According to Mathews (1963) , specific components or ingredients of motor fitness like speed, endurance, leg explosive sive, muscular strength, muscular endurance, muscular flexibility, cardio vascular (or) cardio respiratory fitness, neuro

muscular co-ordination any such of which we might measure to reflect a person's status.

Power

Power can simply be defined as the product of strength and speed.

According to Thomas (1994) "power is the ability to transfer energy into force at a fast rate of speed in other words, the capacity of the individuals to bring into play maximum muscle contraction at the fastest rate of speed."

Endurance

Endurance is the ability of the total body to sustain prolonged rhythmical exercise.

Hardayal Singh (1991) defines, "Endurance is the ability to do sports movements, with the desired quality and speed, under conditions of fatigue."

SIGNIFICANCE OF THE STUDY

The study is significant in the following ways:

1. The study is significant in assessing selected motor fitness variables speed, leg explosive poweer and endurance school level badminton players.
2. The study is significant in determining selected aerobic exercises for improving the motor fitness levels of badminton players.
3. The study significant in determining the effect of nutritional supplementation on selected motor fitness variables among school level badminton players.
4. The study is significant in comparing the effects of aerobic exercises and nutritional supplementation on selected motor fitness variables of school level badminton players.
5. The findings of this study would be beneficial to badminton players to improve their motor fitness levels.

6. The findings of this study would be helpful to the coaches to guide the badminton players the need for using aerobic exercises and nutritional supplementation to improve their motor fitness levels.

CHAPTERIZATION

This study is reported in five chapters. The first chapter consists of general introduction on motor fitness variables, aerobics exercises, nutrition and nutritional supplementation, game of badminton, need of the study, statement of the problem, hypothesis, limitations and delimitations of this study. The second chapter deals with the review of related literature on impact of different training methods in improving motor fitness levels of players. The third chapter explains the methods and methodologies adopted in selection of subjects, orientation of subjects, administration of tests, collection of data and analysis of statistics. The fourth chapter deals with the results and discussion of this study and the fifth chapter summarizes the research, findings, conclusions, recommendations and suggestions made for future studies.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter summarises the research studies relating to the problem under investigation. Review of relevant studies are of fundamental importance to provide an insight and better understanding of the problem for researcher to adopt suitable design and to ensure perfection in the study to be made.

Reviews of literature are used as a basis for inductive reasoning, and the researcher may locate and synthesize all the relevant literature on a particular topic (Thomas and Nelson, 1990) .

STUDIES ON AEROBIC TRAINING

Chan, et al., (2001) made a study to determine the relationship between the psychometric profile and health related fitness of Chineese youths in Hong Kong. They selected 1,615 Chineese school boys as subjects. The physical self description questionnaire suggested by Marsh et al (1994) was used to provide psychometric profiles. Anaerobic fitness estimated from mile run, flexibility scores from sit and reach test, push up scores, curl up scores and percentage of body fat were also collected as health related fitness factors. The results indicated that health related fitness is highly related to psychometric items such as perceived sport competence, perceived activity level, perception of body fat and global physical self concept. These results indicated the promotion of psychometric self perception of youth. The fact that male adolescents have more positive physical self perception than female signify the need to reevaluate the social values concerning physical fitness and perception that were placed on youth.

The 16 PF was administered to thirty eight female athletes who participated in the 1964 United States Olympic teams by Peterson, Wever and Trousdale (1967). This sample consisted of individual sports participants in swimming, diving,, riding,

fencing, canoeing, gymnastics and track and field. These subjects were compared to fifty nine team sport athletes who participated either in the 1964 Olympic volleyball team or one of the top ten AAU basketball teams for 1964. The two groups were found to differ on seven of the 16 factors. The athletes from the individual sports were significantly more dominant and aggressive, adventurous, sensitive, imaginative, radical, self sufficient, resourceful and less sophisticated than the team sport athletes and both groups were characterized by emotional stability.(Peterson, S.L., Weber, J.C., and Trousdale, W.W , 1989)

Alpert et al., (1990) had investigated the effects of aerobic exercise on a sample of 24 preschoolers. Thirty minutes of aerobic exercises were provided daily for a period of 8 weeks for a group of 12 children while the remaining 12 children engaged in free play on the school playground. The children were given pretests and posttests on the following measures: a sub maximal exercise test on a pediatric bicycle (baseline and three workloads), an agility test, a health knowledge test, a self-esteem scale, and an observational measure of their gross-motor activity. Despite comparability on pretests, significant group X repeated measures effects suggested that the aerobic exercise group showed decreases in heart rate at all three workloads as well as increases in agility and self-esteem following the exercise program. These findings suggest that cardiovascular fitness, agility, and self-esteem can be facilitated in preschoolers by an aerobic exercise program.

Ashutosh et al., (1997) conducted a study to assess the long term effects of weight loss with and without additional aerobic and weight training exercises on exercise tolerance and cardio respiratory fitness in obese women. Experimental design was a randomized prospective study for an approximately one-year community setting. Subjects were thirty one healthy obese women volunteers (age 42.8 yrs +/- 6 SD) recruited by community advertisement. All subjects underwent a weight loss program consisting of low calorie diet and behavior therapy for a minimum of 46 weeks. They were randomly assigned to one of the four groups. Group A: diet alone, Group B: diet plus aerobic exercise program in a supervised group setting, Group C: Diet plus weight training and Group D: diet plus weight

training plus aerobic exercise program. Exercise time (Tex) peak sustained workload (Wp), peak oxygen consumption (VO2), oxygen pulse and the rate of change of VO2 on recovery (VO2rec) were measured at the beginning and after 47.5 weeks +/- 1.5 SD, of the program. All subjects lost weight and achieved increased Tex and lowered resting VO2. VO2 peak and VO2 peak kg-1 increase in Groups B and D only. O2 pulse and VO2rec improved in group D. Improvements in exercise time correlated significantly with initial exercise time and weight loss. Weight loss increase Tex irrespective of participation in an exercise program. However, evidence of improved aerobic fitness occurred only in groups performing aerobic exercise.

MacMahon and Gross (1987) had conducted a study to evaluate the effects of aerobic exercise program on the self-concept, academic achievement, motor proficiency, and cardiovascular fitness of boys with learning disabilities. Fifty-four boys were randomly assigned to one of two exercise programs lasting 20 weeks. One program emphasized aerobic exercise and the other consisted of similar but less vigorous activities. The self-concept, academic achievement, motor proficiency, and physical fitness of each subject was assessed before and after the exercise programs. The results from group comparisons demonstrated an association between the aerobic exercise program and improvement of self-concept and physical fitness. No effect on academic achievement or motor proficiency could be attributed to the aerobic exercise program.

Welsman etal., (1996) had conducted study on aerobic training in 10 year old and adult females. The physiological responses of healthy, untrained 10 year old and adult females to an eight weeks aerobic training program were examined. Adult peak VO_2 increased and peak heart rate (HR) declined. Reduction in HR and lactate accumulation (LA) were observed at four sub maximal intensities. In children peak VO_2 did not change but peak HR did. No changes in HR were observed in sub-maximal intensity work but LA was reduced. Improved aerobic functioning was only exhibited in young girls at sub-maximal intensities, and it was concluded that the female children respond to aerobic training in a different manner

to adult female in both heavy and sub-maximal work. Children only exhibit physiological changes at sub-maximal levels.

Obert, et al., (2001) had conducted a study on the effect of a 13 week aerobic training programme on the maximal power developed during a force velocity test in prepubertal boys and girls. Boys and girls (10 – 11 yr), participating in physical activities, served as subjects. One group (M=9, F=8) participated in an extra one hour aerobic training session twice a week for 13 weeks, while others (M=8; F=8) served as controls. A force velocity test (an anaerobic test) was performed on a friction-loaded cycle ergometer. Experimental training consisted on one set of interval runs (intensity = 90 + % of HR max) and a continuous run (intensity = 75-80% of HR max).

Maximal power increased significantly in the trained group even when muscle mass change was accounted for. The increase was due mainly to force production because velocity was not altered. No changes were noted in the control group.

It was concluded that aerobic training in prepubertal children actually altered the anaerobic performance factors of force and power production. Aerobic training in children influences anaerobic performances.

Phol (1984) assessed the effect of a 12 week aerobic dance class on body image, self esteem and fitness in female college students. 119 female college students participated in this study, 43 of those in the experimental group and the 76 to the control group. Self images were assessed using Journard's Self Catherseis Scales and Fitness were assessed using Cooper's 12 min run. Body image, self image and fitness were assessed on a pre test, post test basis with a minimum time between testing occasions of 12 weeks for all sessions. There is a positive and moderate correlation between body and self image.

Scharff, et al., (1997) to determine the effect of vertical impact forces during bench-step aerobics: exercise rate and experience, randomly performed 8-min. protocols of the "basic" bench-stepping technique and a more advanced "travel" technique at 30 and 33 cycles.min.-1. Analysis showed that the faster exercise rate yielded significantly higher vertical impact forces on a reference (B-8) step height (20.3 cm). At 33 cycles.min.-1, the instructors, and novices' responses were both higher than those at 30 cycles.min.-1. The mean peak vertical impact force ranged from 1.54 times the body weight for the novice group at 30 cycles.min.-1 to 1.87 times the body weight for instructors at 33 cycles.min.-1. A comparison of the groups' force curves showed a distinctive pattern in the loading of the impact forces. Specifically, the instructors consistently produced a transitory decrement in force prior to attaining peak force. In addition, the novices exhibited non-uniform increases in the production of vertical impact force across other step heights at the faster (33 cycles.min.-1) speed. Thus, experience with bench-step exercise may afford an ability to make uniform and force-absorbing adjustments in the resultant vertical impact forces at increased speeds.

The explanatory study by Dekel and Gershan (1996) was designed to examine the association between intensity in which adolescents engaged in physical activity and their body image and general self-esteem. 286 male and female adolescents (12-18 years) of whom 146 were healthy and 140 were diagnosed as suffering from structural and non-structural adolescent adiopathic seokosis (AIS) were administered by body image and the Tennaessae self concept questionnaires. Adolescents with AIS not engaged in physical activity had lower body image than peers, particularly males. However both males and females with AIS perceived their body positively when engaged in moderate or extensive physical activities.

Anderson, et al., (1999) examined the short- and long-term changes in weight, body composition, and cardiovascular risk profiles produced by diet combined with either structured aerobic exercise or moderate-intensity lifestyle activity. They designed a sixteen-week randomized controlled trial with 1-year follow-up, conducted from August 1995 to December 1996. The participants were forty obese

women (mean body mass index [weight in kilograms divided by the square of height in meters], 32.9 kg/m2; mean weight, 89.2 kg) with a mean age of 42.9 years (range, 21-60 years) seen in a university-based weight management program. Interventions were structured aerobic exercise or moderate lifestyle activity; low-fat diet of about 1200 kcal/d. Main outcome measures were changes in body weight, body composition, cardiovascular risk profiles, and physical fitness at 16 weeks and at 1 year. The results were recorded. Mean (SD) weight losses during the 16-week treatment program were 8.3 (3.8) kg for the aerobic group and 7.9 (4.2) kg for the lifestyle group (within groups, P<.001; between groups, P = .08). The aerobic group lost significantly less fat-free mass (0.5 [1.3] kg) than the lifestyle group (1.4 [1.3] kg; P = .03). During the 1-year follow-up, the aerobic group regained 1.6 [5.5] kg, while the lifestyle group regained 0.08 (4.6) kg. At week 16, serum triglyceride levels and total cholesterol levels were reduced significantly (P<.001) from baseline (16.3% and 10.1% reductions, respectively) but did not differ significantly between groups and were not different from baseline or between groups at week 68. A program of diet plus lifestyle activity may offer similar health benefits and be a suitable alternative to diet plus structured aerobic activity for obese women.

Lewis (2005) had conducted a study to determine the effects of a home exercise program of combined aerobic and strength training on fitness with a 10.5-year-old girl with Down syndrome (DS). Measurements included cardiovascular variables, strength, body composition, flexibility, and skill. The subject participated in a home exercise program: 30 to 60 minutes of moderate- to high-intensity exercise five to six days per week for six weeks. The cardiovascular variables monitored were heart rate, respiration rate, and oxygen consumption during a sub-maximal treadmill stress test. Other measures included 10-repetition maximal strength of selected muscle groups, body mass index, flexibility, Gross Motor Scales of the Bruininks-Oseretsky Test of Motor Proficiency, and anaerobic muscle power. Improvements in sub-maximal heart and respiration rates, aerobic performance, muscle strength and endurance, gross motor skills, and anaerobic power were observed for this subject. Body weight and flexibility were unchanged.

Rowland and Boyajian (1994) had conducted a study on aerobic response to endurance training in children. An in school 12 week aerobic training program was designed for girls (N=24) and boys (N=13). Three 30 minute training sessions were offered per week. It was found that training changes occurred but were of less magnitude than would be expected of adults. This finding supports the general literature correlation that prepubescent children are more limited in aerobic training adaptations than adults.

Dykstra, et al., (1996) conducted a study on effect of six week sprint and endurance training programme on prepubescent children. Groups (Sprint, Endurance and Control) of children were trained for 20 minutes in a specific programme four times a week for six weeks. No differences were obtained between the two training groups in either aerobic or anaerobic performance parameters. Differences were observed between the training and control groups. The training effects of each different programme were not specific indicating that children can be trained aerobically on a sprint (anaerobic) programme. The effects of specific training programmes are general in children. Any form of training trains all capacities in growing children.

Butki and Rudolph (1997) examined whether short bouts of exercise reduce anxiety. Moderately active females (N=36) were assigned to one of three exercise conditions 10, 15 or 20 minute of treadmill running as a moderate level of perceived exertion. All exercises conditions significantly reduced anxiety. There were no group differences or interactions between exercise form and groups. Exercise sessions as brief as 10 minutes are effective in reducing feelings of tension and anxiety.

Kline and Coleman (2000) examined whether strenuous exercise is associated with reductions in depression scores during final examinations. College students (M=173; F = 430) served as subjects, exercisers were divided into strenuous and non-strenuous groups. Another group of students (M=67; F=134) not taking examinations, served as controls. Strenuous exercisers were less depressed than

non-strenuous exercisers. Males had lower depression scores than females, and it can be concluded that strenuous exercise can lower depression in times of stress.

Hynynen, et al., (2002) had conducted a study on the effects of increased training volume on heart rate variability among young endurance athletes. Trained endurance athletes (N=17) participated in a 5 day training camp where aerobic training was increased from 1 hour to 2-3 hours per day. Daily questionnaires were used to collect athlete's perceptions of exertion and recovery over the previous 24 hours. At the start and end of the camp, a 5 KM running test as a set sub-maximal heart rate was performed.

Higher parasympathetic tone was exhibited at the end of the camp. Averaged speed in the running test increased. Ratings of perceived exertion and physical exertion perceptions increased and compromised recovery feelings suggested over reaching was experienced, after such a short period. Heart rate variability decreased.

It was concluded that a 5 day training camp that increased aerobic training demands reduced the quality of athletes exercise perceptions while improving heart rate variability and performance time. While physiology and performance improved, psychological indicators decline.

Deane, et al., (2003) had conducted a study whether the hip flexor strength training can improve sprint and shuttle run performance. Subjects (M=13, F=11) compared eight weeks of hip flexion resistance training using elastic tubing (three times per week; 4 sets of 15 repetitions for each leg). Isometric hip flexion strength, 40 yard dash, and 4 x 5.8 m shuttle run times were recorded. Shorter shuttle and 40 yard run rimes were recorded in 20 of 24 subjects. All pre and post measures were significantly different. It was concluded that the hip flexion training improved sprint and agility performances.

STUDIES ON NUTRITIONAL SUPPLEMENTATION

Lenaerts K, et.al. (2007) documented that Arginine is classified as a conditionally essential amino acid required exogenously during catabolic disease states and periods of rapid growth, both characterized by increased arginine utilization. Arginine plays an important role in the intestine, where it is extensively metabolized, and enhances its immune-supportive function and mucosal repair. Cell proliferation is important for the latter process. This study aimed for a better molecular insight in the response to arginine deprivation/supplementation of pre-confluent and 5-day-confluent, differentiated Caco-2 intestinal cells. The potential of citrulline to counteract the effects of arginine deprivation was investigated in pre-confluent cells. 2-DE combined with MALDI-TOF-MS and the antibody microarray technology were applied. Evidence is provided that arginine deficiency modulates the protein expression profiles of pre-confluent Caco-2 cells differently than that of post confluent differentiated cells. In pre-confluent cells, certain proteins changed in direct response to arginine deficiency, whereas other proteins did not, but instead responded during the recovery phase after an arginine /citrulline re-supplementation. The protein changes suggest that arginine deprivation decreases cell proliferation and heat shock protein expression, and enhances the cells susceptibility to apoptosis. These processes are critical for proper cell function, and hence a state of arginine deficiency can be detrimental for intestinal cells which proliferate actively in vivo.

Topbas OF, et.al. (2000) found that Vitamin E is the most important lipophilic antioxidant. Oxidative injuries are prevented or minimized by vitamin E supplementation. Various physiological and pathological situations are accompanied by vitamin E deficiency. However, it is not clear whether alimentary vitamin E deficiency in itself constitutes oxidant stress that induces appropriate responses, which, in turn, can be avoided by adequate vitamin E supplies, or whether the remaining cellular antioxidants compensate a temporary vitamin E deficiency. We studied effects of the dietary vitamin E status on cellular vitamin E levels and on the expression of heat shock proteins (HSPs) in alveolar type II cells

and liver. The expression of HSPs, representing an early and very sensitive marker of cellular stress, was compared with the activity of antioxidative enzymes. Vitamin E depletion caused a substantial increase in HSP32 in alveolar type II cells, whereas in liver there was a marked increase in HSP70. The activity of the antioxidant enzymes, however, did not change significantly. A reversal of HSP expression to almost normal levels was seen after vitamin E re-supplementation. These results indicate that, under normal conditions, a suboptimal supply of vitamin E to rats exposes the alveolar type II cells and the liver to reversible cellular stress.

Möller JC, et.al. (1999) documented that Meconium aspiration syndrome (MAS) is still a condition associated with a high mortality, and many patients require extracorporeal membrane oxygenation (ECMO) as rescue therapy. Beneficial effects of surfactant and perflubron lavage have been reported. However, pure surfactant supplementation has not been proven to be beneficial in the most severe forms of MAS. This study was performed to demonstrate an improvement in oxygenation in neonates transferred for ECMO and fulfilling ECMO criteria with a saline lavage and surfactant re-supplementation. Twelve newborns with MAS [gestational age 36-40 weeks, mean birth weight 3200 g, age 4-16 h, oxygenation index (OI) > 40] transferred for ECMO therapy were treated with saline lavage (5-10 cm3/kg body weight, as long as green colored retrieval was observed) and re-supplementation with bovine surfactant (Alveofact, Boehringer, Ingelheim, Germany). The OI at admission and 3 h after this procedure was compared using the t-test for paired samples. ECMO was available as rescue therapy at all times. The OI decreased from 49.4 (SD +/- 13.3) to 27.4 (SD +/- 7.3), $P < 0.01$. The decrease was sustained in nine patients, three patients required ECMO and all patients survived. As MAS is a condition with parenchymal damage, pulmonary hypertension and obstructive airway disease, no simple causative therapy is possible. Surfactant application after removal of meconium by extensive lavage is feasible as long as 16 h after birth even in infants considered for ECMO therapy; it might reduce the necessity of ECMO.

Van Reyk DM, et.al. (1999) found that murine macrophages incubated in metal-supplemented RPMI could block or promote oxidation of low-density lipoprotein (LDL) depending on the degree of metal supplementation. Only at high concentrations of Cu (1 micromol/L) and Fe (30 micromol/L) were cells prooxidant, leading to an accelerated rate of LDL oxidation over that measured in comparable cell-free media. At lower concentrations of Cu and Fe in RPMI, LDL oxidation in the presence of macrophages was inhibited relative to the cell-free condition. This appeared to be dependent on a stable modification of the culture medium, because preconditioning of media by incubation with macrophages could also decrease their capacity to sustain subsequent cell-free LDL oxidation. This was due, in part, to a removal of metal from the media during preconditioning.

However, re-supplementation of media with metals did not fully restore oxidative capacity, indicating that other cell-dependent antioxidant modifications occurred. This did not involve significant alterations to the thiol content of the media. This study highlights the complexity of the role that cells such as macrophages have with regards to LDL oxidation in vitro and demonstrate that there are both antioxidative and prooxidative components.

Sando K, et.al. (1992) documented that Selenium (Se) is not routinely included in total parenteral nutrition (TPN) solution; thus, patients receiving long-term TPN may be at risk of Se deficiency, which may cause fatal cardiomyopathy. Platelet glutathione peroxidase (GSH-Px) activity, as well as Se levels and GSH-Px activity in plasma and erythrocytes during prolonged TPN, was measured in six patients with chronic gastrointestinal disease. During the time course of TPN, Se administration was discontinued for 12 weeks, and then re-supplemented for another 12 weeks. Before the study period, all Se indices had been maintained within the normal range. After discontinuation of Se supplementation, a significant decrease in platelet GSH-Px activity was observed after 1 week (from 64 +/- 7 [mean +/- SD] to 39 +/- 5 U/g of protein). After re-supplementation, it increased after 1 week (from 44 +/- 9 to 65 +/- 10 U/g of protein). Plasma Se indices significantly changed within 3 weeks after withdrawal and reintroduction of Se (Se: from 136 +/-

28 to 75 +/- 14 and from 61 +/- 22 to 125 +/- 33 micrograms/L; GSH-Px: from 236 +/- 50 to 140 +/- 36 and from 128 +/- 32 to 220 +/- 64 U/L). Erythrocyte Se indices showed no significant changes during the study period. The results demonstrate that platelet GSH-Px activity is the most sensitive index of Se status in TPN patients.

Van Beek ME, and Meistrich ML. (1991) documented that optimal conditions for obtaining stage-synchronization of the seminiferous epithelium were investigated. In this study, 147 rats were subjected to protocols in which vitamin A deficiency was induced by feeding a diet without retinol (R-ol) or retinoic acid (RA), followed by maintenance on a diet containing RA and supplementation of R-ol by injection and diet. An acceptable degree of stage synchronization and recovery of the seminiferous epithelium was observed in 90 (61%) of the 147 rats. The effects on synchrony of variations in the protocol, including the degree of deficiency before RA maintenance, the dose and duration of RA maintenance, and the manner of injection of R-ol, were tested. Initiation of maintenance on RA when a medium degree of deficiency was achieved (4-12 g of weight loss, 3-6 days without growth) resulted in a more reliable (80% of the rats) induction of synchrony than did initiation of maintenance on RA at either a less (70% synchronized rats) or more severe (50-60% synchronized rats) deficiency. Maintenance on food containing 10 mg/kg RA gave better and more reliable synchrony (70%) than maintenance on food containing 5 mg/kg RA (less than 40%). Although the duration of this maintenance did not influence the degree of synchrony, the reliability was lower when maintenance was continued for a month or more (54%). During the interval from 33 to 128 days after re-supplementation, the degree of synchronization decreased, as did the predictability of the stages, while the restoration of spermatogenesis increased. Linear regression, performed on the location of the median point of synchronization, indicated that spermatogenesis progressed at a rate of 12.4 days per cycle. The median stage of synchronization, predicted by this regression line, differed by an average of 8% of the cycle from the actual location in individual rats. Extrapolation of the regression line indicated that spermatogenesis was reinitiated in mid-to-late stage VII.

Tahara Y, et.al. (1988) documented that A man with diabetes mellitus, chronic hepatitis, chronic pancreatitis, and blind loop syndrome but without any previous thyroid disease developed three episodes of transient primary hypothyroidism associated with protein-calorie malnutrition (PCM). Clinical examinations suggested that this primary hypothyroidism was not caused by chronic thyroiditis, iodine deficiency, or iodine excess. Since the three times association of primary hypothyroidism with PCM suggested the possibility that the primary hypothyroidism was caused by PCM, we have tried to clarify its mechanism. For this purpose we have investigated the change of thyroid functions during protein-calorie repletion and the effect of amino acid deficiency. Total parenteral nutrition with full supplementation of amino acids resulted in a rapid increase in serum thyroxine (T4), triiodothyronine (T3), free T4, and reverse T3, and subsequently, a rapid decrease in TSH in several days after the nutrition was begun. When amino acid solution was changed to that depleted of phenylalanine and tyrosine after the restoration of thyroid functions, serum T4 and T3 showed a gradual decrease, but serum free T4 and TSH remained within normal range.

However, re-supplementation of phenylalanine and tyrosine after 8 weeks of depletion gave a rapid increase in serum T4, T3, free T4, and reverse T3. These results suggested that the primary hypothyroidism was caused by an impaired T4 production and that the deficiency of amino acids in PCM partly contributed to the impairment of T4 production.

Anttila PH, et.al. (1986) documented that Immune responses were characterized in six patients with acrodermatitis enteropathica during a break in zinc supplementation and during re-supplementation. During hypozincaemia the number of T-cells increased but the amount of B-cells and the responses of T- and B-lymphocytes to phytohaemagglutinin, concanavalin A-, pokeweed mitogen- and Staphylococcus aureus stimulations in vitro were subnormal. Cell counts and stimulation results both normalized when serum zinc values improved. One patient was anergic to tuberculin while showing signs of acrodermatitis enteropathica; she converted during supplementation whereas the others were continuously positive.

Three females had antibodies against nuclear antigens and slightly elevated serum IgE concentrations; these values were not affected by the break in supplementation. Four females were continuously rheumatoid factor positive. Our findings suggest that zinc deficiency is closely associated with impaired immune responses in patients with acrodermatitis enteropathica, and laboratory markers of autoimmunity occur in a considerable number of the acrodermatitis enteropathica patients, irrespective of their zinc status.

De M, et.al. (2011) documented that screening of women of child bearing age among the tribal and rural population of different north eastern and eastern states of India was performed. More than 50% of women in some areas were found to have anemia. As part of the study nutritional supplementation was given to a proportion of the anemic population, comparing the effects of Spirulina, a compound containing vitamins and micronutrients and an iron-folic acid-B12 supplement. Follow-up of the cases was done over a period of one year and the impact of supplementation and a comparison of the two compounds made.

Radjen S, et.al. (2011) found that Iron is a vital constituent of hemoglobin, myoglobin, and some mitochondrial enzymes; therefore, body iron deficiency may result in reduced aerobic capacity. The aim of this study was to evaluate the effects of daily oral iron supplementation on body iron status, and the maximal oxygen uptake (VO2max) in female athletes with latent iron deficiency, as well as with iron-deficiency anemia. A total of 37 female volleyball players were included in the study. Seventeen female athletes had latent iron deficiency, and 20 ones iron deficiency anemia. Both groups were divided into the experimental and the control group. The experimental groups received a daily oral iron supplement (200 mg ferrous sulfate), for a two-month training course. Iron status was determined by serum parameters as follows: red blood cells count, hemoglobin concentration, serum iron and ferritin levels, an unsaturated iron binding capacity, total iron binding capacity and transferrin saturation. VO2max was determined by an indirect test. Statistical difference between the latent iron deficient group versus the iron deficient anemic group was found regarding VO2max ($p < 0.001$). There were

correlations between hemoglobin concentration and VO2max in the latent iron deficient group, as well as in the iron deficient anaemic group ($p < 0.05$). After two months, there was a significant increase in VO2max in all groups (from 7.0% to 18.2%). Values of VO2max at the end of training period were significantly different (45.98 +/- 1.76 vs 42.40 +/- 1.22 mL/kg/min; $p < 0.001$) between the experimental and the control group only in female athletes with iron deficiency anemia. After the supplementation, markers of iron status were significantly higher in supplemented groups than in the controls. VO2max was significantly lower in the iron deficient anemic group versus the latent iron deficient group. Iron supplementation during a two-month training period significantly improved body iron status in the iron deficient female athletes with or without anemia, and significantly increased VO2max only in the subjects with iron deficiency anemia.

De Azevedo Paiva A, et.al. (2010) investigated the effect of vitamin A supplementation on parameters of the immune system of vitamin A-deficient children. The study was carried out in four phases: 1) determination of serum retinol in 631 children from 36 to 83 months of age; 2) assessment of immunological markers [immunoglobulins and complement fractions, immunophenotyping of T and B lymphocytes, and natural killer (NK) cells], blood count, and serum ferritin of 52 vitamin A-deficient children (serum retinol < 0.70 micromol/L); 3) supplementation of the 52 deficient children with 200,000 IU of vitamin A; 4) determination of serum retinol and the immunological parameters 2 months after vitamin A supplementation. Before vitamin A supplementation, 24.0 % of the children were anemic and 4.3 %had reduced ferritin concentrations. There was no significant difference between mean values of retinol according to the presence/absence of anemia. The mean values of the humoral and cellular immunological parameters did not show a statistically significant difference before and after supplementation with vitamin A. Children with concomitant hypovitaminosis A and anemia presented a significant increase in absolute CD4 and CD8 T-cell counts after vitamin A supplementation ($p < 0.05$).vitamin A had an

effect on the recruitment of T and B lymphocytes to the circulation of children with hypovitaminosis A and anemia.

Tiwari AK,et.al. (2011) assessed the desirable and undesirable effects of iron (100 mg/day as ferrous sulphate) and folic acid (500 µg/day) supplementation in iron deficient anemic women. Iron and folic acid supplementations were given to 117 anemic women (mild = 55, moderate = 40, and severe = 22) and 60 age matched placebo treated (100 mg cane sugar) non-anemic controls for 100 days. Blood index values, oxidative stress parameters, antioxidant enzymes and vitamins were estimated as per standard protocols. Haemoglobin (Hb) levels along with antioxidant enzymes, namely catalase, superoxide dismutase (SOD), glutathione reductase (GSH-Rd), reduced glutathione (GSH) and total antioxidant capacity (TAC) were found significantly increased ($P < 0.01$) in anemic women after treatment. However, the glutathione peroxidase (GSH-Px) and antioxidant vitamins A, C and E were found significantly decreased ($P < 0.01$) in all treated groups. Lipid peroxide levels (LPO), protein carbonyl (PC), conjugated dienes (CD), lipid hydroperoxide (LOOH) and oxidized glutathione (GSSG) levels were found significantly increased ($P < 0.01$) after oral iron supplementation groups. Moreover, undesirable side effects of iron supplementation were observed maximally in mild as compared with moderate and severe anemic groups, whereas nausea, vomiting, systemic reactions were negligible in all treated subjects. Study found recommended dose of iron effective for improving Hb, but at the cost of increased oxidative stress (mild > moderate > severe). It is suggested that blind iron supplementation should be avoided and shall be provided on need basis.

Kaldara-Papatheodorou EE, et.al. (2010) documented that Anemia has been identified as an independent prognostic factor of both morbidity and mortality for patients with congestive heart failure (CHF). The association between anemia and adverse outcomes has raised the hypothesis that anemia correction might lead to an improvement in the prognosis of patients with CHF. Nevertheless, data from large randomized trials about the effect of anemia correction on patient outcome are still

lacking. Numerous clinical studies, randomized and nonrandomized, have evaluated the efficacy of erythropoietin or iron supplementation for treating anemia in patients with CHF, and their effect on patient symptoms and functional status. The superiority of any of these approaches has not been established yet. This review will discuss different treatment options for anemic patients with CHF, with emphasis on the correction of iron deficiency.

Rosado JL, et.al. (2010) evaluated the efficacy and children's acceptance of several recognized strategies to treat anemia. Non-breastfed children (n = 577), 6 to 43 mo of age, were screened for the trial; 267 were anemic (hemoglobin < 11.7 g/dL), and 266 of those were randomized into 1 of 5 treatments to received daily either: an iron supplement (IS), an iron+folic acid supplement (IFS), a multiple micronutrient supplement (MMS), a micronutrient-fortified complementary food as porridge powder (FCF), or zinc+iron+ascorbic acid fortified water (FW). The iron content of each daily dose was 20, 12.5, 10, 10 and 6.7 mg respectively. Hemoglobin (Hb), ferritin, total iron, weight and height were measured at baseline and after 4 months of treatment. Morbidity, treatment acceptability and adherence were recorded during the intervention. All treatments significantly increased Hb and total iron concentration; ferritin did not change significantly. Groups MMS, IS and IFS increased Hb (g/dL) [1.50 (95%CI: 1.17, 1.83), 1.48 [(1.18, 1.78) and 1.57 (1.26, 1.88), respectively] and total iron ((µg/dL) [0.15 (0.01, 0.29), 0.19 (0.06, 0.31) and 0.12(-0.01, 0.25), respectively] significantly more than FCF [0.92 (0.64, 1.20)] but not to FW group [0.14 (0.04, 0.24)]. The prevalence of anemia was reduced to a greater extent in the MMS and IFS groups (72% and 69%, respectively) than in the FCF group (45%) ($p < 0.05$). There were no significant differences in anthropometry or in the number of episodes of diarrhea and respiratory infections among treatment groups. The supplements MMS and IS were less acceptable to children, than IFS, FCF and FW. The three supplements IS, ISF and MMS increased Hb more than the FCF; the supplements that contained micronutrients (IFS and MMS) were more effective for reducing the prevalence of anemia. In general, fortified foods were better accepted by the study participants than supplements.

Sanghvi TG, et.al. (2010) examined the evidence regarding the impact on maternal mortality of iron-folic acid supplementation and the evidence for the effectiveness of this intervention in supplementation trials and large-scale programs. The impact on mortality is reviewed from observational studies that were analyzed for the Global Burden of Disease Analysis in 2004. Reviews of iron-folic acid supplementation trials were analyzed by other researchers and are summarized. Data on anemia reduction from two large-scale national programs are presented, and factors responsible for high coverage with iron-folic acid supplementation are discussed. Iron-deficiency anemia underlies 115,000 maternal deaths per year. In Asia, anemia is the second highest cause of maternal mortality. Even mild and moderate anemia increases the risk of death in pregnant women. Iron-folic acid supplementation of pregnant women increases hemoglobin by 1.17 g/dL in developed countries and 1.13 g/dL in developing countries. The prevalence of maternal anemia can be reduced by one-third to one-half over a decade if action is taken to launch focused, large-scale programs that are based on lessons learned from countries with successful programs, such as Thailand and Nicaragua. Iron-folic acid supplementation is an under-resourced, affordable intervention with substantial potential for contributing to Millennium Development Goal 5 (maternal mortality reduction) in countries where iron intakes among pregnant women are low and anemia prevalence is high. This can be achieved in the near term, as policies are already in place in most countries and iron-folic acid supplements are already in lists of essential drugs. What is needed is to systematically adopt lessons about how to strengthen demand and supply systems from successful programs.

Ahmed F, et.al. (2010) study examined whether long-term once- or twice-weekly supplementation of MMN can improve hemoglobin (Hb) and micronutrient status more than twice-weekly IFA supplementation in anemic adolescent girls in Bangladesh. Anemic girls (n = 324) aged 11-17 y attending rural schools were given once- or twice-weekly MMN or twice-weekly IFA, containing 60 mg iron/dose in both supplements, for 52 wk in a randomized double-blind trial. Blood samples were

collected at baseline and 26 and 52 wk. Intent to treat analysis showed no significant difference in the Hb concentration between treatments at either 26 or 52 wk. However, after excluding girls with hemoglobinopathy and adjustment for baseline Hb, a greater increase in Hb was observed with twice-weekly MMN at 26 wk (P = 0.045). Although all 3 treatments effectively reduced iron deficiency, once-weekly MMN produced significantly lower serum ferritin concentrations than the other treatments at both 26 and 52 wk. Both once- and twice-weekly MMN significantly improved riboflavin, vitamin A, and vitamin C status compared with IFA. Overall, once-weekly MMN was less efficacious than twice-weekly MMN in improving iron, riboflavin, RBC folic acid, and vitamin A levels.

Micronutrient supplementation beyond 26 wk was likely important in sustaining improved micronutrient status. These findings highlight the potential usefulness of MMN intervention in this population and have implications for programming.

Shrimpton R et.al. (2009) provided an independent interpretation of the policy and program implications of the results of the meta-analysis. METHODS: A group of policy and program experts performed an independent review of the meta-analysis results, analyzing internal and external validity and drawing conclusions on the program implications. RESULTS: Although iron content was often lower in the multiple micronutrient supplement than in the iron-folic acid supplement, both supplements were equally effective in tackling anemia. Community-based supplementation ensured high adherence, but some mothers still remained anemic, indicating the need to concomitantly treat infections. The small, significant increase in mean birth weight among infants of mothers receiving multiple micronutrients compared with infants of mothers receiving iron-folic acid is of similar magnitude to that produced by food supplementation during pregnancy. Larger micronutrient doses seem to produce greater impact. Meaningful improvements have also been observed in height and cognitive development of the children by 2 years of age. There were no significant differences in the rates of stillbirth, early neonatal death, or neonatal death between the supplemented groups. The non-significant trend toward increased early neonatal mortality observed in the groups receiving multiple

micronutrients may be related to differences across trials in the rate of adolescent pregnancies, continuing iron deficiency, and/or adequacy of postpartum health care and merits further investigation. CONCLUSIONS: Replacing iron-folic acid supplements with multiple micronutrient supplements in the package of health and nutrition interventions delivered to mothers during pregnancy will improve the impact of supplementation on birth weight and on child growth and development.

Allen LH, et.al. (2009) compared the effects of multiple micronutrients with those of iron supplements alone or iron with folic acid, on hemoglobin and micronutrient status of pregnant women. METHODS: Studies were identified in which pregnant women were randomized to treatment with multiple micronutrients, or with iron with or without folic acid. A pooled analysis was conducted to compare the effects of these supplements on maternal hemoglobin, anemia, and micronutrient status. Effect size was calculated for individual and combined studies, based on mean change from baseline to final measure in the group receiving iron, with or without folic acid, minus the mean change in the group, divided by the pooled standard deviation of the two groups. The effect on the relative risk of anemia or iron deficiency was calculated as the probability of anemia or iron deficiency in the group receiving multiple micronutrients divided by the probability in the group receiving iron, with or without folic acid. RESULTS: Multiple micronutrient supplements had the same impact on hemoglobin and iron status indicators as iron with or without folic acid. There was no overall effect on serum retinol or zinc. In the only study in which status of other micronutrients was analyzed, a high prevalence of multiple deficiencies persisted in the group receiving multiple micronutrients provided with daily recommended intakes of each nutrient. CONCLUSIONS: Multiple micronutrient supplements increased hemoglobin synthesis to the same extent as supplementation with iron with or without folic acid, although often they contained lower amounts of iron. The amount of supplemental iron and other nutrients that can enable pregnant women with micronutrient deficiencies to achieve adequate status remains to be determined.

Falkingham M, et.al. (2010) assessed whether iron supplementation improved cognitive domains: concentration, intelligence, memory, psychomotor skills and scholastic achievement. METHODOLOGY: Searches included MEDLINE, EMBASE, PsychINFO, Cochrane CENTRAL and bibliographies (to November 2008). Inclusion, data extraction and validity assessment were duplicated, and the meta-analysis used the standardised mean difference (SMD). Sub-grouping, sensitivity analysis, assessment of publication bias and heterogeneity were employed. RESULTS: Fourteen RCTs of children aged 6+, adolescents and women were included; no RCTs in men or older people were found. Iron supplementation improved attention and concentration irrespective of baseline iron status (SMD 0.59, 95% CI 0.29 to 0.90) without heterogeneity. In anaemic groups supplementation improved intelligence quotient (IQ) by 2.5 points (95% CI 1.24 to 3.76), but had no effect on non-anaemic participants, or on memory, psychomotor skills or scholastic achievement. However, the funnel plot suggested modest publication bias. The limited number of included studies were generally small, short and methodologically weak. CONCLUSIONS: There was some evidence that iron supplementation improved attention, concentration and IQ, but this requires confirmation with well-powered, blinded, independently funded RCTs of at least one year's duration in different age groups including children, adolescents, adults and older people, and across all levels of baseline iron status.

Kotecha PV,et.al. (2009) documented that In June 2000, Adolescent Anaemia Control Programme was initiated as a pilot programme in Vadodara district of Gujarat covering over 69000 girls in over 426 schools. Programme strategy was to provide once weekly fixed day (Wednesday) supervised iron folic acid (IFA) supplements to all adolescent girls in Grade 8-12. Currently, programme covers 10 lakh schoolgirls and 2.6 lakh out of school girls with a compliance rate of over 90 per cent as reported by education department. This study was undertaken to institutionalize once a week IFA supplementation in the schools for adolescent girls with built in compliance monitoring in one district and scale up the programme from its learning to all the districts as feasible. METHODS: Baseline survey for three

areas of Vadodara district, tribal, rural and urban from 10 schools each was conducted to collect data for anaemia prevalence. Education Inspectors were assigned responsibility to supervise and motivate teachers to try out innovative ideas to promote the programme. Simultaneously anganwadi workers of urban Vadodara were motivated to initiate IFA supplementation for out of schoolgirls on similar strategy. After approximately 17 months of intervention, impact study was conducted in the same 30 schools in November 2001 to obtain levels of anaemia and some of the paired data from the students who were part of the baseline study. Study also included knowledge and practices of the adolescent girls with reference to their dietary habits and package of intervention included nutrition education through schools by providing information and education material prepared by the government. RESULTS: Baseline study had shown around 75 per cent anaemia prevalence, which was similar in all the three areas. Level of serum ferritin was also low. Impact evaluation showed reduction in anaemia prevalence by 21.5 per cent that is, from 74.7 per cent to 53.2 per cent ($P<x0.05$). Further improvement in Hb was recorded among 80 per cent girls. Pre- and post-intervention also showed improvement in serum ferritin value. Programme is now scaled up to cover 10 lakh schoolgirls and 2.6 lakh out of school girls in the State. Out of schoolgirls is only small fraction of total out of schoolgirls in the state. Data on dietary and nutritional related knowledge and practices did not show significant changes among schoolgirls. Retention of messages specified in IEC material was not satisfactory. INTERPRETATION & CONCLUSION: Supervised, once a week IFA supplementation to adolescent girls through institutions specially, schools was found to be an effective intervention to reduce anaemia and was scalable within the system. The experience to educate the girls on dietary behaviour has not been satisfactory and covering all out of school girls is still a challenge to the success of anaemia control.

Jimenez C, et.al. (2010) reported interrelationship between vitamin A and Fe metabolism, and with immunological response, the objective was to evaluate the effect of a single dose of vitamin A administered to preschool children, on Fe and

vitamin A nutritional status, anaemia and phagocytic function of neutrophils, 30 d after supplementation. A total of eighty children (sixty-eight supplemented and twelve controls) were supplemented orally with 200,000 IU (60 mg) vitamin A, and evaluated for nutritional, haematological and immunological responses at the beginning of the study and 30 d after supplementation. Parameters studied included Hb, serum ferritin, retinol and Fe concentrations, transferrin saturation, IL-4, interferon-gamma and phagocityc capacity of neutrophils using non-fluorescent latex microbeads. After supplementation there was a significant increase in Hb concentration ($P = 0.03$), mean corpuscular Hb concentration ($P = 0.001$) and serum retinol ($P = 0.0078$). Prevalences of anaemia and vitamin A deficiency decreased significantly from 17.6 % to 13.2 % and from 25 % to 13.2 %, respectively. Regarding phagocytic function, there was a significant increase in the number of microbeads engulfed by neutrophils ($P < 0.05$) and no significant changes in cytokine concentrations at 1 month after treatment. A single dose of 200,000 IU (60 mg) vitamin A administered orally to a group of preschool children with a high prevalence of vitamin A deficiency enhanced serum retinol and Hb concentrations, decreased the prevalence of anaemia and vitamin A deficiency and improved the constitutive phagocytic capacity of neutrophils. Vitamin A supplementation could help to decrease vitamin A deficiency, anaemia prevalence and to improve the innate immunity response in preschool children. The effects were obtained without Fe supplementation.

Pasricha SR, et.al. (2009) found that Iron deficiency anemia is highly prevalent among women living in rural Vietnam. However, the utility and cut-offs of indices for diagnosing iron deficiency anemia in the public health context is ill defined. We assessed the ability of iron indices to predict the hemoglobin response (HBR) to weekly iron-folic acid supplementation (WIFS) in anemic rural Vietnamese women. We compared hemoglobin, serum ferritin, and soluble transferrin receptor in a cohort of 221 non-pregnant women of reproductive age before and after 3 months of WIFS and deworming. At baseline, anemia (Hb < 120 g/L) was present in 81/221 (36.7%) of subjects. After 3 months, anemia prevalence fell to 58/221 (26.2%),

and the mean hemoglobin change was +3.5 g/L (95% confidence interval, 0.9, 6.6). A hemoglobin response was observed in 50/75 (66.6%) of anemic women. A ferritin cut-off < 30 ng/mL was a more sensitive predictor of response than ferritin < 15 ng/mL.

Chen K, et.al. (2009) found that Anemia is a widespread public health problem, which is due to many factors, nutritional or non-nutritional. Iron, vitamin A and growth status were assessed to investigate anemia of preschool children in suburb Chongqing, China. METHODS: A descriptive, cross-sectional survey was performed on 459 preschool children aged 2 to 7 years randomly chosen from the kindergartens in 6 suburban districts of Chongqing. Weight and height levels, hemoglobin, erythrocyte protoporphyrin, serum retinol, and ferritin concentrations were measured to evaluate the anthropometric and nutritional status. RESULTS: The rates of stunt, underweight, overweight, wasting, obesity, anemia, iron deficiency, vitamin A deficiency (VAD), and marginal VAD were 6.3%, 3.9%, 3.7%, 1.5%, 3.1%, 23.5%, 15.0%, 6.3% and 25.9%, respectively. Serum retinol concentration was significantly lower in children with anemia than in those without anemia (P=0.003), and the retinol concentration was associated with hemoglobin (Pearson's correlation coefficient, r=0.22, P<0.01). Children with VAD had a significantly increased risk for anemia (odds ratio, 2.56; 95% confident interval, 1.15-5.70). In all 108 children with anemia, only 42 were related to VAD and 12 related to iron deficiency, suggesting that almost half of the anemia children cannot be explained solely by iron deficiency or VAD. CONCLUSIONS: Vitamin A and iron deficiency are still public health problems in some localities of China. Public health interventions in anemia control should be used to eliminate deficiencies of vitamin A, iron, and other micronutrients by deliberate supplementation. Attention must be paid to such deficiencies in high-risk groups, especially in preschool children.

Benkhedda K, et.al. (2010) measured non-haem Fe absorption with and without added Ca in a short-term feeding study, in thirteen women with marginal Fe status, by the use of a double stable isotope technique. Supplementing 500 mg Ca as calcium carbonate significantly (P = 0.0009) reduced Fe absorption from a single

meal from 10.2 % (range 2.2-40.6) to 4.8 % (range 0.7-18.9). A significant inverse correlation in the absence (- 0.67, P = 0.010) and presence (- 0.58, P = 0.037) of Ca, respectively, was found between Fe absorption and Fe stores measured by serum ferritin (SF). Wide variation in Fe absorption was observed between individuals in the absence and in the presence of Ca, despite pre-selection of participants within a relatively narrow range of iron stores (SF concentrations). Correction of Fe absorption data based on group mean SF was not found to be useful in reducing the inter-individual variability in iron absorption. It appears that selecting a study group with a narrow initial range of Fe stores does not necessarily reduce the inter-individual variability in Fe bioavailability measurements. These results support the hypothesis that body Fe stores, although an important determinant of dietary Fe absorption, are not the main factor that determines Fe absorption under conditions of identical dietary intake in subjects with low Fe stores.

Mwanakasale V, et.al. (2009) studied impact of once weekly iron supplementation on praziquantel cure rate, Schistosoma haematobium reinfection, and haematological parameters in pupils aged between 9 and 15 years of age in Nchelenge district, Zambia. METHODS: Pupils in the intervention group received once weekly dose of ferrous sulphate at 200 mg while those in the control received once weekly vitamin C at 100 mg for up to 9 months. Both study groups received a single dose of praziquantel at baseline. RESULTS: S haematobium reinfection intensity was significantly lower in boys in the intervention group than in boys in the control group at 6 months (P < 0.001) and 9 months (P < 0.001) of supplementation. Significantly lower S haematobium reinfection intensity was found in girls in the intervention group than in girls in the control group only at 6 months of supplementation (P = 0.018). Boys in the intervention group were 42% (Adjusted Risk Ratio = 0.58, 95% confidence interval 0.39, 0.86) less likely to be reinfected with S haematobium than in the control group at 6 months follow up. CONCLUSION: Once weekly iron supplementation can decrease S haematobium reinfection after 6 months and should be incorporated into school based schistosomiasis control programs in highly endemic areas.

Ayoya MA, et.al. (2009) reported that Iron deficiency and anemia remain among the most important global public health problems facing school children. Helminth infections often peak at school age and aggravate nutritional risks. We conducted a 12-wk randomized controlled trial in 406 Malian anemic schoolchildren infected with Schistosoma hematobium to examine the effects of 2 doses of praziquantel (P) (40 mg/kg body weight), P + 60 mg/d iron (Fe), and/or a multiple micronutrient supplement (MM) that included 18 mg/d Fe. Supplements were administered to the children each school day (5 d/wk) throughout the study. Changes in hemoglobin (Hb), serum ferritin (SF), and serum transferrin receptors (s-TfR) were followed. We also examined interactions between Fe and MM supplements on Hb and SF concentrations and malaria incidence. The effects of Fe on Hb and SF concentrations were greater than the effects of P alone and MM with or without added Fe at 6 and 12 wk ($P < 0.001$). In all groups, s-TfR decreased at 6 and 12 wk compared with baseline. The decrease was most pronounced in the P + Fe group compared with the other 3 groups at wk 6 ($P = 0.05$). Fe and MM interacted negatively at wk 6 and 12 to affect Hb (beta = -0.43, 95% CI = -0.77, -0.09; $P = 0.01$ and beta = -0.47, 95% CI = -0.83, -0.11; $P = 0.01$, respectively) and SF (beta = -0.42, 95% CI = -25.60, 12.31; $P < 0.001$, and beta = -0.37, 95% CI = -0.63, -0.12; $P = 0.004$, respectively). Malaria incidence was higher in the groups treated with added Fe (relative risk: 1.66; 95% CI: 0.75, 3.67). In this context, MM with added iron were not more effective than Fe without MM. Fe supplementation of schoolchildren with 60 mg/d for anemia control should be considered carefully.

Ahmadi A, et.al. (2010) reported that Iron deficiency anemia is the most prevalent micronutrient deficiency in the world, affecting 20-50% of the world's population. It is estimated that 10 and 20% of male and female athletes are iron deficient, respectively. Iron deficiency has deleterious effects on the physical performance of athletes. It decreases aerobic capacity, increases heart rate and elongates the recovery time after exercise. In this cross-sectional study, 42 semi-professional female athletes who had been playing in basketball, volleyball and handball super league teams served as subjects. Data on socioeconomic and fertility

status as well as the type of sport were obtained through a questionnaire. Nutritional data were gathered with a 3 day dietary recall. Total intake of calorie, iron, zinc, folate, vitamin C and B12 were also analyzed. In addition, ferritin and TIBC were measured and a CBC test was done for each subject. The results showed that the mean total calorie intake of women was 2049.79 +/- 735.12 kcal, where their iron intake was 22.33 +/- 9.24 mg day(-1). There was a significant difference between the iron intake of basketball and volleyball players (p = 0.036). Of our subjects, 33.33% had low ferritin levels (< 30 ng mL(-1)) and it was lowest in handball players. Higher than normal ferritin levels were seen in 12.5% of the subjects. We saw a significant difference in ferritin levels of basketball and handball players (p = 0.047). We conclude that the intake of calorie and iron is low in female athletes and therefore, their hematological indices such as ferritin level are below standard values.

Alaofè H, et.al. (2009) studied the impact of socioeconomic and health related factors on the iron status of adolescent girls has never been studied in Benin. OBJECTIVE: These factors were studied in 180 girls aged 12 to 17 years living in two boarding schools from South Benin. METHODS: Iron deficiency (ID) was defined as either serum ferritin (SF) < 20 microg/L or SF between 20-50 microg/L plus two abnormal values in the three following parameters: serum iron < 11 micromol/L, total iron binding capacity > 73 micromol/L or transferrin saturation < 20%. Socioeconomic and health related factors were obtained from each participant by mean of an interview using a standardized and pre-tested questionnaire. RESULTS: Almost half the participants reported some health problems in the last four months before the study, whereas more than 75% auto-medicated before going to the hospital. The majority of the girls believed themselves to be in good health, although only 16% could define the term 'anemia'. Multivariate regression analysis indicated that girls whose mother was a manual worker (P = .002), who came from a larger family (P = .0001), and who auto-medicated (P = .014), had a lower hemoglobin level, whereas girls who had started their menstruation (P = .008) had a lower SF level. In a logistic regression analysis, girls from a large family size and whose mother was a manual worker showed a higher risk of IDA (OR = 3.5; 95% CI = 1.1-2.5; P = .04; OR

= 3.0; 95% CI = 1.2-2.2; P = .04 respectively). CONCLUSION: The findings indicate that iron deficiency is related to the occupation of the mother, family size, auto-medication, and menstruation.

SUMMARY

Based on the experiences gained by the investigator by reviewing the above related literature, the investigator formed the methodology to be adapted for this study, which is presented in Chapter III.

CHAPTER III
METHODOLOGY

The purpose of this study was to find out the effect of aerobic exercises and nutritional supplementation on selected motor fitness variables of badminton players. In this chapter the subjects selected, variables chosen, research design, test administration, training schedule, collection of data and statistical techniques employed were detailed.

SELECTION OF SUBJECTS

This study was designed to find out the effects of 12 weeks of aerobics training and nutritional supplementation on selected motor fitness variables on badminton players. For the purpose of this study 60 school badminton players were selected on random basis as subjects from schools in the state of Andhra Pradesh. The age of the players were ranging from 15 to 17 years.

The selected subjects were divided into three groups consisting of 20 subjects in each.

All the subjects were oriented the purpose of the study and the subjects were make known the utility of the research and the subjects volunteered for the purpose of the study.

VARIABLES SELECTED

Based on the experience gained through review of related literature, books and experts, the following dependent and independent variables were selected for the study.

Dependent Variable

1. Speed
2. Endurance
3. Leg Explosive power

Independent Variable

1. 12 weeks aerobic exercises
2. 12 weeks nutritional supplementation

EXPERIMENTAL DESIGN OF THE STUDY

Research design is important in controlling the outcome of an experimental research. A well designed research study is only explanation for changes in the dependent variable were how the subject were treated with independent variables, which enable the researcher to eliminate all rival or alternate hypotheses. In the present study a pre test and post test randomized true experimental group design was used.

Pre test and post test randomized true experimental groups design was used. In this design the treatments to internal validity such as history, maturation, testing, instrumentation, statistical regression, selection biases, experimental workability and selection maturation interaction are controlled due to random selection of subjects.

Randomly selected 60 school level badminton players (N=60) were divided into 3 groups each consisting of 20 badminton players. Group I was treated as aerobic training group. Group II was treated as nutritional supplementation group and group III was considered as control group.

All the subjects selected were measured of their initial scores on speed, endurance and leg explosive power through standard tests, which formed pre test scores. After the experimental period of 12 weeks, the subjects were again tested on the criterion variables, which formed post test scores. The difference between the

initial and final scores was considered as the effect of respective treatment on selected dependent variables. The collected data were subjected to statistical treatment using ANCOVA. In all cases 0.05 level was fixed to test the hypothesis of the study.

CRITERION MEASURES

The dependent variables selected were tested through the following standard tests.

1. Speed was measured through 50 M sprint test and scores recorded in seconds.
2. Endurance was measured through Havard Step up test and scores recorded in Physical Efficiency Index (PEI).
3. Leg explosive power was used through vertical jump test and scores recorded in centimeters.

PILOT STUDY

Prior to experimental treatment 10 badminton players who were not the subjects of this study were grouped into two. The aerobic exercises and nutritional supplementation were provided to each group. Through this pilot study, the schedule of aerobic exercises and nutritional supplementation processes were fixed for this study. Apart from fixing up work load for the experimental treatment, the pilot study process helped the investigator and assistants to well verse with the data collection procedure and determine reliability of tests.

RELIABILITY OF THE INSTRUMENTS

Standard equipments such as stop watches (Casio, Japan), non extensible measuring tape (Freeman, India), steppers (platform) and one meter scale were used for this study. The instruments were tested for its accuracy through comparing the calibrations. The instruments used were procured from standard companies and were considered reliable.

TESTER COMPETENCY

The competency of the tester was assessed by test retest method. To determine the reliability of the test and testers' competency the performance of 10 subjects not included in the study were measured on the selected motor fitness variables twice under similar conditions by the investigator. The scores obtained were correlated using Pearson Product Moment Correlation and is presented in Table I.

Table I
The Tester 'Test and Retest' Correlation Value of the Selected Physical Fitness Variables

S.No	Variables	'r'
1	Speed	0.92
2	Endurance	0.85
3	Leg Explosive power	0.92

Table r (2,8) (0.01) = 0.426

SUBJECT RELIABILITY

The above test retest co-efficient correlation also indicated subject reliability as the same tester used the same subjects under similar conditions.

ORIENTATION OF SUBJECTS

Orientation is a programme designed to introduce one into a new situation. To bring forth the best effort from the subjects, it is essential to explain the subjects in detail about the testing procedure. Hence, before the collection of data the investigator briefed the subjects in order to orient them about the purpose of the study. The subjects were encouraged to ask questions and cleared doubts if any.

The investigator explained to the subjects about the procedure to be used to assess the selected physical fitness variables. Necessary instructions were given to the subjects about the procedures to be adopted by them. The subjects were verbally motivated to attend the training sessions and to perform well during the tests. Before the commencement of the training programme, several sessions were spent to familiarize the subjects with correct techniques involved in the exercise training programme.

TRAINING SCHEDULE

STEP AEROBICS

All the subjects performed the step aerobics exercises after proper warm- up.

Warm Up Segment

A ten minutes warm up session consisted of jogging 200 meters, a balanced combination of static stretches; smoothly controlled rhythmic callisthenic and limbering exercises were performed by the subjects prior to the training sessions.

Step Aerobics Exercise Segment

The step aerobics exercises were given for 20 minutes, along with the music which was at 118 beats per minute with an 18 cm high plat form as stepper. To start with the exercises, the subject stood with both feet at shoulder width distance and the arms were kept on either side of the body in a relaxed position, then the following exercises comprising of node consumption (cycle) of 4 counts and 8 counts were continued.

I. 'V' Step

Cycle: 4 counts

Counts

1. The subject placed the left foot forward and diagonally out to the left side at 45 degree angle to mount on the stepper and simultaneously placed the hands on hip.
2. The same step was performed with the right leg to the right side so that both the legs were on top of the stepper.
3. The left foot was brought back to the starting position.
4. The right foot and hands were brought back to the starting position.

Counts 5 to 8 were repetitions of count 1 to 4 with right foot as the lead foot.

Number of Sets

Four sets were performed continuously on both left and right side for a total of 32 counts.

II. Leg Curl

Cycle: 4 counts

Counts

1. The left foot was placed diagonally forward at 45 degree angle to mount on the stepper and simultaneously both the hands were placed on the hip.
2. The right leg was swung diagonally forward to the left side with the knee flexed.
3. The right leg was brought back to the starting position.
4. The left leg and arms were brought back to the starting position.

Counts 5 to 8 were repetitions of count 1 to 4 with right leg as the lead leg.

Number of Sets

Four sets were repeated continuously for a total of 32 counts.

III. Toe Tap

Cycle: 4 counts

Counts

1. The left foot was brought forward and the toes were tapped on the stepper.
2. The toes were tapped again and the foot was placed in an outward angle at about 45 degree while mounting on the stepper.
3. The right foot was placed across the stepper.
4. With a pivot turn of the right foot the left foot was brought near the right foot.

Count 5 was repetitions of count 1 to 4 continued in the reverse direction starting with right foot as lead foot to reach the starting position.

Number of Sets

Four sets were repeated continuously left and right side alternatively for a total of 32 counts.

IV. Trunk Twist with Extended Arms

Cycle: 4 counts

Counts

1. The left foot was placed forward to mount on the stepper.
2. Right foot was placed forward to mount on the stepper.
3. Both the arms were extended sidewards at shoulder height.
4. The trunk was twisted to the left side about 90 degree.
5. Return to count 3 position
6. Return to count 2 position
7. The right foot was brought to the starting position
8. The left foot was brought to the starting position

Counts 9 to 16 were repetition of counts 1 to 8 with the right foot as lead foot.

Number of Sets

Two sets were performed continuously on left and right side alternatively for a total of 32 counts.

V. Front Kick

Cycle: 4 counts

Counts

1. The left foot was placed forward to mount on the stepper
2. The right knee was flexed and raised to the hip level and kicked forward.
3. The right leg was brought back to the starting position.
4. The left leg was brought down to the starting position

Counts 5 to 8 were repetitions of count 1 to 4 with right foot as the lead foot.

Number of sets

Four sets were performed continuously on both left and right side alternatively for a total of 32 counts.

VI. Slice

Cycle: 8 counts

Counts

1. The left foot was placed forward to mount on the stepper and simultaneously arms were raised upward above the head, palms facing forward.
2. Right foot was placed forward to mount on the stepper and simultaneously the arms pulled downwards with clenching the hands, and fists to the shoulder level.
3. Left arm was extended downwards along the side of the leg and simultaneously the right arm was raised upward straight above the head.
4. Pulled both fists back to the shoulder

5. Right arm was extended downwards along the side of the leg and simultaneously the left arm was extended straight above the head.
6. Repeated the movement of count 4.
7. Returned to count 1 position
8. Returned to the starting position

Number of Sets

Few sets we performed on left and right side alternatively for a total of 32 counts.

VII. 90 Degree Turn with Single Arm Extension (or) Stretch

Cycle: 8 counts

Counts

1. The left foot was brought diagonally forward to the left at 45 degree angle to mount on the stepper, and simultaneously right elbow was fixed at the side of the trunk with clenched hand, and flexed the elbow.
2. The right foot was swung diagonally forward to the left and straddle down across the stepper, and simultaneously extended the right arm sidewards at shoulder height.
3. A left turn was made by the right foot and simultaneously flexed the elbow and the left leg was brought close to the right leg.
4. The right arm was brought back to the position

Counts 5 to 8 were marching on the spot, with alternate leg and arm movements.
Counts 9 to 16 were repetitions of 1 to 8 continued in the reverse direction with the right foot as lead foot to return to starting position.

Number of Sets

Two sets were performed continuously on left and right side alternatively for a total of 32 counts.

VIII. Side Kick

Cycle: 4 counts

Counts

1. The left foot was placed forward to mount on the stepper.
2. The right leg was raised to hip level and kicked side wards.
3. The right leg was brought back to the starting position.
4. The left leg was brought back to the starting position

Counts 5 to 8 were repetitions of count 1 to 4 with right foot as the lead foot.

Number of Sets

Four sets were repeated continuously on both left and right side for a total of 32 counts.

IX. 'V' Step with Flexed Knees

Cycle: 8 counts

Counts

1. The left foot was brought forward and placed diagonally on the stepper at 45 degrees angle.
2. The right foot was taken diagonally out forward at 45 degree angle to mount to form a 'v' step and hands were placed on the thigh.
3. With trunk kept erect it was lowered below the hip level.
4. Simultaneously the left shoulder was bent inward and forward towards the medial axis of the body.
5. For counts 5 and 6 the trunk was raised and simultaneously count 3 and 4 were repeated on the right side.
6. The trunk was raised to the standing position and the right foot was brought back to the starting position.
7. The left foot and arms were brought back to the starting position.

Number of Sets

Four sets were performed continuously for left and right side alternatively for a total of 32 counts.

X. Straddle Down

1. The left leg was brought diagonally forward to the left at 45 degrees to mount on the stepper, simultaneously hands were placed on the hip.
2. The right leg swung forward to the left at 45 degree angle and the knee was flexed.
3. The right leg was straddle down across the stepper.
4. The left leg was straddle down on the starting side of the stepper.
5. A right turn was made by the right foot towards left, with a backward movement the left foot was placed on the stepper.
6. Repeat the movements of count 2
7. Return back to the count 5 position
8. The left foot was brought closer to the right leg

Counts 9 to 16 were repetitions of counts 1 to 8 continued in reverse direction to return back to the starting position.

Number of Sets

Two sets were repeated continuously for a total of 32 counts.

NUTRITION SUPPLEMENTATION

The experimental group was given eight weeks Nutritional Supplementation for iron deficiency among college women selected. The subjects were provided with lotus stem with one whole egg during nutritional supplementation period. The nutritional supplementation was provided to the subjects under the supervision of dieticians. The description of the nutritional supplementation is described below.

Lotus Stem

Lotus stem is a great source of iron. Deep frying will not reduce the iron content but will greatly increase the fat content of your diet. One could be able to purchase the lotus stem from any local vendor. The low cal version of cooking Lotus stem is described below.

Ingredients:

Lotus stem -100 gm Salt - to taste Yellow chilli powder -1 tsp Mashed potatoes - 40 gm Chopped green chilli - 1 tsp Chopped ginger - 1 tsp Grated cottage cheese - 40 gm Garam masala powder - 1/2 tsp Grated cheese - 20 gm

Method:

Clean and boil the lotus stem. Grate the boiled lotus stem and mix it with the rest of the ingredients. Skewer the mixture and cook them in the tandoor till they are done.

LOTUS STEM - dry - Nutritive Value of Common Foods

	234
Moisture(gm)	**9**
Protein(gm)	**4**
Fat(gm)	**1**
Mineral(gm)	**8**
Fibre(gm)	**25**
Carbohydrates(gm)	**51**
Calcium(mg)	**405**
Phosphorous(mg)	**128**
Iron(mg)	**60**

Hard Boiled Egg

Put the eggs in a single layer in a saucepan, covered by at least an inch or two of cold water. Starting with cold water and gently bringing the eggs to a boil will help keep them from cracking.. Adding a half teaspoon of salt is thought to help

both with the preventing of cracking and making the eggs easier to peel. Put the burner on high and bring the eggs to a boil. As soon as the water starts to boil, remove the pan from the heat for a few seconds. After a minute, remove the pan from the cover, and let sit for 12 minutes. Strain out the water from the pan, fill the pan with cold water, strain again, fill again, until the eggs cool down a bit. Once cooled, strain the water from the eggs.

Nutritional Value Per 100 g Chicken Egg whole, Hard Boiled

Energy	647 kJ (155 kcal)
Carbohydrates	1.12 g
Fat	10.6 g
Protein	12.6 g
- Tryptophan	0.153 g
- Threonine	0.604 g
- Isoleucine	0.686 g
- Leucine	1.075 g
- Lysine	0.904 g
- Methionine	0.392 g
- Cystine	0.292 g
- Phenylalanine	0.668 g
- Tyrosine	0.513 g
- Valine	0.767 g
- Arginine	0.755 g
- Histidine	0.298 g
- Alanine	0.700 g
- Aspartic acid	1.264 g
- Glutamic acid	1.644 g
- Glycine	0.423 g
- Proline	0.501 g
- Serine	0.936 g
Water	75 g
Vitamin A equiv.	149 µg (19%)
Thiamine (vit. B_1)	0.066 mg (6%)

Riboflavin (vit. B_2)	0.5 mg (42%)
Pantothenic acid (B_5)	1.4 mg (28%)
Folate (vit. B_9)	44 µg (11%)
Vitamin B_{12}	1.11 µg (46%)
Choline	294 mg (60%)
Vitamin D	87 IU (15%)
Vitamin E	1.03 mg (7%)
Calcium	50 mg (5%)
Iron	1.2 mg (9%)
Magnesium	10 mg (3%)
Phosphorus	172 mg (25%)
Potassium	126 mg (3%)
Zinc	1.0 mg (11%)
Cholesterol	424 mg

TEST ADMINISTRATION

The following dependent variables were measured.

Administration of the tests and the method of collecting the data were explained here.

MOTOR FITNESS VARIABLES

SPEED (50 Meters Run)

Purpose:

To measure speed.

Equipments

An area on a track, football field or play ground with a starting line a 50 yard dash, and a finish line. Stop watches or spilt second timers.

Procedure

The subject took a position behind the starting line. The starter used the command, "ready" and "Go". The latter was accompanied by a downward sweep of the arm as a signal to the timer. The subject ran across the finish line. One trial was permitted.

Scoring

The score was the elapsed time to the nearest one tenth of a second between the starting signal and the instant the subject crossed the finish line.

EXPLOSIVE POWER (VERTICAL JUMP TEST)

Purpose

To measure the leg power.

Equipments

A measuring tape and a smooth wall surface at least 12 feet from the floor are required.

Description

The performer stood with one side towards a wall heels together kept on the floor, he reached upward as high as possible and made a mark on the wall. The performer then jumped as high as possible and made another mark at the peak height of their jumped and arched.

Score

The score was the vertical distance between the reach and jump and reached marks recorded in centimeters

ENDURANCE

Purpose

To measure the cardio respiratory endurance through Physical Efficiency Index.

Equipments

A stable bench 20 inches high and a stop watch.

Procedure

1. The subject step up and down 30 times a minute on a bench 20 inches high. Each time the subject should step all the way up on the bench with the body erect. The stepping process is performed in four counts, as follows: 1. one foot is placed on bench, 2. other foot is placed on the bench; 3. one foot is placed on the floor; 4. the other foot is placed on floor. The tester may lead off with the same foot each time or any change feet as he desires, so long as the four count step is maintained. The steps were counted the cadence as 'up, up, down, down'.
2. The stepping exercise continues for exactly five minutes, unless the subject is forced to stop sooner due to exhaustion. In either case the duration of the exercise in seconds is recorded; the maximum number of seconds is 30 for the full five minute period.
3. Immediately after completing the exercise, the subject sits on a chair. The pulse is counted 1 – 1½ , 2 – 2½ and 3 – 3½ minutes after the stepping ceases.

Scoring

A physical efficiency index (PEI) is computed utilizing the following formula:

$$PEI = \frac{\text{Duration of Exercise in Seconds x 100`}}{\text{2 x Sum of pulse counts in recovery}}$$

STATISTICAL PROCEDURE

To find out the effects of treadmill running with and without weights on motor fitness and physiological variables the collected pre test and post test scores were analysed by using ANCOVA statistical technique. When the F ratio was found to be significant, Scheffe's post hoc test was to find out the paired mean significant difference. (Thirumalaisamy, 1998).

CHAPTER IV
RESULTS AND DISCUSSION

The purpose of this study was to find out the effect of aerobic exercises and nutritional supplementation on selected motor fitness variables of badminton players. This study was designed to find out the effects of 12 weeks of aerobics training and nutritional supplementation on selected motor fitness variables on badminton players. For the purpose of this study 60 school badminton players were selected on random basis as subjects from schools in the state of Andhra Pradesh. The age of the players were ranging from 15 to 17 years. The following dependent and independent variables were selected for the study.

Dependent Variable

1. Speed
2. Endurance
3. Leg Explosive power

Randomly selected 60 school level badminton players (N=60) were divided into 3 groups each consisting of 20 badminton players. Group I was treated as aerobic training group. Group II was treated as nutritional supplementation group and group III was considered as control group. All the subjects selected were measured of their initial scores on speed, endurance and leg explosive power through standard tests, which formed pre test scores. After the experimental period of 12 weeks, the subjects were again tested on the criterion variables, which formed post test scores. The difference between the initial and final scores was considered as the effect of respective treatment on selected dependent variables. The collected data were subjected to statistical treatment using ANCOVA. In all cases 0.05 level was fixed to test the hypothesis of the study.

RESULTS ON SPEED

The statistical analysis comparing the initial and final means of Speed due to Aerobic training and nutritional supplementation among school level badminton players is presented in Table II

Table II
ANCOVA RESULTS ON EFFECT OF AEROBIC TRAINING AND NUTRITIONAL SUPPLEMENTATION COMPARED WITH CONTROL ON SPEED

	AEROBIC TRAINING	NUTRITIONAL SUPPLEMENTATION	CONTROL GROUP	SOURCE OF VARIANCE	SUM OF SQUARES	df	MEAN SQUARES	OBTAINED F
Pre Test Mean	6.83	6.91	6.92	Between	0.11	2	0.05	1.63
				Within	1.85	57	0.03	
Post Test Mean	6.68	6.90	6.91	Between	0.71	2	0.36	12.77*
				Within	1.59	57	0.03	
Adjusted Post Test Mean	6.72	6.88	6.88	Between	0.31	2	0.16	27.72*
				Within	0.31	56	0.01	
Mean Diff	-0.15	-0.01	0.00					

Table F-ratio at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.
*Significant

As shown in Table II, the obtained pre test means on Speed on aerobic Training group was 6.83, nutritional supplementation group was 6.91 was and control group was 6.92. The obtained pre test F value was 1.63 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Speed on aerobic Training group was 6.68, nutritional supplementation group was 6.90 and control group was 6.91. The obtained post test F value was 12.77 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 27.72 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table III.

Table III
Post Hoc Analysis Multiple Paired Adjusted Mean Comparisons using Scheffe's Confidence Interval Test Scores on Speed

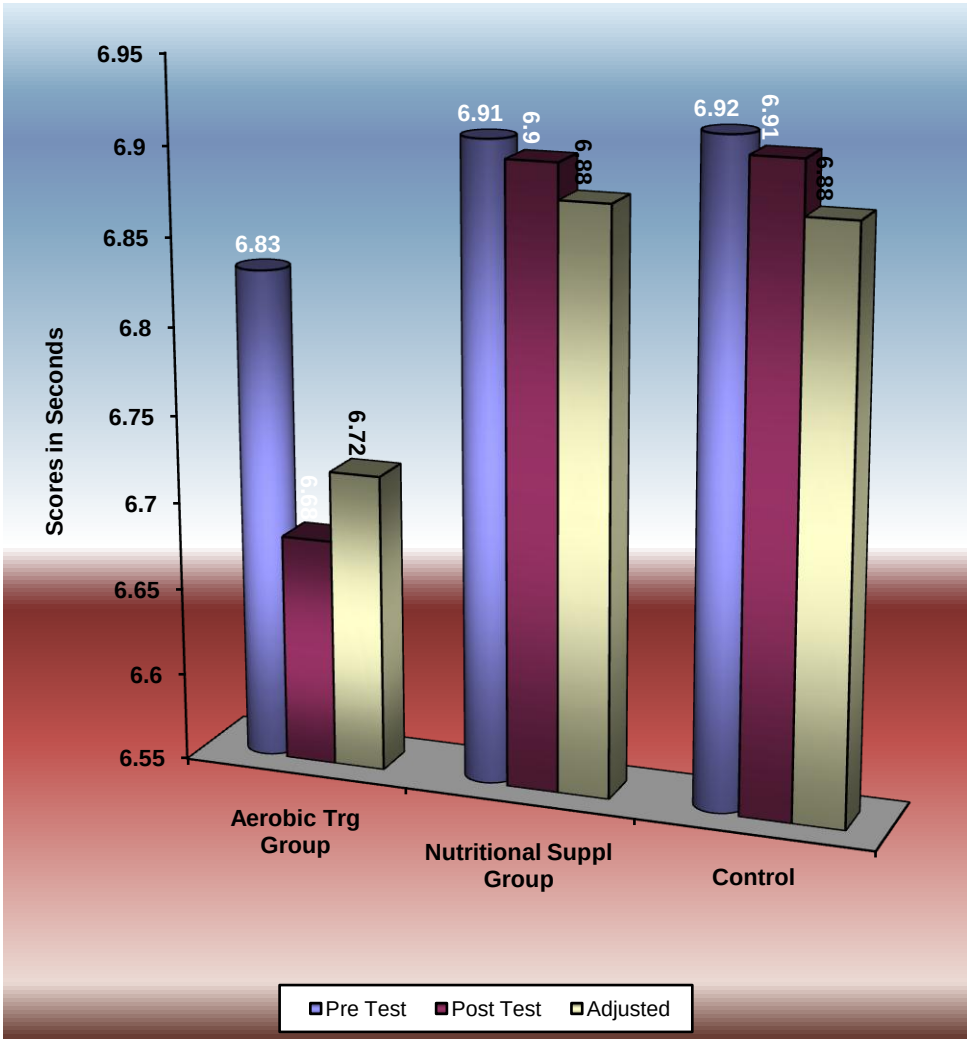
MEANS				Reqd. C I
Aerobic Training Group	Nutritional Supplementation Group	Control Group	Mean Difference	
6.72	6.88		0.15*	0.06
6.72		6.88	0.16*	0.06
	6.88	6.88	0.01	0.06

* Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between aerobic training group and control group (MD: 0.16). There was no significant difference between nutritional supplementation group and control group (MD: 0.01). There was significant difference between treatment groups, namely, aerobic training and nutritional supplementation group. (MD: 0.15).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure I.

Figure I
BAR DIAGRAM SHOWING PRE TEST, POST TEST AND ORDERED ADJUSTED MEANS ON SPEED



DISCUSSIONS ON FINDINGS ON SPEED

The effect of aerobic training and nutritional supplementation on Speed is presented in Table II. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 27.72 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table III proved that there was significant difference between aerobic training group and control group (MD: 0.16).

There was no significant difference between nutritional supplementation group and control group (MD: 0.01). Comparing between the treatment groups, it was found that there was significant difference between aerobic training group and nutritional supplementation group among badminton players.

Thus, it was found that aerobic training was significantly better than nutritional supplementation and control group in altering Speed of the school level badminton players.

RESULTS ON ENDURANCE

The statistical analysis comparing the initial and final means of Endurance due to Aerobic training and nutritional supplementation among school level badminton players is presented in Table IV

Table IV
ANCOVA RESULTS ON EFFECT OF AEROBIC TRAINING AND NUTRITIONAL SUPPLEMENTATION COMPARED WITH CONTROL ON ENDURANCE

	AEROBIC TRAINING	NUTRITIONAL SUPPLEMENTATION	CONTROL GROUP	SOURCE OF VARIANCE	SUM OF SQUARES	df	MEAN SQUARES	OBTAINED F
Pre Test Mean	58.04	58.54	58.29	Between	2.52	2	1.26	0.02
				Within	3585.71	57	62.91	
Post Test Mean	61.76	59.41	58.13	Between	135.20	2	67.60	1.19
				Within	3232.26	57	56.71	
Adjusted Post Test Mean	61.98	59.19	58.13	Between	157.75	2	78.88	9.43*
				Within	468.28	56	8.36	
Mean Diff	3.72	0.86	-0.16					

Table F-ratio at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.
*Significant

As shown in Table IV, the obtained pre test means on Endurance on aerobic Training group was 58.04, nutritional supplementation group was 58.54 was and control group was 58.29. The obtained pre test F value was 0.02 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Endurance on aerobic Training group was 61.76, nutritional supplementation group was 59.41 and control group was 58.13. The obtained post test F value was 1.19 and the required table F value was 3.16, which proved that there was no significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 9.43 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table V.

Table V
Post Hoc Analysis Multiple Paired Adjusted Mean Comparisons using Scheffe's Confidence Interval Test Scores on Endurance

MEANS				Reqd. C I
Aerobic Training Group	Nutritional Supplementation Group	Control Group	Mean Difference	
61.98	59.19		2.79*	2.30
61.98		58.13	3.84*	2.30
	59.19	58.13	1.05	2.30

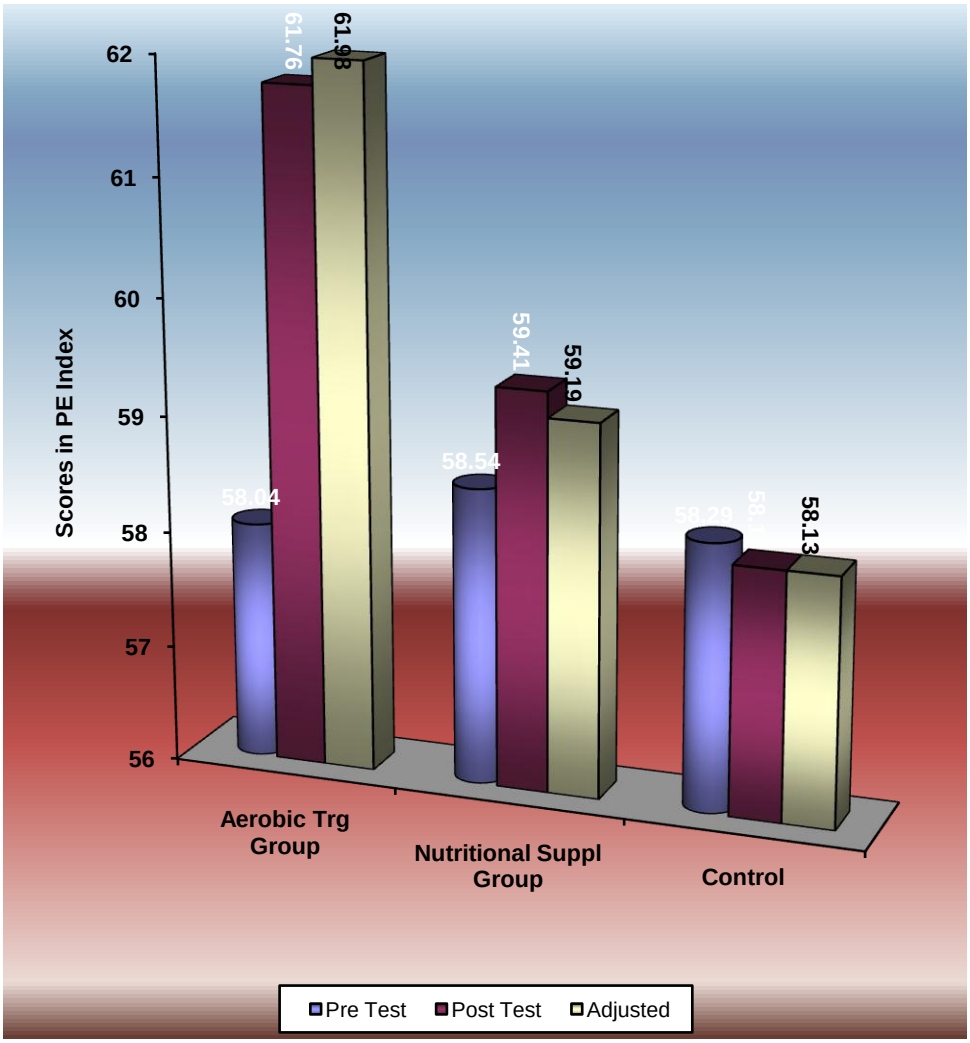
***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between aerobic training group and control group

(MD: 3.84). There was no significant difference between nutritional supplementation group and control group (MD: 1.05). There was significant difference between treatment groups, namely, aerobic training and nutritional supplementation group. (MD: 2.79).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure II.

Figure II
BAR DIAGRAM SHOWING PRE TEST, POST TEST AND ORDERED ADJUSTED MEANS ON ENDURANCE



DISCUSSIONS ON FINDINGS ON ENDURANCE

The effect of aerobic training and nutritional supplementation on Endurance is presented in Table IV. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 9.43 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table V proved that there was significant difference between aerobic training group and control group (MD: 3.84). There was no significant difference between nutritional supplementation group and control group (MD: 1.05). Comparing between the treatment groups, it was found that there was significant difference between aerobic training group and nutritional supplementation group among badminton players.

Thus, it was found that aerobic training was significantly better than nutritional supplementation and control group in altering Endurance of the school level badminton players.

RESULTS ON LEG EXPLOSIVE POWER

The statistical analysis comparing the initial and final means of Leg Explosive Power due to Aerobic training and nutritional supplementation among school level badminton players is presented in Table VI

Table VI

ANCOVA RESULTS ON EFFECT OF AEROBIC TRAINING AND NUTRITIONAL SUPPLEMENTATION COMPARED WITH CONTROL ON LEG EXPLOSIVE POWER

	AEROBIC TRAINING	NUTRITIONAL SUPPLEMENTATION	CONTROL GROUP	SOURCE OF VARIANCE	SUM OF SQUARES	df	MEAN SQUARES	OBTAINED F
Pre Test Mean	57.00	57.25	57.00	Between	0.83	2	0.42	0.01
				Within	3143.75	57	55.15	
Post Test Mean	64.85	58.05	58.10	Between	612.03	2	306.02	7.26*
				Within	2403.30	57	42.16	
Adjusted Post Test Mean	64.92	57.92	58.17	Between	630.95	2	315.48	49.58*
				Within	356.35	56	6.36	
Mean Diff	7.85	0.80	1.10					

Table F-ratio at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16.
*Significant

As shown in Table VI, the obtained pre test means on Leg Explosive Power on aerobic Training group was 57.00, nutritional supplementation group was 57.25 was and control group was 57.00. The obtained pre test F value was 0.01 and the required table F value was 3.16, which proved that there was no significant difference among initial scores of the subjects.

The obtained post test means on Leg Explosive Power on aerobic Training group was 64.85, nutritional supplementation group was 58.05 and control group was 58.10. The obtained post test F value was 7.26 and the required table F value was 3.16, which proved that there was significant difference among post test scores of the subjects.

Taking into consideration of the pre test means and post test means adjusted post test means were determined and analysis of covariance was done and the obtained F value 49.58 was greater than the required value of 3.16 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table VII.

Table VII
Post Hoc Analysis Multiple Paired Adjusted Mean Comparisons using Scheffe's Confidence Interval Test Scores on Leg Explosive Power

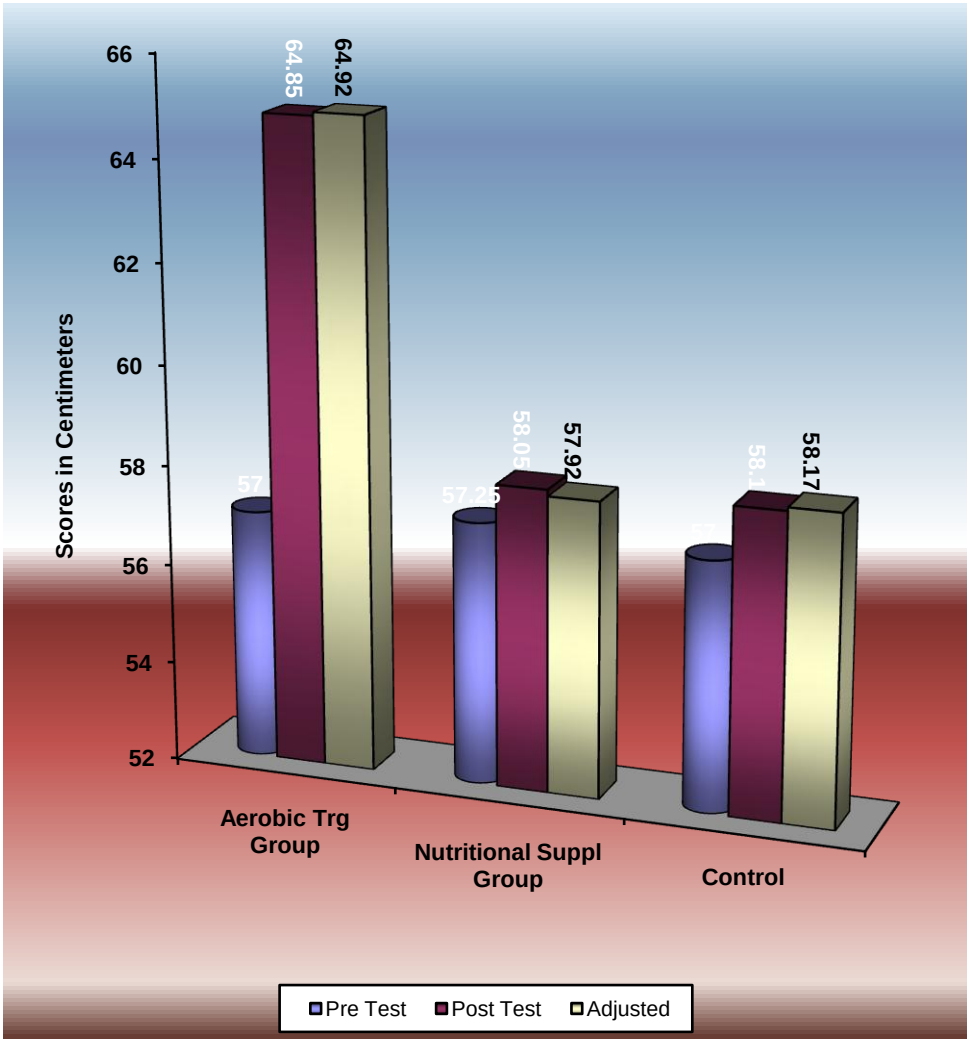
MEANS				Reqd. C I
Aerobic Training Group	Nutritional Supplementation Group	Control Group	Mean Difference	
64.92	57.92		7.00*	2.01
64.92		58.17	6.75*	2.01
	57.92	58.17	-0.25	2.01

* Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between aerobic training group and control group (MD: 6.75). There was no significant difference between nutritional supplementation group and control group (MD: 0.25). There was significant difference between treatment groups, namely, aerobic training and nutritional supplementation group. (MD: 7.00).

The ordered adjusted means were presented through bar diagram for better understanding of the results of this study in Figure III.

Figure III
BAR DIAGRAM SHOWING PRE TEST, POST TEST AND ORDERED ADJUSTED MEANS ON LEG EXPLOSIVE POWER



DISCUSSIONS ON FINDINGS ON LEG EXPLOSIVE POWER

The effect of aerobic training and nutritional supplementation on Leg Explosive Power is presented in Table VI. The analysis of covariance proved that there was significant difference between the experimental group and control group as the obtained F value 49.58 was greater than the required table F value to be significant at 0.05 level.

Since significant F value was obtained, the results were further subjected to post hoc analysis and the results presented in Table VII proved that there was

significant difference between aerobic training group and control group (MD: 6.75). There was no significant difference between nutritional supplementation group and control group (MD: 0.25). Comparing between the treatment groups, it was found that there was significant difference between aerobic training group and nutritional supplementation group among badminton players.

Thus, it was found that aerobic training was significantly better than nutritional supplementation and control group in altering Leg Explosive Power of the school level badminton players.

DISCUSSIONS ON HYPOTHESIS

For the purpose of the study, the following were hypothesized

1. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as speed among badminton players
2. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as endurance among badminton players.
3. There would be significant improvement due to aerobics exercises and nutritional supplementation on motor fitness variable such as leg explosive power among badminton players.
4. There would not be any significant difference in altering selected motor fitness variables, speed, endurance and leg explosive power among badminton players.

The ANCOVA results presented in Table II showed significant improvement on speed due to experimental treatments. The post hoc analysis presented in Table III proved that the improvement was due to aerobic training and nutritional supplementation group and control group failed to significantly alter motor fitness of speed among badminton players and to this extent the formulated hypothesis No. 1 was

The ANCOVA results presented in Table IV showed significant improvement on endurance measured through physical efficiency index due to experimental treatments. The post hoc analysis presented in Table V proved that the improvement was due to aerobic training. The nutritional supplementation group and control group failed to significantly alter motor fitness of endurance among badminton players and to this extent the formulated hypothesis No. 2 was accepted.

The ANCOVA results presented in Table VI showed significant improvement on leg explosive power measured through physical efficiency index due to experimental treatments. The post hoc analysis presented in Table VII proved that the improvement was due to aerobic training. The nutritional supplementation group and control group failed to significantly alter motor fitness of leg explosive power among badminton players and to this extent the formulated hypothesis No. 3 was accepted.

The post hoc analysis results presented in Tables III, V and VII proved that there was significant differences between treatment groups, aerobic training and nutritional supplementation and the formulated hypothesis that there would not be any significant differences between treatment groups on selected motor fitness variables, speed, endurance and leg explosive power was rejected at 0.05 level.

CHAPTER V
FINDINGS, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

SUMMARY

Badminton is a game which requires a high level of motor fitness, mental alertness and mastery over techniques. Motor fitness is the combination of speed, endurance and leg explosive power. It is the ability to enjoy our lives and to achieve our goals without undue fatigue or stress. Motor fitness varies from person to person and different types of fitness are needed for different types of profession. Aerobic exercise is an activity that can meet the fitness demands of both children and adults. Performed at a high intensity level, using complex skills, it can be strenuous enough for an athlete in training, yet, performed at a slower pace, using simplistic skills, suitable for the beginner or as part of a rehabilitation program. The investigator was interested to compare the effect of aerobic training with nutritional supplementation among school level badminton players.

The purpose of this study was to find out the effect of aerobic exercises and nutritional supplementation on selected motor fitness variables of badminton players. This study was designed to find out the effects of 12 weeks of aerobics training and nutritional supplementation on selected motor fitness variables on badminton players. For the purpose of this study 60 school badminton players were selected on random basis as subjects from schools in the state of Andhra Pradesh. The age of the players were ranging from 15 to 17 years. The dependent variables selected for this study were speed, endurance and leg explosive power.

Randomly selected 60 school level badminton players (N=60) were divided into 3 groups each consisting of 20 badminton players. Group I was treated as aerobic training group. Group II was treated as nutritional supplementation group and group III was considered as control group. All the subjects selected were measured of their initial scores on speed, endurance and leg explosive power

through standard tests, which formed pre test scores. After the experimental period of 12 weeks, the subjects were again tested on the criterion variables, which formed post test scores. The difference between the initial and final scores was considered as the effect of respective treatment on selected dependent variables. The collected data were subjected to statistical treatment using ANCOVA. In all cases 0.05 level was fixed to test the hypothesis of the study.

It was found that aerobic training was significantly altered selected motor fitness variables, speed, endurance and leg explosive power among school level badminton players.

CONCLUSIONS

From the results and findings of this study the following conclusions are drawn subject to the limitations and delimitations of this study.

1. Aerobics exercise has significant effect on the motor fitness component, such as, speed among school level badminton players compared to control group. . Comparing between treatment groups, it was found aerobic exercise group was significantly better than nutritional supplementation group.
2. Aerobics exercise has significant effect on the motor fitness component, such as, endurance among school level badminton players compared to control group. . Comparing between treatment groups, it was found aerobic exercise group was significantly better than nutritional supplementation group in improving endurance among badminton players.
3. Aerobics exercise has significant effect on the motor fitness component, such as, leg explosive power among school level badminton players compared to control group. .Comparing between treatment groups, it was found aerobic exercise group was significantly better than nutritional supplementation group in improving leg explosive power among badminton players..

RECOMMENDATIONS FOR FUTURE RESEARCH

The following recommendations are suggested for further research on the basis of this results of this study.

1. This study may be conducted in collegiate level ball badminton players to find out the difference in motor fitness due to aerobic exercises and nutritional supplementation.
2. The tests used in this study may be utilized to find out the motor fitness requirements of players of other games like basketball, cricket, football and athletes to develop in running, jumping and throwing events and to distinguish them on the basis of their motor fitness requirements.
3. The same study may be conducted among women badminton players to understand the importance of sex difference on the motor fitness requirements among them.
4. This study may be conducted on different age groups from College level players to National level players to understand the motor fitness requirements of badminton players.
5. This study may be conducted on players and athletes of different levels of participation like district level, state level and university level.

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APPENDIX I

RAW SCORES ON SPEED

S.No.	Aerobics Group		Nutritional Group		CONTROL GROUP	
	Initial	Final	Initial	Final	Initial	Final
1	7.0	6.9	6.8	6.7	7.0	7.0
2	6.8	6.8	6.9	6.8	7.2	7.1
3	6.6	6.6	6.7	6.7	7.1	7.1
4	6.9	6.8	6.8	6.9	7.2	7.2
5	7.1	6.9	7.0	7.0	7.1	7.0
6	7.0	6.9	6.9	6.9	6.7	6.7
7	6.6	6.4	7.1	7.1	6.9	6.9
8	6.6	6.5	7.2	7.3	7.0	7.0
9	6.7	6.6	6.9	6.8	6.6	6.8
10	6.8	6.8	6.7	6.7	7.0	7.0
11	6.6	6.5	7.2	7.2	6.8	6.8
12	6.9	6.8	6.9	6.8	6.7	6.9
13	6.7	6.6	6.7	6.7	6.7	6.7
14	6.8	6.7	7.2	7.2	6.9	6.9
15	6.8	6.7	6.9	6.8	6.8	6.8
16	6.6	6.6	6.7	6.7	7.1	7.0
17	6.9	6.8	6.8	6.9	7.2	6.9
18	7.1	6.9	7.0	7.0	7.1	7.1
19	7.0	6.9	6.9	6.9	6.7	6.8
20	6.6	6.4	7.1	7.1	6.9	6.9

APPENDIX II

RAW SCORES ON ENDURANCE

S.No.	Aerobics Group		Nutritional Group		CONTROL GROUP	
	Initial	Final	Initial	Final	Initial	Final
1	58.8	67.7	69.1	70.2	67.1	66.2
2	51.2	53.1	57.1	59.1	55.1	57.3
3	63.2	62.8	56.1	57.5	79.1	75.1
4	54.8	58.4	54.9	55.3	52.9	55.1
5	72.1	76.6	75.8	76.3	44.4	46.7
6	60.1	64.6	61.1	60.4	53.3	57.3
7	49.1	47.1	53.3	54.3	46.7	48.4
8	57.9	58.8	54.0	54.6	62.7	57.3
9	68.8	67.8	50.4	52.2	55.1	55.1
10	64.1	67.7	69.6	71.7	59.6	57.3
11	46.3	53.1	56.7	57.7	54.2	52.9
12	57.0	62.8	56.2	57.3	67.6	61.8
13	53.4	58.4	48.7	50.3	54.7	52.9
14	63.2	76.6	64.7	63.2	54.2	57.3
15	53.4	62.8	60.2	61.3	58.2	57.3
16	57.0	56.6	51.8	53.1	49.8	52.9
17	58.8	67.7	69.1	70.1	67.1	66.2
18	51.2	53.1	57.1	58.1	55.1	57.3
19	63.2	62.8	53.2	53.5	79.1	75.1
20	57.0	56.6	51.8	52.1	49.8	52.9

APPENDIX III

RAW SCORES ON LEG EXPLOSIVE POWER

S.No.	Aerobics Group		Nutritional Group		CONTROL GROUP	
	Initial	Final	Initial	Final	Initial	Final
1	48.0	54.0	48.0	53.0	48.0	49.0
2	47.0	56.0	62.0	60.0	47.0	51.0
3	58.0	66.0	55.0	57.0	58.0	59.0
4	48.0	56.0	67.0	65.0	48.0	52.0
5	48.0	56.0	67.0	63.0	48.0	51.0
6	65.0	68.0	60.0	57.0	65.0	62.0
7	62.0	74.0	48.0	50.0	62.0	62.0
8	65.0	68.0	60.0	60.0	65.0	62.0
9	62.0	74.0	48.0	54.0	62.0	63.0
10	55.0	61.0	55.0	60.0	55.0	55.0
11	67.0	76.0	67.0	67.0	67.0	68.0
12	60.0	72.0	60.0	58.0	60.0	60.0
13	48.0	54.0	48.0	53.0	48.0	49.0
14	47.0	56.0	62.0	60.0	47.0	51.0
15	58.0	66.0	55.0	57.0	58.0	59.0
16	48.0	56.0	67.0	65.0	48.0	52.0
17	65.0	68.0	60.0	62.0	65.0	67.0
18	62.0	74.0	48.0	50.0	62.0	65.0
19	65.0	68.0	60.0	58.0	65.0	62.0
20	62.0	74.0	48.0	52.0	62.0	63.0

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