CHAPTER I
INTRODUCTION

Relation between nutrition, exercise and performance has all too often been marked by confusion, conflict and exploded expectations. Failures have stemmed invariably from misinformation, misconception and misguided enthusiasm that has given birth to a whole gaggle of myths.

The growing awareness of the synergy between diet and physical activity has fuelled an expanding interest in the valuable role that micronutrient can play in achieving one’s genetic potential in physical performance. Micronutrients differ from macronutrients in key characteristics. Water, proteins, carbohydrates, and fat are consumed in large amounts, whereas vitamins and minerals are ingested in much smaller amounts (milligrams to micrograms per day). These differences in magnitude reflect turnover rates in the body and specific functions. Macronutrients provide sources of energy needed to fuel the body, maintain cellular hydration, and provide the body structure to perform work. Micronutrients enable the use of macronutrients for all physiologic processes. Despite their relative paucity in the diet and the body, vitamins and minerals are key regulators of health and function, including work performance.

1.1 Vitamins: Ergogenic Theory

Organic compounds, found in small amounts in foods, are designated as nutrients because they cannot be synthesized by the body and are required to support health and well being. Vitamins catalyze numerous biochemical reactions. They are
not direct sources of energy; but facilitate energy metabolism. Since the rates or activities of these metabolic processes increase during physical activity, an adequate supply of vitamins is needed to promote optimal physical performance. Vitamins are classified based on their solubility in water or fat.

The B vitamins and vitamin C (ascorbic acid) are water-soluble vitamins. The B vitamins (thiamin, riboflavin, niacin, pyridoxine, folate, biotin, pantothenic acid, and choline) regulate energy metabolism by modulating the synthesis and degradation of carbohydrate, fat, protein, and bioactive compounds. Vitamin B12 is required for hemoglobin synthesis and vitamin C acts as an antioxidant.

Vitamins A, D, E, and K are stored in adipose tissue in substantial amounts. These fat-soluble vitamins have no direct role in energy metabolism; they function in roles supportive of energy use. Carotene, a precursor of vitamin A, and vitamin E act as antioxidants in reducing muscle damage and enhancing recovery from exercise. Vitamin D, which promotes calcium absorption and use in bone formation, and vitamin K, which functions in coagulation and bone formation, have not been shown to influence exercise performance.

Vitamins, just as minerals and trace elements, meet with great interest in the world of sports because of their supposed role in enhancing physical performance. Vitamins function in the human body as metabolic regulators, influencing a number of physiological processes important to exercise or sport performance. For example, many of the B-complex vitamins are involved in processing carbohydrate and fats for energy production, an important consideration during exercise of varying intensity. Several B vitamins are also essential to help form hemoglobin in red blood cells, a
major determinant of oxygen delivery to the muscles during aerobic endurance exercise. Additionally, vitamins C and E function as antioxidants, important for preventing oxidative damage to cellular and sub-cellular structure and function during exercise training, theoretically optimizing preparation for competition.

1.2 Physical Activity and Immune Function

The immune system protects against, recognizes, attacks and destroys elements that are foreign to the body. The immune system can be divided into two broad functions: innate (natural and non-specific) and acquired (adaptive and specific) immunity, which work together synergistically. The attempt of an infectious agent to enter the body immediately activates the innate system. This so-called ‘first-line of defence’ comprises three general mechanisms with the common goal of restricting the entry of micro-organisms into the body: (1) physical/structural barriers (skin, epithelial linings, mucosal secretions); (2) chemical barriers (pH of bodily fluids and soluble factors such as lysozymes and complement proteins); and (3) phagocytic cells (e.g. neutrophils and monocytes/macrophages). Failure of the innate system and the resulting infection activates the acquired system, which aids recovery from infection. Monocytes or macrophages ingest, process and present foreign material (antigens) to lymphocytes. This is followed by clonal proliferation of T- and B-lymphocytes that possess receptors that recognize the antigen, engendering specificity and ‘memory’ that enable the immune system to mount an augmented cell-mediated and humoral response when the host is re-infected by the same pathogen. Critical to the activation and regulation of immune function is the production of cytokines, including interferons, interleukins and colony-stimulating factors (Gleeson and Bishop, 1999).
A fundamental characteristic of the immune system is that it involves multiple functionally different cell types, which permits a large variety of defence mechanisms. Assessing immune function status, therefore, requires a thorough methodological approach targeting a large spectrum of immune system parameters. However, currently no instruments are available to predict the cumulative effects of several small changes in immune system parameters on host resistance to infection (Keil et al., 2001).

A heavy schedule of training and competition can lead to immune impairment in athletes, which is associated with an increased susceptibility to infections, particularly upper respiratory tract infections (URTI) (Peters and Bateman, 1983; Nieman et al., 1990). This exercise-induced immune dysfunction seems to be mostly due to the immunosuppressive actions of stress hormones such as adrenaline and cortisol. Nutritional deficiencies can also impair immune function and there is a vast body of evidence that many infections are increased in prevalence or severity by specific nutritional deficiencies (Scrimshaw and SanGiovanni, 1997; Calder and Jackson, 2000). However, it is also true that excessive intakes of individual micronutrients (n-3 polyunsaturated fatty acids, iron, zinc, vitamins A and E) can impair immune function and increase the risk of infection (Chandra, 1997). As most athletes will be aware, even medically harmless infections can result in a decrement in athletic performance.

Physical activity influences immune function and risk of certain types of infection such as upper respiratory tract infections (URTI). In contrast to moderate physical activity, prolonged and intensive exertion by endurance athletes causes
numerous changes in immunity in multiple body compartments and an increased risk of URTI. Elite endurance athletes must train intensively to compete at the highest levels and are prime candidates for immune nutrition support to bolster immune system function in the face of physiological stress.

Each acute bout of heavy exertion leads to physiological stress and transient but clinically significant changes in immunity and host pathogen defense. Research has repeatedly shown that the immune system reflects the physiologic stress the endurance athlete’s body is experiencing as cortisol, epinephrine, and pro- and anti-inflammatory cytokines rise to high levels. Natural killer cell activity, various measures of T and B cell function, upper airway neutrophil function, salivary IgA concentration, granulocyte oxidative burst activity, skin delayed-type hypersensitivity response, and major histocompatibility complex (MHC) II expression in macrophages are suppressed for at least several hours during recovery from prolonged, intense endurance exercise. These immune changes occur in several compartments of the immune system and body (the skin, upper respiratory tract mucosal tissue, lung, blood, muscle, and peritoneal cavity).

During the “open window” of impaired immunity (which may last between three and 72 hours, depending on the immune measure), viruses and bacteria may gain a foothold, increasing the risk of subclinical and clinical infection.

Mounting evidence indicates that physical activity influences immune function and risk of certain types of infection, such as upper respiratory tract infections (URTI). In contrast to moderate physical activity, prolonged and intensive exertion causes numerous negative changes in immunity and an increased risk of infections.
1.3 Immuno-nutrition Support for Athletes

There is a growing interest in potential nutritional countermeasures to exercise-induced immune dysfunction. Various nutritional agents have been tested for their capacity to attenuate immune changes following intensive exercise and thus lower the magnitude of physiologic stress and URTI risk. This strategy is similar to the immune-nutrition support provided to patients recovering from trauma and surgery, and to the frail elderly. Supplements studied thus far in human athletes include zinc, N-3 polyunsaturated fatty acids (N-3 PUFAs), plant sterols, antioxidants (vitamins C and E, beta-carotene, N-acetylcysteine, and butylated hydroxyanisole), glutamine, bovine colostrum, and carbohydrate.

Several vitamins are essential for normal immune function. Deficiencies of fat-soluble vitamins A and E and water-soluble vitamins folic acid, B6, B12 and C impair immune function and decrease the body’s resistance to infection (Scrimshaw and SanGiovanni, 1997; Calder and Jackson, 2000; Calder et al., 2002). Correcting existing deficiencies with specific vitamin supplements can be effective in restoring immune function to normal (Calder and Jackson, 2000).

1.4 Need and Significance

The existing data imply that there is a relationship between exercise and infection, and that heavy exertion may suppress various components of immunity. Research data on the resting immunity of athletes and non-athletes, however, are limited and present a confusing picture at present. Studies available suggest that the innate immune system responds differentially to the chronic stress of intensive
exercise, with natural killer cell activity tending to be enhanced while neutrophil function is suppressed (Nieman et al., 1999). The adaptive immune system (resting state) in general seems to be largely unaffected by athletic endeavour.

The influence of nutritional supplements on the immune and infection response to intense and prolonged exercise is an active area of research by multiple investigators (Gleeson, Nieman, & Pedersen, 2004). Supplements studied in humans include zinc, dietary fat, plant sterols, antioxidants (vitamins C and E, beta-carotene, N-acetylcysteine, and butylated hydroxyanisole), glutamine, and carbohydrate. Except for carbohydrate beverages, none of these supplements has emerged as an effective countermeasure to exercise-induced immune suppression (Gleeson et al., 2004; Nieman, 2001; Nieman & Pedersen, 2000). Antioxidants (vitamin C and Vitamin E) have received much attention, but the data thus far do not support their role in negating immune changes after heavy exertion. Therefore, an investigation on the effect of vitamin E supplementation on immune variables among endurance athletes would add to the existing knowledge on the role of Vitamin E as immune-nutritional support for endurance athletes.

1.5 Statement of the Problem

The present study is entitled “Effect of Vitamin E Supplementation on Immune Responses of Middle and Long Distance Runners”.

1.6 Delimitations of the Study

(i) The study was delimited to forty six middle and long distance runners which included 26 male and 20 female athletes.
The study was delimited to supplementation of vitamin E with Evion 400 (mgu) capsules one per day.

The study was confined to supplementation of vitamin E for a period of two months only.

The study was confined to analysis of the following variables:

(a) Hemoglobin
(b) WBC Total
(c) Neutrophils
(d) Lymphocyte
(e) Eosinophils
(f) Monocytes
(g) RBC
(h) Platelet
(i) Serum Cortisol
(j) Immunoglobulin
   i) IgG
   ii) IgA
   iii) IgM

1.7 Limitations of the Study

Personal and lifestyle factors including other nutritional habits, rest, sleep, daily routine, and other health factors which might have affected the immune variables and therefore affected the study results might be considered as limitations of the study.
1.8 Operational Definition of Key Terms

The following operational definitions were considered suitable for the present study:

1.8.1 Vitamin E

Vitamin E is a fat-soluble vitamin that is essential for normal reproduction; an important antioxidant that neutralizes free radicals in the body. In the present study Vitamin E was supplemented by Evion 400 (mgu) capsules.

1.8.2 Immune System

Immune system includes a diffuse, complex network of interacting cells, cell products, and cell-forming tissues that protects the body from pathogens and other foreign substances, destroys infected and malignant cells, and removes cellular debris.

1.9 Objectives of the Study

The present study on effect of vitamin E supplementation on immune responses of middle and long distance runners was undertaken with the following objectives:

(i) To find out the effect of vitamin E supplementation and placebo dose on selected immune response among middle and long distance runners.

(ii) To find out the acute immune response for the experimental and control groups following competition.
1.10. Hypotheses

(i) There would not be any significant difference between the experimental and control group on immune responses following the supplementation of Vitamin E and placebo dose

(ii) There would not be any significant difference for the experimental and control group on acute responses on selected immune variables following competition

1.11. Scope of the Study

The human immune system is highly complex yet precisely ordered array of cells, hormones and soluble immune modulators that inhibit the bone marrow, lymphoid tissues and ducts, and peripheral circulation. In the field of sports performance, vitamin E supplementation is a new concept, and studies are scanty in this regard.

Recent studies on exercise and immunology have noted that physical fatigue has long been considered a factor affecting susceptibility to illness. Physical activity influences immune function and risk of certain types of infection. In contrast to moderate physical activity, prolonged and intensive exertion by endurance athletes causes numerous changes in immunity in multiple body compartments and an increased risk of infections. Immune function is profoundly affected by acute exercise also. The present study as a look towards future of exercise immunology attempted to understand whether vitamin E supplementation will promote immune function among middle and long distance runners.