NUTRITION KNOWLEDGE, DIETARY INTAKE AND NUTRITIONAL STATUS OF ELITE KENYAN ATHLETES

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Declaration

I hereby declare that this dissertation is my original work and has not been presented for a degree in any other university.

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This dissertation has been submitted for examination with our approval as University supervisors.

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DEDICATION

I feel privileged to dedicate this work to the men in my life, my late dad, Mr. Titus Kibata, my husband, Harris Muiruri and my two sons, Tim Ndaguri and Joe Karani. I thank them for all their support and encouragement which saw me through in pursuing my dream to become a Nutritionist.

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

ABBREVIATIONS

AK	Athletics Kenya
BEE	Basal Energy Expenditure
BMR	Basal Metabolic Rate
BMI	Body Mass Index
BPS	Board of Postgraduate Studies
Ca	Calcium
Cal	Calories
EI	Energy Intake
EE	Energy Expenditure
EPO	Erythropoietin
Fa	Field Assistants
Fe	Iron
FFQ	Food Frequency Questionnaires
IAAF	International Association of Athletics Federations
KAAA	Kenya Amateur Athletics Association
KCSE	Kenya Certificate of Secondary Education
KEMRI	Kenya Medical Research Institute
MAR	Mean Adequacy Ratio

NAR	Nutrient Adequacy Ratio
OR	Odds Ratio
RDA	Recommended Dietary Allowances
RNI	Recommended Nutrient Intake
SPSS	Statistical Package for Social Sciences
TEE	Total Energy Expenditure
UON	University of Nairobi.

OPERATIONAL DEFINITIONS

Carbohydrate Loading is a diet (or carb-loading diet) which involves increasing the amount of carbohydrates you eat and decreasing your activity several days before a high-intensity-endurance athletic event.

Common Injuries are those injuries suffered by the athletes during the training period and hence affected their performance or caused them to drop out of their competition.

Elite Athlete is a runner who has won two or more international competitions.

Endurance is the ability to withstand prolonged strain such as in long distance athletes (delayed fatigue).

Long Distance Runners are those athletes who run races of a distance between 1500m to a marathon which is a distance of 42km.

Nutrition Knowledge refers to verbalized or demonstrated ability to reproduce from memory facts and principles of nutrition related to sports and exercise. The knowledge should indicate understanding of correct foods for middle and long distance runners.

Poor Nutritional Status is where by the nutritional status of the athlete is below 18.5 as measured by BMI.

Sports Anemia is a false or dilutional anemia, resulting from the acute increase in plasma volume that accompanies heavy aerobic training.

Sports Nutrition is the study and practice of nutrition and diet as it relates to athletic performance.

ABSTRACT

Kenyan athletes are renowned the World over for their outstanding performance in middle and long distance races. Sometimes the performance of some athletes has been impaired by injuries possibly traceable to nutritional deficiency. This study was therefore designed to assess the nutrition knowledge, nutritional status and dietary intake of energy, protein, iron and calcium of a selected group of elite Kenyan athletes.

The study took place at the Moi International Sports Complex, Kasarani, Nairobi during a training camp held between 26th July - 9th August, 2009. It involved 30 elite middle and long distance runners, both men and women who had been selected to participate in the World athletics championships to be held later in Berlin, Germany in August 2009. A previously pre-tested structured questionnaire was used to collect information on socio-demographics and nutrition knowledge. A Weighed Food Record was also conducted to assess intakes of energy, protein, calcium and iron. Anthropometric measurements of height and weight were used to calculate BMI and determine nutritional status of the athletes. Nutri-survey software was used to analysis the dietary intakes. SPSS 16.0 and Ms-Excel 2007 soft-ware was used for analysis.

The participants were aged between 18-32 years and 60% were male and 40% female. Only 8.4% females had normal nutritional status (BMI ≥ 18.5) The remaining majority were either moderately or severely malnourished. About 66.7% of the males and 66.7% of the females reported possessing nutrition knowledge. Of the female athletes 33.4% reported carbohydrates, 55.7% reported minerals and vitamins and 11.2% reported proteins to be the most important nutrient for distance runners.

The male athletes had 38.5% report carbohydrates, 30.8% report minerals and vitamins and 30.8% report proteins to be the most important nutrient for distance runners. About 67% of the female athletes had suffered injuries that had affected their performance, only 28% of the male athlete had suffered similar injuries. Those who after the injury did not participate in their events were 16.7% and were mainly female athletes. The study established also that dietary intake was inadequate. The energy (kcal) intake indicated 22.2% males and 33.3% females above the recommended dietary intake.

In conclusion the nutritional knowledge possessed by the athletes was low, their nutritional status was poor and their dietary intake of the essential nutrients especially carbohydrates, protein, calcium and iron was below the recommended.

CHAPTER 1: INTRODUCTION

1:1 Background Information

Many of the world's nutrition problems relate to a failure to match energy intake to energy requirements. In many under developed countries, chronic under nutrition is a leading nutritional problems. In industrialized countries, however, excess intake of dietary energy is the major problem leading to overweight and obesity (Maughan, 2006).

Most adults succeed in maintaining their body weight within fairly narrow limits, indicating that the match between energy intake and energy expenditure is quite close. However, and it has been estimated that the body fat content of the average male doubles and that of women typically increase by 50%. between the ages of 20 and 50 years.

Training and competing in sports involve a range of activities of varying energy demands. Athletes face two main challenges in balancing their individual energy needs. The first one is inadequate dietary intake, while the second one is the propensity to restrict energy intake to maintain a low body mass and body fat level (Burke, 2006).

Kenyan athletes are renowned the World over for their endurance running in middle and long distance races. They have won approximately 40% of all major international long distance races that they have participated in the last decade. (Fudge, 2006) However their dietary practices, nutritional status and training habits have not been adequately studied. There is therefore no structured nutrition training program for them. Understanding of the required practice of sports nutrition would help develop optimal athletic performance and provide lifetime health benefits for the athletes. The runners would acquire the quality of running if they had adequate knowledge and practiced sound nutrition and dietary habits.

The quality of diets of runners can be evaluated by assessing the requirements for certain nutrients specifically energy, iron, protein and calcium when exercising, by learning the way the body utilizes these nutrients and how these practices complement future diet and exercise of the individual (Maughan, 2008). Sports nutrition is a broad interdisciplinary field that involves dietitians/nutritionists, biochemists, exercise physiologists, cell and molecular biologists, and occasionally psychotherapists. It has both a basic science aspect that includes such concerns as understanding the body's use of nutrients during athletic competition and the need for nutritional supplements among athletes, and an application aspect concerned with the use of proper nutrition and dietary supplements to enhance an athlete's performance (Burke, 2006).

The psychological or psychiatric dimension of sports nutrition is concerned with eating and other mental disorders related to nutrition among athletes. Some persons who specialize in the field of sports nutrition are registered dietitians (RDs) who have pursued an advanced degree in the field of exercise physiology (Johnson, 1999). Long distance running depends on endurance, which places high demand on the cardiovascular system. Long distance events range from 5km to marathon. Training for the events normally involves gym work 2-3 times per week, road running of a few kilometers 1-2 times per week, and a longer distance practice once every few weeks. Long distance running is high demanding on energy requirements.

1:2 Problem Statement

Some elite Kenyan athletes have experienced injuries which are nutritional related prior to major international competitions and as a result have dropped out of the competition. Reasons for this have not been established but it could be due to sore muscles. The injuries may result from a negative energy balance and inadequate intake of iron and calcium.

The dietary practices of Kenyan athletes consists mainly of their basic staple diets based predominantly on energy rich foods and these have been presumed to provide adequate nutrition for efficient and effective performance. However, knowledge by the runners of dietary intake to meet energy and micro-nutrient requirements has not been well documented.

1:3 Justification of the Study

Sports Nutrition is not well recognized in Kenya yet sports and athletics have played a great role in the development and publicizing Kenya as a country. Running has become very lucrative and the youth look at it as a career opportunity. Therefore to develop the next cadre of excelling professional runners, it would be important to develop the field of sports nutrition and promote appropriate nutritional standards and understanding of this knowledge and practices by the athletes.

Knowledge on nutritional status of athletes will help in formulation of diets which help to improve their stamina and endurance. For 'The Athletics Kenya the body that governs athletics in Kenya, this information on sports nutrition and dietary practices would be important to help formulate guidelines and support athletes in endeavoring towards improvement and sustenance of good performance. The information will also help to foster the mission of the 'Ministry of Sports and Youth Affairs' *to empower and maximize full potential of the youth* by providing accurate information on sports and nutrition.

1:4 Research Hypotheses

1. Elite Kenyan athletes have inadequate nutrition knowledge.
2. Dietary intakes of energy, protein, iron and calcium by the elite Kenyan athletes are inadequate for optimized performance.
3. The nutritional status of the athletes as measured by BMI is poor.

1:5 Objectives

1:5:1 Main Objective:

The main objective of the study was to assess the nutrition knowledge, nutritional status and dietary intake of energy, protein, iron and calcium of selected elite Kenyan athletes.

1:5:2 Specific Objectives:

1. Establish the social demographic characteristics of the athletes
2. To determine the nutrition knowledge of the athletes
3. To assess their nutritional status
4. To assess their dietary intake of energy/carbohydrates, protein, iron and calcium
5. Establish the extent of common injuries suffered by the athletes

CHAPTER 2: LITERATURE REVIEW

Sports nutrition is a marginalized area of study yet nutrition plays a major role in good sportsmanship. Sports nutrition focuses on the link between dietary nutrients and athletic performance (Burke, 2004). One goal of sports nutrition is to maintain glycogen levels and prevent glycogen depletion. Another goal is to optimize energy levels and muscle tone. Sports nutrition is therefore the study and practice of nutrition and diet as it relates to athletic performance. An athlete's dietary practices plays a vital role in accomplishing his/her goals because it allows the athlete to reach his/her maximum performance with an appropriate diet. The goal of sports nutrition is to try and answer questions such as: What types of foods and fluids should be consumed throughout the day and how much?

2:1 Nutrition and Sports

Meeting energy needs is the first priority for athletes. Specific nutrient requirements can vary depending on many factors, including type of sport participation, food preferences, body weight, and body composition goals (Manore et al., 2000).

2:1:1 Carbohydrate Requirements

Carbohydrate is a critical fuel for strenuous exercise. The body's ability to store carbohydrate, primarily in the form of glycogen in the muscles and liver is limited and often inadequate.

Exercise intensity is a particularly important consideration since higher exercise intensities are associated with an increased reliance on carbohydrate as a fuel. The runners can maintain their glycogen stores by consuming approximately 65-70% of total daily energy from carbohydrate (Burke et al., 2004).

2:1:2 Protein Requirements

It remains controversial whether protein requirements are needed in endurance running (Tipton, 2004). It is suggested that endurance athletes should consume 1.2 to 1.4 g of protein per kg of body weight per day to cater for the strenuous training prior to competitions (IAAF Consensus Statement, 2007). Very few athletes are at risk of protein deficiency provided that their intake is sufficient to maintain body weight and that sound nutrition practices are followed (Wolfe, 2004). Protein is necessary to build muscle power which act as fuel for energy.

2:1:3 Fat Requirements

Fat is an important fuel for runners and depending on the exercise intensity, may contribute more than half of the energy to fuel muscle contraction (Burke, 2004). Fat is also more energy dense than carbohydrate or protein, which means less grammes are needed on a per weight basis in order to meet the dietary requirement. But consuming high amounts of saturated fats has been linked to an increased risk for some chronic diseases, and consumption of fats which are synthetically derived to improve shelf life of processed foods, should be avoided (Burke, 2004).

2:1:4 Micronutrient Requirements

(a) Iron

Iron deficiency anemia is regarded as the most commonly occurring nutritional deficiency in the world (Deakin, 2000). In developing countries or among high–risk groups, iron deficiency can affect 30-40% of the population, whereas the prevalence of iron deficiency anemia in the general community is typically 1-3%. Since the 1970s, athletes have come under scrutiny as one such high-risk group.

In early studies of long distance runners, exercise scientists reported on some confusing hematological findings. These athletes were found to have reduced hemoglobin concentrations in their blood (a sign of anemia); this characteristic seemed unfavorable for the performance of events that rely on the delivery of oxygen to working muscles (Eichner, 2000). Later, this phenomenon was found to be a false or dilutional anemia, resulting from the acute increase in plasma volume that accompanies heavy aerobic training. Termed "sports anemia", it is not considered a pathology or disadvantage to performance, and does not respond to iron supplementation therapy.

Iron drain is thought to progress through a number of stages with different functional and diagnostic criteria (see Table 1). The end stage of iron deficiency anemia is detected by blood iron status measures that are below population reference standards and also below the "normal or usual" concentrations for an individual. At this stage, there is inadequate iron available in the bone marrow for the normal manufacture of hemoglobin and erythrocytes, leading to the production of red blood cells that are small and pale (Deakin, 2000).

Anemia causes a reduction in exercise performance. In cases of severely reduced hemoglobin levels, individuals may report breathlessness on even the mildest exertion, and may be unable to carry out everyday activities and work tasks. Impaired functioning of iron-related enzymes may result in reductions in brain function, temperature control, and immunity, which exacerbate the symptoms of impaired exercise tolerance. Although the effects of gradually reduced hemoglobin on performance have not been systematically studied, it is believed that even a small decline in hemoglobin levels (e.g. 1mg to 2mg/100ml) will reduce the competition performance of athletes.

Since the range of "normal" hemoglobin levels is reasonably wide, it is possible that an athlete may show a level that is within reference standards, but is below the level that is "usual" for them and is required for their optimal performance. Although a low hemoglobin level may be relatively easy to detect, it is difficult to confirm optimal iron status from a single blood test. Fluctuations in iron status measures may occur without any change in true iron status. For example, concentrations of all parameters are increased by hemoconcentration (in the severely dehydrated athlete) just as parameters are diluted when there is an increase in blood volume. Ferritin levels are increased in response to acute stress such as a strenuous training session, infection or illness, further confusing the picture in athletes in training (Deakin, 2000).

It is valuable to standardize the time and conditions of iron status monitoring and to establish history of iron status results from the individual athlete to establish a feel for what is normal and "optimal" for them. Athletes often believe that the "more is better" principle applies to hemoglobin levels per se and may undertake specialized training, such as altitude training to stimulate the production of erythrocytes. However, in the very high hemoconcentration due to dehydration, very high hemoglobin levels are usually explained by genetic individuality or drug use (e.g. erythropoietin (EPO) (Eichner, 2000).

Studies have failed to address the complaint commonly made by athletes with reduced iron stores that they fail to recover between a series of competitions or training sessions. Therefore, at the present time there is no evidence to suggest that a moderately reduced Ferritin level per se is detrimental to performance or that endurance athletes should receive routine iron supplementation.

However, low Ferritin levels may become progressively lower and eventually lead to problematic iron deficiency. For this reason, it makes sense to routinely assess the iron status of athletes with high risk of iron deficiency and implement a treatment plan where iron status is declining.

Table 1: Stages of Iron Drain

STAGE	CHARACTERISTICS	HEMOGLOBIN (G-100ML-1)	FERRITIN (MG-ML-1)	TRANSFERRIN SATURATION(%)
Normal iron status	Iron status measurement within normal reference ranges, normal appearance of erythrocytes	>12.0 (F) >16.0 (M)	>20 (F) >110 (M)	20- 40 (M,F)
Iron depletion	Normal hematocrite normal hemoglobin, low serum Ferritin, normal to high Transferrin saturation	As above	<30 (M,F)	20- 40 (M,F)
Iron deficiency	Low serum Ferritin, low serum iron and serum Transferrin, reduced transferring saturation. Normal hemoglobin	As above	<12 (M,F)	<16 (M,F)
Iron deficiency anemia	Low hemoglobin, change in erythrocytes (small and pale), low hematocrite, low serum iron, low transferring saturation	<12.0 (F) <14.0 (M)	<10 (M,F)	<16 (M,F)

(Source: Deakin, 2000)

(i) Causes of Iron Deficiency

Athletes are often considered a high-risk group for iron deficiency, and causes of iron deficiency in athletes are the same as those in sedentary populations. Iron requirements and/or losses exceed iron intake over a sufficiently lengthy period of time.

Iron requirements are increased during periods of growth, reflected by the higher recommended dietary allowances for iron during adolescence and during pregnancy. Iron needs are higher in females of reproductive age than in males because of the need to replace the monthly menstrual blood losses (Eichner, 2000). Given the individual characteristics of athletes it is not possible to make general recommendations with regard to iron requirements for people who exercise, but there is a general appreciation that there is an increase in iron requirements and iron turnover in those who undertake prolonged and heavy exercises. Even though the small losses from mechanical trauma and gastrointestinal blood loss might seem inconsequential, they may lead to iron drain over a prolonged period unless there is a compensatory increase in iron intake or absorption.

(ii) Prevention and Treatment of Iron Deficiency and Anemia

Evaluation and management of iron status should be undertaken on an individual basis by a sports medicine expert, and preferably by a team including the physician and dietician/nutritionist. Any case of iron deficiency anemia warrants immediate iron therapy supported by a diet rich in iron. Low iron status, indicated by serum Ferritin levels lower than 20mg/ml, should be considered for further assessment and treatment. Prevention and treatment for iron deficiency may include iron supplementation. The long-term management plan should be based on dietary counseling to increase intake of bioavilable iron, and appropriate strategies to reduce any unwarranted iron loss (Deakin, 2000). Assessment of total dietary iron intake is not necessarily a good predictor of iron status. After all, the mixing and matching of foods at meals plays an important role by determining the bio availability of dietary iron intake. In a mixed diet, where lean meats are consumed regularly, heme iron may provide around half of the absorbed iron.

However in many Western countries, cereal products such as bread and breakfast cereals are the single richest source of total dietary iron due to the fortification of these products with additional iron and the frequency with which they are consumed.

Table 2: Iron Rich Foods

HAEM IRON SOURCES (ANIMAL SOURCES)	NON-HAEM IRON SOURCES (PLANT SOURCES)
Lamb liver	Macadamia nuts
Lean beef	Weetabix (cereal from wheat)
Fish (non specified type)	Chickpea (mbaazi)
Chicken breast	Spinach
Eggs yolk	Beans
Kidney	Lentils
Sausages	Green leafy vegetables
Beef burger	
Dagaa (Omena/Small fish)	

(Modified from Deakin, 2000)

(b) Calcium

Osteoporosis, or low bone density, is now widely recognized as a problem for both men and women, and an increased bone mineral content is one of the benefits or participation in an exercise program. Regular exercise results in increased mineralization of those bones subjected to stress and increased peak bone loss. The exercise may also delay the rate of bone loss. Calcium plays a permissive role in bone status, meaning that inadequate calcium intake can interfere with optimal bone health, while high calcium intakes do not stimulate additional bone growth (Aulin, 2000). Interest in the calcium status of female athletes has intensified with recent studies reporting low bone density and an increased risk of stress fractures in various groups.

However, these problems do not simply arise from inadequate calcium intake. Rather, there is a complex interrelationship between hormonal status, particularly of the female sex hormone estrogen, and bone health. Athletes often experience disturbance to regular menstrual function. Secondary amenorrhea (cessation of the normal menstrual cycle) is the most widely publicized form, but primary amenorrhea (failure to start menstruating) is commonly encountered in sports such as gymnastics where girls train intensively from early ages. Since this will not be noticed unless blood tests are taken, the female athlete may not be aware of the early signs of menstrual dysfunction.

The prevalence of menstrual dysfunction in female athletes is uncertain as it is hard to compare reports that have studied athletes of different caliber, or that have used athletes of different definitions to describe menstrual dysfunction (Kerr et al., 2000). Nevertheless, it appears that problems occur more frequently than in the general female population, and that athletes in "weight-conscious" sports are most at risk. Despite a number of interesting hypotheses, there is no single cause that can explain menstrual disturbances in athletes. Many athletes are able to maintain regular cycles while at low body fat levels, while other athletes and non-athlete counterparts may become amenorrhea at relatively higher body fat levels. Rather, a number of risk factors seem to be involved and individual athletes may be susceptible to certain factors or combinations of these factors (Aulin, 2000).

(i) Dietary Intake of Calcium

Reduced bone density in athletes or failure to optimize peak bone mass may be a risk factor for the development of stress fractures during their athletic career, and more importantly, the earlier onset, or increased risk of osteoporosis in later life (Turner, 2001).

Note that some calcium balance studies suggest that calcium intakes of 1500mg/day might be needed in post menopause women. The recommended dietary intake guidelines for postmenopausal women should be extended to athletes who have developed a low estrogen status as evidence by menstrual dysfunction. Typically, dairy products provide around 55-70% of the calcium intake in Western diets. In many dietary surveys of female athletes, it has been reported that they consume significantly less calcium than the recommended intakes (Turner, 2001). Dietary restriction or disordered eating may not only be a risk factor for the development of menstrual dysfunction, but is also likely to be associated with suboptimal intakes of calcium. Restriction of energy intake is a common cause of inadequate consumption of calcium. Many athletes also restrict their intake of dairy foods as fattening or cause "allergies" or "mucus". Some athletes have cultural, religious, or environmental beliefs that prevent them from consuming dairy foods. In this case, fortified soy products provide an alternative source of calcium, moderate sources of calcium include canned fish eaten with bones and some vegetables. It is useful to provide dietary advice for athletes in which high calcium eating is matched with other dietary goals, for example, finding low fat calcium choices or mixing a calcium rich food into a high carbohydrate meal.

It is often difficult to work with athletes who suffer from disordered eating, amenorrhea, impaired bone status, or combinations of these problems and there is no single management plan. Rather, these athletes need individualized assessment and therapy, involving input from appropriate experts. Assessment is necessary to determine the factors underlying each problem, and the overall threat to the athletes' health and performance. Ideally, the athlete should aim to return to menstrual health and an optimum diet, as this may be possible, at least in the short term (Manore et al., 2000).

(ii) Calcium Rich Foods

Calcium combined with weight-bearing activity helps to increase bone density plus build and maintain strong bones. Adults need a daily intake of 800mg calcium, and the simplest way to meet these requirements is to eat plenty of dairy products. The amount of calcium which adults are advised to take every day is at least 800mg, though in certain circumstances such as for athletes the level should be at least 1,000mg. The following foods are valuable sources of calcium in the diet:

Table 3: Calcium Content of Some Foods

TYPE OF FOOD	AMOUNT OF CALCIUM
Glass of whole milk	(190ml) - 226mg
Glass of yoghurt	(150g) - 225mg
Grated hard cheese	2 tablespoons (20g) - 148mg
Scoop ice cream	(60g) - 66mg
Thick slice white bread	37mg
Thick slice wholemeal bread	20mg
Scone	(48g) - 90mg
Bowl muesli/weetabix/cornflakes	(50g) - 55mg
1 egg	32mg
Green vegetables	(110g)- 35mg
Small can baked beans	(150g) - 80mg
Red kidney beans	2 tablespoons (70g) - 50mg
Large orange	(210g) - 70mg
1 tablespoon sesame / sunflower seeds	(12g) – 80mg

(Modified from Deakin, 2000)

Although dairy products may contain higher levels of calcium, beans and seeds may have amounts which are more bio-available, that is absorption is higher percentage of the calcium from these foods.

2:1:5 Energy Requirements

(a) Basal Energy Expenditure

After optimal body weight has been determined, approximate energy needs can be calculated. Daily basal energy expenditure (BEE) can be determined using the following formula in terms of age (years), body mass (kilograms) and height (centimeters)

Women: BEE = 65.5 + (9.6 x mass) + (1.85 x height) – (4.7 x age)

Men: BEE = 66.0 + (13.7 x mass) + (5.0 x height) – 6.8 x age)

(b) Energy Drain Syndrome

A more complex scenario involving a cluster of proposed risk factors is the "energy drain" syndrome. This syndrome describes the female athlete who consumes a diet that is restricted in energy intake and variety, while undertaking a heavy exercise load (Yeager, 1993). This athlete is exposed to a chronic energy deficit, psychological stress and/or perhaps a struggle to achieve or maintain body fat below the level that is genetically determined as "natural" for them.

Many athletes, particularly female endurance athletes consider amenorrhea to be a "normal" condition for heavily training athletes. Although it might be "normal" in the sense that is widely prevalent among some athletic groups, it is clearly not a healthy or desirable state. Sports medicine experts have described the syndrome as the "female athlete triad" (Yeager, 1993). This describes the common presentation of disordered eating, menstrual dysfunction, and reduced bone health among female athletes. Nevertheless, the female athlete triad has drawn the attention of doctors, nutritionists, coaches, and athletes towards the importance of early intervention and management of any symptom.

(c) Determination of Energy Needs

By interviewing the athlete about daily activities, the additional energy cost of these activities can be determined. Information about daily routines (eating, sleeping, shopping, reading, walking, stair climbing) as well as specific sports activities (type of activity, frequency, intensity, and duration) over a week's time are required to achieve accurate results.

Using a figure of energy expenditure according to Mc Ardle et al. 1994 the average daily activity level can be factored into the recommended calorie intake:

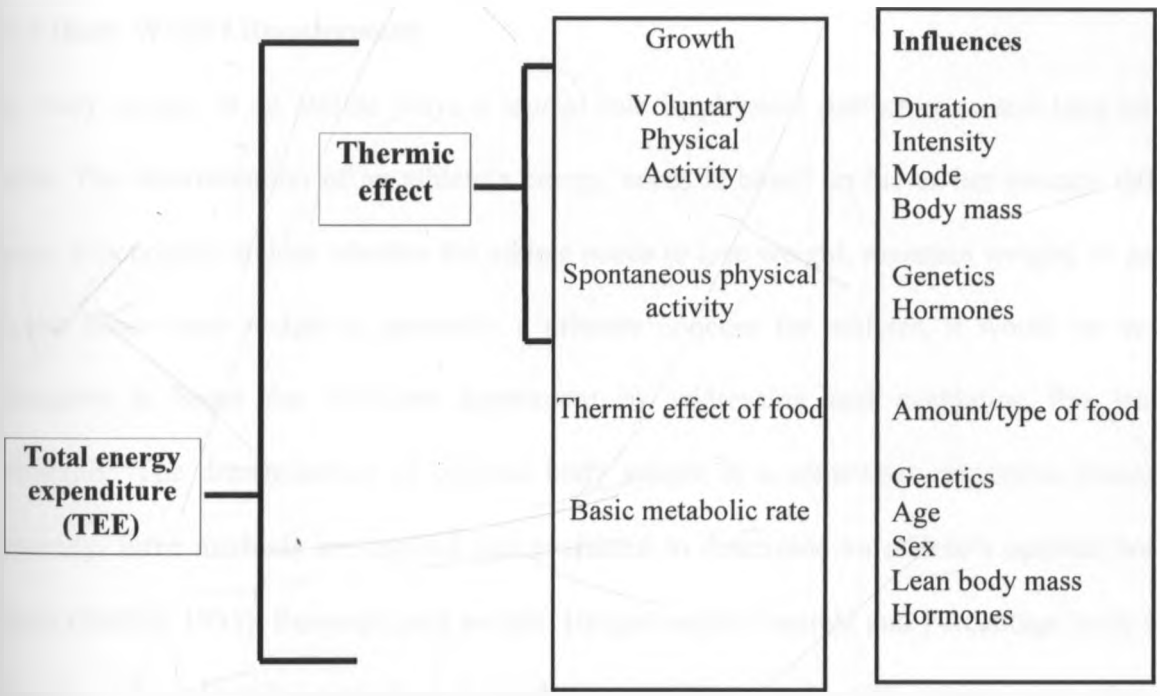

Figure 1: Components of Body Energy Expenditure

(Source: Mc Ardle et al., 1994)

2:1:6 Fluid Requirements

Performance is optimal when athletes maintain fluid balance during exercise and exercise performance is impaired by dehydration. Optimal hydration can be achieved by drinking 150 to 350 ml of fluid every 15-20 minutes during exercise (Maughan et al., 2006).

Consuming carbohydrate with the fluids can extend endurance performance by helping to maintain blood sugar (glucose) levels and spare body stores of carbohydrate. Ingesting a small (5g/liter) amount of sodium in a sport drink is also recommended to replace sodium lost in sweat. Electrolyte imbalances can occur in athletes either because of dehydration or over-drinking of water. Endurance athletes are more likely to suffer from dehydration than from over hydration, although hyponatremia (low blood sodium concentrations) in marathon runners who over drink water has been reported (Tarnopolsky et al., 2005).

2:1:7 Body Weight Requirement

The body weight of an athlete plays a crucial role in physical performance and long-term health. The determination of an athlete's energy needs is based on his or her average daily energy expenditure and on whether the athlete needs to lose weight, maintain weight, or gain weight. Since body weight is generally a primary concern for athletes, it would be most productive to begin the nutrition assessment by addressing and evaluating this issue thoroughly. The determination of optimal body weight is a somewhat subjective process. Generally, three methods are applied and evaluated to determine an athlete's optimal body weight (Storlie, 1991). Personal goal weight, Height/weight formula and Percentage body fat prediction. The athlete's personal goal weight is an indicator both of the athlete's knowledge of his or her own body and the weight at which it performs and feels best and of his or her motivation and body image. The collection of anthropometric data such as current weight, height, and percentage body fat offers the tools to predict optimal body weight.

These data can then be reviewed and applied to determine how the athlete's present weight deviates from both the predicted weight and the athlete's personal goal weight:

(a) Optimal Body Weight

This is the weight at which the body performs optimally both mentally and physically and prompts the greatest opportunity for health (Burke, 2000). The process of determining optimal body weight is generally a dynamic one. Body weight goals change with age and with sport. Athletes who participate in several different sports throughout the year may have different weight goals that are sport specific. Since performance is the ultimate goal of the athlete, nutritionists must keep this in mind and caution them when athletes desire to reach unrealistic weight goals. Using this information may be the most helpful way to achieve a negotiated optimal body weight that can meet both performance and health goals.

(b) Body Mass Index (BMI)

BMI = weight in kilograms / (height in meters)^2

BMI is the most appropriate way of establishing the nutritional status of athletes together with any other tool used for dietary assessment such as the 24-hour weighed food record. (Gibson, 2005).

2:2 Recommended Dietary Allowances

The Recommended Dietary Allowance (RDA) is the daily intake that meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population group (Bowman, 2001). The estimation of RDA starts by defining the criteria for requirements and correcting for physiological and dietary factors.

2:2:1 Recommended Daily Requirements for Energy

The athletes should derive approximately 65-70% of their daily energy from carbohydrates (breads, cereals, fruits, and vegetables), no more than 30% from fats (and no more than 10% as saturated fats), and 15% from protein (meat, eggs, dairy products, or alternatives such as legumes). Carbohydrate and protein provide 4 Cal of energy per gram and fat provides 9 Cal of energy per gram. Thus, for a 70kg male athlete whose daily energy requirement is approximately 2800 Calories the recommended composition is as follows:

2800 x 65% carbohydrate =1820 Cal / 4 Cal per g =455 g of carbohydrate

2800 x 15% protein =420 Cal / 4 Cal per g =105 g of protein

2800 x 30% fat =840 Cal / 9 Cal per g =93 g of fat

2:3 Sports Diets

Sports diets should contain adequate amounts of all the necessary nutrients required for healthy growth and activity and as it relates to athletic performance.

2:3:1 Atkins Diet

The Atkins diet, officially called the Atkins Nutritional Approach, is a low-carbohydrate diet created by Dr Robert Atkins based on the recipe he read in the *Journal of the American Medical Association*, which he used to resolve his own overweight condition. The Atkins diet plan allows unrestricted amounts of protein, including meats, eggs and cheese but severely limits foods containing carbohydrates. The Atkins Diet allows for change in metabolism and easy weight loss by eating foods high in protein and fat and limiting foods high in carbohydrates. There are four stages to the Atkins diet regime: Induction, Ongoing Weight Loss, Pre-Maintenance and Lifetime Maintenance.

Each stage becomes progressively less restrictive and gradually increases carbohydrates. This diet is popular with athletes all over the world. Water is the vastly preferred beverage. Atkins advises eight, 250ml glasses of water per day. The diet recommends no beverage with sugar, including juice and cider. Herbal teas, or decaffeinated coffee or tea are good choices.

Table 4: Sample Atkins Diet Menu

Breakfast:
Egg/Sausage Cup of herbal tea
Lunch:
Stewed fish Leafy green vegetables *(spinach, amaranth, cow-pea leaves, nightshade, cat's whiskers)* Bacon/cheese sandwich
Dinner:
Fried pork chops Broccoli and cauliflower Fresh fruit salad
Snacks:
Roast meat sausage or any high protein snack

(Modified from the Journal of the American Medical Association, 2006)

2:3:2 Carbohydrate Loading Diet

A carbohydrate-loading diet (or carb-loading diet) involves increasing the amount of carbohydrates eaten and decreasing activity several days before a high-intensity-endurance athletic event. Carbohydrate loading helps maximize energy storage (glycogen) and boosts the athletic performance.

Carbohydrate loading is primarily beneficial for endurance athlete, such as marathon runner, swimmer or cyclist-preparing for a high-intensity competition that will last 90 minutes or more. Carbohydrate loading may help maximize energy storage for better endurance and delayed fatigue and increase the levels of glycogen stored in the muscles by up to two times the normal amount. However, carbohydrate loading may not be as effective for women as it is for men. Fewer studies of carbohydrate loading in women exist, and they have yielded unclear results. Women may need to consume a greater percentage of calories from carbohydrates during carbohydrate loading to get the same benefits, and the menstrual cycle also may play a role, but more research is needed. Even if one has loaded up on carbohydrates ahead of time, there is still need to replenish them during the event to maintain the blood sugar levels - especially if it has been for more than 60 minutes. Carbohydrate loading is not right for every endurance athlete (Clark, 2003). Side effects may include weight gain, digestive discomfort and high blood sugar levels. Carbohydrate loading is done in two steps the week before a high-endurance activity:

Step 1. About a week before the event, reduce or maintain your carbohydrate intake at about 50 to 55% of the total calories. Increase protein and fat intake to compensate for any decrease in carbohydrates. Continue training at normal level. This helps deplete carbohydrate stores and make room for the loading that comes next.

Step 2. Three to four days before the event, increase carbohydrate intake to 70% of the daily calories-or about 9 grams of carbohydrates per kg of body weight. Cut back on foods higher in fat to compensate for the extra carbohydrate-rich foods. Also scale back the training to avoid depleting glycogen stores. Rest completely for a day before the event.

Table 5 represents a sample of a carbohydrate-loading meal plan for an athlete who weighs 55 kilograms. Based on 8 grams of carbohydrates per kg of body weight, it consists of about 70% carbohydrates. Despite the lack of whole grains, fruit, vegetables and meat, these meal plans provide approximately 25 grams of fiber and enough protein for an endurance athlete.

Table 5: Sample Carbohydrate Loading Diet for an Endurance Athlete

BREAKFAST	**SERVING (S)**	**CARBOHYDRATES** (gms)
Orange juice	220ml	52g
Ripe banana (medium)	1	28g
Milk	2 cups	6g
Porridge	1 cup	25g
Sugar (brown)	1 teaspoon	3g
MORNING SNACK		
Biscuits (crackers)	10	18g
Yoghurt (packed)	250g	20g
LUNCH		
Chicken breast, roasted	400g	
Fruit juice	165ml	16g
Rice, white, cooked	1cup	53g
Lemon /lime	165ml	38g
AFTERNOON SNACK		
Fruit of your choice	1 cup	32g
Medium queen cakes	2	25g
DINNER		
Spaghetti, cooked	2 cups	84g
Pasta sauce	1 cup	20g
Bread, white	1 slice	15g
Lemon/lime	165ml	38g
EVENING SNACK		
Cookies (chocolate chip)	1	9g
Milk	110ml	12g
	TOTAL CALORIES 2185 kcal	

(Modified from Clark, 2007)

Loading up on carbohydrates ahead of time still needs to be replenished during the event to maintain blood sugar levels - especially if one has been running for more than 60 minutes. This can be done by use of a piece of fruit or a sports drink of which Kenyan athletes do not use much.

2:3:3 Fluids and Electrolytes Balance

Daily fluid need water is often referred to as the 'silent nutrient', reflecting the extent to its presence and availability are taken for granted. As with all nutrients, however a regular intake of water is required for the body to maintain health, and both deficiency symptoms and over dosage symptoms can be observed. Water is the largest single component of the normal body, accounting for about 50-60% of total body mass. Lean body tissues contain a constant fraction of about 75% of water by mass ,whereas the adipose tissue has little water content (Maughan, 2006). The fraction of body mass that is accounted for by fat therefore largely determines the normal body water content: the higher the body fat level, the lower the fraction of total mass that is accounted for by water: For a healthy lean young male with a body mass of 70kg, total body water will be about 42 liters. The turnover rate of water exceeds that of most other body components. In spite of its abundance, however, there is a need to maintain the body water content within narrow limits, and the body is much less able to cope with a restriction of water intake than with restrictions of food intake (Burke et al., 2004). In the absence of strenuous exercise, a few days of total fasting has little impact on functional capacity, provided fluids are allowed, and even longer periods of abstinence from food are well tolerated. In contrast, except in exceptional circumstances, cessation of water intake results in serious debilitation after times ranging from only an hour or two to a few days at most.

Several factors will influence the body's water losses and thus determine the requirements for fluid intake. Among the most important of this are ambient climatic conditions and the level of physical activity. Body size is, of course, also important: both body composition and volume, which is closely related to body mass and which defines the amount of metabolically active tissue, and body surface area, which is a fraction of the square of body mass and which represents the surface available for heat exchange with the environment are important. There also appears to be a large inter-individual variability in water intake and loss even after accounting for body size, but the reasons for this have not been thoroughly studied. All of these factors will combine to determine the physiological requirement for water. The requirements for water is set by the total water losses occurring by various routes for in all cases except the very short term, the water intake must equal the loss (see Fig.2) The only significant additional fact influencing the water is the electrolyte content, and to a lesser extent the protein content, of the diet, which influence the volume of urine that must be excreted (Maughan, 2006).

The water formed by the oxidation of food stuffs will make some small contribution to meeting the daily water losses, but water in drinks and foods will meet most of the demand. The water losses from the body are highly variable and include a number of significant losses as well as a number of minor ones. Losses in urine, faces, sweat, and expired air and through the skin are the major avenues of water loss. Smaller losses occur through blood loss, and in semen, tears, etc, but this are normally trivial. The regulations of body water involve a number of neural and hormonal mechanisms which influence both intake and loss.

Superimposed on these physical control mechanisms are the various social and other factors that act to increase or restrict fluid intake. Figure 2 shows the daily fluid balance:

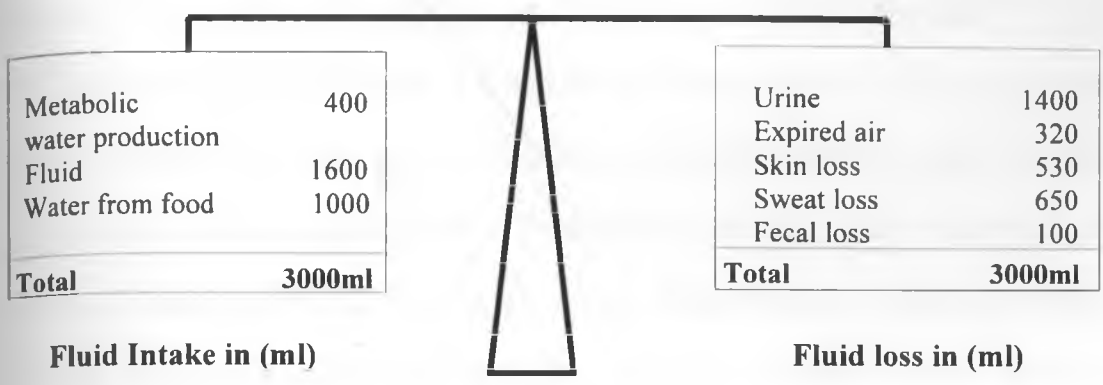

Figure 2: Schema of Daily Fluid Balance (Intake and Loss)

(Source: Maughan, 2006)

2:3:4 Basal Water Requirement

Body size is clearly a factor having a major influence on water turnover, but the total body water content will also be markedly affected by the body composition. It is expected therefore that there is differences between men and women and between adults and children (Burke et al., 2000). Environmental conditions affect an individual's water requirements by altering the losses that occur by the various routes. Trans cutaneous and respiratory losses will be markedly influence by the humidity of the ambient air, and this may be a more important factor than the ambient temperature. Respiratory water losses are incurred because of the humidification of the expired air. These losses are relatively small in the resting individual in a warm, moist environment (amounting to about 200ml per day), but are increased approximately twofold in regions of low humidity, and are as high as 1500ml per day during periods of hard work in the cold dry air at altitude. To these losses must be added insensible loss through the skin (about 600ml per day) and urine loss, which is not usually less than 800ml per day.

The water content of food ingested is also influenced greatly by the nature of diet, and water associated with food may make a major contribution to the total fluid intake. Control of water balance, water intake and excretion are divided by a complex interaction of neural and hormonal factors which respond to a number of different inputs. The kidney can conserve water or electrolyte by reducing the rate of loss, but can do nothing to restore a deficit, which can only be corrected by fluid intake. The subjective sensation of thirst initiates the desire to drink and hence plays a key role in the control of fluid balance (Maughan, 2006). Thirst, whether measured as a perceived response or as the outcome (i.e the volume of fluid consumed) appears to be relatively insensitive to acute changes in hydration status in humans, but the overall stability of the total water volume of an individual indicates that the desire to drink is a powerful regulatory factor over the long term.

2:4 Methods for Assessing Nutritional Status of Athletes

Figure 3 shows the nutritional assessment of athletes and factors that affect their nutritional status.

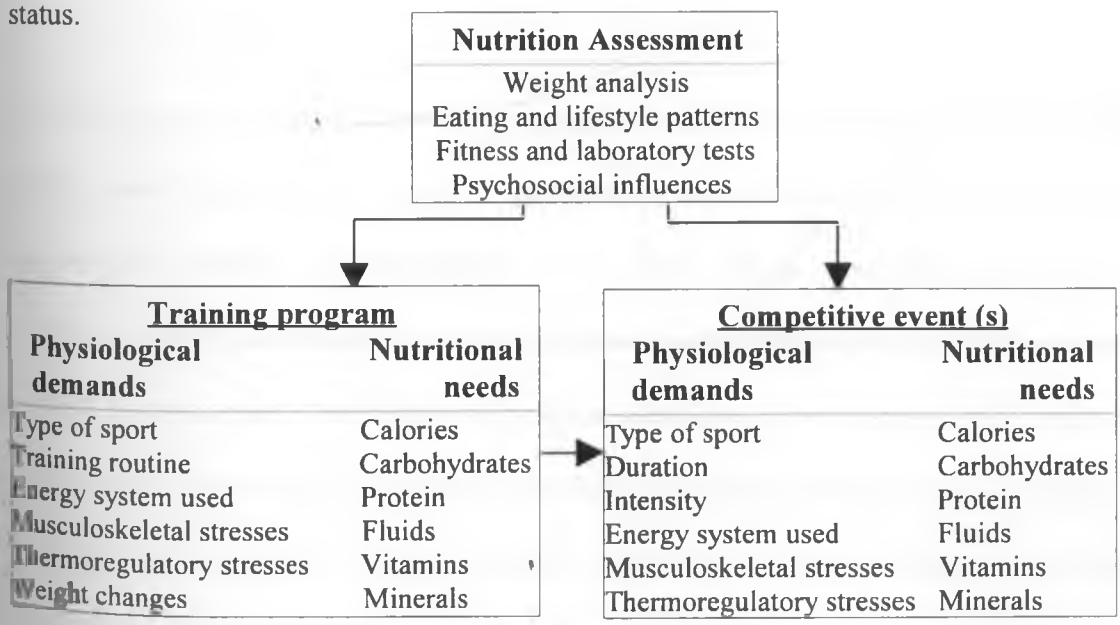

Figure 3: Assessing Nutritional Status.

(Source: Maughan, 2000)

2:5 Nutritional Assessment Techniques

No single technique or piece of information can tell the full story. Instead, an assessment is made by piercing together information from a variety of sources. Many serious athletes undertake a complete screening that includes a variety of medical, physiological, and psychological measures at critical times of their competitive year. A complete nutritional screening should include a dietary evaluation (an overview of what the athlete is eating), biochemical and hematological testing of blood and perhaps urine, anthropometric testing to assess body composition, and a clinical assessment of the athlete's appearance and well being. An evaluation of the dietary patterns of an athlete provides a key piece of the puzzle, it is important to understand what is involved and how the information should be used in light of the limitations of the various methods of evaluation. A complete evaluation of an athlete's dietary patterns is time-consuming and requires special expertise. There are a number of methods that can be used to monitor dietary intake and each has specific advantages and disadvantages and each adds a typical bias to the information collected.

The dietary survey method chosen to monitor the intake of an individual athlete or group of athletes will depend on the type of information that is sought, and the resources and opportunities available (Jonnalagadda et al., 2000). When assessing the intake of an individual athlete, most sports nutritionists use several techniques in combination, using one method to cross-check the results of another technique. For example, the results of an athletes' food diary may be compared with the information collected using a 24-hour recall. It is important to underpin all the information provided by dietary recalls or records with an appreciation of the following:-

The athlete's lifestyle and commitments, the interest in and understanding of nutrition, motivation, finances, food availability, nutrition beliefs, domestic skills, time too will influence the athlete's present dietary patterns and their ability to make changes. Therefore, the primary contact with the athlete should include a thorough interview to collect information such as where they live, who cooks their meals, how often they travel, how and why they have chosen their present eating patterns, what supplements they take, and how their time is spent in a typical day. Against this background, the athlete's eating patterns can then be monitored and assessed (Jonnalagadda, 2001).

Sometimes, information about the athlete's typical consumption pattern of food and drinks is compared directly against dietary benchmarks, while on other occasions an assessment is made of typical nutrient intake provided by these foods and fluids. Techniques for information dietary intake fall into two major categories: recall techniques that monitor behavior in the past or monitor ongoing behavior, this includes dietary history, diet recall, and food frequency questionnaires (FFQs) (Rockett, 1997).

Table 6: Psychological Influences and factors affecting the athletes' performance

Dimension	Factors to Consider
Social influences	Forms of Support
Family members	Sources of conflict/friction
Friends	Vicarious interests
Teammates	Expectations/pressures
Coaches	Role modeling
Celebrities	
Self-concept	Body image
Self-efficacy	
Self-confidence	
Fears of failure, fears of competition	Locus of control
Competitive goals	Realistic aspirations
	(athletic talent, self discipline)
	Priority/importance
Competitive anxieties	Attitudes and philosophy
Balanced vs. Imbalanced approach	
Towards life	Aspirations (career, school, other areas)
	Tendency to be driven or single-minded
Need for power and control	Stress patterns /life satisfaction

(Source: Jonnalagadda, 2000)

CHAPTER 3: STUDY DESIGN AND METHODOLOGY

3:1 Study Area

The study was conducted at Moi International Sports Complex, Kasarani, Kenya. The Athletics Kenya held the training camp from 26th July to 9th August 2009 for all athletes who had qualified for the IAAF World championships; the training was in preparation for the IAAF World Championship competitions that was held in Berlin, Germany from 15th to 23rd August 2009. The complex is in Kasarani in Nairobi, Kenya. It is a municipality located on the outskirts of Nairobi City, close to the Karura Forest. Kasarani also refers to an electoral constituency in Kenya and a Division of Nairobi, in the northeastern section. The Moi International Sports Center is a multi-use stadium which was originally built in 1987 specifically for the All-Africa Games. The sports complex is equipped with all athletics facilities of international standards. It has a sitting capacity of 6500 people and is the largest in Kenya. Athletics Kenya (AK) is the body that governs Athletics in Kenya. It was known as the Kenya Amateur Athletics Association (KAAA) until 2002. The Federation was founded in colonial Kenya in 1952 by the late Sir Derek Erskine. Athletics Kenya is a member of the IAAF and the Confederation of African Athletics. AK organizes athletics competitions held in Kenya and selects Kenyan athletes to participate in international championships. Athletics Kenya is currently headed by a chairman. AK is headquartered in *Riadha House,* next to Nyayo National Stadium in Nairobi.

3:2 Study Population and Sampling Frame

The study population included elite middle and long distance runners in Kenya and the sampling frame included those selected to represent Kenya in the IAAF World Championships, 2009 in Berlin, Germany.

These included all those selected and participated in training at the Moi International Sports Complex, Kasarani and who were willing to participate in the study.

Table 7: The Races in which the Elite Kenyan Athletes Participated

Women	Men
400m	400m
800m	800m
1500m	1500m
3000m Steeplechase	3000m Steeplechase
5000m	5000m
10000m	10000m
	20km Walk

3:3 Study Design

The study was cross sectional involving a preparatory phase comprising of provincial and national athletics trials to select the best athletes to make up the team that would represent the country. It also involved key informant interviews, observational study to capture the dietary practices and questionnaire that was filled by the respondent through a face to face interview. The study also undertook a Weighed Food Record, individual Food Frequency Tables, collecting socio-demographic information and anthropometric measurements of height and weight. The weight was taken both at the beginning and at the end of the training camp. This was useful in categorizing individual weight increase or weight loss due to the strenuous training.

3:3:1 Sample Size Calculation

The sample size included all those who were selected by Athletics Kenya to represent Kenya in the World Championships.

This was purposive and exhaustive sampling including all the elite Kenyan middle and long distance runners both male and female who had been selected to participate in the IAAF World Athletics Championships, 2009. Table 8 shows the sample size in terms of the male and female participants and the races in which the athletes participated in:

Table 8: Type of Races for the Athletes

Type of Race	Frequency	
	Female	Male
400m	1	1
800m	2	3
1500m	4	6
3000m (steeplechase)	3	4
5000m	2	3
10000m	5	6
20km walk	0	1
TOTAL	**17**	**24**

3:3:2 Sampling Procedure

The athletes purposive selected were all those in the training camp at the time of the study. This included both male and female athletes. The sampling procedure is shown in Figure 4.

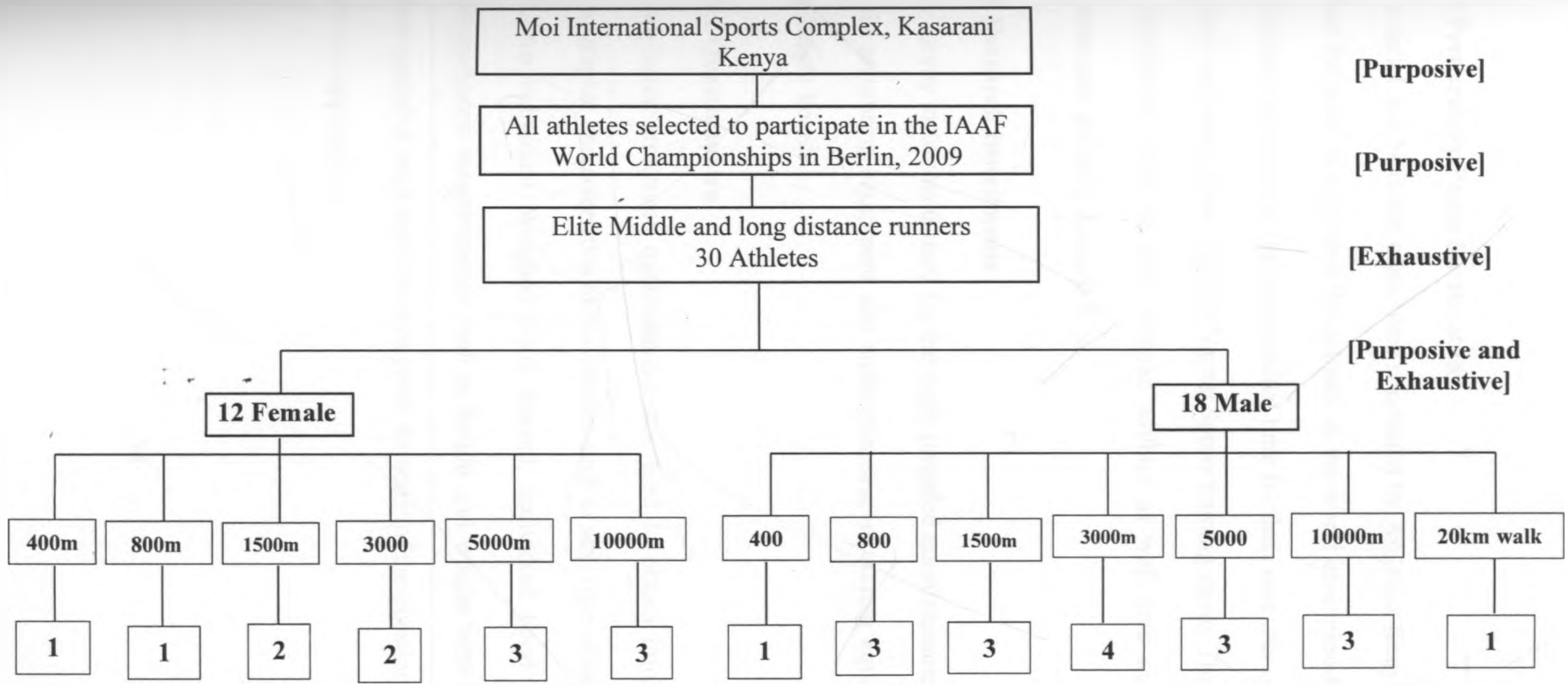

Figure 4: Sampling Procedure

3:4 Preparatory Phase for the study

Provincial and National trials were conducted by Athletics Kenya at Nyayo Stadium to select the team to represent the country in the world championships. Those selected to participate had to close the international time for their race. An observational study was carried out during these trials in Ngong Sports training camp. This helped the researcher to familiarize with the elite Kenyan athletes as well their dietary practices, eating patterns and attitudes towards food.

3:5 Research Instruments

The survey instruments used for the study included questionnaires, food weighing scale, liquid measuring equipment and anthropometric measuring equipment such as weight and height board.

3:5:1 Questionnaire

A pre-tested structured questionnaire was used to obtain information on the socio-demographic characteristics of the athletes such as sex, type of race, education level and age. An individual Weighed Food Record, individual Food Frequency Table and anthropometric measurements such as height and weight were also integrated in the questionnaire. Coded options were given for some of the questions. The questionnaire is shown in appendix 2.

3:5:2 Weight and Height Measurements

Anthropometric measurements consisting of weight and height. Sex, type of race, education level and age of the athletes were also taken. The height and weight was measured using the height and weight board. Individual food consumption was assessed using the weighed food record by use of a digital food scale which measures to one gram. All the survey equipment was portable and durable.

3:6 Recruitment and Training of Field Assistant

3:6:1 Recruitment of the Field Assistant

One field assistant was recruited according to the following criteria: completed secondary school education, must have a nutrition background (first year nutrition student), have a good command in English and Kiswahili and previously involved in similar field nutritional surveys. The person identified was interviewed and trained.

3:6:2 Training of Field Assistant

The selected enumerator was given a one day intensive training. Prior to the training, a training curriculum had been developed by the principal investigation and served as a guide during the training sessions (appendix 6). The training consisted of brief explanations of the study objectives, aim and purpose of the study, a thorough review of the questionnaire, role play of the interviewing techniques, taking anthropometric measurements and also training on the ethics during field work.

The Weighed Food Record training included practical measurement of foods in the Moi International Sports Complex, Kasarani restaurant and training for anthropometry included practical sessions of weight and height measurement of other athletes within the complex who were not part of the study, such as the para-olympic athletes.

3:7 Data Collection Procedures

As a pre-requisite, the objectives, purpose, aim, procedures and techniques of data collection were explained to the officials of Athletics Kenya, administrative staff of Moi International Sports Complex, Kasarani and the Athletes in order to gain approval.

3:7:1 Questionnaire Administration

Prior to the actual data collection, verbal informed consent was obtained from the respondents for the entire study. The principal investigator explained to all the respondents the objectives, aim and purpose of the study.

The respondents were also assured that the information to be collected would be handled with strict confidentiality it deserved and would only be exposed to public in form of sports nutrition information in a format which it cannot be traced to any of the athletes. The questionnaire was also used to collect the following data :-

a) Weighed Food Record

The mean dietary intake of the subjects was assessed using the Weighed Food Record. Each athlete had their food intake weighed in 24 continuous hours. The respondents had each portion of their food weighed before they ate.

The leftovers from the amount served was weighed again and subtracted from the total amount served. The principal investigator also got a detailed account of the amounts of ingredients used in food preparation, total food prepared and the amounts served at every meal. The measures used in assessing the foods included a diet scale to 1gm and a liquid measuring jar. A list of conversion factors were determined and used to compute the total food consumed by the athletes. The National food composition tables (Sehmi, 1993) for Kenya and the Nutri-survey software were used to compute the energy, protein, calcium and iron consumed by each individual athlete in 24 hours. The Weighed Food Record data was used to calculate the nutrient intake per day. Iron, calcium, protein and energy intakes were converted into nutrient adequacy ratio (NAR). This was done by dividing the nutrient intake by the recommended values for age and sex (Wisesmann et al., 2009). This was done by use of the nutri-survey software to get the average nutrient intake in the diet in a day. The Mean average ratio (MAR) is the average NAR for as many nutrients as are of interest. In this case there were four nutrients, carbohydrates, protein, iron and calcium.

b) Individual Food Frequency

The individual food frequency table shown in appendix 4 consists of all the foods that are essential for a middle and long distance runner. The foods included animal and vegetable proteins, milk and milk products, fruits and vegetables. They were used to collect information on the foods and drinks taken in the camp and outside the camp.

The questionnaire was administered and the responses were ticked according to their corresponding food category. Any food consumed was given a score of 1 while any food not consumed was given a score of 0. A total score was determined at the end of the interview by summing up the individual score.

c) Anthropometry

Anthropometric measurements were taken twice for each athlete at the beginning of the training camp and at the end. Their age, sex, type of race and educational level were also recorded. In assessing the weight the respondents were requested to remove excessive clothing and shoes. They also required them to hand straight on the height board with their feet together, knees straight on the height board with their feet together, knees straight and heels, buttocks and shoulder blades in contact with the vertical surface of the height board. The measurements were done to the nearest millimeter and were used to calculate Body Mass Index (BMI) for each elite athlete and also to define their nutritional status,that is their weight in kilos over their height in meters squared.

d) Nutrition Knowledge

Responses to knowledge questions were given scores. Each aspect was scored to gauge knowledge per aspect then finally an aggregate score for all the sections were added up and converted to a percentage. The questions that specifically related to sports nutrition carried more marks, a correct response was awarded three points except for those where the answer was yes or no.

The weighting was different because the interest was in nutrition knowledge, mentioning a correct response was more important than a yes or no response which one could guess. These included questions on important nutrients for an endurance runner and nutrition complications they know that affect their performance. They were also expected to have knowledge on foods they eat frequently because they believed are good for them. The respondents were expected to say if there is a relationship between common injuries and nutrition then explain the relationship. Those who said there was a relationship got one point. If they correctly explained the relationship they got two points. The correct response was that good nutrition prevents frequency of common injuries.

e) Key Informant Interviews

The key informant interviews were conducted on six individuals who had a great influence on the athlete, this included the team coach, the team physiotherapist, the team doctor, the chaperone, the cook and one of the elite athlete who had won five major international competitions in the last decade. The guidelines for this key informant interview is shown in appendix 5. The special guide was used to interview the key informants to collect information on nutrition knowledge, common injuries, dietary intake and practices of the elite Kenyan athletes. The informants were invited for the interview a week before the interview was administered and were asked to choose an appropriate time convenient for them.

The principal investigator carried out all the interviews and confidentiality to any information given was assured. The investigator also took notes during the interviews and this were later expanded to enhance the results from the semi-structured questionnaire.

3:8 Data Quality Control

Data quality control measures that were employed throughout the data collection process were carried out in the following sections:-

3:8:1 Minimizing Bias

To obtain accurate and reliable information standardization tests were done every morning prior to field work on the electronic diet with known weights to minimize instrument bias. The respondents were well informed of the study objectives and its purpose in order to reduce the respondent bias. To avoid observer bias and assure validity of anthropometric measurements, two recordings were taken for each measurement.

3:8:2 Training of Field Assistant

For efficient and accurate data collection an educated and well experienced field assistant was recruited for the study. All the interviews were done by the principal investigator personally to improve the validity of the data.

3:8:3 Reviewing of the Questionnaires

The questionnaires completed each day were cross-checked for any anomalies. The principal investigator examined the questionnaires to check for completeness, accuracy in recording the measurements, consistency of the answers as well as correct filling of the questionnaires. Any errors encountered during the cross checking of the questionnaires were corrected immediately.

3:8:4 Accuracy of Anthropometric Measurements

Accuracy of anthropometric measurements was ensured through proper training and supervision by the principal investigator during the measuring exercise. The height and weight measurements were also taken twice and then averaged. This helped in improving the precision of the field assistance. The widest acceptable difference in height and weight was 0.5cm and 0.5kg respectively.

3:8:5 Supervision

All the activities during the study period were closely monitored and supervised. The presence of the principal investigator throughout the study, supervising and participating in all the activities such as taking anthropometric measurements, interviewing and the weighed food record improved the quality of data collected. The supervisors from the university of Nairobi supervised the field work and also provided technical assistance that ensured high quality data.

3:9 Data Entry, Cleaning and Analysis

Immediately after data collection the principal investigator with the help of a bio statistician developed a data entry template. Data entry was then carried out using SPSS (16.0). After data entry, cleaning was carried out to ensure that the data had been entered correctly in the computer. Frequencies were run to check for any missing data entry errors, outliers as well as consistency of responses between questions. Required coding and modification of data was done to fit the appropriate statistical method. The statistical package for social sciences (SPSS16.0) was used for most analysis of this study. Graphs and descriptive information were produced using both SPSS16.0 and Ms-Excel software. Both descriptive and analytical methods were used in generation of the study results, frequency tables, means, range, proportions and cross tabulations were used to describe the characteristics of the athletes. Data was subjected to the following analysis: Chi-square to determine association between variables, Correlation to test the strength of the association and Odds Ratio to test for confounding factors.

3:10 Ethical Considerations

To gain legal grounds for undertaking the study, a research permit was obtained from the National Council of Science and Technology in the Ministry of Education, Science and Technology. The study proposal was also approved by the Board of Post Graduate Studies (BPS) of the University of Nairobi. The Athletes Kenya executive committee also provided permission in writing.

The administration of Moi International Sports Complex, Kasarani were also informed about the objectives and methodology that was applied in the study. All the tools that were applied throughout the research such as questionnaire anthropometry tools, weighed food records were non-invasive. Verbal informed consent was obtained from the athletes before the commencement of the study. All the data collected was treated with utmost confidentiality throughout the process.

CHAPTER 4: RESULTS

This chapter presents results of the study. Results for demographic characteristics, nutrition knowledge, dietary intake, nutritional status as well as common injuries that the athletes suffered during this study period are presented. The results are presented using both descriptive and analytical procedures.

4:1 Socio-Demographic Characteristics

4:1:1 Age and Sex of the Athletes

A total of 30 athletes were investigated. Out of the 30 athletes involved in the study, 60% were male while 40% were females. The female to male ratio of the study respondents is 1.1.5. The athletes were aged between 18-32 age in years. The majority of the athletes (60%) were aged between 19-30 years. Distribution of the athletes by age and sex is shown in Figure 5.

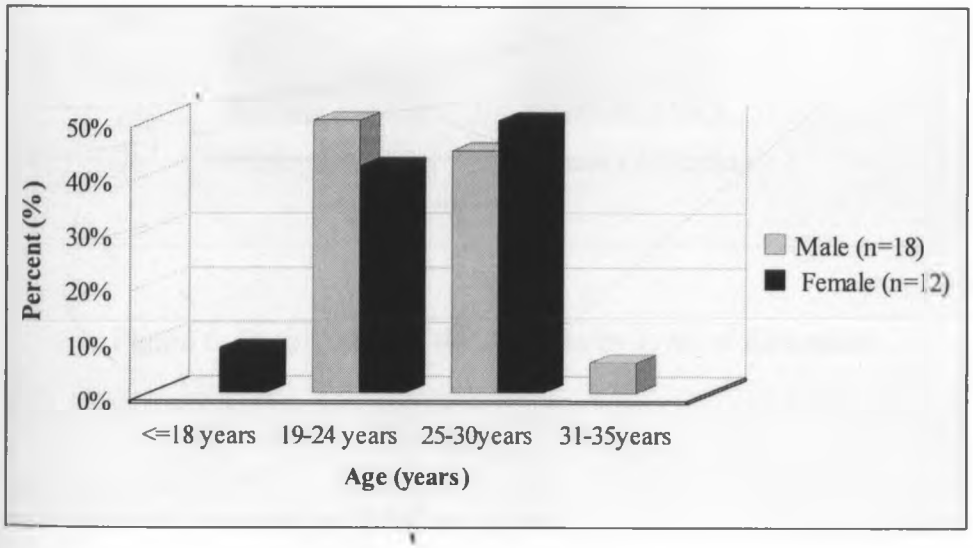

Figure 5: Distribution of the Athletes by Age

4:1:2 Level of Education of the Athletes

Nearly all the athletes that participated in the study had completed secondary school education. But 83% of the male athletes had secondary education while 75% of the female had the same level of education. A small proportion of the athletes had only primary education 17% of the male athletes and 25% of the female athletes. None of the athletes had tertiary education. The distribution of the athletes by level of education is shown in Figure 6.

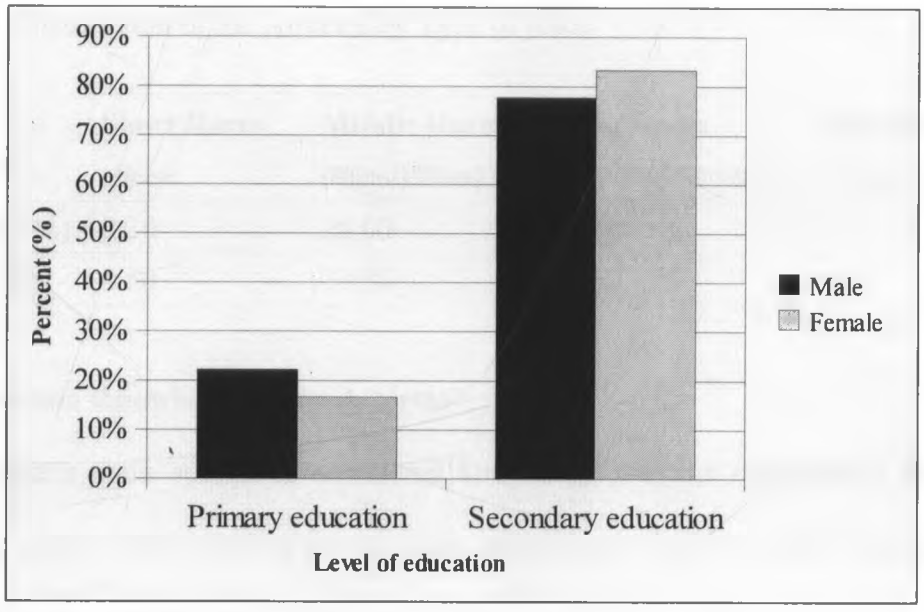

Figure 6: Distribution of the Athletes by level of Education

4:1:3 Distribution of the Athletes by Type of Race

For both male and female athletes the preference was the middle and long distance races. These included track races such as 3000m steeplechase, 5000m, 10000m, 20km walk and other long races usually between 10km to 25km and 42km marathon. Of the 18 male athletes 56% and of the 12 female athletes 67% participated in the long distance races. The middle distance races had 33% male athletes and 25% female athletes participation. Distribution of the athletes by type of race is shown in Table 9.

Table 9: Distribution of the Athletes by Type of Race

	Short Races (400m)	**Middle Races (800m/1500m)**	**Long Races (3000/5000/10000m)**	**Walk Race (20km)**
Female (%)	8.30	25.00	66.70	0
Male (%)	5.60	33.30	55.50	5.6

4:2 Nutrition Knowledge of the Athletes

The athlete's main source of nutritional knowledge was the nutritionists during the training camps. Only 66.7% of the male athlete and 66.7% of the female athlete reported having nutritional knowledge. There was no structured and specific training program on sports nutrition knowledge for these athletes. Acquisition of knowledge depended on individual initiatives, sources of knowledge included the internet, tips from the coaches, sports magazines and the sports nutrition section in the daily newspapers.

The female athlete, 33.4% indicated carbohydrates, 55.7% minerals and vitamins, 11.2% proteins as the most important nutrients for distance runners. The male athlete, 38.5% indicated carbohydrates, 30.8% minerals and vitamins and 30.8% proteins as the most important nutrients for distance runners. These results are shown in Table 10.

Table 10: Nutrition Knowledge, Source and Important Nutrients

Nutrition Knowledge	**Male (n=15) %**	**Female (n=10) %**
Heard about Sports Nutrition		
Yes	88.9	75
No	11.1	25
Source of Knowledge		
Nutritionist	62.5	88.9
Internet	6.3	11.1
Coach	6.3	0
Daily/Sport Newspaper	25	0
Nutrition is Important		
Yes	94.4	100
No	5.6	0
Knowledge of Important Nutrients		
Know	66.7	66.7
Do not know	16.7	25
Not sure	16.7	8.3
Important Nutrients		
Carbohydrates	38.5	33.4
Mineral and Vitamins	30.8	55.7
Proteins	30.8	11.2

4:2:1 Nutrition Knowledge on Important Nutrients for Athletes

Table 11 shows the distribution of the athletes knowledge of important nutrients by sex. The figures do not add to 100% or are less than 100% due to the small sample size used. Some of the athletes did not indicate any of the three important nutrients in their list. They indicated water and other non nutrients.

Table 11: Reported Order of Important Nutrients by Sex

Three important nutrients for athletes	Male (%)			Female (%)		
	1st Important	2nd most important	3rd most important	1st Important	2nd most important	3rd most important
Carbohydrates	0	42.9	66.7	0	66.7	20
Minerals and vitamins	66.7	14.3	33.3	0	25	80
Proteins	33.3	33.3	0	0	25	0

The nutrition knowledge score was established through a nutrition knowledge test based on the respondents self reported order of importance of three nutrients that are essential in an athletes diet. All the athletes did not report carbohydrates as the first most important nutrient for long distance runners for endurance. Up to 66.7% male athletes but only 25% of the female athletes indicated minerals and vitamins as the most important nutrient in their diets. Up to 80% of the female athletes and only 33% of the male athletes indicated vitamins and minerals as the third most important nutrient.

Table 11 shows protein was not perceived to be very important nutrient for the long distance runners. In general, the female athletes did not perceive any of the nutrients as first in importance. None of the athletes knew that carbohydrates are important for energy as 33% of the male knew that the body relies on protein for immediate energy, the others knew that the body needs minerals and vitamins to repair worn out tissues from strenuous exercises. This information was erroneous indeed.

4:3 Nutritional Status measured as BMI

This section contains results of the athlete's nutritional status measured as BMI in terms of normal (greater than or equals to 18.5), mildly malnourished (17.0-18.4), moderately malnourished (16.0-16.9) and severely malnourished (less than 16.0).

Table 12: Nutritional Status of the Athletes as BMI

Nutritional Status as BMI	Male (%)	Female (%)
Normal and Above	77.8	8.4
Mildly Malnourished	16.7	75
Moderately Malnourished	5.7	8.3
Malnourished	0	8.3

4:3:1 Severely Malnourished

Only 8.3% of the female athlete were severely malnourished and none of the male athlete were severely malnourished.

4:3:2 Moderately Malnourished

Table 12 indicates that 8.3% female athletes and 5.7% male athletes are moderately malnourished. These were those with BMI of between 16.0 and 16.9 and therefore in the borderline of being severely malnourished.

4:3:3 Mildly Malnourished

Table 12 indicates that the majority of the female athletes were mildly malnourished, that is 75% while only 16.7% of the male athletes were mildly malnourished.

4:3:4 Normal Nutritional Status

The majority of the male athletes (77.8%) had a normal BMI as compared to the female athlete who were only 8.4% as indicated in Table 12. These were all those with a BMI that was equal to or greater than 18.5. None of the athletes were above normal, this means that none of the elite Kenyan athlete are overweight or anywhere near being overweight.

4:4 Nutrient Intake

The weighed dietary record was used to analyze mean nutrient intakes of protein, energy, iron and calcium. The mean nutrient intakes of carbohydrates, proteins, calcium and iron were below the RDA for each nutrient. The nutrient intake for proteins for the female athlete was at 50% of RDA. For the male athlete only 38.9% had mean intakes of protein equal to or above the RDA and the other 61.1% were all below the recommended intake.

For calcium only 6.7% of all the athletes in this study were above the RDA. All the male and female athletes were below the RDA for carbohydrates. Among the male athletes only 22.2% met the RDA for energy, while among the female athletes about 33.3% satisfied the RDA for the same nutrient. For iron most of the female athletes were below the RDA and only 16.7% were above the RDA and the male athlete had 38.9% satisfying the RDA of the same nutrient. The results are given in Table 13.

Table 13: The Recommended Dietary Allowances for Nutrients

Nutrient intake	RDA	Range of RDA taken	Above RDA (%)
Energy (kcal)			
Male	2200 kcal	1800-3000kcal	22.2
Female	2100 kcal	1000-2200kcal	33.3
Carbohydrates			
Male	294g	300g-700g	0.0
Female	290g	100g-400g	0.0
Proteins			
Male	61g	55g-100g	38.9
Female	60g	25g-65g	50.0*
Iron			
Male	10mg	8mg-12mg	38.9
Female	14mg	4mg-18mg	16.7
Calcium			
Male	1000mg	200mg-1200mg	6.7
Female	1000mg	200mg-1500mg	0.0

***Significant at 5% level**

4:5 Dietary Practices and their Relationship to Nutritional Status

Table 14 shows a correlation analysis from the study findings indicating an insignificant negative association between dietary practices and nutritional status. The dietary practices of the elite Kenyan athlete does not affect their nutritional status.

Table 14: Dietary Practices and Nutritional Status

Dietary Practices	Nutritional Status		OR	P-value	95% CI
	Normal	Poor			
Male	77.8	22.2	51.5	0.008*	2.84 - 932.14
Female	8.4	91.6			
Skip Meals					
Yes	46.7	53.3	2.1	0.35	0.44 - 10.30
No	53.3	46.7			
Knowledge of Important Nutrient					
Yes	66.7	46.7	1.2	0.89	0.07 - 19.8
No	33.3	53.3			
Eat Between Meals					
Yes	33.3	40	1.4	0.71	0.25 - 7.73
No	66.7	60			
Drink Milk					
Yes	91.7	100	0.8	0.002*	0.04 - 13.24
No	8.3	0			
Water Intake					
Yes	46.7	16.7	3.1	0.17	0.61 - 15.26
No	53.3	83.3			
Common Injuries					
Yes	72	33	0.5	0.44	0.10 - 2.69
No	28	67			

***Significant at 5% level**

However, the females were 51.1 times more likely to have poor nutritional status than the male athletes and this was significant at p value of 0.008. Those who skipped meals were 2 times more likely to have poor nutritional status than those who did not skip their meals. Athletes who took milk were 0.8 times more likely to have poor nutritional status compared to those who did not take milk, implying that those who did not take milk were 1.3 times more likely to exhibit poor nutritional status and this was significant at p value of 0.002.

4:6 Common Injuries

The injuries that were common to the athletes included tendon injuries, hamstring injuries, tight muscles and sore muscles.

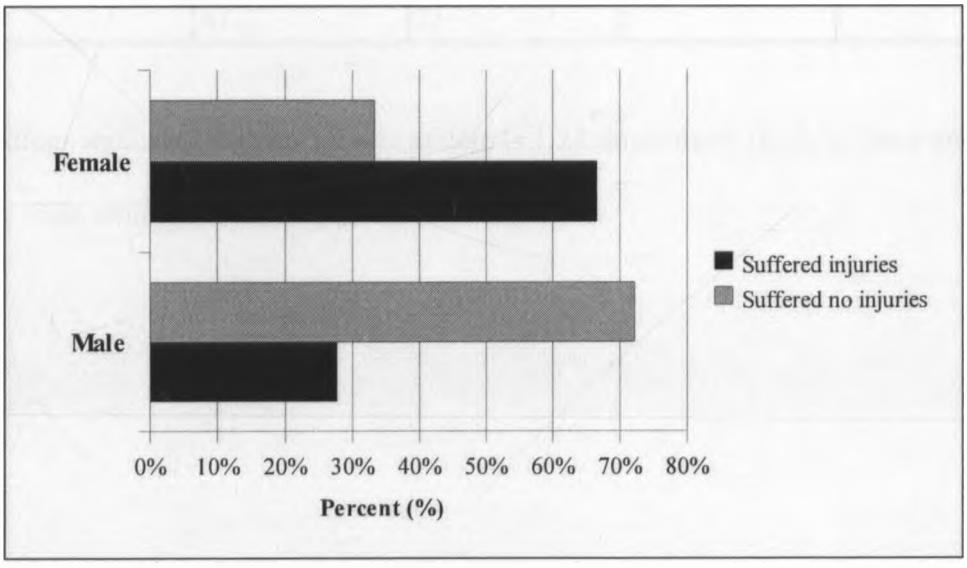

Figure 7: Exhort of Common Injuries

The majority assumed that it was normal to suffer this common injuries. Yet 67% of the female athletes suffered injuries that affected their performance and the male athletes had a total of 28% who suffered injuries. Significantly more females suffered injuries than males. Those who suffered this injuries and did not participate in their events were 16.7% in total who were all female athletes. This is shown in Figure 7.

4:7 Correlation Between Common Injuries and Sex

Table 15 shows a correlation analysis between common injuries and sex.

Table 15: Relation between Common Injuries and Sex

	Common injuries		OR	95% CI
	Yes (%)	No (%)		
Male	28	72	1.22	0.62 - 2.40
Female	67	33		

The findings indicated that the female athlete is 1.22 times more likely to have an injury than the male athlete. (OR 1.22, CI 0.62 – 2.40)

CHAPTER 5: DISCUSSION

5:1 Socio-Demographic Characteristics

The majority of the athletes (60%) were between the age of 18 years and 24 years as compared to a recent study of the Ethiopian elite runners who were found to have the majority of athletes between the age of 24 years and 32 years (Scott, 2008). However, the female to male ratio was 1.1.5 was similar and there were no male athletes below 18 years of age and no female athletes above the age of 30 years in both cases. These could be because the female athletes after a certain age took to other roles such as motherhood and retired from professional running.

In this study, none of the athletes had tertiary education as compared to young American athletes who were all college graduates (IAAF Consensus Statement, 2007). We found most of the athletes were civil servant employees of the army, the police force and prisons after their high school education.

5:2 Nutrition Knowledge

There were about 4 common sources of nutrition knowledge among the elite athletes. These include nutritionists, coaches, information from internet and sports magazines. According to the information received from the key informants who are in direct contact with the athletes there is no specific training on nutrition and information from the internet or sports magazines may not be scientifically proven therefore misleading.

This information searched and shared among the athletes from the different sources is given individual interpretation by athletes. This is clearly reflected in the athletes knowledge on the most important nutrients for endurance runners (Jacobson, et al., 2001). The reason to this could be that Kenyan diet is presumed to be adequate for long distance runners and nutrition education not seen as important since the performance has been outstanding. However, in comparison to their counterparts the elite Ethiopian athletes engaged in full time nutritional consultation and had a nutritionist advise them throughout the year during their training (Fudge, 2006).

5:3 Nutritional Status

The nutritional status especially for the female athlete was worrying as only 8.3% of the total number had normal nutritional status (≥18.5). The other 91.7% had poor nutritional status either moderately or severely malnourished (<18.5). From the information received from the key informants the female athlete may run very well during training and have a good record time but prior to major competitions the speed, stamina and endurance slows down. This is caused by the rampant loss of appetite reported for the female athletes and the frequent skipping of meals. During the training camp 75% of the female athlete skipped at least 2 or 3 meals per a day. On the other hand the majority (77.8%) of the male athletes had a normal BMI. We found that the females were many more times likely to be malnourished than the males due to the fact that their dietary practices were poorer.

They skipped meals more often than the male athletes. The female endurance athletes reported experiencing amenorrhea due to heavy training. Although it might be widely prevalent among some athletic groups, it is clearly not a healthy or desirable state. Sports medicine experts have described the syndrome as the "female athlete triad". This describes the common presentation of disordered eating, menstrual dysfunction, and reduced bone health among distance and track female athletes in Washington DC (Manore, 2002) which could also be the case with the female Kenyan athletes. Nevertheless, the female athlete triad has drawn the attention of doctors, nutritionists, coaches, and athletes towards the importance of early intervention and management of any symptom in other countries like the USA, South Africa, Australia, Canada and Scandinavian athletes.

5:4 Dietary Intake Nutrients

This refers to the achievements of the recommended intakes of energy, protein, iron and calcium which are the important nutrients for an athlete for good health benefits, endurance and stamina. A complete evaluation of an athlete's dietary patterns is time-consuming and requires special expertise. Athletes around the globe illustrate various nutritional challenges and issues arising in their respective sport. When assessing the intake of an individual athlete we saw it is important to use several techniques in combination, using one method to cross check the result of the other technique. A deficiency in energy requirement manifests itself in the poor nutritional status of the athletes.

The majority of these elite athletes had lost 2 to 4 kilograms of body weight by the end of the training camp. Experts from the American College of Sports Medicine over the last two decades have reported similar findings (ACSM., 2000). The athletes were offered a variety of Kenyan dishes and in this case their knowledge was put to test here as to which foods have the important nutrients for them. This was not considered at all as it was self service and each athlete eat whatever they desired and not necessarily a balanced meal. We found the knowledge of carbohydrates being important to an athlete was clear but the knowledge of the micro-nutrients iron and calcium and their importance in the body was very poor (Burke, 2004)

Usually the athletes should take an average of 2800 Cal per day during peak activity for provision of sufficient energy. The runners can maintain their glycogen stores by consuming approximately 65-70% of total daily energy from carbohydrate. Calcium is important in the diet of an endurance athlete as reduced bone density or failure to optimize peak bone mass may be a risk factor for the development of stress fractures during their athletic career, and more importantly, the earlier onset, or increased risk of osteoporosis in later life (MacKelvie, 2000). Both the male and female athlete should take at least 1000mg of calcium per day. We found that these athletes were below the recommended calcium requirement. Protein is necessary to build muscle power which act as fuel for energy for endurance athletes.

The female athletes were below the recommended amount of protein but the male athlete had more than half of them above the recommended amount. It is suggested that endurance athletes should consume 1.2g to 1.4g of protein per kg of body weight per day to cater for the strenuous training prior to competitions although the elite Kenyan athletes are not at risk of protein deficiency as they eat a sufficient amount as roast goat or beef and fermented milk is their delicacy. Impaired functioning of iron-related enzymes may result in reductions in brain function, temperature control, and immunity, which exacerbate the symptoms of impaired exercise tolerance. Although the effects of gradually reduced hemoglobin on performance have not been systematically studied, it is believed that even a small decline in hemoglobin levels (e.g. 1mg to 2mg/100ml) will reduce the competition performance of athletes (Deakin, 2000). The recommended dietary intake of iron for athletes is between 10mg and 14mg per day for optimized performance.

5:5 Common Injuries Suffered by the Athletes

There has been misconceptions about injuries such as tendon injuries, hamstring injuries and sore muscles that are common to majority of athletes. Overall, the nutrition knowledge deficits identified in the study confirm that many athletes lack understanding of the roles of protein, vitamins, and minerals in the body, and thus lack the ability to assess whether their dietary intake of nutrients is adequate. The athletes have a misconception that injuries are normal and can not be avoided therefore nothing can be done about it. But the injuries arise from nutrient deficiencies especially calcium.

Previous studies have shown that education strategies for sports professionals and athletes should focus on the roles of selected nutrients in exercise, (Pitsiladis, 2008) and the diets that supply adequate specific nutrients to help prevent common injuries which limit performance.

5:6 Nutrition Knowledge in Relation to Dietary Practices

In this study, we assessed nutrition knowledge, attitude, nutritional status and dietary intake of Kenyan athletes. Specifically it asked if nutrition knowledge and attitude were related to dietary intake. This research is novel because it examined relationships between knowledge about specific nutrients (carbohydrate, protein, iron and calcium) and actual intakes of these nutrients. Among these elite athletes knowledge about carbohydrate and general knowledge of the role of protein in exercise was clear. However, they lacked knowledge about the roles of adequate intake of iron to prevent anemia which causes a reduction in exercise performance. Inadequate calcium intake can interfere with optimal bone health (Mackelvie, et al., 2000) while high calcium intakes do not stimulate additional bone growth . We also saw that nutrition knowledge, education level and dietary practices do not correlated with dietary intake. This shows that these elite athletes do not have adequate nutrition knowledge and their dietary practices are very poor indicating very little practice of the nutrition knowledge.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6:1 Conclusions

1. Most of the runners were young and some still growing. The majority were between the age of 18 - 24 years of age.

2. The education level of the elite Kenyan athlete is limited, none had tertiary education. Most had completed their Secondary education but a few had only Primary education.

3. It was established that the nutrition knowledge and dietary intake of energy, protein, iron and calcium for elite Kenyan athletes are inadequate.

4. The nutritional status measured as BMI was poor especially of the female athlete and good nutrition practice was very low.

5. These elite Kenyan athletes often suffer from injuries that are common to runners and this affects their performance and they have sometimes had to drop out of their competition.

6:2 Recommendations

1. The relevant authorities should engage the services of a nutritionist. There is need to prepare nutrition guidelines for endurance athletes in the country.

2. Nutrition Education should be incorporated into training activities of athletes. The athletes should be encouraged to complete school as they would have better understanding of nutrition and other factors related. This activities should include educating the managers, coaches and other officials who will then pass the knowledge to the athletes as they come.

3. Nutritional support is required for the female athlete as their nutritional status was established to be very low.

4. Further research should explore factors other than nutrition knowledge and dietary practices that influence dietary intake among Kenyan athletes and the extent of practice of nutrition knowledge gained.

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http://lab.nap.edu/napcgi/discover.cgi?term=dietary%20

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APPENDICES

Appendix 1: Informed Consent Form

UNIVERSITY OF NAIROBI

FACULTY OF AGRICULTURE, KABETE CAMPUS

DEPARTMENT OF FOOD SCIENCE, NUTRITION AND TECHNOLOGY

Hello. My name is Murugi Freda Kibata. I am a student at the above stated institution. In order to get information about the nutrition knowledge, dietary intake and the nutritional status of Kenyan long distance runners, I kindly request you to be part of my study and help me fill in this questionnaire.

The information you provide will be useful to find out the nutrition knowledge, dietary intake and therefore assess the nutritional status of long distance runners so as to improve the quality of their performance as understanding sports nutrition leads to a life time health benefit.

This information will be used to develop programs for nutrition practices in this area of athletics so as to improve Kenya's performance and maintain our supremacy in long distance races.

All information you give will be confidential. The information will be used to prepare general reports, but not include specific names. There will be no names to identify that you are the one who gave this information.

If you have any question on the research, you can ask me or any of my two supervisors, Prof. J.K Imungi or Prof. E.A Bukusi who will visit the institution during this period of training and as I carry out my research.

At this time do you have any questions?

Signature of interviewer: _____

Date: _____

Respondent agreed to be interviewed **1.** Yes **2.** No

Appendix 2: Sports Nutrition Questionnaire

Social Demographic Characteristics

Name: _____ **Date:** _____

Age: _____ **Male/Female:** _____ **Type of Race:** _____

Weight (kg): _____ **Height (m):** _____

Level of Education: _____ **Interviewer:** _____

I. Appetite

a. How would you describe your appetite?

1( ) Hearty 2( ) Moderate 3( ) Poor

b. Do you enjoy eating?

1( ) Yes 2( ) No 3( ) Sometimes

II. Eating Pattern and Attitudes about Food

a. Do you skip meals?

1( ) Yes 2( ) No

If yes, what? _____

b. Are there any foods that you do not eat because you don't think they are good for you?

1( ) Yes 2( ) No

If yes, what? _____

c. Do you usually eat between meals?

1( ) Yes 2( ) No

If yes, name the two snacks (including bedtime snacks) that you have most often

_____

d. Are there any foods that you regularly eat because you think that they are good for you?

1( ) Yes 2( ) No

If yes, what? _____

e. Are there any foods you can't eat or are allergic to?

1( ) Yes 2( ) No

If yes, what food (s)? _____

What happens when you eat this food? _____

f. Which method of preparing food do you prefer?

1( ) Baked 2( ) Boiled 3( ) Fried

Other_____

g. Do you drink milk?

1( ) Yes 2( ) No

If yes:

1( ) Whole milk 2( ) Skimmed milk
3( ) Others (specify) _____

h. List three of your favorite foods:

1._____
2._____
3._____

i. List three of your least favorite foods:

1._____
2._____
3._____

III. Weight History

a. Have you ever had any problems with weight?

1( ) Yes 2( ) No

b. If yes, what?

1( ) Underweight 2( ) Overweight
3( ) Other _____

c. Are you now on any diet?

1( ) Yes 2( ) No
If yes, what kind
_____

How long_____

Who recommended_____

d. How do you feel about your weight?

1( ) Too heavy 2( ) Too thin 3( ) Good

IV. Exercise

a. How often do you exercise?

1( ) Every day 2( ) 3 – 4 times/week 3( ) Every week
4( ) Sometimes 5( ) Never

b. List 2 kinds of exercise you do most often: 1)_____
2)_____

c. How often do you get out of breath when you exercise?

1( ) Every-time 2( ) Sometimes 3( ) Never

d. Do you drink water during exercise?

1( ) Yes 2( ) No

e. How often do you drink water?

1( ) After every meal

2( ) Once a day

3( ) Once a week

4( ) Only after exercise

5( ) Other (specify) _____

V. Nutrition Knowledge

a. Have you ever heard about sports nutrition before?

1( ) Yes 2( ) No

b. If yes, where did you hear it from?

1) ( ) Nutritionist

2) ( ) Internet

3) ( ) Fellow athlete

4) ( ) Coach

5) Other (specify)_____

c. Do you think that nutrition is important for you?

1( ) Yes 2( ) No

d. Do you know the nutrients required for a long distance runner?

1( ) Yes 2( ) No 3( ) Not sure

e. If yes, number the 3 important nutrients required for long distance runners in order of importance.

1) Carbohydrates ☐
2) Minerals and vitamins ☐
3) Proteins ☐

f. Are there any nutrition complications you know that affect your performance?

1( ) Yes 2( ) No

g. If yes, which ones?

1) Ham string injuries
2) Sore muscles
3) Tendon injuries
4) Tight muscles

h. Do you seek help in case of this complication?

1( ) Yes 2( ) No

i. If yes, from whom?

1) Nutritionist ( )
2) Hospital ( )
3) Fellow athlete ( )
4) Coach ( )
5) Physiotherapist ( )

Appendix 3: 24 Hour Weighed Food Record

	Dish	Ingredients	Amount In Kgs/gms/mls	Edible Portion	Waste	Amount eaten	Left-over
Break-fast							
Snack							
Lunch							
Snack							
Supper							

Appendix 4: Food Frequency Form

Name: _____ **Date:** _____

Interviewer: _____ **Type of sport:** _____

Food	Don't Eat	Do Eat	Serving Size	Number of serving per week
Animal and vegetable protein foods				
Chicken				
Beef, hamburgers, veal				
Liver, kidney, tongue, etc				
Lamb, goat				
Pork, ham, sausage				
Bacon				
Fish				
Kidney beans, ndengu, lentils				
Soy beans/Tofu				
Milk and milk products				
Milk, fluid: Type:				
Milk, evaporated				
Yoghurt				
Mala				
Ice cream				
Spinach				
Other fruits and vegetables				
Carrots				
Sweet potato or yam				
Zucchini				
Green peas				
Apple				
Banana				
Pineapple				
Snacks, sweets, and beverages				
Potato chips				
French fries				
Cakes, pies, cookies				
Sweets				
Sugar or honey				
Carbonated beverages (sodas)				
Coffee: Type:				
Tea: Type:				
Cocoa				
Wine, beer, cocktails				
Fruit drink				
Other foods not listed that you regularly eat				

Appendix 5: Guide to Key Informant Interviews

Guidelines to key informant interview on knowledge, attitudes and practices on diet and performance for the athletes.

Date of interview: _____ **Time:**_____

Key informant: _____ **Venue:** _____

Q.1 Is nutrition and diet important for the athletes?

Q.2 In your opinion do you think that with proper nutrition the Kenyan runners would perform better?

Q.3 Do you think that the Kenyan runners have adequate knowledge on nutrition?

Q.4 What do you think is their attitude towards nutrition?

Q.5 What factors do you think affect them most: -

(a) Dietary intake: ☐

(b) Choice of food: ☐

(c) Injuries: ☐

(d) Good performances: ☐

Appendix 6: Enumerator's Training/Curriculum Program

Day	Time	Subject Matter	Learning Method	Learning/ Teaching Aids
1	9.00-10.00am	To instruct and discuss guidelines on ethics throughout the study: ✓ Dress code, clean, smart and decent. ✓ Timetable, purpose and background of the survey, organization of the survey team and division of responsibility ✓ Explain sampling frame ✓ Question by question review of the questionnaire, techniques of interviewing, recording answers and checking questionnaire ✓ Explain specific indicators of nutrition ✓ Definitions of terms used in the questionnaire	Demonstration Discussions Taking notes	Handouts with ethical guidelines Note books Questionnaire
	10.00-11.00pm	To instruct on how to take anthropometric measurements: 1. Weight 2. Height	Demonstration Discussion Take notes	Weighing scale Height board Questionnaire Pencils Note books
	11.00-2.00pm	**Break**		
	2.00-4.00pm	Pre testing the survey tools at the Ngong sports training camp: Dietary intake assessment Techniques - ie. 1. Weighed Food Recordings 2. Food Frequency Table	Actual interviews with runners who were not part of the study	

Appendix 7: Recommended Nutrient Intake Table

RECOMMENDED NUTRIENT INTAKE FOR MIDDLE AND LONG DISTANCE RUNNERS					
NUTRIENT	**Energy**	**Carbohydrates**	**Proteins**	**Iron**	**Calcium**
AMOUNT RECOMMENDED: Male	2200kcal	294g	61g	10mg	1000mg
Female	2100kcal	290g	60g	14mg	1000mg

(Source: Wisesmann et al., 2009)