ASSESSMENT OF NUTRIENT INTAKE AND LEVELS OF NUTRITION KNOWLEDGE, ATTITUDE, AND PRACTICE AMONG GYMNASIUM USERS IN JORDAN

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by

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ABSTRAK

Pemakan yang betul adalah penting untuk prestasi fizikal seseorang. Namun, kekurangan pengetahuan mungkin mengakibatkan atitud yang negatif dan praktis diet yang buruk. Tujuan kajian ini adalah untuk menilai pengambilan nutrien dan tahap pengetahuan pemakanan, atitud, dan praktis (KAP) dalam kalangan pengguna gimnasium di Jordan. Dalam kajian ini, seramai 138 orang pengguna gimnasium lelaki (18 – 35 tahun) telah direkrut daripada beberapa buah gimnasium di Jordan. Ketinggian dan berat mereka diukur, dan indeks jisim badan (BMI) dikira. Soal selidik KAP-Nutrisi Sukan yang mengandungi 3 bahagian telah diberikan. Di samping itu, peserta diminta merekodkan pengambilan diet mereka selama tiga hari (dua hari bekerja dan satu hari pada hujung minggu) dalam diari pemakanan yang diberikan. Data telah dianalisis menggunakan 'Nutritionist Pro Software' dan SPSS vs. 25.0 (Analisis deskriptif dan Korelasi Pearson). Sebagai keputusannya, majoriti peserta mempunyai pengetahuan tentang pemakanan sukan yang sederhana (77.6%), atitud yang neutral (84.7%) dan praktis diet yang sederhana (67.4%). Purata skor untuk pengetahuan, atitud, dan praktis adalah masing-masing 18.07±2.56, 58.75±6.24 and 29.72±3.55. Analisis korelasi mendapati bahawa terdapat korelasi yang signifikan dan positif antara pengetahuan dan atitud ($p=0.048$, $r=0.18$) serta praktis ($p=0.018$, $r=0.20$). Purata jumlah pengambilan harian tenaga adalah 2085.7 ± 468.1 Kcals manakala peratusan daripada jumlah tenaga untuk karbohidrat, protein, dan lemak adalah masing-masing 42%, 19%, and 39%.

Pengambilan jumlah harian tenaga dan CHO adalah lebih rendah berbanding dengan nilai yang dicadangkan. Pengambilan protein adalah dalam nilai RDA manakala pengambilan lemak adalah lebih tinggi. Purata pengambilan harian Vitamin B_6, Vitamin C, Vitamin E, kalsium, magnesium, and zink adalah masing-masing 0.7 ± 0.3 mg, 98.0 ± 34.7 mg, 9.0 ± 1.8 mg, 823.5 ± 277.8 mg, 279.3 ± 64.3 mg, dan 8.6 ± 1.1 mg. Berbanding dengan nilai DRI, pengambilan mikronutrien oleh para peserta adalah lebih rendah berbanding DRI kecuali untuk Vitamin C dan kalsium. Sebagai kesimpulan, pengguna gimnasium di Jordan tidak mempunyai pengetahuan yang cukup yang boleh mempengaruhi attitud yang positif serta praktis diet yang bagus. Pendidikan pemakanan sukan adalah dicadangkan untuk memastikan penyampaian pengetahuan yang cukup dan tepat kepada atlet-atlet.

ASSESSMENT OF NUTRIENT INTAKE AND LEVELS OF NUTRITION KNOWLEDGE, ATTITUDE, AND PRACTICE AMONG GYMNASIUM USERS IN JORDAN

ABSTRACT

Proper nutrition is important for physical performance of an individuals. However, lack of knowledge might lead to negative attitude and poor dietary practice. The purpose of this study is to assess nutrient intake and the levels of nutrition knowledge, attitude, and practice (KAP) among gymnasium users in Jordan. In this study, a total of 138 male gymnasium users (18 – 35 years) were recruited from several gymnasiums in Jordan. Their height and weight were measured, and body mass index (BMI) was calculated. The KAP-Sports nutrition questionnaires which contains 3 sections was administered. In addition, participants were asked to record their dietary intake in a given food diary for three days (two weekdays and one day on the weekend). Data were analysed using Nutritionist Pro Software and SPSS vs. 25.0 (Descriptive and Pearson correlation analysis). As a result, majority of the participants had moderate knowledge on sports nutrition (77.6%), neutral attitude (84.7%) and fair dietary practice (67.4%). The mean score for knowledge, attitude and practice was 18.07±2.56, 58.75±6.24 and 29.72±3.55 respectively. The correlation analysis revealed that there was a positive significant correlation between knowledge and attitude ($p=0.048$, $r=0.18$) as well as practice ($p=0.018$, $r=0.20$). The mean of daily total energy intake was 2085.7 ± 468.1 Kcals while the percentage out of total energy for CHO, protein and fat was 42%, 19%, and 39% respectively. The total energy and CHO intake were lower than the recommended value. Protein intake was within the RDA while fat intake was higher. The mean of daily Vitamin

B_6, Vitamin C, Vitamin E, calcium, magnesium, and zinc intake was 0.7 ± 0.3 mg, 98.0 ± 34.7 mg, 9.0 ± 1.8 mg, 823.5 ± 277.8 mg, 279.3 ± 64.3 mg, and 8.6 ± 1.1 mg respectively. Compared to the DRI value, participants' micronutrients intake was lower except for Vitamin C and calcium. In conclusion, gymnasium users in Jordan did not have adequate knowledge that can affect positive attitude as well as good dietary practice. Sports nutrition education is recommended to ensure adequate and correct knowledge are disseminated to the athletes.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

It is generally known that one of the problems that athletes face, is nutrition and food imbalance. Nutrition is of great importance in achieving athletic achievements at a high level in sports, in other words, it directly affects athletic performance. Physical fitness is highly dependent on nutrition among athletes (Beals et al., 1998). In an attempt to gain a competitive edge and improve performance, many youth athletes turn to nutritional supplements and nutrients (Sousa et al., 2016). Nutrition is an important part of sport performance for young athletes, in addition to allowing for optimal growth and development. Macronutrients, micronutrients and fluids in the proper amounts are essential to provide energy for growth and activity. To optimize performance, young athletes need to learn what, when and how to eat and drink before, during and after activity (Purcell, 2013).

According to Gregory et al. (2013), a well-balanced diet combined with regular physical activity is a foundation of excellent health. There are two types of nutrients which are macronutrients and micronutrients. Macronutrients include carbohydrate (CHO), protein and fat while micronutrients include the vitamins and minerals. Macronutrients are needed by human body in large quantity while micronutrients are needed in small quantity. An imbalanced diet consists of either an extra or insufficient intake of any of the above mentioned dietary component. For example, too much fat and protein with insufficient carbohydrates results in an imbalanced diet (Close et al., 2016).

The total calorie intake per day for an individual is depends on several factors such as age, gender, body weight, and physical activity level (Benardot, 2012). Balance between energy intake and energy expenditure is important to maintain a person's body weight. Excess energy intake will lead to weight gain while in excessive energy expenditure will lead to weight loss (Hill et al., 2013). Recommended intakes of nutrients vary by age and sex. Dietary Reference Intake (DRI) is the general term for a set of reference values used to plan and assess nutrient intakes of healthy people. These values include:

- Recommended Dietary Allowance (RDA): Average daily level of intake sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals; often used to plan nutritionally adequate diets for individuals.
- Adequate Intake (AI): Intake at this level is assumed to ensure nutritional adequacy; established when evidence is insufficient to develop an RDA.
- Estimated Average Requirement (EAR): Average daily level of intake estimated to meet the requirements of 50% of healthy individuals; usually used to assess the nutrient intakes of groups of people and to plan nutritionally adequate diets for them; can also be used to assess the nutrient intakes of individuals.
- Tolerable Upper Intake Level (UL): Maximum daily intake unlikely to cause adverse health effects (NIH, 2022).

Having a good nutrition knowledge meaning that the individuals have an understanding of the concepts related to nutrition and health, including diet and health, diet and disease, dietary guidelines and recommendations (Loretta et al., 2014). Attitude towards sports nutrition can be defined as favourable or unfavourable feeling/perception

of performing a behavior with regards to nutrition (Kowalkowska et al., 2018) which may vary depending on age, gender, culture, etc. On the other hand, nutrition practice is defined as eating the right amounts of nutrients on a proper schedule to achieve the best performance and the longest possible lifetime in good health (Supriya & Ramaswami, 2013).

Nutrients deficiency can negatively affect health and sports performance of an athlete. Furthermore, poor nutrition can cause reduced immunity, increased vulnerability to disease, impaired physical and mental growth, and reduced productivity (Saunders & Smith, 2010). There are several factors attributed to this situation which include lack of knowledge regarding nutrition, specifically sports nutrition. This is because, a person with lack of knowledge is most likely to have a negative attitude and poor dietary practice.

Numerous research has been conducted to assess knowledge level regarding sports nutrition among athletes. Research has shown that many athletes possess limited nutritional knowledge (Spendlove et al., 2012). Possibly, this may represent a misunderstanding of ineligible individuals providing nutrition tips for athletes which leads to principles of nutrition being misunderstood and/or improperly applied (Zinn et al., 2006). Thus, focus should be on educating the athletes about sports nutrition to increase their knowledge level and to ensure they get correct information from a valid source. It was previously reported that sports nutrition education increased sports nutrition knowledge, attitude and dietary practice (KAP) among university students' athletes (Kamarun Zaman et al., 2021).

1.2 Problem Statement & Study Rational

Physically active individuals like regular gymnasium users need to consume adequate nutrients to give them the opportunity to improve their performance and fitness. Nevertheless, there are some factors that could impede them from achieving good nutrition to improve their performance, and the lack of nutritional knowledge to recognize basic nutrition ideas is one of these obstacles. It is important to assess their knowledge and to determine whether the knowledge level is significantly associated with the attitude and practice. The levels of general and sports-specific nutrition knowledge among physically active individuals/athletes have been a popular question for researchers. This is because, lack of knowledge in nutrition, healthy food choices, and the components of a well-balanced diet is among the factors that can implicate their sport's performance.

Thus, this study aims to assess the nutritional knowledge and nutritional intake of gymnasium users in Jordan. This research will be useful in improving nutritional information and creating awareness for athletes and coaches as well as obtaining good nutritional knowledge and improving athletic performance to reach the required performance and to avoid myths and misinformation. In addition, to ensure that accurate information is obtained, and optimal sports nutrition is practiced by athletes. The majority of gym-goers obtain their nutritional information from individual athletes or unqualified random coaches. However, more than half of this information is often inaccurate. Most athletes have food without knowing the ingredients it may contain. Athletes need to reach a good nutritional state to improve athletic performance.

1.3 Objectives of the Study

1.3.1 General objective

To assess nutrient intake, and the levels of nutrition knowledge, attitude, and practice (KAP) among gymnasium users in Jordan.

1.3.2 Specific objectives

- To assess macronutrient (carbohydrate, protein and fat) intake among gymnasium users in Jordan.
- To assess micronutrient (vitamins and minerals) intake among gymnasium users in Jordan.
- To determine knowledge regarding nutrition among gymnasium users in Jordan.
- To determine attitude regarding nutrition among gymnasium users in Jordan.
- To determine nutrition practice among gymnasium users in Jordan.
- To investigate correlation between knowledge, attitude and practice with regards to nutrition among gymnasium users in Jordan.

1.4 Research Questions

RQ1: Do gymnasium users in Jordan have enough nutrients from their daily meals?

RQ2: What are the levels of knowledge, attitude, and practice regarding sports nutrition of the gymnasium users in Jordan?

RQ3: Is there any correlation between knowledge, attitude and practice with regards to nutrition among gymnasium users in Jordan?

1.5 Significance of the Study

In this study, the level of knowledge, attitude, and practice (KAP) regarding sports nutrition of the gymnasium users in Jordan was determined. Their 3-day dietary intake was also recorded and analysed. It is hoped that results from this study can be used to understand KAP level among the Jordanian gymnasium users and subsequently can be used to create or enhance awareness with regards to the importance of nutritional knowledge, attitude, and practice to produce a good dietary habit that in turn will help them excel in their exercise performance and overall health.

1.6 Operational Definitions

Knowledge, Attitude, and Practice (KAP)

In this study, knowledge is defined as the participants' understanding of sports nutrition. Attitude refers to their feelings towards sports nutrition, as well as any preconceived ideas that they may have towards it. Practice refers to the ways in which they demonstrate their knowledge and attitude through their actions.

KAP-Sports Nutrition Questionnaire

This is a validated questionnaire developed by Hornstrom et al. (2011) to assess sports nutrition knowledge, attitude, and practice of the participants. It is divided into three sections.

3-day dietary intake

Defined as the participants' entire food and beverage intake, including supplements (if any), during two weekdays and one weekend. The dietary intake was recorded in a food diary given to each participant. Participants were asked to record their dietary intake for 3 days.

Gymnasium users

Those performed exercise at the gymnasium more than 3 times per week for at least 6 months prior to the study in Jordan.

CHAPTER 2

LITERATURE REVIEW

Increasing evidence indicates that nutrition has an important and significant role in reaching the level of achievement required in sport, and the ideal nutritional state has the largest direct role and influence on the level of physical performance (ADA, 2000; Thomas et al., 2016). Incomplete energy or nutrient intake may have a negative impact on growth and development, efficiency, and make injuries and recovery more difficult (Petrie et al., 2004).

As shown in a previous study, several college students who frequently exercise do not understand basic nutrition principles (Zawila et al., 2003), but the majority of them understand that adequate nutrition and appropriate nutrition knowledge are an important part of a training program (Rosenbloom et al., 2006). Hence, a balanced diet with regular physical activity is a corner stone to good health. Studies have shown that inappropriate feeding practices can increase the spread of disease and other health problems (Kant, 2000).

2.1 Total Energy Intake

A sufficient amount of energy is important to ensure optimum strength and energy for daily physical activity. According to the National Institutes of Health (NIH), the total energy intake for men is between 2200 - 2800 Kcals based on their age, height, and body weight (NIH, 2022). The total energy intake also depends on the type of exercise, physical activity level, and gender of an individual. Physically active person burns more fuel to produce energy during exercise. Hence, they might need different amount of energy

intake. It is important to ensure balance between energy intake and energy expenditure to maintain body weight and to ensure enough energy supplied per day for working muscles, especially for athletes/active people (Hill et al., 2013).

Inadequate caloric intake may result in muscle loss, hormonal dysfunction, bone density loss or failure, increased weakness, injury, illness risk, and a longer recovery time. Because of the low energy intake, the body will depend on fat and lean tissue for energy. Using lean tissue for fuel has the potential to reduce strength and stamina, as well as immune, endocrine, and muscular-skeletal function (Burke et al., 2006). Low energy intake can also have an influence on the body's micronutrient levels. It could lead to metabolic problems and a lower resting metabolic rate (ACSM, 2009). Appropriate energy consumption is critical for individuals' health and fitness. Short- and long-term success can be harmed, and negative health consequences can occur when the energy consumption does not match the energy expenditure.

Athletes' energy intake habits are influenced by a variety of factors, including exercise response, time, and food availability (Holtzman & Ackerman, 2019). Athletes' energy consumption is influenced by a variety of factors, including hormonal, behavioural, and environmental influences. Meal frequency and volume are complicated to determine, and no single factor can perfectly predict or adjust energy intake. The temporary suppression of ghrelin and appetite after exercise is especially intriguing, suggesting that energy consumption is not solely controlled by caloric deficit. Furthermore, protein consumption early in the post-exercise window and carbohydrate consumption during the post-exercise window are critical for muscle recovery and

anabolism (Thomas et al., 2016). However, the suppressive effects of exercise on appetite and ghrelin can prevent athletes from maximizing their nutritional response to exercise.

2.2 Macronutrients

Macronutrients are important for energy production. At least 45 percent to 65 percent of total energy should come from carbohydrates, 10 percent to 35 percent from protein, and 20 percent to 35 percent from fat in order to meet the nutritional requirements (NIH, 2022). Carbohydrate is the body's primary energy source. It aids in the maintenance of blood glucose levels and the replacement of muscle glycogen during physical activity/exercise. About 50 to 55% of the daily calories should come from carbohydrates, which are composed of monosaccharides that include fructose, glucose, and galactose. Each gram of carbohydrate contains energy equivalent to 4 kcal. Complex carbohydrates with a low glycemic index steadily raise the blood sugar level and are preferred over simple carbohydrates such as dextrose (Mustad et al., 2020).

A sufficient protein intake is also essential for active people. Protein's primary role is to construct and regenerate tissue. Proteins are comprised of subunits called amino acids. These subunits provide energy and are essential for the construction of structural units of the body e.g., muscle, bone, and ligaments. Around 30% of the dry body weight is attributed to proteins. Approximately 20% of daily calories should come from sources rich in protein such as red and white meat, egg, and legumes. Some amino acids e.g., leucine and valine, are called essential; these are not synthesized by the body and must be obtained in the diet (Budhathoki et al., 2019). These protein intake recommendations will normally be met without the use of protein or amino acid supplements, so there is no need for unnecessary protein supplements consumption. According to a previous study,

consuming too much protein can lead to an increase in urea production, dehydration, and calcium loss (Millward & Jackson, 2013).

Fat is another macronutrient that helps with energy production. Fats are composed of glycerol and fatty acids; these are high energy molecules that help the body grow, keep it warm, and serve as an inventory in case of emergency. Certain fatty acids (essential), e.g., omega-3 and omega-6, are required for the synthesis of eicosanoids such as prostaglandins and leukotrienes and should be consumed in the diet. About 25 to 30% of the daily calories should come from fats, out of which saturated fats should not be more than 10% (NIH, 2022). It is important for athletes to consume adequate essential fatty acids especially polyunsaturated fatty acids. It was reported that circulating testosterone concentrations is better maintained with higher-fat diets than low-fat diets (Pramuková et al., 2011).

2.2.1 Carbohydrate Requirement for Athletes

In the early 1900s, carbohydrates were discovered to be an effective fuel for exercise. The first-ever study in this area found that consumption of carbohydrates increased exercise ability throughout the exercise (Coyle et al., 1983). No major advances were made in the subsequent 20 years until about 2004, which marked the beginning of an era with a series of major breakthroughs with respect to carbohydrate feeding during exercise. During this age, as these breakthroughs and their influence on sports nutrition became available over time, guidelines for athletes have developed.

Carbohydrate intake is widely agreed to be critical for maximizing endurance performance, but guidelines are still not very precise (Rodriguez et al., 2009). Based on a study by Fielding et al. (1985), it was believed that a minimum of 22 g of carbohydrate per hour was required to observe a performance benefit. Subjects exercised for 4 h and at the end carried out a sprint test. Improvements in efficiency were observed when 22 g of carbohydrate was ingested per hour, while no effects were observed when half of that dose (11 g/h) was eaten.

Studies have shown that a mouth rinse or small amounts of carbohydrates may result in a performance gain during exercises lasting about 1 h in length. At concentrations of up to about 60 g/h, a single source of carbohydrates may be oxidized, and this is the recommendation for more sustained exercise (2-3 h). The standard is higher, at around 90 g/h, for ultra-endurance events to allow high oxidation rates and prevent the accumulation of carbohydrates in the intestine, carbohydrates ingested at such high ingestion rates must be multiple transportable carbohydrates (Fielding et al.,
1985).

A liquid, semi-solid, or solid may be the source of the carbohydrate, and the guidelines may need to be changed downwards when the absolute exercise intensity is low, and the oxidation rates of carbohydrates are also low. Carbohydrate intake advice is independent of body weight as well as training status. The recommendation for the consumption of carbohydrates is independent of body weight as well as training status. Although these rules apply to most athletes, they are also highly dependent on the style and period of exercise. These new guidelines may replace the generic existing guidelines for carbohydrate intake during endurance exercise (Jeukendrup, 2014).

2.2.2 Protein Requirement for Athletes

The International Society of Sports Nutrition (ISSN) published its first-place booth in 2007 on the science and application of dietary protein intake (Campbell et al., 2007). There have been continued attempts over the past ten years to advance the research and application of dietary protein consumption to the benefit of athletes and fitness-minded people. Athletes who wish to achieve muscle mass and strength would typically eat more dietary protein than their endurance-trained counterparts. The main belief behind high amounts of dietary protein consumption in resistance-trained athletes is that it is essential for generating more muscle protein. Athletes may need protein for more than just mitigating the risk of inherent deficiencies in dietary guidelines, but also to aid in high performance and possibly adapt to exercise stimuli (Phillips & Van Loon, 2011).

To ensure proper recovery from the physiological stress of extended exercise training, ingestion of sufficient dietary protein is a fundamental consideration. Dietary protein encourages muscle mass and strength gains caused by resistance exercise (Cermak et al., 2012; Morton et al., 2015). While less known, dietary protein supplementation may also support optimum recovery from strenuous exercise training of the endurance sort and encourage skeletal muscle repair and remodelling (Koopman et al., 2004; Moore et al., 2014). As a result, protein intake in all athletes should be optimized to enhance the adaptive response of the skeletal muscle to exercise training, boost muscle recovery, increase the efficiency of exercise training and, as such, maximize performance ability.

According to the NIH, the RDA for protein is 56 g/d. This quantity is considered adequate, but it has been suggested that athletes participating in strenuous exercise

training need more dietary protein than their sedentary counterparts (Tarnopolsky, 2004; Phillips et al., 2007). Recommendations for dietary protein consumption for athletes were up to twice the RDA, with recommendations of 1.2 - 1.6 (Phillips et al., 2007), 1.2 - 1.7 (Rodriguez et al., 2009), 1.3 -1.8 g/kg/d (Phillips & Van Loon, 2011), and 0.8 – 1.8 g/kg/d (NIH, 2022)

2.2.3 Fat Requirement for Athletes

Fats play an important role in nutrition in general, and cardiovascular diseases are highly prevalent and major causes of mortality worldwide (GBD, 2020). Therefore, dietary recommendations by various organizations recommend reducing overall fat consumption within 20-35% of energy and replacing saturated fatty acid (SFA) intake with polyunsaturated fatty acid (PUFA) intake to minimize cardiovascular disease risks (Eckel et al., 2014; Lichtenstein et al., 2006; Food and Agriculture Organization, 2010). In endurance activities, success depends on the overall aerobic strength, the percentage of that power that can be retained and the availability of substrates (carbohydrates [CHO] and fats). Studies have shown that fatigue is related to decreased muscle glycogen and that rising muscle glycogen or blood glucose improves performance while increasing fat and decreasing CHO reduces performance. This has led to a focus on CHO consumption in athletes in endurance sports, which most often contributes to low caloric intake.

Trained subjects are well known to have higher levels of fat oxidative ability, which helps in saving glycogen during endurance sports. Data from recent studies of qualified athletes who were fed high-fat iso-caloric diets (42% to 55%) that preserved acceptable CHO levels have shown an improvement in endurance in both men and women

compared to low-fat diets (10% to 15%). A baseline diet comprising 20% protein, 30% CHO, and 30% fat is recommended on the basis of this study, with the remaining 20% of the calories divided between CHO and fat depending on the strength and length of the sport (Pendergast et al., 2000).

It has been shown that high CHO (60% to 70%) and low-fat (10% to 15%) diets enhance endurance performance, and high-fat diets (60%) are detrimental to performance. Athletes consuming high-carbohydrate (low-fat) diets may not eat as many calories as they consume and do not reach the iron and zinc ADA standards. Recent data, also, indicate that diets comprising 32% to 55% fat can improve endurance capacity compared to diets with 15% fat. There is evidence that fit subjects have higher fat oxidation due to increased enzyme levels, fatty acid transport, and beta-oxidation. In addition, a high-fat diet can increase intramuscular triglycerides and intracellular fats and can facilitate higher levels of fat oxidation without affecting CHO stores. It is clear that if CHO intake is reduced to below 20% of total calories, or to less than 1.9 g/kg/day, glycogen stores are compromised and therefore performance will be compromised. Similarly, reducing fat intake to less than 20% of total calories compromises fat stores and therefore endurance performance (Pendergast et al., 2000).

2.3 Micronutrients

Vitamins and minerals are essential for metabolising energy substrate, for aiding in tissue building, for fluid balance, for carrying oxygen etc. Furthermore, exerciseinduced increase of reactive oxidative stress (ROS) among athletes is reduced by certain vitamins and minerals (Benardot, 2012). Hence, athletes need more vitamins and minerals compared to non-athletes' population. However, excessive minerals and

vitamins are not recommended because it may cause health and sports performance problem. Thus, determining a suitable dose for an individual athlete with different fitness level, body composition and type of sports is crucial. Nevertheless, assessing individual's dietary intake is hard and is often argued due to lack of accuracy. Among various methods of recording dietary intake, dietary record (using food diary) is still the best method presently available to estimate dietary intake (Volpe, 2007).

There are two-types of vitamins; water-soluble and fat-soluble. The watersoluble vitamins include the vitamin B and C (Lykstad & Sharma, 2022) while the fatsoluble vitamins include the vitamin A, D, E, and K (Stevens, 2021). Besides other vitamins, vitamin B_6, C and E are very important for athletes/active men due to their important functions as described in the Table 2.1. Some of the most important minerals for athletes/active men which include calcium, magnesium, and zinc are also shown in the Table 2.1. These minerals are needed for maintaining a healthy body, which helps athletes to ensure an optimum performance (Tardy et al., 2020). These are also among the minerals that are more quickly depleted during training or competition.

Table 2.1 Vitamins and Minerals Requirements for Athletes and its Function (NIH, 2022)

	Dietary Recommended Intake (DRI)	Functions
Vitamin B_6	1.1 mg/day	Protein metabolism, protein synthesis, metabolism of fat and CHO, neurotransmitter formation, glycolysis.
Vitamin C	75 mg/day	Collagen formation, iron absorption, epinephrine formation.
Vitamin E	12 mg/day	Antioxidant protection of cell membranes.
Calcium	800 mg/day	Bone structure and strength, acid-base balance, nerve function, muscle contraction, enzyme activation.
Magnesium	330 mg/day	Protein synthesis, glucose metabolism, bone structure, muscle contraction.
Zinc	9.4 mg/day	Part of numerous enzymes involved in energy metabolism, protein synthesis, immune function, sensory function.

Vitamins and minerals deficiency can affect energy production, reduce overall health and thus decrease the athlete's sports performance. Thus, it is important to observe the athlete's diet and consideration of taking suitable dietary supplements should be deliberated.

2.4 Dietary Supplements Among Athletes

Dietary supplements are widely used by athletes at all levels of sports. The use of supplements has greatly increased in the past 10 years. Dietary supplements are substances meant to be added to one's normal or typical eating program. Nutritional supplements have become widely available worldwide to enhance athletic fitness, sports performance and modify body composition. Athletes/physically active individuals have been the greatest consumers of many of these products. There are many reasons for taking supplements including the management of micronutrient deficiencies, supply of convenient forms of energy and macronutrients, and provision of direct benefits to performance or indirect benefits such as supporting intense training regimens (Maughan et al., 2018). Some supplements give benefits to athletes, but others may harm their health, performance, livelihood, and reputation.

In 2000, The American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine (ADA, 2000) states that only those people who restrict their energy intake, use severe weight-loss practices, eliminate one or more food groups from their diets, or consume high-carbohydrate diets and low micronutrient density may require some dietary supplementation. Nutritional assessment by professionals should be undertaken before decisions regarding supplement use are made (Maughan et al., 2018). Dietary supplements define as a product taken by mouth that

contains dietary ingredients to supplement the diet. Examples of dietary ingredients are vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandular, and metabolites. It can be extracted or concentrated in many forms like tablets, capsules, soft gels, gel caps, liquids, or powders.

Many supplements are claimed, either directly or indirectly, to enhance athletes' performance, but only a few (including caffeine, creatine, specific buffering agents, and nitrate) have scientific evidence of their benefits. The National Collegiate Athletic Association (NCAA) creates a guideline for Division I institutions to determine if a supplement is permissible or non-permissible. The supplements that are permissible for athletes include energy bars, carbohydrate/electrolyte drinks, carbohydrate boosters, vitamins, and minerals, as well as non-muscle-building supplements (which contain < 30% of calories from protein). On the other hand, those supplements that do not fall within one of the four above categories and muscle-building supplements are classified as a non-permissible supplement (NCAA, 2003).

The most popular sports supplement among men and women athletes is creatine (Williams, 2007) along with vitamin and mineral supplements (Jacobson et al., 2001). Creatine is a nitrogen-containing compound that may be formed in the kidney and liver from glycine and arginine and stored in skeletal muscle (Williams, 2007). Supplementation of creatine is able to increase muscle creatine stores, augmenting the rate of PCr resynthesis, enhancing short-term, high-intensity exercise capacity and the ability to perform repeated bouts of high-intensity effort (Buford et al., 2007). The International Society of Sports Nutrition (ISSN) has established the use of creatine

supplementation as long as it is safe, effective, and ethical within the guidelines (Buford et al., 2007).

In 2010, Janina and Maria (2010) carried out a study to examine the consumption of supplements in people who regularly exercise at gyms in Belo Horizonte, Brazil, and to examine the factors affecting their intake. This cross-sectional research included a total of 1102 enrolled subjects who exercised in 50 gyms throughout the area. The consumption of dietary supplements was found to be reported by 36.8% of the participants. In men, the highest intake was (44.6%). The intake of five items was almost daily: protein and amino acid-rich (58%), isotonic beverages (32%), carbohydrate-rich (23%), natural/phytotherapeutic (20%), and multivitamin/mineral supplements (19%). Most individuals (55%) reported using nutritional supplements based primarily on self-prescription and without any specialized clinical guidance. Individuals younger than 30 years, mainly men, took supplements rich in proteins. In the other hand, older participants reported taking multivitamin/minerals-rich supplements and natural/phytotherapeutic agents.

In a separate study, Suleiman et al. (2008) investigated the prevalence of vitamin-mineral supplement use among Jordan University students. The average prevalence of vitamin-mineral supplements used by students was 27.4% in this report (males 22 %) and females 30.2%). Its usage was significantly associated with age, gender, family monthly income, smoking status, physical activity, vegetarian status, and body mass index. Multivitamins (10.4%) and multivitamin-multi-minerals were the most commonly used supplements (10 %). The most frequently provided justification for supplement usage was for therapy.

Caffeine is a stimulant that possesses well-established benefits for athletic performance across endurance-based situations, and short-term, supramaximal, and/or repeated sprint tasks (Maughan et. al, 2018). It is most widely used by athletes to improve endurance capacity such as exercise time to fatigue and endurance activities of varying duration (5–150 min), across numerous exercise modalities (e.g., cycling, running, rowing and others) (Maughan et al., 2018). The protocol for using caffeine is 3–6 mg/kg of body weight, in the form of anhydrous caffeine (e.g. pill or powder form). It should be consumed ~60 min prior to exercise (Ganio et al., 2009). Doses of caffeine of more than 9 mg/kg body weight do not appear to increase sports performance but instead, developed negative side effects including nausea, anxiety, insomnia, and restlessness.

Nevertheless, most of the athletes have lack of knowledge pertaining to dietary supplements. Educating the athletes will allow them to make informed decisions concerning any supplements that could potentially render them ineligible for any competition or cause detrimental health effects.

2.5 Nutritional Knowledge, Attitude, and Practices (KAP) Among athletes

A significant aspect of any physical fitness program is nutrition. For active people, the primary dietary purpose is to obtain sufficient nutrition to improve health fitness and increase performance. In addition, knowledge of nutrition is also very important, and it appears that malnutrition is generally due to a lack of nutritional information rather than a lack of food. Therefore, education can improve nutritional knowledge (James et al., 1997).

Adequate nutrition is not only conducive to maintaining the physical health of athletes but also conducive to maintaining and improving the physical function and competitive state of athletes. The aim is to learn more about trampoline athletes' nutritional knowledge, attitudes, and behaviors, as well as to improve their dietary nutritional levels and sports performance. Reasonable intake of nutrition is also the basic guarantee for fatigue recovery and resistance to injury after sports (Dawson, 2002). KAP is an effective measurement tool to evaluate the effect of nutrition education and nutrition intervention. It has a wide range of applications, such as nutrition investigation and intervention for different groups of people (Sajber et al.,
2013).

Wahlang and Baruah (2020) found that the gym members of Guwahati, India has good knowledge where, male had better knowledge than female gym members. The questionnaire used to assess nutritional knowledge level consisted of 19 sets of statements with three possible answers "yes", "no", and "don't know". For evaluation, a correct answer considered as one point while incorrect answer or a "don't know" is regarded as zero. Another previous study reported that majority of the amateur male bodybuilders had excellent knowledge, with only 8.6% having mediocre understanding (Wamiti, 2015). A five-question questionnaire was used to measure the participants' nutrition knowledge. The overall score was calculated after each response was graded where, the lowest score was 6 and the maximum score was ten out of ten. This study reported that the average score for knowledge was 9.2. Thus, it is speculated that the present study finding was not similar to both previous studies due to difference in questionnaire used.

In a separate study, Webb and his fellows have investigated the knowledge and attitude of athletes and college students by using the diet nutrition knowledge-attitude behavior questionnaire. The results show that athletes have a more positive nutrition attitude, but their nutrition knowledge is relatively lacking (Ozdoğan & Ozcelik, 2011). Heaney has found that carbohydrate intake is insufficient and vitamin D, calcium, iron, and magnesium intake do not meet the recommended value in a dietary survey of 72 female athletes in different programs (Heaney et al., 2010). In addition, Noda and colleagues (2009) has conducted a dietary survey of 31 college football players in Japan and has found that carbohydrate intake is 6.9 g/kg, and protein is l3 g/kg, which are under the lowest recommended range, and the average intakes of green vegetables, milk and dairy products, fruits, and eggs are also lower than the recommended target (Noda et al., 2009).

Without a doubt, dietary knowledge affects attitudes and practices among athletes who often rely on their coaches for nutrition guidance. Obviously, searching for proper nutrition through the internet is growing, however, reliable and authentic information should be evaluated. This has the potential to cause harm if the coaches and athletes are misinformed (Bakhtiar et al., 2021). Previous studies have indicated that identifying knowledge, attitudes, and practices in a population to improve a health program is essential (Parker et al., 1995).

In 2010, Nazni & Vimala (2010) carried out a study to assess the nutrition knowledge, attitude, and practice (KAP) of college sportsmen. Athletes were selected from five separate private colleges located in Salem District, Tamilnadu, India. A total of 102 athletes, 32 sportsmen belonging to the discipline of volleyball, 25 belonging to the discipline of weightlifter, and 45 belonging to the sports discipline of runners, participated

in the study. The KAP questionnaire comprised ten questions about knowledge of nutrition, nine questions about attitudes, and ten questions about the dietary practice. The dietary composition of the sportsmen was also assessed. As a result, it was found that 42% of the volleyball players had good nutritional knowledge (60–69%) compared to weightlifters (43%) who had satisfactory (50–59%) knowledge about nutrition. A total of 29% of the runners had very good (70–79%) knowledge about nutrition. Regarding food consumption pattern intake cereals, other vegetables, and milk were found to be less compared to the RDA for the athletes. In the three sports fields, the runners' total nutrient consumption is high relative to volleyball and weightlifters (Nazni & Vimala, 2010).

A study was conducted in India by Sewak & Singla (2018) aimed to assess the nutrition knowledge, attitude, and practices of 120 (16-25 years) elite athletes and their coaches, selected from 5 universities and participating in 4 sports, i.e. There was basketball, athletics, badminton and lawn tennis. The Knowledge, Attitude, and Practice (KAP) score of participants was measured along with the KAP score of sports nutrition coaches. There was a statistically important gap in the KAP score for male and female hockey and lawn tennis players. The KAP score of male and female athletes as a whole, was found to be statistically non-significant. The majority of coaches (96.7%) did not have formal sports nutrition training and 90% did not have access to a licensed dietitian. The coaches' KAP score data showed that 10% had an impressive KAP score; 53% had a very good score; 30% had a good KAP and 6.7 % had an average to a bad score. The athletes' KAP score had a substantially positive association with the coaches' KAP score (Sewak & Singla, 2018).