UNIVERSITI PUTRA MALAYSIA

EFFECTS OF SPORTS NUTRITION EDUCATION ON KNOWLEDGE, ATTITUDE AND PRACTICE OF SPORTS NUTRITION AND NUTRITIONAL STATUS AMONG ELITE MALE ATHLETES IN MALAYSIA

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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Faculty : Medicine and Health Sciences

A proper knowledge, attitude and practice (KAP) of sports nutrition are associated with many positive outcomes for athletes including optimal health and performance. However, the level of sports nutrition knowledge of athletes has been a popular question for researchers in Malaysia because of the inadequate quantitative reporting in the form of a questionnaire test score. Thus, an education intervention program was carried out to evaluate the effects of the intervention in improving the KAP of sports nutrition and the nutritional status among elite male young adults team sports athletes in Malaysia.

One hundred and five male team sports athletes aged between 18 to 32 years old participated in this study, 52 athletes were recruited in the treatment group (TG) while 53 athletes were in the comparison group (CG). The TG received seven weeks education intervention program. The intervention activities consisted of booklet distribution and 60 to 90 minutes of lecture session with 30 minutes of group discussion on weekly basis. The booklet consist seven topics of basic sports nutrition. The lecture session and group discussion was conducted by the researcher with sports nutrition background. No intervention program was conducted for the CG as it served for the comparison purpose.

A validated questionnaire on KAP of sports nutrition was used in this study. Three-day food records, three-day physical activity records, anthropometric measurement (body weight, height) and body composition assessment (seven sites skin folds) were used to measure athletes nutritional status that consist of dietary intake, energy balance and body composition status.

Looking at within groups effect, results show significant interaction between groups and time with the TG showing increments in the KAP scores while the CG showing reduction in KAP scores over the two time period. For dietary intake, the percentage of carbohydrate intake significantly decreased from 55% to 53% although the total carbohydrate intake in gram showed increment at post-test. This indicates the improvement in total energy intake at post-test in the TG is from the the consumption of high protein foods and fat foods in place of carbohydrate rich foods. The percentage of protein and fat intake were significantly increased and meet the recommendation for total energy requirement with 19% of total protein and 30% of total fat. For energy balance, the TG showed significant increased at post-test by the reduction of negative energy balance during training days (-5 ± 628) and manage to achieve positive energy balance at rest day (188 ± 553). Meanwhile, no significant difference were found in the parameter of anthropometric measures, while there was significant difference in body fat mass. The mean body fat mass showed significant increased in both TG (60.13 ± 5.34) and CG (67.97 ± 12.25) at post-test.

For between groups effect, the main effect comparing two groups with the TG receiving an intervention program while the CG did not receive any intervention was significant ($p<.05$), suggesting there was differences between the two groups and the intervention program lead to positive effect in terms of the improvement in the KAP scores of the TG. There was a significant improvement in the adjusted mean score of knowledge on sports nutrition in the TG at post-test, the mean score of knowledge was significantly higher in the TG (20.04 ± 1.72) compared to the CG(13.68 ± 2.16). For attitude on sports nutrition, the mean score was significantly higher in the TG (64.04 ± 5.52) as compared to the CG (55.17 ± 2.77) at post-test. Meanwhile for practice on sports nutrition the mean score at post-test in the TG (35.67 ± 3.53) was significantly higher as compared to the mean score in the CG (29.28 ± 4.84). For other variables, there were significant differences in the mean for total carbohydrate intake in g/kg body weight (5.82 ± 1.24 vs 4.12 ± 0.57), total protein intake (139.14 ± 22.22 vs 141.34 ± 41.40) and total fat intake (94.03 ± 19.80 vs 96.21 ± 26.76) in the TG as compared to the CG. Furthermore at post-test, the mean energy balance during training days in the TG (-5 ± 628) was significantly higher than the CG (-513 ± 398).

As a conclusion, the sports nutrition education intervention increased the scores of sports nutrition KAP in the TG and this program showed improvement in athletes nutritional status in terms of total energy intake and energy balance. However, the intervention program did not help in improving the anthropometric and body composition status of the athletes. The findings of this study support the need for and the positive effects of sports nutrition education intervention program and is useful for future intervention programs in improving sports nutrition knowledge and application especially among athletes.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PENDIDIKAN PEMAKANAN SUKAN KEATAS PENGETAHUAN, SIKAP DAN AMALAN PEMAKANAN SUKAN DAN STATUS PEMAKANAN DALAM KALANGAN ATLET LELAKI ELIT DI MALAYSIA

Oleh

SITI SORAYA BINTI MOHD ELIAS

Mei 2017

Pengerusi : Hazizi Abu Saad, PhD
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Pengetahuan, sikap dan amalan pemakanan (PSA) sukan yang betul berhubungkait dengan pelbagai kesan positif untuk atlet termasuk kesihatan dan prestasi yang optimum. Walaubagaimanapun, tahap pengetahuan pemakanan sukan atlet telah menjadi persoalan popular dalam kalangan penyelidik, terutamanya di Malaysia kerana kekurangan laporan kuantitatif dalam bentuk skor soal selidik. Oleh itu, satu program intervensi pendidikan telah dijalankan untuk menilai kesan intervensi dalam meningkatkan PSA dalam kalangan atlet elit lelaki dewasa muda sukan berpasukan di Malaysia.

Satu ratus lima orang atlet lelaki elit berumur antara 18 hingga 32 tahun telah menyertai kajian ini, 52 atlet telah diambil dalam kumpulan rawatan (KR) manakala 53 atlet adalah dalam kumpulan perbandingan (KP). KR telah menerima program intervensi pendidikan selama tujuh minggu. Aktiviti intervensi merangkumi pengagihan buku kecil dan 60 hingga 90 minit sesi syarahan bersama 30 minit perbincangan kumpulan pada setiap minggu. Buku kecil merangkumi tujuh topik tentang asas pemakanan sukan. Sesi syarahan dan perbincangan kumpulan telah dijalankan oleh penyelidik dengan latar belakang pemakanan sukan. Tiada program intervensi yang dijalankan untuk KP memandangkan ia bertindak untuk tujuan perbandingan.

Satu borang soal selidik yang telah sahih tentang PSA terhadap pemakan sukan telah digunakan dalam kajian. Rekod makanan tiga hari, rekod aktiviti fizikal tiga hari, pengukuran antropometri (berat badan, tinggi) dan penilaian komposisi tubuh (tujuh

bahagian lipatan kulit) telah digunakan untuk mengukur status pemakanan atlet yang merangkumi pengambilan diet, keseimbangan tenaga dan status komposisi tubuh.

Melihat kepada kesan dalam kumpulan, keputusan menunjukkan interaksi signifikan di antara kumpulan dan masa dengan KR menunjukkan kenaikan dalam skor PSA manakala KP menunjukkan penurunan dalam skor PSA diantara dua selang masa. Untuk pengambilan diet, peratus pengambilan karbohidrat merosot secara signifikan daripada 55% kepada 53% walaupun jumlah pengambilan karbohidrat dalam gram menunjukkan peningkatan pada selepas-ujian. Ini menunjukkan peningkatan dalam jumlah pengambilan tenaga pada selepas-ujian dalam KR adalah daripada pengambilan makanan tinggi protein dan lemak yang menggantikan makanan kaya karbohidrat. Peratusan protein dan lemak meningkat secara signifikan dan memenuhi saranan untuk jumlah keperluan tenaga dengan 19% jumlah protein dan 30% jumlah lemak. Untuk keseimbangan tenaga, KR telah menunjukkan peningkatan signifikan pada selepas-ujian dengan penurunan keseimbangan tenaga negatif semasa hari latihan (-5 ± 628) dan telah mencapai keseimbangan tenaga positif semasa hari rehat(188 ± 553). Sementara itu, tiada perbezaan signifikan yang dijumpai dalam parameter pengukuran antropometri, manakala terdapat perbezaan yang signifikan dalam jisim lemak tubuh. Min jisim lemak tubuh menunjukkan peningkatan signifikan dalam kedua-dua KR (60.13 ± 5.34) dan KP (67.97 ± 12.25) pada selepas-ujian.

Untuk kesan diantara kumpulan, kesan utama membandingkan dua kumpulan dengan KR menerima program intervensi manakala KP tidak menerima sebarang intervensi adalah signifikan ($p<.05$), yang mencadangkan terdapat perbezaan diantara dua kumpulan dan program intervensi membawa kepada kesan positif daripada segi peningkatan dalam skor PSA oleh KR. Terdapat peningkatan signifikan dalam skor min yang diselaraskan untuk pengetahuan terhadap pemakanan sukan dalam KR pada selepas-ujian, skor min pengetahuan adalah lebih tinggi secara signifikan dalam KR (20.04 ± 1.72) berbanding KP (13.68 ± 2.16). Untuk sikap terhadap pemakanan sukan, skor min adalah lebih tinggi secara signifikan dalam KR (64.04 ± 5.52) berbanding KP pada selepas-ujian (55.17 ± 2.77). Manakala untuk amalan terhadap pemakanan sukan, skor min pada selepas-ujian dalam KR (35.67 ± 3.53) adalah lebih tinggi secara signifikan jika dibandingkan dengan skor min KP (29.28 ± 4.84). Untuk pembolehubah yang lain, terdapat perbezaan yang signifikan dalam min yang diselaraskan untuk jumlah pengambilan karbohidrat dalam g/kg berat badan (5.82 ± 1.24 vs 4.12 ± 0.57), jumlah pengambilan protein (139.14 ± 22.22 vs 141.34 ± 41.40) dan jumlah pengambilan lemak (94.03 ± 19.80 vs 96.21 ± 26.76) dalam KR berbanding KP. Tambahan lagi pada selepas-ujian, min keseimbangan tenaga semasa hari latihan dalam KR (-5 ± 628) adalah lebih tinggi secara signifikan berbanding KP (-513 ± 398).

Kesimpulannya, intervensi pendidikan pemakanan sukan telah meningkatkan skor PSA pemakanan sukan di kalangan KR dan program ini telah menunjukkan pembaikan dalam status pemakanan atlet dari segi jumlah pengambilan tenaga dan keseimbangan tenaga. Walaubagaimanapun, program intervensi ini tidak membantu dalam meningkatkan status antropometri dan komposisi tubuh atlet. Hasil kajian ini menyokong keperluan dan kesan-kesan positif program intervensi pemakanan sukan

dan ia berfaedah untuk program intervensi pada masa akan datang dalam meningkatkan pengetahuan dan aplikasi pemakanan sukan terutamanya di kalangan para atlet.

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I certify that a Thesis Examination Committee has been met on 17th May 2017 To conduct the final examination of Siti Soraya Binti Mohd Elias on her thesis entitled "Effects of Sports Nutrition Education Intervention on Knowledge, Attitude and Practice of Sports Nutrition and Nutritional Status Among Elite Young Male Adults Team Sports Athletes in Malaysia" in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.
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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Signature: _____
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Signature: _____
Name of Member of Supervisory Committee: Zubaidah Jamil

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LIST OF ABREVIATIONS

BFM	Body fat mass
BMI	Body mass index
CG	Control group
KAP	Knowledge, attitude and practice
LBM	Lean body mass
PA	Physical activity
RNI	Recommended Nutrient Intake
SCT	Social Cognitive Theory
TG	Treatment group
% BF	Percent of body fat

CHAPTER 1

INTRODUCTION

1.1 Background

Sports persons need more energy to carry out their sporting activity effectively, and it is of primary importance to take care of nutrition for sports performance (Supriya & Ramaswami, 2013). Team sports are sports in which two or more athletes work together on a common playing area to defeat on opposing group of competitors (Fink & Mikesky, 2015). Team sports are based on intermittent high-intensity activity patterns, but experience marked variability of game characteristics between sports, between playing positions and playing styles. This creates a diversity of physiological challenges and nutritional needs for team sports athletes (Mujika & Burke, 2010).

Most of the team sports such as field hockey, football, basketball, rugby and volleyball can be described as moderate- to long- duration exercise including repeated bouts of high intensity activity interspersed with periods of low- to moderate- active recovery or passive rest (Mujika & Burke, 2010). Due to the wide range of fitness requirements of players involved in intermittent sports and high energy requirement, many athletes had tried various ways to increase their performance and reduce their level of fatigue during training and competition. Nutritional requirement for training and competition are determined by the rules of each sport, which vary in playing arena size, duration and frequency of matches, season length, training phase, number of players and substitutions allowed (Holway & Spriet, 2011). Besides optimal and effective training, there are many factors that influence team sports athlete's ability to perform at high intensity activity patterns. These include sports nutrition elements and practice for pre, during and post training and competition nutrition.

Nutrition is an important component in any physical fitness program (Ozdogan & Ozcelik, 2011; Trabucco *et al*., 2013). The main dietary goal for active individuals is to obtain adequate nutrition to optimize health, fitness and to increase sports performance (Nazni & Vimala, 2010). Researchers have documented various benefits of nutrition related to exercise performance, and it is reported that physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition (ACSM, ADA, DC, 2009). Many approaches have been made in order to help athletes improve in their training and performance including the application of sports nutrition.

According to Zinn *et al*. (2005), sports nutrition knowledge is important in order to assess the knowledge of those athletes who practice and disseminate sports nutrition information. The importance of sports nutrition knowledge is to avoid myths and misinformation, to ensure accurate information and optimal sports nutrition are practiced by the athletes. A major concern for athletes lacking in sports nutrition knowledge is that they might disseminate incorrect information, Torres-McGehee *et al*.

(2012) demonstrated that most coaches and athletes have inadequate knowledge, and they suggested that proper nutrition programming should be provided for athletes. How effectively athletes apply their nutritional knowledge to their everyday eating habit is important. However, Davar (2012) found that athletes lack knowledge of nutrition, healthy food choices and components of well balanced diet. These factors give implications on athletes' performance. Hornstorm *et al*. (2011) found a significant yet negative relationship between female softball players' nutrition knowledge score and the quality of their food selections, indicating the players with lower nutrition knowledge had poorer eating habits. Besides all the above important facts, nutrition knowledge is an integral component of health literacy and low health literacy is associated with poor health outcome (Spronk *et al*., 2014).

Athletes have special nutritional needs as compared to the general population. Although there is no specific set of dietary recommendations for athletes, it is recognized that at a minimum, athletes need to consume a diet consistent with recommendations for the general population for their overall good health, and one of the most important strategies to help athletes consume adequate diet is nutrition education (Spendlove *et al*., 2012). The aim of nutrition education is to address the need for athletes to know what to eat, and how to select, and prepare a variety of foods necessary for a healthy diet. However, diets of athletes are often reported to be nutritionally inadequate when compared with sports nutrition and general population recommendations (Burke *et al*., 2001). Research done on male and female collegiate athletes shows only 15% and 26% of athletes had adequate intakes of carbohydrate and protein respectively (Hinton *et al*., 2004).

The need for adequate energy and nutrient intake is essential for sports participants (Croll *et al*., 2006). Provision of sufficient nutrients and energy to meet metabolic needs for optimal functioning of the body constitutes 'nutritionally-adequate' diet, and factors affecting requirements for an availability of nutrients include physical and nutritional status, age and genetic make up of an individual (Ismail *et al*., 1995). In a joint position statement in 2016, the Academy of Nutrition and Dietetics, Dietitians of Canada and American College of Sports Medicine stated that energy balance occurs when energy intake equals total energy expenditure which consists of summation of basal metabolic rate, the Thermic Effect of Food and the Thermic Effect of Activity. Energy expenditure for different types of exercise is dependent upon the duration, frequency and intensity of exercise, sex of the athlete and nutritional status prior to exercise. Body size and fat free mass also influence energy expenditure, the more energy used in activity, the more energy needed to achieve energy balance.

It is well known that achieving energy balance is important for athletes, Burke *et al*., (2004) stated that athletes should aim to achieve carbohydrate intakes to meet the fuel requirements of their training program and to optimize restoration of muscle glycogen stores between workout. However Ruiz *et al*. (2005) reported the contribution of carbohydrate to total energy intake was lower than the recommended for athletes. Similarly, Clark *et al*. (2003) observed that carbohydrate intake failed to meet recommendations to promote repletion, whereas protein and fat intakes were above minimum recommendations for football players. According to Burke *et al*., (2006)

players should be warned against the accidental mismatch of energy intake and energy expenditure, because low energy availability causes disturbances to hormonal, metabolic and immune functions. All of the above suggest that well designed nutritional education and interventions are necessary to optimize performance and promote healthy eating habits in team sports players (Mujika & Burke, 2010). Thus, this study aims to determine the effects of sports nutrition interventions on knowledge, attitude and practice (KAP) among young Malaysia team sport athletes.

Body composition is one of many determinant of sports performance (Malina & Gaither, 2013). Strength and power team sport require muscle-building program and must be accompanied by adequate nutrition and simple anthropometric measurements to monitor and assess body composition (Holway & Spriet, 2011). According to a study by Cholewa *et al*., (2015), sports nutrition education intervention is effective at improving sports nutrition knowledge and respondents in the study showed improvements in body composition by the decreased in body fat percentage. Sports nutrition education and intervention not only important to improve athletes nutrition knowledge but also to help the athletes gain the benefit of practicing correct nutrition practice in their daily life to improve their nutritional status. Rossi *et al*., (2017) stated that improving athletes nutritional knowledge may improve nutrition status thus leading to leaner body composition and enhanced performance.

1.2 Problem Statement

Sports and nutrition are closely related to each other. One of the best ways to convey correct information regarding sports nutrition is via education. A proper KAP of sports nutrition is associated with many positive outcomes for athletes including optimal health and performance. However, the level of general and sports specific nutrition knowledge of athletes has been a popular question for researchers. Because of inadequate quantitative reporting in the form of a questionnaire test score, not much data can be gathered for quality analysis (Heaney *et al*., 2011). Despite many advances in nutritional knowledge and dietary practices, sports nutrition-associated issues are still a challenge (Trabucco *et al*., 2013). Ozdogan and Ozcelik (2011) stated that athletes lack the nutrition knowledge they need to gain the benefit of increased in performance and health via nutrition.

According to Trabucco *et al*. (2013), the transition from theory to practice usually requires an educational program. Therefore, of absolute importance are sources of information from which the athletes practicing sports can learn about nutrition. All of these matters can be improved by having proper nutrition education because nutrition education is useful in improving athletes' dietary intake and nutrition knowledge (Villiant *et al*., 2012) and delivering continuous education helps to improve athletes nutritional KAP (Nazni & Vimala, 2010). Although there are many studies on nutrition education among athletes, but present studies reveal that there is a paucity of nutrition education intervention. By doing sports nutrition education intervention, the data collected can become the scientific evidence on how well participants in the research understand the nutrition education that are delivered to them. Moreover, to

date there is lack of published data on Malaysian athletes' sports nutrition KAP and nutritional status. Therefore, local research focusing on education intervention of sports nutrition is necessary to encourage athletes to gain sports nutrition knowledge and apply it into practice during training and competition to enhance performance.

Without exception, a stable body weight is dependent upon the balance between energy intake and energy expenditure. To be in accordance with the laws of thermodynamics, long-term energy balance must be maintained for weight to remain constant. However, a study done by Edward *et al*., (1993) found that female athletes had a significant imbalance between energy intake and energy expenditure. Inadequate energy intake will have both short- and long-term health implications. This is especially true for a sports that require a high energy expenditure and physically demanding sports. However, there is very little research detailing the energy requirements or intakes for these sportsmen and women (Hill & Davies, 2002).

Research done by Cupisti *et al*., (2002) reported that the recalled dietary intake and nutrition knowledge of Italian adolescent females show some misconceptions and nutrient deficiencies, suggesting more attention should be given by family, coaches, and nutritionists or any personnel that are involved with the athletes to enhance their nutrition knowledge and dietary practice. Similarly, research by Hoogenboom *et al*., (2009) stated that female swimmers athletes often have inadequate diets due to lack of nutritional knowledge and nutritional misconceptions. The swimmers in the study demonstrate fair knowledge of nutrition as measured by a mean score of 71.75% of questions answered correctly, yet 90.59% of subjects did not meet Recommended Dietary Allowance for all macronutrients. These statistics imply despite ability to 'pass' a nutritional knowledge questionnaire and previous background knowledge in nutrition, the athletes did not apply their knowledge to their eating habit. By assessing the dietary intake of the team sports male athletes, we may investigate our Malaysian athletes' dietary intake and whether they achieve the recommended value or not. Research from other countries suggest that many studies were done on female athletes, but information and research on male team sports athletes are lacking especially among Malaysian athletes. Since team sports are sports in which two or more athletes work together to defeat an opposing group of competitors (Fink & Mikesky, 2015), it is major important that each and every members of the team understand and practice the same correct sports nutrition information and apply it in their sports, so that the team could gain the benefit of optimum performance during training and competition.

Nowadays, coaches and athletes recognize that symptoms such as lethargy, fatigue, poor performance capacity and poor recovery are linked to diet. Increased incidences of injury and infections, and excessive gains or losses in body mass are also diet related (Deakin, 2006). Therefore, by determining team sports athletes' nutritional status, it will facilitate the coaches and athletes to know their nutritional status and help them prevent those problems.

In general, there are many research have been done among Malaysian athletes but research and data with regards to young male adults team sports athletes KAP and

nutritional status yet to be discovered. Hence, this present study aims to examine the effects of an education intervention program on KAP of sports nutrition, as well as the nutritional status including energy intake, energy expenditure and body composition among elite young male adults team sports athletes in Malaysia.

1.3 Significance of the Study

This education intervention study will contribute in enhancing the young male team sports athletes' nutritional KAP towards sports nutrition and at the same time it could improve in their nutritional status. It will also be the first investigation of the nutritional knowledge, attitude, practice and nutritional status of young male Malaysia team sports athletes. The results and findings from this research will assist and give input to Malaysia sports nutritionist/dietitian and team sports coaches, or any sports personal to address the nutrition aspect of their team in future. Assessing the nutritional KAP of Malaysia team sports athletes will contribute to shape the delivery of future education and nutrition support strategies for the athletes, and will facilitate the fueling and recovery strategies for training and competition.

This study will give benefit to athletes, coaches, sports nutritionist/dietitian, trainers or other sports practitioners to determine the effects of education program given to the athletes in assisting them to apply the sports nutrition knowledge in improving their nutritional status. The education intervention provided could help athletes in supporting their nutritional strategies for practicing optimum dietary intake and recovery, as well as health and wellness during training and competition at the national and international level. In policy wise for the future, this research could provide positive outcome to the nation in the enhancement of sports performance in Malaysia through the application of sports nutrition discipline among Malaysian national athletes.

1.4 Objectives

1.4.1 General Objective

The general objective of this study is to determine the effects of sports nutrition education intervention on sports nutrition knowledge, attitude, practice (KAP) and nutritional status among Malaysian young adults team sports athletes.

1.4.2 Specific Objectives

The specific objectives of this study are:

1. To compare the baseline knowledge, attitude and practice (KAP) scores on sports nutrition and nutritional status (dietary intake, energy balance and body composition) among young male adults team sports athletes between the treatment group and the comparison group.

2. To determine the differences between pre and post knowledge, attitude and practice (KAP) scores on sports nutrition among young male adults team sports athletes within the treatment group and the comparison group.

3. To determine the differences between pre and post knowledge, attitude and practice (KAP) scores on sports nutrition among young male adults team sports athletes between the treatment group and the comparison group.

4. To determine the differences between pre and post nutritional status (dietary intake energy balance and body composition) among young male adults team sports athletes within the treatment group and the comparison group.

5. To determine the differences between pre and post nutritional status (dietary intake energy balance and body composition) among young male adults team sports athletes between the treatment group and the comparison group.

1.5 Hypotheses

1. There is no significant difference in the baseline knowledge, attitude and practice (KAP) scores on sports nutrition and nutritional status (dietary intake, energy balance and body composition) among young male adults team sports athletes between the treatment group and the comparison group.

2. There is no significant difference between pre and post knowledge, attitude and practice (KAP) scores on sports nutrition among young male adults team sports athletes within the treatment group and the comparison group.

3. There is no significant difference between pre and post knowledge, attitude and practice (KAP) scores on sports nutrition among young male adults team sports athletes between the treatment group and the comparison group.

4. There is no significant difference between pre and post nutritional status (dietary intake energy balance and body composition) among young male adults team sports athletes within the treatment group and the comparison group.

5. There is no significant difference between pre and post nutritional status (dietary intake energy balance and body composition) among young male adults team sports athletes between the treatment group and the comparison group.

1.6 Operational Framework

Figure 1.1 shows how the effects of education intervention program on knowledge, attitude, practice (KAP) related to sports nutrition and nutritional status were studied. Elite young male adults team sports athletes from intermittent sports aged between 18 to 35 years old were recruited and assigned either treatment group or control group. Athletes in the treatment group were given the education intervention program while athletes in the comparison group were not given any intervention program and were recruited for comparison purposes.

Data collection was conducted during baseline and eight weeks after the intervention. The primary outcomes of the study were changes in respondents knowledge, attitude and practice of sports nutrition. Meanwhile, the secondary outcomes expected were changes in dietary intake, energy balance and body composition of the respondents. The impact and outcome evaluations were measured by “within” group and “between” group changes.

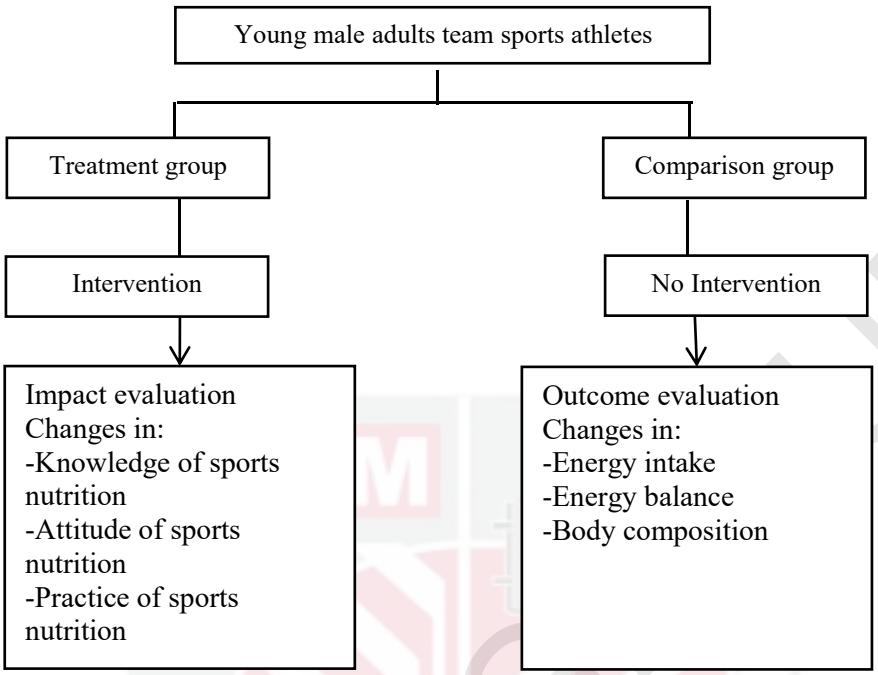

Figure 1.1: Operational framework of the study

1.7 Operational Definitions

Attitude: An enduring and general evaluation or cognitive schema relating to group of athletes and issue on sports nutrition. Attitude can be negative or positive.

Body composition: The measurement of fat mass and fat free mass (lean body mass) based on body fat percentage that is estimated by measuring subjects subcutaneous fat consist of sum seven sites skinfold (triceps, biceps, sub-scapular, abdominal, front thigh and medial calf). The thickness layer of the fat directly underneath the skin is measured using skinfold calipers.

Elite athlete: An athlete who is currently competed as a team varsity player, a professional or a national or international level player.

Energy balance: A state in which body weight remains stable because the amount of energy consumed in the diet during training and rest days are equals to the amount of energy expended during training and rest days.

Intermittent exercise: Sports and exercise that involved both anaerobic and aerobic energy releasing system.

Intervention: Purposely-planned actions designed with the intent of improving the knowledge, attitude and practice of sports nutrition and nutritional status of a target group involving elite athlete.

Knowledge: An awareness of the existence of information and understanding of sports nutrition which is usually acquired by experience or learning.

Knowledge, attitude and practice scores: Comparing the mean total score of pre and post scores of respondents' knowledge, attitude and practice on sports nutrition, by using the Sports Nutrition Questionnaire developed from a study by Hornstrom *et al.* (2011).

Nutritional status: A state of health as it is influenced by the intake and utilization of nutrients, including dietary intake, energy balance and body composition. The dietary intake was assessed by calculating the energy and calorie intake from 3-day food records; energy balance was assessed by comparing the total energy expenditure (using 3-day activity records) with the total energy intake; and body composition was assessed based on body fat percentage.

Practice: Repeating of an act, behavior or sequence of activities frequently to better performance or learn ability or trade of sports nutrition.

Sports nutrition: The application of nutritional principles to enhance athletic performance.

Team sports: Sports that involved intermittent high-intensity activity in which a team of athletes (two or more players) working together towards shared objectives. Examples of team sports are field hockey, football, rugby and cricket.

Young adults: A person of age group between 18 to 35 years old.

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