ENHANCEMENT OF SPORTS NUTRITION KNOWLEDGE AND ENERGY INTAKE AFTER SPORTS NUTRITION EDUCATION FOR COMBAT ATHLETES

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ABSTRACT

Providing nutrition and food support is necessary for enhancing and maximizing athletic performance in individuals engaged in sports activities. This study aimed to examine the impact of sports nutrition education on combat athletes' sports nutrition knowledge and nutritional sufficiency. This quantitative study used a quasi-experimental design, explicitly utilizing a pretest-posttest control group design. The study included a total of 76 participants, who were categorized into two groups: intervention and control. Each group consisted of 38 athletes. The data were analysed using SPSS. The Independent T-Test and Paired T-Test determined if the data followed a normal distribution. The Mann-Whitney and Wilcoxon Signed Rank tests were employed if the data did not follow a normal distribution. The nutrition education intervention comprised seven weekly materials sent to the intervention group. The findings indicated significant nutritional knowledge differences (p=<0.001) between the intervention and control groups. Additionally, there were significant differences in the sufficiency of energy intake (p=0.029) within the intervention group. The study's findings indicated that nutrition education significantly affected the intervention group's sports nutrition knowledge and energy intake adequacy. Additionally, the nutrition education intervention significantly affected the sports nutrition knowledge of the control group. Athletes' enhanced understanding will positively affect their ability to satisfy energy requirements.

Keywords: adequate energy intake, athletes, healthy lifestyle, nutrition education, nutrition knowledge

INTRODUCTION

Providing athletes with specific nutrients and foods that cater to their requirements is essential to enhance and optimize athletic performance (Kerksick et al., 2018). Athletes require macronutrients, including energy, protein, and carbs, in significant amounts. These nutrients are essential for athletes due to their high activity levels, intense training, and the body's requirement to enhance muscle growth (American Dietetic Association et al., 2009).

Previous research demonstrated that most athletes need assistance meeting their specific nutrient requirements. Inadequate nutrient intake among athletes in fulfilling their nutritional requirements can stem from various issues, including a lack of familiarity with sports nutrition (Jagim et al., 2019). Approximately 46% of Australian athletes are limited in sports nutrition, including weight management, macronutrients, micronutrients, supplements, and other relevant topics (Jenner et al., 2018).

Athletes typically receive knowledge regarding sports nutrition indirectly from those in their immediate circle, such as parents, friends, and coaches (Torres-McGehee et al., 2012). Frequently, they also acquire information from their smartphones over the internet; however, although obtaining information is easily accomplished nowadays, the supervision of athletes' nutritional status should be conducted by nutritionists or healthcare professionals. Nevertheless, cell phones provide remote monitoring for nutritionists and aid athletes in tracking their food intake and weight management (Kustiawan et al., 2022).

Likewise, athletes participating in weight-sports such as combat or martial arts such as karate, muaythai, judo, and others must manage their body weight. Monitoring fat mass is essential for maintaining a balanced body composition and weight. The purpose of conducting these body composition measurements is to utilize them as assessments and interventions for athletes (Campa et al., 2021). Only a select few athletes intentionally engage in rapid weight loss prior to a

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match or tournament. Combat athletes commonly employ strategies to lose weight, such as restricting food and hydration intake, engaging in intense physical activity, or utilizing saunas and hot baths to induce profuse sweating (Pettersson et al., 2013).

Nikolaidis (2014) conducted a study revealing that a mere 6% of athletes had a high level of proficiency in sports nutrition knowledge, whereas the remaining 45.6% scored below the mean. In comparative research examining nutrition education interventions over four weeks, it has been observed that the group receiving instruction through the extension approach demonstrates a more significant improvement in knowledge than the group not receiving such education (Zeng et al., 2020).

Athletes' knowledge of sports nutrition can positively affect their dietary choices. Previous study on athletes indicates that a higher level of nutritional knowledge is associated with a preference for fruits, vegetables, and high-carbohydrate diets (Alaunyte et al., 2015). This study aimed to determine the effect of sports nutrition education on combat athletes' sports nutrition knowledge and nutritional sufficiency. Similar research has yet to be discovered on combat athletes thus far. The use of sports nutrition education interventions aims to enhance nutritional awareness and fulfil the specific dietary requirements of combat athletes.

METHODS

Research Type and Design

This study employed a quasi-experimental approach, namely a pretest-posttest control group design, to gather quantitative data. The intervention group received dietary education by distributing informational leaflets, counselling sessions, and group discussions. The control group received solely booklet material for nutrition instruction.

Intervention Procedure

The intervention was administered over seven weeks, with seven weekly sessions from March to April 2023. The sports nutrition education intervention covered the following topics:

Table 1. Intervention Materials

Meeting	Topic	Methods	
		Intervention Group	Control Group
1	Basic Nutrition Science	Booklet media provision, counselling and group discussion Duration: 30-45 minutes	Booklet media provision
2	Preparation period nutrition		
3	Competition nutrition		
4	Post-match nutrition		
5	Body composition and body image		
6	Hydration		
7	Supplementation		

Source: WAVE project, modified (Wong et al., 2018)

Nutrition education interventions were conducted by experienced sports nutritionists who have previously assisted athletes in the National Sports Week (PON).

Research Location and Sample

The study was undertaken at the KONI East Java Province. The participants in this study were combat athletes who satisfied specific criteria, including being between the ages of 16 and 25, having received official education on sports nutrition, and being willing to participate in the study's survey at its conclusion. The exclusion criteria for this study encompassed athletes who were experiencing injuries or undergoing pharmacological therapy, athletes with infectious or other long-standing medical conditions.

A sample calculation was performed in this investigation using the Chow et al. (2017) formula. The study included 76 athletes separated into two intervention groups and a control group, with a sample size ratio of 1:1. There were 38 athletes in both the intervention and control groups.

Data Collection

The data-collecting procedures involved administering online surveys to respondents through Google Forms. The questionnaires consisted of inquiries regarding respondent characteristics and sports nutrition expertise.

Subsequently, interviews were conducted to gather 2x24h food recall data. Two rounds of data collection were conducted to assess sports nutrition knowledge and dietary intake through two 24-hour food recalls before and after the implementation of the sports nutrition education intervention.

The Abridged Nutrition for Sport Knowledge Questionnaire (ANSKQ) was employed as the basis for the sports nutrition knowledge questionnaire. The ANSKQ was adapted and translated into Indonesian to enhance comprehension. The ANSKQ has 34 comprehensive inquiries regarding knowledge in sports nutrition, with response options including agree/disagree/unsure or high/low/not sure or sufficient/not sufficient/not sure or yes/no/not sure.

A 48-hour food recall interview was undertaken to gather data on nutritional sufficiency. The interview took place over two days that were not consecutive. The data collected were obtained from a single weekday and a single weekend. The food recall data for two consecutive 24-hour periods were analysed using the Nutrisurvey 2007 software. The mean of the two outcomes from the 24-hour food recall was computed, and the proportion of calorie, carb, protein, and fat adequacy was subsequently determined and compared to each participant's requirements.

Data Analysis

The data were subjected to descriptive and comparative analysis to identify differences in nutritional awareness and adequacy of intake. Before analysis, the data underwent a Kolmogorov-Smirnov normality test to assess normal distribution. The normality test results indicated that the variables of nutritional awareness, adequate calorie intake, carbs, protein, and fat exhibited a non-normal data distribution. Therefore, the Mann-Whitney test and Wilcoxon signed rank test were employed.

The study has received ethical approval from the ethics commission of the Faculty of Dentistry, Airlangga University, Surabaya, with the reference number 090/HRECC.FODM/II/2023.

RESULTS AND DISCUSSION

Combat athletes or martial arts athletes participate in sports that primarily involve tactics such as kicking and punching (Vertonghen et al., 2014). The participants in this study encompassed individuals aged 16 to 25 years, from youth to early adulthood. The average age of athletes in the intervention group was 19.34 ± 2.44 years; on the other hand, in the control group, the average age was 20.5 ± 2.54 years, providing insight into the optimal age range for professional athletes.

Table 2. Characteristics of Respondents

Respondent Characteristics	Intervention Group		Control Group	
	n	(%)	n	(%)
Age				
Mean ± SD	19.39 ± 2.44		20.5 ± 2.54	
Gender				
Male	19	50.0	16	42.1
Female	19	50.0	22	57.9
Sport Branch				
Kempo	0	0	15	39.5
Kurash	0	0	10	26.3
Taekwondo	0	0	13	34.2
Judo	15	39.5	0	0
Karate	16	42.1	0	0
Muaythai	7	18.4	0	0
Length of time as an athlete				
Mean ± SD	8.94 ± 3.47		10.28 ± 2.88	
Education Level				
Senior High School	20	52.6	10	26.3
College	14	36.8	26	68.4
College Graduate	2	5.3	2	5.3

The age distribution of participants in this study aligns with previous research on combat athletes, specifically young judo athletes, with an average age of 20 ± 1.3 years (Radovanovic et al., 2012). Additional research was conducted on karate athletes between the ages of 16 and 30, as documented by Rynkiewicz et al. (2010). The period of youth is considered a prime time for athletes, frequently encompassing the age range of roughly 20 years. This phase is widely recognized as the most fruitful period for athletes to reach their peak performance and attain the highest level of success (Farapti et al., 2019).

The study included a more significant proportion of female athletes, precisely 41 individuals (53.94%), with 19 individuals in the intervention group and 22 in the control group. Out of 35 athletes, male athletes accounted for 46.05% and significantly preferred combat sports (Farapti et al., 2019). Nevertheless, combat sports

do not impose specific limitations based on gender; both male and female combat athletes frequently undergo the same training regimens and adhere to similar routines.

Female athletes frequently need more diets due to more understanding of nutrition and misconceptions about proper nutrition. Inadequate nutrition can lead to the development of the Female Athlete Triad in female athletes, which consists of poor energy availability, menstruation abnormalities, and low bone mass (Hoogenboom et al., 2009). Male and female athletes must comprehensively understand sports nutrition to prevent nutritional issues stemming from a need for more information.

Adequate nutrition is crucial for the growth and development of athletes (Heikkilä et al., 2019). Comprehending the significance of daily food intake in promoting performance, health, and post-competition recovery necessitates a sufficient understanding of nutrition (Birkenhead & Slater, 2015). Athletes with lengthier training camp experience possess sufficient expertise in sports nutrition. Certain athletes acquire nutritional guidance from nutritionists and their coaching staff (Torres-McGehee et al., 2012)). Nevertheless, some athletes continue to depend on friends, family, and magazines to acquire nutritional information and understand the specific nutrients required for athletes. Athletes with specific dietary objectives will adhere to a diet to enhance their performance and achieve an ideal body composition (Andrews et al., 2016).

Most respondents were college-level athletes, specifically 40 individuals (52.63%). Typically, individuals who are engaged in higher education or are enrolled as students possess a greater comprehension of the significance of nutritional information and the adoption of appropriate dietary patterns (Berliandita & Hakim, 2021). Individuals with greater levels of education tend to possess better memory and concentration abilities than those with lower levels of education (Tam et al., 2022).

Sports Nutrition Knowledge

A thorough understanding of nutrition is essential for making informed choices when

Table 3. The Differences in Nutrition Knowledge Score between Intervention Group and Control Group Before Sports Nutrition Education Intervention

Variable	Mean ± SD		*p-value*
	Intervention Group	Control Group	
Sports Nutrition Knowledge[a]	35.55 ± 12.3	32.79 ± 10.5	0.422

[a]using Mann Whitney test
*there are significant differences (p<0,05)

Table 4. The Differences in Nutrition Knowledge Score between Intervention Group and Control Group after Sports Nutrition Education Intervention

Variable	Mean ± SD		*p-value*
	Intervention Group	Control Group	
Sports Nutrition Knowledge[a]	50.79 ± 12.0	43.84 ± 5.6	**0.025***

[a]using Mann Whitney test
*there are significant differences (p<0,05)

Table 5. The Differences in Sports Nutrition Knowledge Score Before and After Nutrition Education Intervention in Each Intervention Group and Control Group

Variable	Intervention Group	*p-value*[b]	Control Group	*p-value*[b]
	Mean ± SD		Mean ± SD	
Knowledge Level				
Before	35.55 ± 12.32	**<0.001***	32.79 ± 10.56	**<0.001***
After	50.79 ± 12.09		43.84 ± 5.62	

[b]using the Wilcoxon Signed Ranks Test
*there are significant differences (p<0.05)

selecting food. In the absence of knowledge regarding certain food items and their nutritional content, athletes may need help making informed decisions about their diet due to the effect of food and its potential individual advantages (Wansink et al., 2005).

Athletes benefit from having a good understanding of nutrition and consuming high-quality meals (Heaney et al., 2011).

Table 3 indicates no statistically significant difference between the intervention and control groups, as evidenced by a p-value of 0.422 (p>0.05). Nevertheless, Table 4 demonstrates significant differences between the intervention and control groups following the nutrition education intervention, as indicated by a p-value of 0.025 (p<0.05). Based on the mean score, the intervention group outperforms the control group.

This study examined combat athletes and revealed significant differences in sports nutrition knowledge between the intervention and control groups after implementing nutrition education interventions. Both groups exhibited a p-value <0.05, indicating statistical significance (Table 5). This study aligns with the findings of Foo et al. (2021), who demonstrated that a 7-week nutrition education intervention conducted through classroom discussions resulted in a significant 8.3% improvement in athletes' nutritional knowledge.

Prior studies have also demonstrated comparable findings, specifically an augmentation in nutritional comprehension following nutrition education interventions among adolescent athletes participating in diverse sports such as dancing, swimming, and football (Heikkilä et al., 2019). Utilizing booklet media for nutrition education interventions in the control group can help enhance nutritional knowledge. This study aligns with prior research conducted by Afandi (2020) on sports athletes. The study's findings indicate a significant improvement in athletes' nutritional awareness following the provision of a pocketbook (p <0.05) (Afandi & Siregar, 2020).

The enhancement in sports nutrition knowledge in the intervention and control groups can be attributed to using practical approaches and media. The intervention group exhibited a 4.19-point increase in mean sports nutrition knowledge score compared to the control group after the nutrition education intervention (Table 5).

The findings of this study are consistent with prior research conducted by Zeng et al. (2020). The study revealed a noteworthy enhancement in sports nutrition knowledge among the intervention group following nutrition education through lectures or counselling methods (p<0.01), as opposed to groups that solely received educational media (Zeng et al., 2020).

Adequate Intake

Athletes need an ideal training system that includes the availability and adequacy of nutrients specific to their sport to achieve maximum performance. Athletes have a fundamental requirement for meeting their nutritional needs. These nutrients play a vital role in the body's physiological functioning, supplying energy during physical activities such as training, competition, and recovery. This includes both post-training and post-competition recovery periods (Suniar, 2002).

The present study determined the effect of nutrition education interventions on disparities in nutrient intake sufficiency between the pre-intervention and post-intervention periods. Nutrition education interventions are targeted initiatives that aim to assist individuals in altering their dietary patterns and enhancing their

Table 6. The Differences in Adequate Intake between Intervention Group and Control Group Before Sports Nutrition Education Intervention

Variable	Mean ± SD		*p-value*
	Intervention Group	Control Group	
Energy [a]	79.18 ± 22,2	74.47 ± 24.3	0.124
Carbohydrates [a]	64.21 ± 24,5	63.68 ± 23.6	0.975
Protein[a]	80.55 ± 25.2	76.68 ± 29.5	0.499
Fat [a]	109.55 ± 40.1	96.66 ± 38.2	0.146

[a]using the Mann Whitney test
*there are significant differences (p<0.05)

Table 7. The Differences in Adequate Intake between Intervention Group and Control Group after Sports Nutrition Education Intervention

Variable	Mean ± SD		*p-value*
	Intervention Group	Control Group	
Energy[a]	88.03 ± 19.1	71.50 ± 25.4	**0.001***
Carbohydrates[a]	60.58 ± 23.2	64.79 ± 24.9	0.636
Protein[a]	87.84 ± 21.1	72.53 ± 28.0	**0.011***
Fat[a]	97.34 ± 20.2	87.21 ± 37.8	**0.038***

[a]using the Mann Whitney test
*there are significant differences (p<0.05)

understanding of nutrition (Murimi et al., 2017); according to a systematic review conducted by Bentley et al. (2020), athletes' dietary patterns changed for the better following the administration of sports nutrition education interventions. Positive dietary behavior was observed among the participants.

Table 6 shows that, before the intervention, there was no significant difference in the adequacy of intake in both groups; energy, carbohydrate, protein, and fat had a p-value >0.05.

Following a 7-week nutrition education intervention, significant differences in the adequacy of calorie, protein, and fat consumption were seen between the intervention and control groups, as demonstrated by a p-value < 0.005 (Table 7).

The findings of the adequacy of energy intake demonstrated significant positive differences in the fulfilment of adequate energy intake in the intervention group; namely, there was an increase in adequate energy intake. Meeting the energy requirements is crucial for various purposes, including enhancing bodily function, determining the necessary macro and micronutrient intake, and influencing changes in an athlete's body composition (Thomas et al., 2016).

The initial mean sufficiency of energy intake among athletes in the intervention group was 79%. Following nutrition instruction, this figure climbed to 88% (Table 8). The findings of this study align with previous research conducted by Rossi et al. (2017) on the impact of a 12-week nutrition education intervention. Specifically, the initial data collection revealed that athletes' energy consumption was below the recommended intake.

However, after the intervention, there was a significant increase in the consumption of adequate energy intake compared to before the intervention (Rossi et al., 2017).

Table 8. The Differences in Adequate Intake Before and After Nutrition Education Intervention in Each Intervention Group and Control Group

Variable	Intervention Group	*p-value*[b]	Control Group	*p-value*[b]
	Mean ± SD		Mean ± SD	
Energy				
Before	79.18 ± 22.2	**0.029***	74.47 ± 24.3	0.402
After	88.03 ± 19.1		71.50 ± 25.4	
Carbohydrates				
Before	64.21 ± 24.5	0.469	63.68 ± 23.6	0.916
After	60.58 ± 23.2		64.79 ± 24.9	
Protein				
Before	80.55 ± 25.2	0.141	76.68 ± 29.5	0.361
After	87.84 ± 21.1		72.53 ± 28.0	
Fat				
Before	109.55 ± 40.1	0.077	96.66 ± 38.2	0.243
After	97.34 ± 20.2		87.21 ± 37.8	

[b]using the Mann Whitney test
*there are significant differences (p<0,05)

No significant differences were revealed in the levels of carbs, protein, and fat in the intervention and control groups before and after the nutrition education intervention (Table 8).

The sufficiency of carbohydrate nutrition was reduced from 64% to 60%. According to Urdampilleta et al. (2020), consuming carbs in the right amount and type before exercising can help prevent hypoglycemia and sustain performance. The carbohydrate intake declined in the intervention group as athletes preferred consuming higher amounts of protein (Table 7). Athletes, particularly during recovery, require protein intake as it is the primary approach to minimize muscle loss and expedite healing in case of injury (Turnagöl et al., 2021). Multiple studies have discovered a correlation between weariness in athletes and a decrease in muscle glycogen. This mechanism's presence necessitates heightened glucose needs in athletes. Athletes frequently struggle to meet this increased demand, leading to insufficient carbohydrate consumption (Pendergast et al., 2000).

The study found no significant difference in the protein consumption of combat athletes before and after the sports nutrition intervention in both groups. Nevertheless, the intervention group observed a rise in the mean adequacy of protein intake compared to the control group, which encountered a decline in the mean. Athletes, particularly during recovery, require protein intake as it is the primary approach to minimize muscle loss and expedite healing in case of injury (Turnagöl et al., 2021). A protein intake of 2.3 grammes per kilogramme per day has been demonstrated to decrease muscle loss caused by injuries, according to a study by (Mettler et al., 2010)

The mean fat intake in both the intervention and control groups dropped; however, there was no significant difference in the extent of this decline. After implementing a nutrition education intervention in the intervention group, the mean fat intake reached a satisfactory level (97%). In contrast, there was a slight drop in the control group, resulting in a minor deficiency (87%). The classification of nutrient intake adequacy is based on the following categories: above requirements (>120%), mean (90-119%), mild deficit (80-89%), moderate deficit (70-79%), and severe deficit (<70%) (Gibson, 2005). Physical activity can enhance the muscles' capacity to utilize fat as a source of energy. Hence, the consumption of fats is also crucial for athletes. However, the specific kind and quantity are still undetermined—excessive consumption of fat results in the accumulation of excessive fat reserves. According to Kemenkes RI (2021), the recommended fat mass range for male athletes is 9-12%; on the other hand, it is 14-24% for female athletes.

The energy requirements of each athlete vary based on parameters such as basal metabolic rate, activity levels, kind of exercise, intensity of exercise, and length of exercise. Inadequate meal planning for athletes can lead to complications for them. Athletes' dietary preparations are not limited to a single phase of training. Meal arrangements are continuously implemented daily. Athletes' diet is tailored to their training time, ensuring that the nutritional therapy aligns with the desired goals. The meal arrangements for athletes are categorized into three distinct periods: the preparation period, the match period, and the recovery period (Penggalih et al., 2019).

An inherent disadvantage of this study is the absence of blinding during the research process, as the intervention is directly administered to each group. Thus, it permits the introduction of bias in the study. The control and intervention groups in weight management have distinct requirements, which can introduce bias into the results of the 24-hour food recall.

CONCLUSION

Following a nutrition education intervention, combat athletes significantly enhanced their understanding of sports nutrition and achieved higher nutritional sufficiency. A 7-week nutrition education intervention combining booklet media and material delivery, counselling and group discussion methods enhances combat athletes' sports nutrition knowledge, food preferences, and nutritional adequacy more effectively than solely providing booklet media without material delivery.

It is advisable to maintain an active involvement in education on sports nutrition to

ensure that athletes have a deeper understanding of the subject and develop a mentality that emphasizes the significance of nutrition in enhancing performance.

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